GRADE 12

Physical Sciences

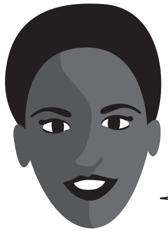
Teacher Toolkit: CAPS Planner and Tracker

2019 Term 1

CONTENTS

A. ABOUT THE PLANNER AND TRACKER

1. Your quick guide to using this planner and tracker

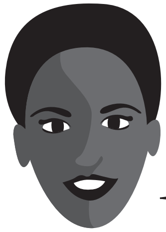


What is the NECT and where do I fit in?

What you do matters! What you do every day as a teacher can change the life-chances of every child that you teach. The NECT supports teachers by providing CAPS planners and trackers so that teachers can plan to cover the curriculum, track progress, and seek help when they are falling behind.

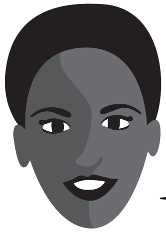
But who will help me?

The NECT will work with your school management team (SMT) and assist them to have supportive and professional conversations with you about curriculum coverage that will be orientated to identifying and solving problems.



I have looked at the planner and tracker. It goes too fast!

The CAPS planner and tracker is an expanded ATP. It helps you pace yourself as if you were able to cover everything in the ATP/CAPS. When you fall behind because time has been lost, or because the learners are progressing slowly, you need to confidently discuss this with your teaching team without feeling blamed. The pace of coverage will be determined by the pace of learning. That is why coverage must be tracked by the teacher and the SMT.



How do I use the planner and tracker?

See the "**Quick 5-step Guide to Using the CAPS Planners and Trackers**" on the opposite page.

QUICK 5-STEP GUIDE TO USING THE CAPS PLANNERS AND TRACKERS

1. Find the textbook that YOU are using.

2. Use the planning page each week to plan your teaching for the week. It will help you link the CAPS content and skills to relevant material in the textbook, the teacher's guide, and other materials such as the DBE workbook.

3. Keep a record of the date when you were able to complete the topic. It may be different from the date you planned, and for different classes. Write this date in the column on the right for your records.

4. At the end of the week, reflect and check if you are up to date. Make notes in the blank space.

5. Be ready to have a professional and supportive curriculum coverage conversation with your HoD (or subject or phase head).

The CAPS planners and trackers also provide guidelines for assessment with samples, and may also have enrichment and remedial suggestions. Read the introduction pages carefully for a full explanation.

2. Purpose of the tracker

The Curriculum and Assessment Planner and Tracker is a tool to support you in your role as a professional teacher. Its main purpose is to help you keep pace with the time requirements and the content coverage of the CAPS by providing the details of what should be taught each day of the term; and of when formal assessments should be done. Each of the sessions for Physical Sciences in Grade 12 is linked to the approved sets of Learner's Books and Teacher's Guides on the National Catalogue, as well as the *Everything Science* textbook (Siyavula) which has been distributed to schools by the Department of Basic Education as an additional resource. You can download it from www.everythingscience.co.za.

The tracker provides a programme of work that should be covered each day of the term and a space for reflection of work done for each of the LTSMs on the National Catalogue. By following the programme in the tracker for the Learner's Book you are using, you will cover the curriculum in the allocated time, and complete the formal assessment programme. By noting the date when each session is completed, you can assess whether or not you are on track. If you are not, strategise with your head of department (HOD) and colleagues to determine the best way in which to make up time to ensure that all the content prescribed for the term is completed. In addition, the tracker encourages you to reflect on what parts of your lessons were effective, and which parts of your lessons can be strengthened. These reflections can be shared with colleagues. In this way, the tracker encourages continuous improvement in practice.

This tracker should be kept and filed at the end of the term.

3. Links to the CAPS

The Grade 12 Physical Sciences tracker is based on the requirements prescribed by the Department of Basic Education's Curriculum and Assessment Policy Statement (CAPS) for Physical Sciences in the Further Education and Training (FET) band. The CAPS prescribes four hours per week for Physical Sciences. The work set out in the tracker for each day is linked directly to the topics and subtopics given in the CAPS, with the specified amount of time is allocated to each topic. It gives the page number in the CAPS document of the topics and subtopics being addressed in each session. This enables you to refer to the curriculum document directly should you wish to do so.

4. Links to approved LTSMs

There is a tracker for each set of Learner's Books and Teacher's Guides of the approved books on the National Catalogue. The tracker aligns the CAPS requirements with the content set out in the approved Learner's Books and Teacher's Guides. You must refer to the tracker for the book that is used by learners at your school. If you have copies of other Learner's Books, you can also refer to these trackers to give you ideas for teaching the same content in a different way. However, ensure that you cover the content systematically. For each set of LTSMs in the tracker, links are given to the relevant pages in both the Learner's Book and Teacher's Guide to make it easier for teachers to access the correct resources. Links to the *Everything Science* materials have been inserted in the trackers for all Learner's Books.

In addition, further suggestions for extension, enrichment, and/or homework exercises have been made. We recommend that you always have an extra activity available for those learners who complete their work earlier than others.

Each tracker is based on the latest print editions of the three approved LTSMs. Take note that page numbers may differ slightly from other print runs of the same Learner's Book. If the page numbers in your edition are not exactly the same as those given in the tracker, you should use the activity/exercise numbers given in the tracker to guide you to the correct pages. These should only differ by a page or two from those given in the tracker.

5. Managing time allocated in the tracker

The tracker provides a suggested plan for 40 one-hour sessions, organised into four 60-minute sessions per week. Depending on your school's timetable, you may use two of these sessions in one double period. You might also need to adjust the work prescribed for a session to meet other demands of your timetable. However, the content that needs to be covered in a week, should always be covered in a week. If for some reason you do not complete the work set for the week, you need to find a way to get back on track.

The breakdown of work to be done each week corresponds to the annual teaching plan and programme of assessment drawn up by the Department of Education; however the tracker gives a more detailed outline of what should be taught each day.

Please note: The tracker has been planned for a first term of 10 weeks with a short first week of 3 sessions rather than 4. The content in the CAPS is specified over 11 weeks. As a result, the breakdown of work to be done each week has been adjusted to be completed in this shortened time and there is very little time at the end of term that is not required for teaching. If you are likely to lose a lot of time for the school's formal assessment programme, you will need to find a way to do this work earlier in the term. If the year in which you are using it has a longer or shorter first term, you will need to adjust the pace of work accordingly. It is important that you take note of this at the start of the year.

Homework has been allocated for most sessions. For learners to benefit from these activities, it is necessary to provide feedback on the homework. Do this at the beginning of the next lesson or at the end of a topic. Learners who do not complete their written work in time can complete the activity for homework. If some learners complete their work well ahead of schedule, consider providing them with enrichment activities. We have provided some examples of enrichment activities in this tracker. If some learners do not complete their written work in time, they can complete the enrichment activity for homework. If for any reason you miss a lesson, or find that you need to spend more time than planned on some aspect of the work, find a way to get back on track so that the curriculum for the term is covered as required.

6. Links to assessment

The tracker indicates where in the series of lessons the CAPS assessment activities/tasks/practical activities should be done. This varies slightly from Learner's Book to Learner's Book, but is always in line with the CAPS specifications. We suggest that you discuss testing times with your colleagues who teach other subjects. In this way you can avoid having learners write several tests on the same day in a single week.

For these informal assessment tasks, you may want to use a variety of assessment methods, including peer assessment, self-assessment and spot marking.

7. Resource list

The tracker suggests resources that you could use for certain lessons. In addition, suggestions for alternative equipment and resources have been made. Learners need to interact with learning material as much as possible, therefore every attempt has been made to allow for such interaction.

8. Columns in the tracker

The tracker plan consists of the following columns for each set of LTSMs:

1. Session number
2. CAPS content, concepts and skills for the day
3. Relevant CAPS page number
4. Learner's Book page number
5. Learner activity number
6. Teacher's Guide page number
7. *Everything Science* Learner's Book page number
8. *Everything Science* Teacher's Guide page number
9. Date completed – this needs to be filled in each day and there are columns for each of the classes you teach

9. Weekly reflection

The tracker provides a space to record reflections on a weekly basis. This weekly reflection provides you with a record for the next time you implement the same lesson, and also forms the basis for collegial conversations with your head of department (HOD) and colleagues. It should be shared both informally and at regular departmental meetings. Together with your HOD and colleagues, think of ways of improving your lessons and in turn your learners' work. If for some reason not all the work for the week has been covered, strategise with your HOD and colleagues as to how best to catch up so that the curriculum is covered. You are encouraged to reflect on your lessons daily – thinking about what went well, or did not go so well in each, and how better to help learners grasp the content being taught. Briefly jot down your reflection by following the prompts in the tracker. When reflecting, you could think about things such as:

- Was my preparation for the lesson adequate? For example: Did I have all the necessary resources? Had I thought through the content so that I understood it fully and could teach it effectively?
- Did the purpose of the lesson succeed? For example: Did the learners reach a good understanding of the key concepts for the day? Could the learners use the language expected from them? Could the learners write what was expected from them?
- Did the learners cope with the work set for the day? For example: Did they finish the classwork? Was their classwork done to an adequate standard? Did I assign any homework?

- What can I do to support learners who did not manage the work, or to extend those who completed the work easily?
- What might I change next time I teach this same content? Will I try a different approach?

10. End-of-term reflection

At the end of the term, it is useful to make judgements about what went right and wrong in general, and to use this information to produce real change so that growth can occur. Consider the things that went well, take time to celebrate success and to build on these as you prepare for the next term's work. Try to take positive action to include the successful strategies into your lessons on a regular basis.

Identify the areas that need improvement by considering those lessons when you felt harassed, hurried, under pressure or your learners simply sat passively, not taking in much. Think about why things failed, and what the issues that arose were. By carefully finding out what caused the failure, you will have a good chance of turning things around for success in the future.

Talk to your HOD about your findings and about your strategies for change, and write down one change that you will implement in the coming term.

Use the findings from the reflections on your teaching practice to develop yourself professionally. Your reflections recorded in the tracker can also be used to provide evidence of your development when applying for other positions, and in review with your HOD.

The following questions are asked at the end of the term:

- Was the learners' performance during the term what you had expected and hoped for? Which learners need particular support with Science in the next term? What strategy can you put in place for them to catch up with the class? Which learners would benefit from extension activities? How can you help them?
- With which specific topics did the learners struggle the most? How can you adjust your teaching to improve their understanding of this section of the curriculum in the future?
- What ONE change should you make to your teaching practice to help you teach more effectively next term?
- Did you cover all the content as prescribed by the CAPS for the term? If not, what are the implications for your work on these topics in future? What plan will you make to get back **on track**?

B. TERM PLANNING

Before considering weekly and daily plans which are set out in the tracker, think about the term as a whole.

1. Check the term focus

Take note of the focus for the term. The CAPS document provides clear details regarding the focus for Grade 12:

- **Term 1 – *Physics:***
  Momentum and impulse
  Vertical projectile motion in one dimension
  Chemistry:
  Organic chemistry
- Term 2 – *Physics:*
  Work, energy and power
  The Doppler effect
  Chemistry:
  Rate and extent of reaction
  Chemical equilibrium
  Acids and bases
- Term 3 – *Physics:*
  Electric circuits
  Electrodynamics
  Optical phenomena
  Chemistry:
  Electrochemical reactions
  The chemical industry
- Term 4 – Revision

Overview of Term 1 Topics

A large amount of content and many varied and complex concepts are introduced in Physical Sciences during this term. Learners will need to engage in discussions and in problem solving so that they obtain a useful knowledge of these topics. There is no time to return to re-teach any of the Grade 12 topics in detail later in the year, though there are two weeks of revision available in Term 4. It is a good idea to share the term planner with the learners to make them aware of the demands of the course.

Momentum and impulse

The section on momentum and impulse helps learners to actively engage with the concepts of force and Newton's laws from a new perspective. The idea of *an amount of motion that an object has* is intuitive. The idea of a heavy 110 kg rugby player moving at a fair pace and bumping a smaller 50 kg boy who is initially standing still invariably conjures up the picture of the boy being swept along or pushed over by the player. And the reason is quite often given as: the rugby player had a greater *amount of motion*, meaning he had a greater momentum. Defining and quantifying momentum and discussing its vector nature follows naturally once the learners can visualise what it means to have a larger or smaller momentum than some other object. The relationship between mass and momentum, and velocity and momentum also needs to be established. When the velocity of an object is increased (when it accelerates) its momentum also increases: momentum is directly proportional to velocity. Similarly an object of greater mass moving at the same velocity as another will have greater momentum than the other.

The idea of a change in momentum can present difficulties as learners very often simplify the phrase into *momentum* and forget about finding the *change in momentum*. Emphasise the fact that whenever we calculate a change in any physical quantity we are actually finding the difference between its final value and its initial value. It is also useful to remind learners that the net force and the change in momentum are both vector quantities, and they both act in the same direction, e.g. when a ball bounces on the floor, it receives an upward net force acting on it, therefore its change in momentum is also upward. The CAPS requirements include the use of vector diagrams to express change in momentum. Linking these diagrams with the net force acting on the object can help learners decide which is the correct direction of the change of momentum.

When solving problems using the law of conservation of momentum, learners must remember to show that they are applying this principle. For those learners who struggle with the notation of m_1v_{i1} etc., it may be easier to simply preface their solution with $\Sigma p_i = \Sigma p_f$ or to write down *Applying the law of conservation of momentum* as they begin writing their solution.

It is very important that momentum is handled as a vector quantity and that a sign convention is used to assign one direction as positive and the opposite direction as negative. Failure to include the direction into the calculations is a common mistake. It may appear to arise from carelessness, but is usually an indication that the concept of momentum as a vector quantity has not yet been assimilated. It does no harm to continually remind learners to express momentum with its magnitude and its direction when writing the answers and when talking and discussing solutions to problems in class.

Impulse is introduced as the last concept in this topic and it wraps up the study by bringing in many everyday examples of how we deal with change of momentum to minimise the net force acting on us, e.g. bending your knees when jumping down from a higher place or bringing your hands back towards you when you catch a fast-moving object like a cricket ball. By extending the time during which momentum is changed, we effectively decrease the net force. Applying these principles to vehicle safety features and design places these ideas in a familiar context.

Vertical projectile motion

Learners have been using the equations of motion for motion in one dimension since Grade 10, so they should find it relatively easy to apply these to objects in free fall. However, in our daily experience nothing actually free falls. Air resistance opposes the gravitational force, and despite us telling the learners that all objects of any size, shape and mass will all strike the ground at the same time, our learners know that some things manage to fall faster than others!

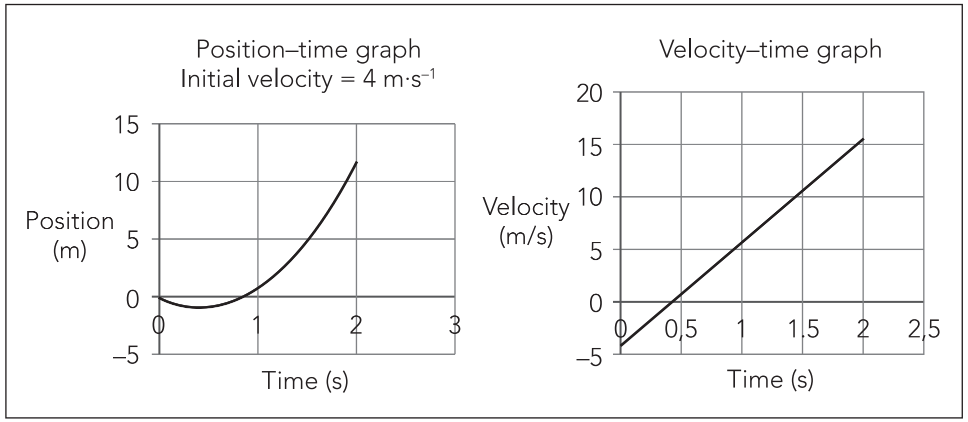
It is therefore very important to put the concept of *free-falling bodies* into context. This topic explores how we can determine the position, velocity, and acceleration of any object when it is in free fall, i.e. when the only force acting on an object is its weight (the force due to gravity). That objects are in free fall here on Earth is a simplification of what is really happening: **if** there was no air resistance, objects **would** free fall on Earth. The learners have to imagine that there is no air resistance and this goes against their experience of how things fall in everyday contexts.

It is useful to point out that there are really only three scenarios of free fall that can be examined:

- An object is dropped (from rest)
- An object is thrown downwards (with an initial velocity (v_i down))
- An object is thrown up (with an initial upward velocity (v_i up))

The learners must state their choice of positive direction, as either *up* or *down*. Since everything that goes up, comes down, and the net force acting on the object is always down towards the centre of the Earth, it makes sense to choose the downward direction as positive. When an object is thrown up into the air, its initial velocity will then be negative, but, like all other cases, its acceleration remains 9,8 $m \cdot s^{-2}$ downwards (i.e. +9,8 $m \cdot s^{-2}$) all the time while it is in the air. Figure 1 shows graphs for an object that is thrown up with an initial velocity of 4 $m \cdot s^{-1}$. In this case the origin of the frame of reference was the position from which the object was released.

Figure 1: POSITION–TIME AND VELOCITY–TIME GRAPHS FOR AN OBJECT THROWN UP WITH AN INITIAL VELOCITY OF 4 m·s⁻¹



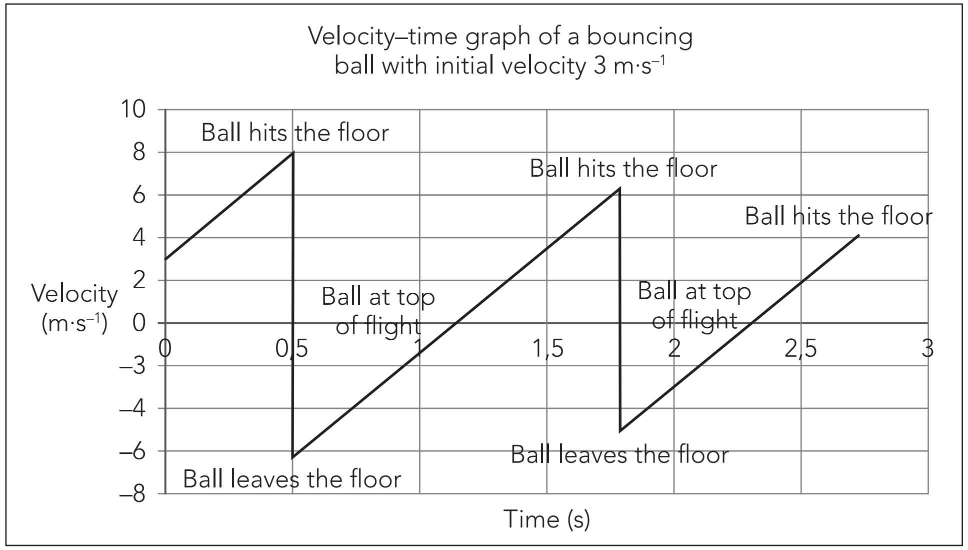
Note that if a particular question shows a graph which has DOWN chosen as negative (i.e. UP as positive) then the learners must answer the question using *down as negative*.

The equations of motion are always linked to the graphs of motion (as they were in Grades 10 and 11). By studying graphs of motion, concepts can be consolidated, e.g. the graph of acceleration versus time for a free-falling body is always a straight-line graph parallel to the time axis, with the value of 9,8 $m.s^{-2}$. The visual representation of this data can aid understanding: the object is accelerating uniformly for the entire length of time that it is in the air. This includes the moment when it reaches maximum height.

It is a common misconception that an object stops when it reaches maximum height because its velocity is zero at this instant. If objects stopped at maximum height we would see them hanging up there in the air before they turned around to descend again. This clearly doesn't happen. So what does the value of zero for the velocity actually tell us when an object is at maximum height? The velocity–time graph cuts through the time axis when the object reaches its maximum height. In that infinitesimally small moment in time the velocity is zero because the direction of the velocity is going to change (from going up to coming down). The velocity doesn't remain zero for any length of time, so the object doesn't stop moving!

The scenario of a bouncing ball may present difficulties for some learners, so learners should be given many opportunities to analyse and describe the motion of simple vertical projectile motion (up and down) before these more complex problems are

Figure 2: VELOCITY–TIME GRAPH OF A BOUNCING BALL WITH INITIAL VELOCITY OF 3 m·s⁻¹



introduced. Emphasise the fact that there are two places at which the velocity of the object is zero: at the top of its flight, and when it hits the ground and bounces up again. The data point and time when the velocity of the object is zero at the top of the object's flight always occurs on the part of a graph which is sloping either upwards or downwards (Figure 2). The data point where the object bounces is usually associated with a sudden and large change in velocity such as a straight vertical (or almost vertical) line.

Encourage learners to note these data points on the graph as *top of flight*, *ball hits the floor* and *ball leaves the floor*. Also encourage them to describe what the object is doing at each stage of its motion *before* they start answering the questions, e.g. is it bouncing up, or returning to the ground?

It is tempting to spend a little longer on a topic when learners struggle to grasp the principles. Do not slow down the pace at this point – rather move on, and set some additional tasks for those who battle so that they can practise a little more. *Everything Science* offers extra examples for this purpose.

Organic chemistry

Organic chemistry is an amazing example of the classification of carbon compounds and their reactions into a coherent and comprehensive framework. We use this framework to develop and produce new materials to suit our needs, e.g. plastics and polymers, products from fossil fuels, margarine from vegetable oils. Mastering this topic relies on a good understanding of covalent bonding, intermolecular forces and the physical structure of molecules.

The prescribed practical for Term 1 is the preparation and identification of esters. The practical is marked on the learner's skill in handling equipment, following instructions, and the ability to work efficiently in a small group. It is therefore useful to include an informal practical into the course before the learners carry out their prescribed practical, so they can develop these skills while paying attention to the progress of a reaction, and learning how to report the results of a chemistry experiment. There are two opportunities for this: the identification of saturated and unsaturated organic compounds, and investigating the physical properties of some organic compounds, e.g. viscosity, boiling point, melting point. Learners need to work collaboratively in small groups, be able to read and work through the given procedures, identify various substances by colour or smell, and to conduct their investigation with due regard to safety precautions. They should prepare for practical assessments in the previous day's homework session and they should come to class ready to carry out the procedures.

The International Union of Pure and Applied Chemistry (IUPAC) naming system is very specific in its requirements. Learners must pay attention to spelling the names of compounds correctly; *ethane* is a different substance from *ethene* and *ethyne*. Their writing must be clear and easy to read and their naming must identify the substance correctly. It is by practising naming that they will develop these skills. There is no shortcut to learning how to work with this system – learners must engage with it and practise drawing structures and naming them.

Identifying the different types of reactions and their reaction conditions is a memory-based activity. The terminology, reactants, catalysts (where appropriate), temperatures and products that are formed have to be committed to memory. Chemistry is a body of knowledge about matter and materials. Recalling systematic facts is a skill required in order to build up a personal chemistry knowledge bank. (A summary of organic chemical reactions is provided at the end of Section G *Additional Worksheets for Learners*.)

Polymerisation gives learners another opportunity to store facts in memory. It also provides learners with useful information on why some plastics should be recycled and the environmental responsibilities of 21st century citizens.

Finally, you need to remind learners to learn and recall the statements of the definitions, terminology and laws. The examinations allocate almost 15% of the marks to basic recall of facts, definitions, statements of laws and simple application of knowledge. In most cases, the marking memoranda indicate that there are no part marks for the statement of laws and definitions. It is therefore very important that learners learn these laws and definitions and are able to recall them verbatim in order to earn these marks in their final examinations.

2. Prepare resources

This stage in your preparation is vital. The prescribed Learner's Books provide both information and activities. The Teacher's Books also provide valuable information as teaching guidelines. When you are planning, you need to be familiar with the information in the textbook your learners will be using. This will ensure that you do not need to either read from the textbook or ask your learners to copy down notes from the chalkboard or projector.

Teaching Physical Sciences should not be based on reading and discussing the textbook. Learners need activities, demonstrations, problem solving opportunities and active debates. This all takes careful planning and preparation of resources.

Resources can range from everyday objects like a marble or a ball, to more scientific apparatus like a ticker timer, or even digital resources like a short video clip or simulation. Whatever resource you select as the focus of the lesson, make sure you think carefully about the questions you will ask learners to think about and discuss. You may plan these discussions in pairs or small groups. Through observation, reflection and discussion you will engage learners in helping them construct their own knowledge. It is important to challenge this knowledge and at times disagree with them even if they are correct. You can also present a common misconception and encourage them to be critical of the proposed idea.

Problem solving and application of knowledge are very important in Physical Sciences. Your learners will need to practise exam-type questions; the textbooks all give worked examples. There are also end-of-chapter or unit questions, exam practice and additional worksheets. These have been referenced in the tracker for each book and are included as homework activities. However, in some cases the Learner's Book may not have enough questions and we have referred you to additional activities from the *Everything Science* textbook. If your learners don't have a copy, they can access these questions online from www.everythingscience.co.za. The Learner's Books can also be downloaded or print copies can be ordered from a supplier referred to on the same site. There is a huge database of questions that will be very useful for learners to work through both for remediation, revision and extension. Not all the activities are referenced in the tracker. If you identify that your learners are struggling in a particular section, select questions that are relevant to them for further practice. The page numbers which apply to each section in *Everything Science* are referenced alongside the references to the Learner's Books.

3. Plan for required assessment tasks

Most of the Learner's Books and/or Teacher's Guides provide examples of CAPS-compliant formal assessment tasks, including practical investigations, revision activities and a sample control test.

Where the LTSMs used at your school have the test in the Learner's Book, this test cannot be used because the learners will be able to prepare for it in advance, but it is useful for revision and informal assessment. An exemplar examination in the Teacher's Guide, you should set your own test and either use this for the Term 1 Test or use the exemplar test paper provided in Section F *Assessment Resources* of this tracker. If your school writes the provincial control test, you will of course write this at the time set by the province. You could use the exemplar test and the test in your LTSM as practice tests in class or for homework.

Table 1 gives an overview of the practical task/investigation and optional project in each of the LTSMs. This will help you in your preparation.

Table 1: FORMAL ASSESSMENT TASKS INCLUDED IN EACH SET OF APPROVED LTSMs FOR TERM 1

Name of book	Formal practical assessment	Control test
Solutions for All Physical Sciences	**Week 7** *Preparation of esters* LB pp. 126–127	**Week 10** Term 1 Control Test TG pp. 426– 435
Study and Master Physical Sciences	**Week 7** *Preparation of esters* LB pp. 108–109	**Week 10** Term 1 Control Test TG pp. B10–B13

C. DAILY LESSON PLANNING AND PREPARATION

The tracker provides details of the content (in hour sessions) that you need to teach to your class. However, to deliver the lessons successfully, you must do the necessary preparation yourself. This entails a number of key steps that range from ensuring that you have a good understanding of the term focus through to checking the detailed preparation of resources needed for each lesson. Physical Sciences require a range of resource, from printed material to typical science apparatus, such as test tubes, or household items including food items.

1. Check your own knowledge of the content

However well you know your work, it is easy to make small mistakes when in a classroom with learners asking questions. Always read through the content that you are going to cover to ensure that you are very familiar with the work. If possible, also do additional reading from other sources. Refer to Section E *Additional Information and Enrichment*

Activities of this tracker where additional information about many of the topics for the term and some common errors – not always made explicit in the Learner's Books or Teacher's Guides – are addressed.

2. Prepare the conceptual framework for the lesson topic

When preparing the content to be taught think carefully about how the concepts are organised in a conceptual framework; how to help learners develop this framework for themselves; what possible questions learners might ask; and difficulties learners might have and how to address these.

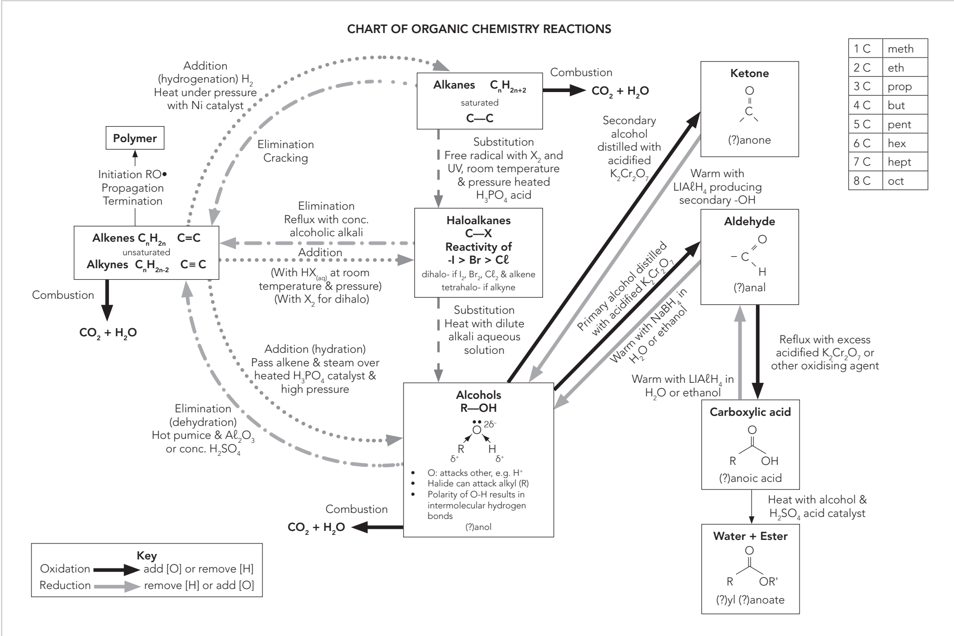
One way of preparing the content is to summarise it using a tool like a concept map, as shown in Figure 3. A concept map is different from a mind map because we describe the links between the concepts to show the relationship between them. When you introduce a topic learners will benefit from seeing the big picture and a concept map is a useful way to present this. It is also a useful way of showing learners how the class is progressing. At the end of the topic encourage your learners to make their own summaries in words and/or pictures. In this way, they will interact with concepts, and this in turn will promote deep learning.

While preparing the conceptual framework, it is important to think about what prior knowledge learners should have and to have a clear idea of where and when they will need to draw on the concepts taught in the Grade 12 lessons. It is vital that you are familiar with the Grade 12 Examination Guides for Physical Sciences and also with the topics taught in Grades 10 and 11. In your preparation, think carefully about the types of questions learners will ask. You may want to pre-empt some of these questions by asking open-ended questions to arouse learners' curiosity and to engage them in the process of learning. It is also a good idea to leave a question unanswered for a short time and let the lesson activities suggest a possible answer. If the question is still unanswered, then you should provide the necessary help. Doing this will provide good opportunities for you to correct any wrong ideas or misconceptions.

3. Baseline assessment and remediation of misconceptions

Baseline assessment should take place at the beginning of each new topic. This enables you to establish what learners already know and to pick up any possible misconceptions. Some of the most common misconceptions have been addressed in relation to the relevant CAPS content in Section E *Additional Information and*

Figure 3: CONCEPT MAP FOR ORGANIC CHEMISTRY REACTIONS (FULL-PAGE DIAGRAM AT THE END OF SECTION G *ADDITIONAL WORKSHEETS FOR LEARNERS*)



Enrichment Activities of this tracker. Baseline assessment can take many forms – such as a quick question and answer session; or a paper and pencil activity. Once a gap in understanding or a misconception has been identified (e.g. some people think that when you kick a ball, it continues to move forward because of the force of the kick), address these misconceptions before moving on to teaching the new work for the term. In this context the word remediation refers to overcoming the learners' wrong ideas.

4. Learner activities

Think about the tasks that learners need to complete in each lesson because it is important that they do something constructive. On rare occasions they may copy something from the chalkboard or another medium, but this should not be the sole focus of the lesson. Some examples of activities they can do in each lesson include, answering questions by writing the answers (the CAPS encourages writing); completing translation activities by converting a drawing to a description, or a table to a graph. You set the stage for the learner activities by giving explanations about different concepts, asking questions, setting problem-solving activities, or giving clear instructions about what learners need to do.

In Section E *Additional Information and Enrichment Activities* of this tracker you will find ideas for activities linked to several CAPS topics beyond the scope of those given in many of the LTSMs. Refer to this resource when preparing your lessons, especially where there is an asterisk (*) in the tracker for the book your learners are using, as this indicates that there is insufficient content or an inadequate amount of work for them to do on the topic. In some instances, a more appropriate practical activity than the one in the Learner's Book has been included for your use. You should also refer to the *Everything Science* resources note in the tracker.

Ensure that you have enough chalk or markers. Where instructions in the Learner's Book that you are using is not clear, use the chalkboard (or whatever media you use in your classroom) to draw or write instructions about what the learners need to do in order to complete the prescribed activity. Chalkboards are also useful for the writing down and explaining of new vocabulary.

Always allow time in your lessons to review learners' work and to give formative feedback on any assessment that has been done. Ensure that during peer or self-assessment you have a list of possible answers.

5. Informal assessment

In addition to specifying the number and nature of the formal assessment tasks, the CAPS suggests that there should also be ongoing informal assessment each term. Learners can do a variety of informal assessment tasks, both in class and for homework, and many of the Learner's Book activities are useful for this purpose. Informal assessment tasks do not have to be marked by the teacher. You can allow learners to mark their own or each other's work. You should consider taking in about five or six pieces of work from time to time to help you assess progress informally and to keep learners attentive. Also change your review techniques from time to time.

While learners do not always need marks for their work, they do need feedback. You need to know which concepts they understood and which one they did not. This will enable you to correct and support their learning. Record any marks that are awarded or key comments for your own interest.

Table 2: INFORMAL ASSESSMENT TASKS INCLUDED IN EACH SET OF APPROVED LTSMs FOR TERM 1

Name of book	Practical investigation	Test
Solutions for All Physical Sciences	**Week 4** *Measuring acceleration due to gravity* LB pp. 67–69 **Week 6** *Saturated and unsaturated organic compounds* LB pp. 136–138 **Week 9** *Preparing polymers:* Polystyrene LB pp. 147–149 Silicon rubber LB pp. 152–154	**Week 3** *Momentum and impulse formative test* (Worksheet 5 in Section G *Additional Worksheets for Learners*)
Study and Master Physical Sciences	**Week 4** *Measuring acceleration due to gravity* LB p. 64 **Week 6** *Saturated and unsaturated organic compounds* LB pp. 93–95 **Week 9** *Preparing polymers:* Silly putty and slime LB pp. 129–130	**Week 3** *Momentum and impulse formative test* (Worksheet 5 in Section G *Additional Worksheets for Learners*)

6. Learners with special needs

People are not all the same. Learners will attend the Physical Science classes with different needs, styles of learning and also with a variety of alternative ideas about scientific phenomena. It is challenging for a teacher to accommodate all these differences, but it is important that you consider these differences during your preparation.

For different learning styles, the teacher can use a variety of teaching methods. These include whole-class teaching, peer interaction, small-group learning, writing activities, drawing and mind-mapping activities, presentations, debates and role play. Wherever possible, encourage reading, writing and speaking skills.

There is a large amount of additional information to help you in the Teacher's Guides. The Learner's Books also provide additional suggestions. Additional to this, the DBE has published some excellent materials to support you in working with learners with learning barriers. Two such publications are:

- Directorate Inclusive Education, Department of Basic Education (2011) *Guidelines for responding to learner diversity in the classroom through curriculum and assessment policy statements.* Pretoria. www.education.gov.za, www.thutong.doe.gov.za/InclusiveEducation
- Directorate Inclusive Education, Department of Basic Education (2010) *Guidelines for inclusive teaching and learning. Education White Paper 6. Special needs education: Building an inclusive education and training system.* Pretoria. www.education.gov.za, www.thutong.doe.gov.za/InclusiveEducation

7. Enrichment

In certain tasks, learners will work at different speeds. For those learners who complete their work earlier than others, refer to enrichment or extension activities in the Teacher's Guide, those suggested in Section E *Additional Information and Enrichment Activities* or provided in Section G *Additional Worksheets for Learners* of this tracker.

8. Homework

It is essential for Grade 12 learners to do homework every day. Examine the tracker and decide what sorts of tasks are appropriate for homework each week. Allow a few minutes at the end of the each lesson to provide homework instructions. Homework can be a useful consolidation exercise and need not take learners very long. If well planned in advance, learners can sometimes be given a longer homework exercise to be handed in within a week. This arrangement allows for flexibility.

If homework tasks are allocated, it is essential to allow a few minutes at the start of the following lesson to review the previous day's homework.

9. Practical work

Practical work must be integrated with theory to strengthen the concepts being taught. This may take the form of simple practical demonstrations or an experiment or practical investigation. Some of these practical activities will be done as part of formal assessment and others can be done as part of informal assessment. In Grade 12 learners will do three out of the four prescribed experiments for formal assessment: one Chemistry, one Physics, and then a choice between a Chemistry or Physics experiment. Learners need to understand and experience that practical work in science distinguishes this discipline from other knowledge areas.

In Term 1, learners are required to prepare esters and identify them by smell. To prepare learners for this formal assessment, give them opportunities to complete other experiments and investigations during the term. It is recommended that learners identify saturated and unsaturated organic compounds using bromine water and potassium permanganate as an informal assessment.

In Term 2, learners may choose to validate the law of conservation of linear momentum (for their third experiment). When working through momentum and impulse, introduce the learners to the type of apparatus they will use. Demonstrations of elastic and inelastic collisions using trolleys provide visual evidence for the learners to develop a better understanding of the law of conservation of momentum.

For learners to achieve the most from their experience of practical work, you need to be extremely well prepared. Think carefully and plan how to accommodate all learners in doing practical activities. In most schools, there may be a limited amount of equipment. This means that you may need to give groups of learners the opportunity to complete the practical work after school hours. If equipment is limited, one solution is to set up different stations with different equipment. Learners rotate from one station to the next in order to complete a series of experiments. Learners also need to be well prepared for any formal or informal practical work. In the trackers, you will see that learners are required to review the investigations for homework on the day before they are required to do the investigation. You could ask them to complete pre-practical questions.

Safety is critical whenever doing practical work. Discuss safety rules with your learners regularly. Refer to the following websites that deal with laboratory safety:

- International chemical safety cards: www.inchem.org/pages/icsc.html
- Merck safety data sheets: www.merck-chemicals.com/msds-search/
- School chemistry laboratory safety guide: www.cdc.gov/niosh/docs/2007–107/pdfs/2007–107.pdf
- WCED laboratory safety guidelines: www.curriculum.wcape.school.za/site/52/pol/view/

To conduct a successful practical activity, the following procedures are suggested:

- Before the practical session, check that the materials are the correct ones so that no mistakes occur.
- Talk through the activity with learners or get them to read the descriptions from the Learner's Book before they come to a practical class.
- Stop from time to time to emphasise certain points. For example, **remember to use safety glasses and not to look directly at burning magnesium.**
- Let learners sometimes work in their chosen groups of friends and change the groups on other occasions.
- Keep a watchful eye on the activity and walk around looking at what learners are doing. This teaching strategy provides the teacher with an opportunity to assess their skills of working with apparatus.
- Drawing the experimental set-up on the chalkboard or another medium helps learners to focus.
- Ensure that books and bags are safely stowed away from the practical work area.
- Enforce a strict rule of **no tasting**. There should be no eating of any kind at all in the laboratory or classroom where investigations are conducted.
- Ensure that work areas are clean both before and after the practical activity.
- Encourage learners to wear plastic aprons and safety glasses and insist on closed shoes wherever possible.
- Insist on the correct labelling of all tubes and bottles.
- Set a good example by following correct procedures at all times.
- Insist that learners tidy their work places when they have finished.
- Have a supply of tap water at hand in case of accidental acid spills. Do not attempt to neutralise acids and bases on a learner or yourself. Simply wash with plenty of water.
- Have a fire extinguisher handy and know how to use it.
- Keep a supply of gauze and plasters in a simple first aid box. A plastic container works well.

D. TRACKERS FOR EACH SET OF APPROVED LTSMs

This section maps out how you should use your Physical Sciences Learner's Book and Teacher's Guide in a way that enables you to cover the curriculum sequentially and in a well-paced manner, aligning with the CAPS for meaningful teaching.

The following components are provided in the columns of the tracker:

1. Lesson number
2. CAPS concepts, practical activities and assessment tasks
3. CAPS page number
4. Learner's Book page number
5. Learner's Book activity/task
6. Teacher's Guide page number
7. *Everything Science* Learner's Book page number
8. *Everything Science* Teacher's Guide page number
9. Completion date

In addition, a list of resources for each session and enrichment ideas are provided.

Weekly reflection

The tracker provides space for you to jot down both successes and ideas for a different approach in future years. This reflection should be based on the daily sessions you have taught during the week.

Share your ideas with colleagues and with your HOD. Discuss aspects that went well and aspects that did not go as well as you expected.

- Did the learners grasp the main concepts of the lesson?
- Was my content preparation adequate?
- Did I have all the correct resources in sufficient numbers?
- Did the learners interact with the learning material provided?
- Did learners ask and answer questions relating to the concept?
- Did the learners finish their work in time?
- Was there enough work to keep learners busy for the allocated time?
- What quality of homework did learners produce?

Put your thoughts in writing by briefly jotting down your reflections each week but **think** about your lessons daily.

The prompts for reflection in the tracker are as follows:

- *What went well?*
- *What did not go well?*
- *What did the learners find difficult or easy to understand or do?*
- *What will you do to support or extend learners?*
- *What will you change next time? Why?*
- *Did you complete all the work set for the week?*
- *If not, how will you get back on track?*

The reflection should be based on the daily lessons you have taught each week. It will provide you with a record for the next time you implement the same lesson, and also forms the basis for collegial conversations with your HOD and peers.

Explanation of abbreviations and symbols used in the trackers

3D	three-dimensional
A.	Answer
Act.	Activity
CA	Class activity
c.o.e.	Carry over errors
CP	Check Point (*Solutions for All Physical Sciences*)
Demo.	Demonstration
ES	*Everything Science*
Ex.	Exercise
Exp.	Experiment
HOD	Head of Department
IA	Informal assessment
LB	Learner's Book
No.	Number
p.	Page
PA	Practical activity
PT	Periodic Table
pp.	Pages
Q.	Question
S #	Hour session
SA	Summative Assessment
TG	Teacher's Guide
TY	Test Yourself (*Study and Master Physical Sciences*)
WS	Worksheet
*	Additional/alternative activity provided

1. *Solutions for All Physical Sciences* (Macmillan South Africa)

This Learner's Book has a wide variety of exercises for classwork and homework as each concept is introduced. The exercises are relatively challenging. They promote the development of thinking skills and adequately cover the type of questions that learners can expect to answer in the CAPS NSC examinations.

If the learners in your class(es) have difficulty solving these problems there is an option to set them homework from *Everything Science* and to tackle the more demanding questions collaboratively as a class during lessons. In Section E *Additional Information and Enrichment Activities* you will find references to the exercises in *Everything Science* which could supplement or replace the homework for the day. This idea may work very well with classes of mixed ability. The more able learners will be extended by the exercises in *Solutions for All*, while those learners who work at a slower pace can gain confidence by working with the *Everything Science* exercises.

Solutions for All Physical Sciences												
Week 1: Momentum												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**					
								Date completed				
1	**Momentum** Introduction to the topics of momentum and impulse by checking learners' understanding of terms and concepts from Grades 10 and 11, and placing these new concepts into context, e.g. change of momentum during collisions • Define momentum • Calculate the momentum of a moving object using $p = mv$ • Describe the vector nature of momentum and illustrate with some simple examples	56–59 62–65 99	13–15	Check myself CP 1	1–6	20–25	36–37					
	Homework Ex. 1.1 Q. 1–8		18	Ex. 1.1 Q. 1–8	6–7							
2	• Draw vector diagrams to illustrate the relationship between the initial momentum, the final momentum and the change in momentum in each of the above cases	99	16–19	CP 2 Ex. 1.1 Q. 9–14	7–9	25–29	36–37					
	Homework Ex. 1.1 Q. 15–16		19	Ex. 1.1 Q. 15–16	9							
3	**Newton's second law expressed in terms of momentum** • State Newton's second law in terms of momentum: *The net force acting on an object is equal to the rate of change of momentum* • Express Newton's second law in symbols: $F_{net} = \frac{\Delta p}{\Delta t}$ • Explain the relationship between net force and change in momentum for a variety of motions	99	19–24	CP 3 Ex. 1.2 Q. 1–4	9–11	30–31	38					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	Homework Ex. 1.2 Q. 5–7		20–21	Ex. 1.2 Q. 5–7	11							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 2: Momentum

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	• Calculate the change in momentum when a resultant force acts on an object and its velocity increases in the direction of motion (e.g. 2nd stage rocket engine fires), decreases (e.g. brakes are applied), reverses its direction of motion (e.g. a soccer ball kicked back in the direction it came from)	99	22–24	Ex. 1.2 Q. 8–13	11–12	31–35	38					
	Homework Ex. 1.2 Q. 14–17		22–24	Ex. 1.2 Q. 14–17	13							

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
2	**Conservation of momentum and elastic and inelastic collisions** • Explain what is meant by a system (in Physics) • Explain (when working with systems) what is meant by internal and external forces • Explain that an isolated system is one that has no net force (external) acting on it • State the law of conservation of momentum as: *The total linear momentum of an isolated system remains constant (is conserved)* • Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention ***Teacher demonstration: Collision types using trolleys (or air track)**	100	28–32	CP 4	14–15	35–39	38–39					
	Homework Ex. 1.3 Q. 1–7		34–35	Ex. 1.3 Q. 1–7	16–17							
3	• Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention • Distinguish between elastic and inelastic collisions • Know that kinetic energy is only conserved in an elastic collision	100	35–36	Ex. 1.3 Q. 8–12 CP 5	17–19	40–53	38–39					
	Homework Ex. 1.3 Q. 13–16		36	Ex. 1.2 Q. 13–16	18							
4	**Recommended demonstration for informal assessment** Investigate the conservation of momentum and energy using Newton's cradle (qualitative) (Refer to Section E *Additional Information and Enrichment Activities*: How Newton's cradle works) • Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention	100	36–39	Ex. 1.4 Q. 1–5	20–24	37–53	39–40					
	Homework Ex. 1.4 Q. 6–7		39	Ex. 1.4 Q. 6–7	24–25							

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Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences												
Week 3: Momentum and impulse												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**					
								Date completed				
1	• Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention • Define impulse as the product of the net force and the contact time: Impulse = $F_{net}.\Delta t$ • Know that impulse is a vector quantity • Know that impulse is a change in momentum, i.e. this relationship is referred to as the impulse-momentum theorem: Impulse = Δp	100	40–43	Ex. 1.4 Q. 8–9 CP 6	25–26	53–56	40–42					
	Homework Ex. 1.5 1–4		46		27–28							
2	• Use the impulse-momentum theorem ($F_{net}.\Delta t = \Delta p$) to calculate the force exerted, time for which the force is applied and change in momentum for a variety of situations involving the motion of an object in one dimension	101	42–45	CP 7 & 8	27	56–61	40–42					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
	Homework Ex. 1.5 Q. 5–8		46	Q. 5–8	27–28							
3	• Use the impulse-momentum theorem ($F_{net}.\Delta t = \Delta p$) to calculate the force exerted, time for which the force is applied and change in momentum for a variety of situations involving the motion of an object in one dimension • Apply the concept of impulse to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds	101	46–49	Q. 9–16	28–29	61–65	42–44					
	Homework Ex. 1.6 Q. 1–4		47–49		30							
4	• Apply the concept of impulse to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds Extend yourself Q. 1–8	101	49–50	CP 9 Extend yourself Q. 1–8	30–32	66–69	45–49					
	Homework Extend yourself Q. 8–11		50	Extend yourself Q. 8–11	31–32							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 4: Momentum and impulse and Vertical projectile motion

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Momentum and impulse informal assessment (30 minutes)** See Worksheet 5: Momentum and impulse formative test in Section G *Additional Worksheets for Learners* Review Momentum and impulse formative test (30 minutes)	99–101		IA: Test								
	Homework Review the key points in the chapter and the summary		51–52									
2	**Vertical projectile motion* (one dimension) represented in words, diagrams, equations and graphs (near the surface of the Earth and in the absence of air friction)** Introduction to vertical projectile motion: Recall the equations of motion from Grade 10 • Explain that projectiles fall freely with gravitational acceleration **g** accelerating downwards with a constant acceleration irrespective of whether the projectile is moving upward or downward or is at maximum height • Know that projectiles can have their motion described by a single set of equations for the upward and downward motion • Use equations of motion to determine the position, velocity and displacement of a projectile at any given time	56–57 102	53–60	Check myself CP 1 & 2 Ex. 2.1 1–3	33–38	72–76	52					
	Homework Ex. 2.1 4–7		60	Ex. 2.1 4–7	38–39							
3	• Use equations of motion to determine the position, velocity and displacement of a projectile at any given time • Know that projectiles take the same time to reach their greatest height from the point of upward launch as the time they take to fall back to the point of launch; this is known as time symmetry	102	60–64	CP 3 Ex. 2.2 1–5	39–41	76–83	52–55					
	Homework Ex. 2.2 6–8		64		41–42							
4	• Use equations of motion to determine the position, velocity and displacement of a projectile at any given time	102	64–67	CP 4 Ex. 2.3 1–7	42–44	76–83	52–55					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	Homework Worksheet 4: Measuring the acceleration due to gravity in Section G *Additional Worksheets for Learners* Draw the graph for homework Prepare for informal practical: Measuring the acceleration due to gravity		67–69									

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 5: Vertical projectile motion and Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	**Recommended experiment for informal assessment** Investigate the motion of a falling body Worksheet 4: Measuring the acceleration due to gravity in Section G *Additional Worksheets for Learners* Answer questions from the worksheet with reference to the graph Use the data to determine the acceleration due to gravity	102	67–69	PA	44–46	74–76						
	Homework Reflect on the practical investigation Complete the practical report											

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S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
2	• Draw position vs time (x vs t), velocity vs time (v vs t) and acceleration vs time (a vs t) graphs for one-dimensional projectile motion • Give equations for the graphs of position vs time, and velocity vs time graphs for one-dimensional projectile motion • Given x vs t, v vs t or a vs t graphs, determine the position, velocity or acceleration at any time t	102–103	70–76	CP 5 & 6	46–48	83–91	55–57					
	Homework Review pp. 70–76 Extend yourself Q. 2		70–76 82		55–56							
3	• Given x vs t, v vs t or a vs t graphs describe the motion of the object, e.g. graphs showing a ball bouncing, thrown vertically upwards, thrown vertically downward, and so on	103	76–81	Ex. 2.4 Q. 1–7 Extend yourself Q. 1	48–55	91–106	58–70					
	Homework Extend yourself Q. 3		83	Extend yourself Q. 3	56							
4	**Organic chemistry** • Define organic molecules as molecules containing carbon atoms • Describe carbon as the basic building block of organic compounds, that recycles through the Earth's air, water, soil, and living organisms including human beings • Discuss the special properties of carbon that make it possible to form a variety of bonds • Give condensed structural, structural, and molecular formulae for alkanes • Explain the terms functional group, hydrocarbon and homologous series	104	85–89	CP 1 & 2	57–71	108–116	72–75					
	Homework Review pp. 85–89; summarise facts											

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 6: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	• Give the IUPAC name when given the formula • Give the formula when given the IUPAC name • Naming is restricted to compounds with the following functional groups: alkanes, alkenes, alkynes, alkyl halides, aldehydes, ketones, alcohols, carboxylic acids and esters (up to a maximum of eight carbon atoms in the parent chain, i.e. in the longest chain) • Organic compounds are restricted to one type of functional group per compound and to a maximum of two functional groups of the same type per compound	105	85–94	CP 3 Ex. 3 Q. 1–2	71–72	131–161	85–94					
	Homework Review pp. 89–94; summarise facts		89–94									

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
2	• Give condensed structural, structural, and molecular formulae for alkenes and alkynes • Explain the terms functional group, hydrocarbon and homologous series • Explain the terms saturated and unsaturated **Activity** (1) Drawing structural formulae and writing systematic names for alkanes, alkenes, alkynes (2) Building molecular models of simple alkanes, alkenes, alkynes (3) Building molecular models of but-2-enes	104	94–100	CP 4, 5, 6 & 7	73–76	131–142 117–118	87–94					
	Homework Ex. 3.2 Q. 1–2			Ex. 3.2 Q. 1–2	76–78							
3	• Identify compounds that are saturated or unsaturated (up to eight carbon atoms) **Recommended experiment for informal assessment** (1) Use the reactions of alkanes and alkenes with bromine water and potassium permanganate to indicate **saturated and unsaturated** molecules (2) Prepare alkynes and investigate the reactions with bromine water and potassium permanganate	104	95–104	CP 8,9 & 10 Ex. 3.3 Q. 1–3	79–80	118–119	87–94					
	Homework Ex. 3.4 1–3			Ex. 3.4 Q. 1–3								
4	• Give condensed structural, structural and molecular formulae for alkanes and compounds containing the following functional groups: (up to eight carbon atoms) – double carbon-carbon bonds – triple carbon-carbon bonds – alkyl halides – alcohols – carboxylic acids – esters – aldehydes – ketones	104		Ex. 3.1 Q. 3 Ex. 3.5	81–84	120–128 142–161	95–109					
	Activity (1) Building molecular models of compounds with different functional groups (2) Building molecular models of butan–2-ol or propanoic (propionic) acid											

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
	Homework Ex. 3.5 complete the questions; Ex. 3.6 Q. 1–3			Ex. 3.5 Ex. 3.6 Q. 1–3	85							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 7: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	• Explain the term: isomer • Remember ALL possible isomers have the SAME molecular formula • Emphasise the different representations of organic compounds: macroscopic, sub-microscopic and symbolic, and the links between them • Isomers are restricted to structural isomers: – chain isomers (different chain) – positional isomers (different position of the same functional group) – functional isomers (different functional group) • Illustrate their 3D orientation using models to build representations of the organic molecules **Activity** Building molecular models of isomers	105	104–110	Ex. 3.7 Q. 1–3	86–87	129–131	83–84					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class Date completed				
	Homework Search and present information on the principles and applications of the alcohol breathalyser			Research								
2	**Structure–physical property relationships** • Recognise and apply to given examples the relationship between: – physical properties and intermolecular forces (ethanol, dimethyl ether, ethanoic acid, ethane, chloro-ethane) – physical properties and number and type of functional groups (ethanol, dimethyl ether, ethanoic acid, ethane, chloro-ethane) – physical properties and chain length (methane, ethane, propane, butane, hexane, octane) – physical properties and branched chains (pentane, 2-methylbutane; 2,2-dimethylpropane) • The physical properties to be considered are: – point – boiling point – vapour pressure – physical state at room temperature – density – molecular shape – flammability – smell • The intermolecular forces to consider are hydrogen bonds and Van der Waals forces	106	113–119	CP 13–18	88–92	162–167 168–179	112–118					
	Homework Ex. 3.8		119–120									
3	• Compare physical properties of the following compounds: propane, butane, ethanol, propan-1-ol and butan-1-ol • Explain the physical properties of these compounds using 3D models of the molecules **Applications of organic chemistry** **Combustion** • Alkanes are our most important (fossil) fuels • The combustion of alkanes (oxidation) is highly exothermic and carbon dioxide and water are produced: alkane + $O_2 \rightarrow H_2O + CO_2$ with $\Delta H < 0$	106–107	121–125	CP 19–20	91–95	167–168 179–184	118–119					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	Homework Study the summary of organic reactions and revise properties of functional groups											
4	**Esterification** • An ester is the product of an acid-catalysed condensation between an alcohol and a carboxylic acid • Identify the alcohol and carboxylic acid used to prepare a given ester and vice versa, and write an equation to present this preparation	107	121–125	Ex. 3.9	92–95	179–184	118–119					
	Homework Prepare for prescribed experiment: Preparing and identifying esters Use safety data to learn the properties of these compounds: methanol, ethanol, pentanol, acetic acid, salicylic acid, concentrated sulphuric acid		126–127									

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	**Prescribed experiment for formal assessment** Prepare different esters and identify the esters by smell See No. 8 Practical: Preparation of esters in Section F *Assessment Resources*	107	126–127	PA	95–96	184–186						
	RESOURCES **Apparatus and materials** Per group: Six test tubes in test tube rack, water bowl, glass rod, glass beaker, burner, test tube holder, tripod stand, gauze, propette, spatula Chemicals: Methanol, ethanol, pentanol, acetic acid, salicylic acid, concentrated sulphuric acid Photocopies: Safety data should be available so that learners know the properties of these compounds and how to handle them											
	Homework Study the summary of organic chemistry and revise all work covered thus far											
2	**Substitution, addition and elimination** • (ONLY alkanes, alkenes, alkynes, alcohols, halo-alkanes, carboxylic acids, and esters) • Describe criteria to **classify** elimination, substitution or addition reactions according to structural change • Recall some organic compounds that are produced by people in their homes, e.g. alcohol from sorghum beer or grapes or malt or rice ***Substitution reactions:*** **Haloalkanes from alkanes:** • $CH_4 + Br_2 \rightarrow CH_3Br + HBr$ • Reaction conditions: X_2 (X = Cℓ, Br) added to alkane in the presence of light or heat (Refer back to the test for saturated and unsaturated organic compounds: Week 6: Lesson 2) **Reactions of bases with haloalkanes (hydrolysis) to produce alcohols:** • $C(CH_3)_3X + KOH \rightarrow C(CH_3)_3OH + KX$ where X = Br, Cℓ • Reaction conditions: Haloalkane dissolved in ethanol before treatment with aqueous sodium hydroxide and warming of the mixture • The same hydrolysis reaction occurs more slowly without alkali, i.e. H_2O added to the haloalkane dissolved in ethanol	112–113	128–132	CP 21–23	96–98	186–187 192–194	122					

S #	CAPS concepts, practical activities and assessment tasks		LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
	Interconversion between alcohols and haloalkanes: • Reactions of HX (X = $C\ell$, Br) with alcohols to produce haloalkanes • Tertiary alcohols are converted into haloalkanes using HBr or $HC\ell$ at room temperature: $C(CH_3)_3OH + HBr \rightarrow C(CH_3)_3Br + H_2O$ The reaction works best with tertiary alcohols; primary and secondary alcohols react slowly and at high temperatures • Write equations for simple substitution reactions											
	Homework Ex. 3.10											
3	***Addition reactions:*** • Unsaturated compounds (alkenes and cycloalkenes) undergo addition reactions to form saturated compounds **Halogenation:** • Use the reactions of alkane and alkenes with bromine water to indicate saturated and unsaturated molecules (refer back to Week 6: Lesson 2) • Bromine discolours (from light brown to colourless) • $CH_2{=}CH_2 + Br_2 \rightarrow CH_2Br{-}CH_2Br$ reaction proceeds spontaneously • $CH_3{-}CH_3 + Br_2 \rightarrow CH_3{-}CH_2Br + HBr$ reaction proceeds slowly, in the presence of sunlight (Cyclohexane and cyclohexene could be used) (Similarly use potassium permanganate solution to test for saturated and unsaturated compounds) • Addition of X_2 (X = $C\ell$, Br) to alkenes, e.g. $CH_2{=}CH_2 + C\ell_2 \rightarrow CH_2C\ell{-}CH_2C\ell$ • Reaction conditions: X_2 (X = $C\ell$, Br) added to alkene **Hydration:** ***Video clip: Preparing ethanol from ethene:** www.youtube.com/watch?v=ZkX9rVtCa7c • Addition of H_2O to alkenes, e.g. $CH_2{=}CH_2 + H_2O \rightarrow CH_3\text{-}CH_2OH$ • Reaction conditions: H_2O in excess and a small amount of HX or other strong acid (H_3PO_4) as catalyst • During addition of H_2O to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms • The -OH group attaches to the more substituted C atom **Hydrogenation:** • Addition of H_2 to alkenes e.g. $CH_2{=}CH_2 + H_2 \rightarrow CH_3{-}CH_3$	108–109	132–138	CP 24–27	98–104	187–190	120–121					

S #	CAPS concepts, practical activities and assessment tasks		LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
	• Reactions conditions: Alkene dissolved in non-polar solvent with a catalyst (Pt, Pd or Ni) in an H_2 atmosphere ***Video clip: Hydrogenation of vegetable oils to form margarine:** www.youtube.com/watch?v=2iKczqO1TiE **Hydrohalogenation:** • Addition of HX to an alkene, e.g. $CH_2{=}CH_2 + HC\ell \rightarrow CH_3{-}CH_2C\ell$ • Reaction conditions: HX (X = Cℓ, Br, I) added to alkene; no water must be present • During addition of HX to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms • The X atom attaches to the more substituted C atom											
	RESOURCES Preparing ethanol from ethene: www.youtube.com/watch?v=ZkX9rVtCa7c This video clip begins with an explanation of the preparation of ethanol from fermentation; it then goes on to the cracking of hydrocarbons to form smaller molecules (ethene), and moves on to the preparation of ethanol from ethene Hydrogenation of vegetable oils to form margarine: www.youtube.com/watch?v=2iKczqO1TiE											
	Homework Ex. 3.11		138									
4	***Elimination reactions:*** • Saturated compounds (haloalkanes, alcohols, alkanes) undergo elimination reactions to form unsaturated compounds (If more than one elimination product is possible, the major product is the one where the H atom is removed from the C atom with the least number of H atoms) **Dehydrohalogenation:** • $CH_2C\ell{-}CH_2C\ell \rightarrow CH_2{=}CHC\ell + HC\ell$ • Reaction conditions: Heat under reflux (vapours condense and return to reaction vessel during heating) in concentrated solution of NaOH or KOH in pure ethanol as the solvent, i.e. hot ethanolic NaOH/KOH **Dehydration of alcohols:** • Elimination of H_2O from an alcohol, e.g. $CH_3{-}CH_2OH \rightarrow CH_2{=}CH_2 + H_2O$ • Reaction conditions: Acid-catalysed dehydration – heating of alcohol with an excess of concentrated H_2SO_4 (or H_3PO_4)	110–111	138–142	CP 28–29	104–107	190–192	121					

S #	CAPS concepts, practical activities and assessment tasks		LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	Cracking of hydrocarbons: • Breaking up large hydrocarbon molecules into smaller and more useful bits • Reactions conditions: High pressures and temperatures without a catalyst (thermal cracking) or lower temperatures and pressures in the presence of a catalyst (catalytic cracking) ***Video clip: Cracking alkanes:** www.youtube.com/watch?v=Xsqlv4rWnEg											
	RESOURCES The industrial process of cracking: www.youtube.com/watch?v=Xsqlv4rWnEg											
	Homework Ex. 3.12 Prepare a summary of the reactions		142									

Reflection

Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences

Week 9: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
1	* **Summary of organic reactions** Present the summary of reactions, and explain how the students can use this summary for revision					194–195	122–125					
	Homework Review or summarise, and learn all organic chemistry covered thus far											
2	**Plastics and polymers** • Make learners aware of materials made from polymers, e.g. What do you know about Kevlar and Mylar? What is the function of these materials and what are they used for? Who discovered or invented the materials? • Analyse information about the discovery of polyethene and the development of addition polymers • Describe **addition** reactions that are important in industry, e.g. **addition polymerisation** reactions to produce polyethylene, polypropylene and PVC • Describe the terms: polymer, macromolecule and functional groups • Illustrate the reaction to produce a polymer by an addition reaction using the polymerisation of ONLY ethene to produce polyethene [$nCH_2{=}CH_2 \rightarrow (–CH_2–CH_2–)_n$] • What is the industrial use of polythene? Squeeze bottles, plastic bags, films, toys and moulded objects, electric insulation **Activities:** Build physical or computer models of addition polymers	113–116	143–147	CP 30 Build models of polymers	107–111	196–202	125–126					
	Homework Search for information or read articles about the discovery of polythene and the development of addition polymers		149									
3	**Plastics and polymers** • Illustrate the reaction to produce a polymer **by condensation** reaction with the reaction to produce polyester Use ONLY the reaction to make the polymer polyethylene • Identify a polymer as the product of an addition or condensation polymerisation reaction from its structural formula Use ONLY polythene and polylactic acid (PLA)											

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S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
	• Identify the monomer used to produce a polymer from the structural formula of a section of a chain For the identification of monomers use ONLY the following polymers: PVC (polyvinyl chloride), polystyrene, polythene and PVA (polyvinyl acetate)	114–116	149–152	CP 31	111–113	202–209	126–128					
	Homework Ex. 3.13		155–156		113–114							
4	• Investigate plastics' physical properties and recycling numbers (polythene has the recycling number 4) • Discuss or present information on environmental issues related to the use of plastics Extend yourself: Q. 1–4	114	156–160	Extend yourself Q. 1–4	114–115	209–213						
	Homework Extend yourself: Q. 5–7		160–161		115–118							

Reflection

Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Solutions for All Physical Sciences												
Week 10: Assessment and review of test												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**					
								Date completed				
1	**Informal assessment: Recommended experiments** (1) Making slime using cross-linking polymers using white wood glue (polyvinyl alcohol, PVA) and borax powder (sodium borate) (2) Making silly putty using cross-linking polymers white wood glue (polyvinyl alcohol, PVA) and borax powder (sodium borate)	116				209						
	RESOURCES (1) 4% white wood glue solution, 1% borax solution, food colouring (2) 50% white wood glue solution (Alcolin or Red Devil), 15% borax solution, food colouring Apparatus: Empty yoghurt containers, stirring rod (or wooden ice cream stick)											
	Homework Summary of organic chemistry	104–116	161–164			213–218	128–133					
2	*Term 1 Chemistry test			*	426–435							
3	*Term 1 Physics test			*	426–435							
4	Review the Chemistry and Physics tests											
5	Review the Chemistry and Physics tests											

End-of-term reflection	
Think about and make a note of: 1. Was the learners' performance during the term what you had expected and hoped for? Which learners need particular support with Science in the next term? What strategy can you put in place for them to catch up with the class? Which learners would benefit from extension activities? How can you help them? 2. With which specific topics did the learners struggle the most? How can you adjust your teaching to improve their understanding of this section of the curriculum in the future?	3. What ONE change should you make to your teaching practice to help you teach more effectively next term? 4. Did you cover all the content as prescribed by the CAPS for the term? If not, what are the implications for your work on these topics in future? What plan will you make to get back on track?
HOD:	**Date:**

Study and Master Physical Sciences (Cambridge University Press)

This Learner's Book contains many solved problems that teach learners how to tackle many problems set in varying scenarios. It is short on exercises for the learners themselves on a day to day basis. To overcome this, extra practice has been set from *Everything Science* for homework and sometimes also for class work. These exercises are marked with an asterisk (*ES) to denote *Everything Science*. The page numbers are also stated alongside each exercise.

Study and Master Physical Sciences													
Week 1: Momentum													
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**					
						LB pp.	**TG pp.**						
								Date completed					
1	**Momentum** Refer back to definitions and concepts covered in Grades 10 and 11 in the topic of Mechanics as you introduce these new concepts • Define momentum • Calculate the momentum of a moving object using *p.mv* • Describe the vector nature of momentum and illustrate with some simple examples • Draw vector diagrams to illustrate the relationship between the initial momentum, the final momentum and the change in momentum in each of the above cases	56–59 62–65 99	30–33	TY 1 Q. 1–2	D5–D6	20–25	36–37						
	Homework *ES Ex. 2.1 Q. 1 p. 29		35	*ES 29	*ES 37								
2	• State Newton's second law in terms of momentum: *The net force acting on an object is equal to the rate of change of momentum* • Express Newton's second law in symbols: $F_{net} = \frac{\Delta p}{\Delta t}$ • Explain the relationship between net force and change in momentum for a variety of motions	99	35–40	TY 2 Q. 2–4	D6–D7	25–31	36–38						
	Homework Read the Case study: Rocket motion TY 2 Q. 1 *ES Ex. 2.2 1–2 p. 35		38–40	TY 2 Q. 1 *ES 35	D6–D7 *ES 38								

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
3	• Calculate the change in momentum when a resultant force acts on an object and its velocity increases in the direction of motion (e.g. 2nd stage rocket engine fires), decreases (e.g. brakes are applied), reverses its direction of motion (e.g. a soccer ball) kicked back in the direction it came from) * WS 1: Extra examples on Momentum and Newton's second law; Q. 1–4	99	38–40	*WS 1 Q. 1–4		31–35	38					
	Homework *ES Ex. 2.3 Q. 1–3 p. 39			*ES 39	*ES 38–39							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences

Week 2: Momentum

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
1	**Conservation of momentum and elastic and inelastic collisions** • Explain what is meant by a system (in Physics) • Explain (when working with systems) what is meant by internal and external forces • Explain that an isolated system is one that has no net force (external) acting on it • State the law of conservation of momentum as: *The total linear momentum of an isolated system remains constant (is conserved)*	100	40–42 47	TY 3 Q. 1–2	D7	35–39	38–39					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class (Date completed)				
	• Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention											
	Homework ES Ex. 2.4 Q. 1–2 p. 53		47	*ES 53	*ES 39–40							
2	• Distinguish between elastic and inelastic collisions • Know that kinetic energy is only conserved in an elastic collision **Teacher demonstration: Conservation of momentum, using trolleys**	100	42–47			40–353	38–39					
	Homework *Worksheet 2: Conservation of momentum Q. 1–7 in Section G *Additional Worksheets for Learners*		47	*WS 2 1–7								
3	**Recommended demonstration for informal assessment** Investigate the conservation of momentum and energy using Newton's cradle (qualitative) (Refer to Section E *Additional Information and Enrichment Activities*: How Newton's cradle works)	100	46–47		D8	37–53	39–40					
	Homework Prepare for informal practical assessment Activity 1: 43–44		43–44	Act. 1								
4	**Informal practical** Verify the law of conservation of momentum	100	43–44	Act. 1	D7	53–56	40–42					
	Homework Complete the report on the practical to verify the law of conservation of momentum		43–44	Act. 1								

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences

Week 3: Momentum and impulse

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	• Define impulse as the product of the net force and the contact time: Impulse = $F_{net}.\Delta t$ • Know that impulse is a vector quantity • Know that impulse is a change in momentum, i.e. this relationship is referred to as the impulse-momentum theorem: Impulse = Δp • Use the impulse-momentum theorem ($F_{net}.\Delta t = \Delta p$) to calculate the force exerted, time for which the force is applied and change in momentum for a variety of situations involving the motion of an object in one dimension	101	47–51	TY 3 Q. 1–2 TY 4 Q. 1–3	D9	53–56	40–42					
	Homework ES Ex. 2.5 Q. 1–6 p. 61–62			*ES 61–62	*ES 40–42							
2	• Use the impulse-momentum theorem ($F_{net}.\Delta t = \Delta p$) to calculate the force exerted, time for which the force is applied and change in momentum for a variety of situations involving the motion of an object in one dimension • Apply the concept of impulse to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds	101	47–51		D10	56–61	42–44					
	Homework Summative Assessment: Q. 4–7			SA Q. 4–7	D12– D13							
3	• Apply the concept of impulse to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds *ES Ex. 2.7 Q. 11–16	101	47–51	TY 5 Q. 1–2 *ES 68–69	D10 *ES 47–49	66–68	45–49					
	Homework ES Ex. 2.7 Q. 1–10			*ES 66–68	*ES 45–47							
4	***Momentum and impulse informal assessment (30 minutes)** See Worksheet 5: Momentum and impulse formative test in Section G *Additional Worksheets for Learners* Review Momentum and impulse formative test (30 minutes)	99–101		*IA Test 1								
	Homework Review the key points in the chapter and complete summary notes											

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences												
Week 4: Vertical projectile motion												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**					
								Date completed				
1	**Vertical projectile motion * (one dimension) represented in words, diagrams, equations and graphs (near the surface of the Earth and in the absence of air friction)** ***Introduction to vertical projectile motion:*** Recall the equations of motion from Grade 10 • Explain that projectiles fall freely with gravitational acceleration g accelerating downwards with a constant acceleration irrespective of whether the projectile is moving upward or downward or is at maximum height • Know that projectiles can have their motion described by a single set of equations for the upward and downward motion • Use equations of motion to determine the position, velocity and displacement of a projectile at any given time • Know that projectiles take the same time to reach their greatest height from the point of upward launch as the time they take to fall back to the point of launch. This is known as time symmetry	56–57 102	52–56			72–76	52					
	Homework *Worksheet 3: Vertical projectile motion: Section G *Additional Worksheets for Learners* Q. 1–3			Q. 1–3								

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
								Date completed				
2	• Use equations of motion to determine the position, velocity and displacement of a projectile at any given time	102	62–63			76–83	52–55					
	Homework *Worksheet 3: Vertical projectile motion: Section G *Additional Worksheets for Learners* Q. 4–5			Q. 4–5								
3	• Draw position vs time (x vs t), velocity vs time (v vs t) and acceleration vs time (a vs t) graphs for 1D motion • Give equations for the graphs of position vs time, and velocity vs time graphs for one-dimensional motion • Given x vs t, v vs t or a vs t graphs determine the position, velocity or acceleration at any time t	102	56–61			76–83	52–55					
	Homework *Worksheet 3: Vertical projectile motion: Section G *Additional Worksheets for Learners* Q. 6–7		64	Q. 6–7								
4	**Recommended experiment for informal assessment** Investigate the motion of a falling body Use Worksheet 4: Measuring the acceleration due to gravity in Section G *Additional Worksheets for Learners* Answer questions from the worksheet with reference to the graph Use the data to determine the acceleration due to gravity	102	64		D10–D11	74–76						
	Homework TY 6: Q. 1–3			TY 6 Q. 1–3 SA Q. 12	D11 D14							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences												
Week 5: Vertical projectile motion and Organic chemistry												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**	**Date completed**				
1	• Given x vs t, v vs t or a vs t graphs describe the motion of the object, e.g. graphs showing a ball: thrown vertically upwards, thrown vertically downward, and so on	102–103	65–68	SA Q. 8–11	D13–D14	83–91	55–57					
	Homework SA Q. 13–14			SA Q. 13–14	D15							
2	• Given x vs t, v vs t or a vs t graphs describe the motion of the object e.g. graphs showing a ball bouncing, thrown vertically upwards, thrown vertically downward, and so on	103	68–73	TY 4–6 Q. 4	D11	91–106	58–70					
	Homework SA Q. 1–3			SA Q. 1–3	D12							
3	**Organic chemistry** • Define organic molecules as molecules containing carbon atoms • Describe carbon as the basic building block of organic compounds, that recycles through the Earth's air, water, soil, and living organisms including human beings • Discuss the special properties of carbon that makes it possible to form a variety of bonds • Explain the terms functional group, hydrocarbon and homologous series	104	74–81			108–116	72–75					
	Homework TY 1 1–5		81	TY 1 Q. 1–5	D17							
4	• Give condensed structural, structural, and molecular formulae for alkanes and compounds containing the following functional groups (up to eight carbon atoms): – double carbon-carbon bonds – triple carbon-carbon bonds – alkyl halides – alcohols – carboxylic acids – esters – aldehydes – ketones	104	82–89			120–128 142–161	95–109					

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S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	• Explain the terms functional group, hydrocarbon and homologous series • Explain the terms saturated and unsaturated											
	Homework Learn to identify the functional groups of the compounds: refer to the table in LB p. 80		80–89									

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences

Week 6: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	**Structure–physical property relationships** • The physical properties to be considered are: – melting point – boiling point – vapour pressure – physical state at room temperature – density – molecular shape – flammability – smell	106	90–93	Act. 2	D18–D19	162–179	112–118					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
	• The intermolecular forces to be considered are hydrogen bonds and Van der Waals forces • Recognise and apply to ethanol, dimethyl ether, ethanoic acid, ethane and chloro-ethane the relationship between **physical properties and intermolecular forces** and **physical properties and number and type of functional groups** • Summarise findings into a table and analyse the results											
	Homework • Recognise and apply to methane, ethane, propane, butane, hexane and octane the relationship between **physical properties and chain length** • Explain how the physical properties are related to the intermolecular forces in substances											
2	• Identify compounds that are saturated, unsaturated (up to eight carbon atoms) **Recommended experiment for informal assessment** (1) Use the reactions of alkanes and alkenes with bromine water and potassium permanganate to indicate saturated and unsaturated molecules (2) Prepare alkynes and investigate the reactions with bromine water and potassium permanganate	104	90–95	Act. 3	D19–D20	118–119	87–94					
	RESOURCES Cyclohexane, cyclohexene, test tubes with stoppers in test tube stand, bromine water, acidified potassium permanganate solution calcium carbide pellets, conical flask with stopper, dropping funnel, delivery tube											
	Homework Analyse the results of Activity 3 and complete the practical report			Act. 3	D19–D20							
3	• Explain the term: isomer • Remember ALL possible isomers have the SAME molecular formula • Emphasise the different representations of organic compounds: macroscopic, sub-microscopic and symbolic, and the links between them • Isomers are restricted to structural isomers: – chain isomers (different chain) – positional isomers (different position of the same functional group) – functional isomers (different functional group) • Illustrate their 3D orientation using models to build representations of the organic molecules **Activity** Building molecular models of isomers	105	95–97 101	Act. 4 Q. 3–5	D21	129–131	83–84					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class / Date completed				
	Homework TY 2: Q. 1–3			TY 2 Q. 1–3	D20							
4	• Give the IUPAC name when given the formula • Give the formula when given the IUPAC name • Naming is restricted to compounds with the following functional groups: alkanes, alkenes, alkynes, alkyl halides, aldehydes, ketones, alcohols, carboxylic acids and esters (up to a maximum of eight carbon atoms in the parent chain, i.e. in the longest chain) • Organic compounds are restricted to one type of functional group per compound and to a maximum of two functional groups of the same type per compound **Activity** (1) Drawing structural formulae and writing systematic names for alkanes, alkenes, alkynes (2) Building molecular models of simple alkanes, alkenes, alkynes (3) Building molecular models of compounds with different functional groups See Exercises from *Everything Science*: *Ex. 4.8 Q. 1–2 p. 135 *Ex. 4.9 Q. 1–2 p. 138 *Ex. 4.10 Q. 1–2 pp. 140–141 *Ex. 4.11 Q. 1–2 p. 142 *Ex. 4.12 Q. 1–2 p. 144	105	98–101	Act. 4 Q. 1–2 ES 135–144	D21 ES 85–96	131–161	85–96					
	Homework TY 3: Q. 1–3			TY 3 Q. 1–3	D22							

Reflection

Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: Date:

Study and Master Physical Sciences

Week 7: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	• Give the IUPAC name when given the formula • Give the formula when given the IUPAC name *See *Everything Science*: *Ex. 4.13 Q. 1–2 pp. 147–148 *Ex. 4.14 Q. 1–2 p. 152 *Ex. 4.15 Q. 1–2 p. 154 *Ex. 4.16 Q. 1–2 p. 157 *Ex. 4. 17 Q. 1–2 p. 159	105	98–101	ES 147–160	ES 96–109	131–161	96–109					
	Homework *ES Ex. 4.18 Q. 1–3 pp. 160–161			ES 160–161	106–109							
2	**Structure–physical property relationships** • Recognise and apply to given examples the relationship between: – physical properties and intermolecular forces (ethanol, dimethyl ether, ethanoic acid, ethane, chloro-ethane) – physical properties and number and type of functional groups (ethanol, dimethyl ether, ethanoic acid, ethane, chloro-ethane) – physical properties and chain length (methane, ethane, propane, butane, hexane, octane) – physical properties and branched chains (pentane, 2-methylbutane; 2,2-dimethylpropane)	106	104–106	TY 3 Q. 4 TY 4 Q. 1–2	D22–D23	162–179	112–118					
	Homework SA: Q. 5–8		139–141	SA Q. 5–8								
3	**Applications of organic chemistry** • Alkanes are our most important (fossil) fuels • The combustion of alkanes (oxidation) is highly exothermic • Carbon dioxide and water are produced: alkane + $O_2 \rightarrow H_2O + CO_2$ with $\Delta H < 0$ • An ester is a product of an acid-catalysed condensation between an alcohol and carboxylic acid • Identify the alcohol and carboxylic acid used to prepare a given ester and vice versa, and write an equation to present this preparation	107	107–108	TY 5 Q. 1	D25	179–184	118–119					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
	Homework Prepare for the prescribed practical: Preparing and identifying esters		108–109	Act. 5	D23–D25							
4	**Prescribed experiment for formal assessment** Prepare different esters and identify the esters by smell See No. 9 Practical assessment: Preparation of esters in Section F *Assessment Resources*	107	108–109	Act. 5	D23–D25	184–186						
	RESOURCES **Apparatus and materials** Per group: Six test tubes in test tube rack, water bowl, glass rod, glass beaker, burner, test tube holder, tripod stand, gauze, propette, spatula Chemicals: Methanol, ethanol, pentanol, acetic acid, salicylic acid, concentrated sulphuric acid Photocopies: Safety data should be available so that learners know the properties of these compounds, and how to handle them											
	Homework Search and present information on the principles and applications of the alcohol breathalyser			Act. 2	D18							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences

Week 8: Organic chemistry

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Prescribed experiment for formal assessment** Write up the practical on preparing different esters and identify the esters by smell				D23–D25	184–186						
	Homework TY 6 Q. 1–2			TY 6 Q. 1–2	D25–D26							
2	**Substitution, addition and elimination** • (ONLY alkanes, alkenes, alkynes, alcohols, halo-alkanes, carboxylic acids, and esters) • Describe criteria to **classify** elimination, substitution or addition reactions according to structural change • Recall some organic compounds that are produced by people in their homes, e.g. alcohol from sorghum beer or grapes or malt or rice ***Addition reactions:*** • Unsaturated compounds (alkenes and cycloalkenes) undergo addition reactions to form saturated compounds **Hydrohalogenation**: • Addition of HX to an alkene e.g. $CH_2{=}CH_2 + HC\ell \rightarrow CH_3\text{-}CH_2C\ell$ • Reaction conditions: HX (X = Cℓ, Br, I) added to alkene; no water must be present • During addition of HX to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms • The X atom attaches to the more substituted C atom **Halogenation:** • Use the reactions of alkane and alkenes with bromine water to indicate saturated and unsaturated molecules (refer to the demonstration on saturated and unsaturated compounds) • Bromine discolours (from light brown to colourless) • $CH_2{=}CH_2 + Br_2 \rightarrow CH_2Br\text{–}CH_2Br$ reaction proceeds spontaneously • $CH_3\text{–}CH_3 + Br_2 \rightarrow CH_3\text{–}CH_2Br + HBr$ reaction proceeds slowly, in the presence of sunlight (Cyclohexane and cyclohexene could be used) (Similarly use potassium permanganate solution to test for saturated and unsaturated compounds)	108–109				186–190	120–121					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
	• Addition of X_2 (X = $C\ell$, Br) to alkenes, e.g. $CH_2{=}CH_2 + C\ell_2 \rightarrow CH_2C\ell{-}CH_2C\ell$ • Reaction conditions: X_2 (X = $C\ell$, Br) added to alkene **Hydration:** ***Video clip: Preparing ethanol from ethene:** www.youtube.com/watch?v=ZkX9rVtCa7c • Addition of H_2O to alkenes e.g. $CH_2{=}CH_2 + H_2O \rightarrow CH_3{-}CH_2OH$ • Reaction conditions: H_2O in excess and a small amount of HX or other strong acid (H_3PO_4) as catalyst • During addition of H_2O to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms • The –OH group attaches to the more substituted C-atom **Hydrogenation:** • Addition of H_2 to alkenes e.g. $CH_2{=}CH_2 + H_2 \rightarrow CH_3{-}CH_3$ • Reactions conditions: Alkene dissolved in non-polar solvent with a catalyst (Pt, Pd or Ni) in an H_2 atmosphere ***Video clip: Hydrogenation of vegetable oils to form margarine:** www.youtube.com/watch?v=2iKczqO1TiE											
	RESOURCES Preparing ethanol from ethene: www.youtube.com/watch?v=ZkX9rVtCa7c This video clip begins with an explanation of the preparation of ethanol from fermentation; it then goes on to the cracking of hydrocarbons to form smaller molecules (ethene), and moves on to the preparation of ethanol from ethene Hydrogenation of vegetable oils to form margarine: www.youtube.com/watch?v=2iKczqO1TiE											
	Homework TY 6: Q. 3 Review addition reactions: Learn conditions and examples of addition reactions			TY 6 Q. 3	D25– D26							
3	***Elimination reactions:*** • Saturated compounds (haloalkanes, alcohols, alkanes) undergo elimination reactions to form unsaturated compounds (If more than one elimination product is possible, the major product is the one where the H atom is removed from the C atom with the least number of H atoms) **Dehydrohalogenation:** • $CH_2C\ell{-}CH_2C\ell \rightarrow CH_2{=}CHC\ell + HC\ell$ • Reaction conditions: Heat under reflux (vapours condense and return to reaction vessel during heating) in concentrated solution of NaOH or KOH in pure ethanol as the solvent i.e. hot ethanolic NaOH/KOH	110–111				190–192	121					

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S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
	Dehydration of alcohols: • Elimination of H_2O from an alcohol: e.g. $CH_3–CH_2OH \rightarrow CH_2{=}CH_2 + H_2O$ • Reaction conditions: Acid catalysed dehydration–heating of alcohol with an excess of concentrated H_2SO_4 (or H_3PO_4) **Cracking of hydrocarbons:** • Breaking up large hydrocarbon molecules into smaller and more useful bits • Reactions conditions: High pressures and temperatures without a catalyst (thermal cracking) or lower temperatures and pressures in the presence of a catalyst (catalytic cracking) ***Video clip: Cracking hydrocarbons:** www.youtube.com/watch?v=Xsqlv4rWnEg											
	RESOURCES The industrial process of cracking: www.youtube.com/watch?v=Xsqlv4rWnEg											
	Homework TY 6 : Q. 4			TY 6 Q. 4	D26							
4	***Substitution reactions:*** **Interconversion between alcohols and haloalkanes:** • Reactions of HX (X = $C\ell$, Br) with alcohols to produce haloalkanes • Tertiary alcohols are converted into haloalkanes using HBr or $HC\ell$ at room temperature: $C(CH_3)_3OH + HBr \rightarrow C(CH_3)_3Br + H_2O$ • The reaction works best with tertiary alcohols; primary and secondary alcohols react slowly and at high temperatures **Reactions of bases with haloalkanes (hydrolysis) to produce alcohols:** • $C(CH_3)_3X + KOH \rightarrow C(CH_3)_3OH + KX$ where X = Br, $C\ell$ • Reaction conditions: Haloalkane dissolved in ethanol before treatment with aqueous sodium hydroxide and warming of the mixture • The same hydrolysis reaction occurs more slowly without alkali, i.e. H_2O added to the haloalkane dissolved in ethanol **Haloalkanes from alkanes:** • $CH_4 + Br_2 \rightarrow CH_3Br + HBr$ • Reaction conditions: X_2 (X = $C\ell$, Br) added to alkane in the presence of light or heat • Write equations for simple substitution reactions	112–113				192–194	122					
	Homework TY 6: Q. 5–6			TY 6 Q. 5–6	D26							

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences												
Week 9: Organic chemistry												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**					
								Date completed				
1	**Plastics and polymers** • Make learners aware of materials made from polymers, e.g. What do you know about Kevlar and Mylar? What is the function of these materials and what are they used for? Who discovered or invented the materials? • Analyse information about the discovery of polyethene and the development of addition polymers • Describe **addition** reactions that are important in industry, e.g. addition polymerisation reactions to produce polyethylene, polypropylene and PVC • Describe the terms: polymer, macromolecule and functional groups • Illustrate the reaction to produce a polymer by an addition reaction using the polymerization of ONLY ethene to produce polyethene [$nCH_2{=}CH_2 \rightarrow (–CH_2–CH_2–)_n$] • What is the industrial use of polythene? Squeeze bottles, plastic bags, films, toys and moulded objects, electric insulation	113–114	119–124		D28–D29	196–202	125–126					
	Homework SA Q. 1–4			SA Q. 1–4								

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class / Date completed				
2	• Illustrate the reaction to produce a polymer by **condensation reaction** with the reaction to produce polyester Use ONLY the reaction to make the polymer polyethylene • Identify a polymer as the product of an addition or condensation polymerisation reaction from its structural formula Use ONLY polythene and polylactic acid (PLA) • Identify the monomer used to produce a polymer from the structural formula of a section of a chain For the identification of monomers use ONLY the following polymers: PVC (polyvinyl chloride), polystyrene, polythene and PVA (polyvinyl acetate)	115–116	125–126			202–209	126–128					
	Homework TY 7: Q. 1–3			TY 7 Q. 1–3								
3	• Investigate plastics' physical properties and recycling numbers (polythene has the recycling number 4) • Discuss or present information on environmental issues related to the use of plastics	114	134–136			209–213						
	Homework Summarise environmental issues related to the use of plastics				D29–D30							
4	**Informal assessment: Recommended experiments** (1) Making slime using cross-linking polymers using white wood glue (polyvinyl alcohol, PVA) and borax powder (sodium borate) (2) Making silly putty using cross-linking polymers white wood glue (polyvinyl alcohol, PVA) and borax powder (sodium borate)	116	129–130	Act. 8	D27	209						
	RESOURCES (1) 4% white wood glue solution, 1% borax solution, food colouring (2) 50% white wood glue solution (Alcolin or Red Devil), 15% borax solution, food colouring Apparatus: Empty yoghurt containers, stirring rod (or wooden ice cream stick)											
	Homework SA Q. 16–20			SA Q. 16–20								

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Study and Master Physical Sciences

Week 10: Assessment and review of tests

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.					
								Date completed				
1	*Term 1 Chemistry test											
2	*Term 1 Physics test											
3	Review Term 1 Chemistry test			*	B11, B13							
4	Review Term 1 Physics test			*	B10, B12							
5	Review any concepts learners struggled with											

End-of-term reflection

Think about and make a note of:

1. Was the learners' performance during the term what you had expected and hoped for? Which learners need particular support with Science in the next term? What strategy can you put in place for them to catch up with the class? Which learners would benefit from extension activities? How can you help them?
2. With which specific topics did the learners struggle the most? How can you adjust your teaching to improve their understanding of this section of the curriculum in the future?
3. What ONE change should you make to your teaching practice to help you teach more effectively next term?
4. Did you cover all the content as prescribed by the CAPS for the term? If not, what are the implications for your work on these topics in future? What plan will you make to get back on track?

HOD: **Date:**

E. ADDITIONAL INFORMATION AND ENRICHMENT ACTIVITIES

1. Weekly summary

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Week 1: Momentum	
Momentum	Be aware of some preconceptions that your learners may have about this topic. The following list of common misconceptions and the strategy for implementation of a conceptual approach were sources in an article entitled *Helping Students Learn Physics Better* which can be found at http://phys.udallas.edu/C3P/Preconceptions.pdf **Common misconceptions of momentum and conservation of momentum** • Momentum is not a vector quantity • Conservation of momentum only applies to collisions • Momentum is the same as force • Moving masses in the absence of gravity have no momentum • Momentum is not conserved in collisions with 'immovable' objects, e.g. a ball hitting a wall • Momentum and kinetic energy are the same • Only animate things (people, animals) exert forces; passive things (tables, floors) do not exert forces • Once an object is moving, heavier objects push more than lighter ones • A force applied by, for example, a hand, still acts on an object after the object leaves the hand **A strategy for successful implementation of a conceptual approach** • Recognise preconceptions that exist • Probe for learners' misconceptions through demonstrations and questions, e.g.: – When throwing a ball into the air, ask whether the object is free falling – What force acts on it (if we ignore air resistance)? – What force acts on it at the top of its flight? – What is its acceleration at the top of its flight? • Ask the learners to clarify their conceptions • Provide contradictions to learners' misconceptions through questions, implications and demonstrations • Encourage discussion, urging learners to apply physical concepts in their reasoning • Foster the replacement of the misconception with new concepts through: – questions – thought experiments – hypothetical situations with and without underlying physical laws – experiments or demonstrations designed to test hypotheses • Re-evaluate learners' understanding by posing conceptual questions **A useful demonstration** Demonstrate the vector nature of momentum to emphasise that a change in direction of velocity results in a change in momentum as well, e.g.: • Push a trolley to the left, and then to the right; stress that when the direction of velocity changes the direction of the momentum also changes; velocity and momentum are vector quantities • Similarly any other object can be used to illustrate this concept, e.g. you could throw a ball to and fro with the learners
Newton's second law expressed in terms of momentum	This is the general form of Newton's second law. The form applies only to the special case when the mass is constant, and should be presented as such. Stress that the motion of an object, and therefore its momentum, only changes when a net (resultant) force is applied. Conversely, a net force causes an object's motion, and therefore its momentum, to change.

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
	This can be demonstrated using a dynamics trolley on a track: • The trolley remains at rest until a net force is exerted on it • Once the trolley starts moving, resistive forces act on it (e.g. friction in the wheels): the trolley will slow down due to the net force opposing its motion • If no net force acts on the trolley, its motion remains uniform (it moves at constant velocity)
Week 2: Momentum	
Conservation of momentum **Elastic and inelastic collisions**	To establish the idea of conservation of momentum start by looking at simple collisions, first of all visually and then with some measurement of velocities. * Teacher demonstration: Collision types using trolleys (or air track) (see the next item in this section)
Week 3: Impulse and momentum	
Impulse and the impulse-momentum theorem	A simple but effective demonstration of the idea of a reduced force when the stopping time is large can be shown by throwing raw eggs at a sheet: • Some learners hold an ordinary bed sheet vertically • The teacher throws an egg at the sheet • The sheet will give a little and the egg will not break (until it rolls down and hits the ground) • The extra stopping time allowed when the sheet gives slightly reduces the net force acting on the egg This activity is taken from Resourceful Physics http://resourcefulphysics.org/
Week 4: Vertical projectile motion	
Vertical projectile motion	**Common misconceptions of projectile motion** Here are some of the misconceptions presented by learners' common sense ideas of motion: • There are two forces acting on the object: the force of gravity and weight • When a constant force acts on a body, it moves at a constant speed

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
	• When a constant force acts on a body, its speed increases; the increase in speed is directly proportional to the force and to the distance travelled • The force of gravity doesn't act instantaneously when an object is dropped: initially the force is zero, but as it falls and gains velocity, the force of gravity also increases • The force of gravity is a constant force = 9,8 N • Objects of different mass fall at different accelerations, with heavier objects falling at faster rates • There can be no motion in a vacuum because force can't act in a vacuum • There can be no force acting in a vacuum • Acceleration is the same as velocity • Freely falling bodies can only move downwards • Gravity only acts on things when they are falling It is very difficult to change the perceptions of each and every learner in the class, and many learners tend to just do what they are taught to get the correct answers without really believing the physics they are taught is true! It is useful to know that learners may have misconceptions, because if you understand what they are holding on to, you may be able to break their misconceptions down and open the way for that learner to realise her/his faulty reasoning. The overriding issues can often be traced back to the learner not being able to apply Newton's laws of motion to situations. NB Do not tell the learners about these misconceptions, as this may be the only things they remember!
Week 5: Vertical projectile motion and Organic chemistry	
Vertical projectile motion **Organic chemistry**	If you have a motion sensor, you can track the bounce of a ball by positioning the motion sensor above the ball and dropping the ball on the floor to let it bounce a few times. To keep the ball in a straight line it may be useful to drop the ball in a long tube with the motion sensor attached to the top of the tube. The graphs of position vs time,

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
	velocity vs time and acceleration vs time will then be available for learners to see and discuss following the demonstration. Organic chemistry presents many challenges to learners: • They need to deal with the symbolic representations of molecules: structural, condensed structural and molecular formulae • The polarity of the molecules and bonds within the molecules determines the physical and chemical properties of the substances: learners need to be able to distinguish between intermolecular forces and intra-molecular bonds, and their relationships to the properties of the compounds • It helps learners to understand the properties of compounds if they can visualise the structure of the molecules – building physical models of molecules aids and develops their acquisition of this knowledge and understanding Once learners have grasped the systematic organisation of organic chemistry as a body of knowledge, they generally begin to enjoy this topic, as it follows set patterns which they can study to make further predictions.
Week 6: Organic chemistry	
Terminology, functional groups, homologous series, saturated and unsaturated compounds, isomers, IUPAC naming	When the hydrocarbons are introduced to learners, it is useful to demonstrate the test for saturated and unsaturated compounds. This will reinforce the fact that the presence of single or double/triple bonds affects the chemical behaviour of compounds. Prepare in advance for this demonstration so that all proceeds smoothly during the lesson. The hydrocarbons also provide an excellent opportunity to introduce the concept of isomers and this leads on to the necessity of having a precise method of naming compounds (the IUPAC system). Learners need to learn the rules of the IUPAC naming system and practise applying them to many different compounds.

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Week 7: Organic chemistry	
Relationships between structure and the physical properties of organic compounds, applications of organic chemistry, combustion and esterification ***Prescribed practical: Preparation of esters**	The relationship between the structure of compounds and their physical properties, the intermolecular forces, chain length, branched nature of the compound, etc. is deduced from data that is usually supplied in tables or graphs. These concepts often prove to be very difficult for learners to grasp in any depth. Generally the problems arise when learners have a poor understanding of intermolecular forces (IMF) acting between molecules. IMF are confused with chemical bonds between atoms in the molecules. One way to address these misconceptions is to use models of the molecules, and to provide visual representations of how molecules behave inside the substances. The time allowed to teach this topic is only 1 hour. Do not spend much more than an hour on it at present – move on – and make a note to re-visit it later (e.g. in an after-hours revision session or just before the preliminary examinations). Combustion of alkanes can easily be demonstrated by burning laboratory gas (or referring to the burning of LP gas – in stoves, gas heaters, etc.). Emphasise that we are studying complete combustion (in an excess of oxygen) and therefore the products are only carbon dioxide and water. Learners should have no trouble in remembering that combustion of hydrocarbons is an exothermic process. The prescribed practical for this term is the preparation of esters from a small variety of carboxylic acids and alcohols. Ensure that you have sufficient stock of all chemicals and apparatus required, and if possible, run through the practical yourself beforehand so that you are aware of any procedural difficulties the learners may encounter. Preferably the laboratory should be set up neatly with work stations with all the necessary apparatus laid out for each group before the learners come into the laboratory. The practical work will take about 30 minutes for each group to complete, and tidy up thereafter.

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Week 8: Organic chemistry	
Reactions **Addition, substitution and elimination**	The summary chart of organic chemistry reactions (at the end of Section G *Additional Worksheets for Learners*) will help learners place these reactions in context. There is a lot of recall required in this section of the work; alert the learners to this, and encourage them to start memorising conditions and reaction types as they progress through the topic. To make the lessons more interesting and relevant, you can demonstrate some of these reactions: **Video clips** • Ethene → ethanol when heated in steam in the presence of phosphoric acid • Vegetable oils → margarine by hydrogenation • Alkanes are cracked into simpler parts (e.g. liquid paraffin → ethene and other fractions)
Week 9: Organic chemistry	
Plastics and polymers **Addition and condensation polymerisation, recycling of plastics, making slime and/or silly putty**	Plastics and polymers are in daily use around us: plastic bottles, containers, clothing, shoes, nylon ropes, fishing line, Kevlar, Teflon, rayon, etc. It therefore makes sense that this section of organic chemistry has been included in the syllabus. The learners need to identify the type of polymerisation (addition or condensation) that takes place and the properties of the polymer which is formed. Environmental concerns over the recycling of materials is also very topical. Some plastics can be recycled to relieve the load on rubbish dumps. These topics can be handled as debates or short research tasks where learners report their findings to the class or make a poster to inform others. The informal practical of making slime or silly putty can be used as an investigative exercise where learners adapt the recipe and report how the polymer changes its properties.
Week 10: Term 1 tests	
	Physics 1 hour Chemistry 1 hour Review of Chemistry and Physics tests

2. Teacher demonstration: Collision types using trolleys (or air track)

Inelastic collisions

Start with inelastic collisions, in which the trolleys stick together. Describe these as hit and stick collisions. Point out that kinetic energy is not conserved in these collisions. Try simple combinations such as trolleys of equal mass, or a single trolley colliding with another of double the mass.

How does velocity change? What quantity remains constant?

Note that you are asking learners to judge changes in velocity by eye. If the mass of the trolley doubles, its velocity halves, and so on. It should become apparent that the product of mass and velocity is constant. Name this quantity (mass × velocity) momentum.

Emphasise that you are looking at **events** and that you are comparing **before** with **after**. This will feed into the standard approach for solving numerical problems.

When changing the mass of the colliding trolleys (gliders) rather double the mass or make it three times larger, than just increase it by a few grams. Comparative estimates of final velocities are easier to explain and observe. (If necessary fill plastic bags with sand so you can use these to double the mass of the trolley.)

e.g.	Trolley A	mass = m	Initial velocity = v to the right
	Trolley B	mass = m	Initial velocity = 0 (stationary)

Hit and stick collision:

$mv+m(0)=(m+m)v_f$

$v_f = \frac{mv}{2m} = \frac{1}{2}v$

The final velocity of the trolleys will be about one half of the initial velocity of trolley A.

Explosions

Now try explosions, in which the spring of one trolley is released to push the two apart. Try two single trolleys, then a single trolley pushing on another of double the mass.

What rule can you see? The heavier (more massive) trolley comes away more slowly.

But what about momentum? Has it been created out of nothing?

Emphasise the need to think of momentum as a vector (because velocity is a vector, mass is a scalar). Before the explosion, there is no momentum in the system; after, there are equal but opposite momenta, so the vector sum is zero.

Elastic collisions

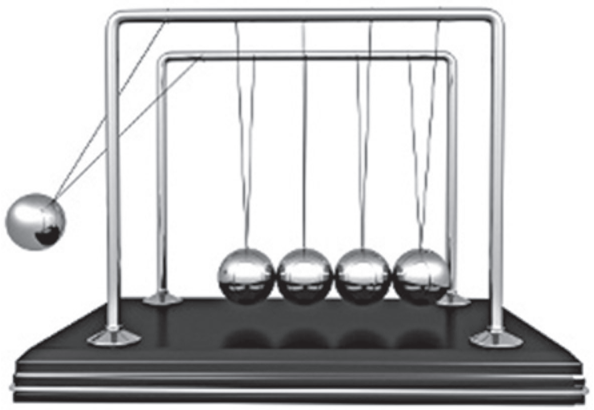
Use Newton's cradle to demonstrate an elastic collision where momentum is transferred from one object to another. Discuss the conservation of kinetic energy during an elastic collision. (Elastic collisions can also be demonstrated on a linear air track.)

Conclusions

Now you can state the principle of conservation of momentum in simple terms: in a 'hit and stick' (inelastic) collision, the momentum of the moving object is shared between the colliding masses; in the Newton's cradle the momentum is clearly transferred, and in an explosion, there is no initial momentum, and the moving masses have equal but opposite momenta after the collision. So total momentum before an event = total momentum after the event in all the cases, provided the system is isolated.

This activity is adapted from Resourceful Physics http://resourcefulphysics.org/

3. How Newton's cradle works



In a Newton's cradle, when the ball on the end strikes the others, it sends the one on the opposite end into the air. But why are the balls in the middle so calm?

If you pull a ball up and out and then release it, it falls back and collides with the others with a loud click. Then, instead of all four remaining balls swinging out, only the ball on the opposite end jumps forward, leaving its comrades behind, hanging still. That ball slows to a stop and then falls back, and all five are briefly reunited before the first ball is pushed away from the group again.

This toy illustrates the three main physics principles at work:

- Conservation of energy
- Conservation of momentum
- Friction

Making your own Newton's cradle

To make a Newton's cradle, you can use **five heavy beads** with **inextensible light string** threaded through them. The strings must be of equal length, and the beads must hang in the centre of the string, all aligned with their centres in contact. Attach the strings to **two rigid parallel rods** as shown in the diagram on the left. Usually the apparatus is placed **on a heavy base** to keep it stationary when the balls are swinging.

http://science.howstuffworks.com/newtons-cradle1.htm

F. ASSESSMENT RESOURCES

1. Sample item analysis sheet

PHYSICAL SCIENCES TERM 1 GRADE 12

SUGGESTED ITEM ANALYSIS RECORD SHEET FOR FORMAL ASSESSMENT

Term 1		Investigation Process skills					Mark Practical 20	Physics test					Chemistry test				Mark Test 100
Learners' names		A	B	C	D	TOTAL		Q. 1	Q. 2	Q. 3	Q. 4	TOTAL	Q. 1	Q. 2	Q. 3	TOTAL	
Name	Surname	16	27	4	5	50		8	12	13	17	50	10	36	4	50	

Term 1		Investigation Process skills					Mark Practical 20	Physics test					Chemistry test				Mark Test 100
Learners' names		A	B	C	D	TOTAL		Q. 1	Q. 2	Q. 3	Q. 4	TOTAL	Q. 1	Q. 2	Q. 3	TOTAL	
Name	Surname	16	27	4	5	50		8	12	13	17	50	10	36	4	50	

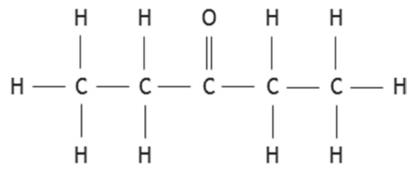
2. Physical Sciences Grade 12: End-of-term 1 Chemistry test

Question 1

Multiple choice questions

In each of the following questions, four possible answers are provided. On the Answer Sheet, place a cross (X) over the letter (A, B, C or D) which corresponds to the most correct answer to each question.

1.1 Identify the homologous series to which this compound belongs:



A alkenes
B ketones
C alcohols
D aldehydes (2)

1.2 The general formula for the alkynes is:
A CH_n
B C_nH_{2n+2}
C $C_{2n}H_{n-2}$
D C_nH_{2n-2} (2)

1.3 Which one of these monomers could be used to produce a polymer by condensation?
A ethene
B butane
C lactic acid
D ethanoic acid (2)

1.4 A structural isomer of butane is ...
A propane
B 2-methylbutane
C methylpropane
D dimethylpropane (2)

1.5 Ethene is oxidised by acidified potassium permanganate, and a colour change from purple to brown is observed. Distillation is required because a mixture of products results, but the major organic product of this reaction is:
A a diol (di-alcohol)
B a ketone
C a carboxylic acid
D an ester (2)

[10]

Question 2

Consider the condensed structural (semi-structural) formulae of the following organic compounds:

A	$CH_3CH_2CH_2C\ell$	**B**	CH_3COCH_3	**C**	$CH_3CH_2CH_3$
D	$CH_3CH_2CH_2OH$	**E**	$CH_3CH{=}CH_2$	**F**	HCOOH

2.1 Name compound A. (2)

2.2 Give the name of the homologous series to which compound B belongs. (2)

2.3 Explain what chemical test could be carried out to distinguish between compounds C and E. (3)

2.4 Explain with reference to the relevant intermolecular forces why compound D is a liquid at room temperature (boiling point 98°C) whereas compound C is a gas (boiling point –42°C). (4)

2.5 Compound B is a liquid at room temperature (25°C). Predict a possible boiling point for compound B. Clearly explain the reasoning behind your prediction. (4)

2.6 Predict which of compounds B, C or D would be the most soluble in water. Clearly explain the reasoning behind your prediction in terms of the polarity of the molecules and the intermolecular forces. (4)

2.7 Compound E can be produced from compound D. What type of reaction does compound D need to undergo in order to form compound E? (1)

2.8 Which of compounds A to F would turn blue litmus red? (1)

2.9 Compound A undergoes hydrolysis when boiled with a solution of potassium hydroxide (KOH).

2.9.1 Write a balanced equation for this substitution reaction using semi-structural formulae for the organic compounds. (2)

2.9.2 Give the IUPAC name of the organic product formed. (1)

2.9.3 With reference to the polarity of the bonds explain why compound A undergoes substitution reactions more easily than compound C. (3)

2.10 Compounds D and F are gently heated together in the presence of concentrated sulphuric acid.

2.10.1 Give the **structural formula** and **name of the organic product** formed in this reaction. (2)

2.10.2 Draw the structural formula of an **isomer of the organic product** formed in this reaction. (2)

2.10.3 Name the type of isomer that is formed. (1)

2.11 Write a balanced chemical equation for the complete combustion of compound C in oxygen. (4)

[36]

Question 3

Ethene undergoes polymerisation.

3.1 Name the polymer formed from the polymerisation of ethene. (1)

3.2 Draw the structure of the repeat unit that makes up this polymer. (2)

3.3 What type of reaction is used to make this polymer? (1)

[4]

TOTAL MARKS: 50

TIME: 1 HOUR

END OF TEST

PHYSICAL SCIENCES GRADE 12

END-OF-TERM 1 CHEMISTRY TEST: ANSWER SHEET

NAME: ______________________________ **CLASS:** ______________

Question 1

Multiple choice questions

1.1	A	B	C	D	
1.2	A	B	C	D	
1.3	A	B	C	D	
1.4	A	B	C	D	
1.5	A	B	C	D	
				TOTAL	

3. Physical Sciences Grade 12: End-of-term 1 Chemistry test memorandum

Question 1

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

[10]

Question 2

2.1 ✓ 1-chloropropane ✓ (2)

2.2 Ketone ✓✓ (2)

2.3 Bubble the substance through bromine water. ✓ Compound C will have no effect ✓ and compound E will rapidly decolourise the bromine water (red to colourless). ✓ (3)

2.4 Compound D (propanol) has **hydrogen bonds between its molecules** ✓which are **stronger** ✓ than the **van der Waals forces** ✓ found between the molecules of compound C (propane) ✓

OR

Compound D needs more energy ✓ to break hydrogen bonds between its molecules ✓and to change to its gas, whereas compound C needs less energy because it has weaker ✓van der Waals forces between its molecules. ✓ (4)

2.5 **98°C > B.Pt > 25°C**. ✓ Compound B has **dipole-dipole forces** ✓ between its molecules due to the **polar carbonyl group** ✓ but these forces are **weaker** than the **hydrogen bonds** ✓ found between the molecules of compound D. (4)

2.6 **Compound D** ✓ (propanol) will dissolve most easily in water since it will form **hydrogen bonds** ✓with the water molecules. Water and propanol are both **polar** molecules. ✓ Compounds C and B are both non-polar molecules so they will not dissolve in water. ✓ (4)

2.7 Elimination (or dehydration). ✓ (1)

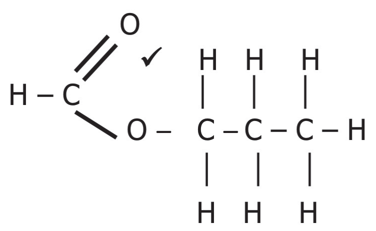
2.8 Compound F (HCOOH) ✓ (1)

2.9.1 $CH_3 CH_2 CH_2 C\ell + KOH \rightarrow CH_3 CH_2 CH_2 OH$✓ + $KC\ell$✓ (2)

2.9.2 propanol ✓ (1)

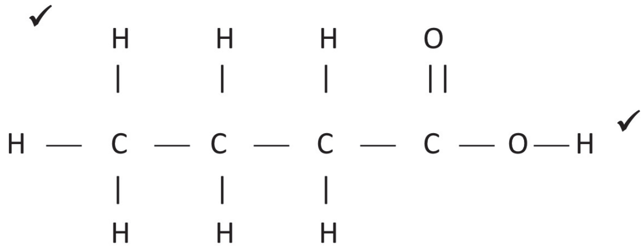
2.9.3 The **–C –Cℓ bond** in compound A (1-chloropropane) is **more polar than the –C–H** bond in compound C (propane). ✓✓ The weak bond dipoles in compound C cancel due to symmetry in the molecule whereas the Δ^+C of the –C–Cℓ bond is a **reactive site** attracting negative ions or nucleophiles. ✓ (3)

2.10.1



propyl methanoate ✓ (2)

2.10.2 ✓



(2)

2.10.3 Functional isomer ✓ (1)

2.11

$CH_3CH_2CH_3 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ ✓ ✓ ✓ ✓

(C_3H_8)

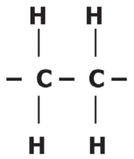
(4)

[36]

Question 3

3.1 Polyethene ✓ (or polythene) (1)

3.2



✓✓ (2)

3.3 Addition ✓ (polymerisation) (1)

[4]

TOTAL MARKS: 50

4. Cognitive Analysis for Physical Sciences Grade 12: End-of-term 1 Chemistry test

Please note that these levels are not all the same for every learner, every school and every teacher and textbook. A great deal depends on what is handled in class before the examination. However, in assessing cognitive level, a judgement is made based on a learner of average ability who has all the resources needed for the subject and who has covered the curriculum.

	L1	L2	L3	L4		
Question	Recall	Comprehension	Analysis Application	Synthesis Evaluation	Total	Comment
Question 1						
1.1				2	2	The product is ethandiol
1.2	2				2	
1.3		2			2	
1.4	2				2	Common routine question
1.5		2			2	
Question 2						
2.1		2			2	
2.2	2				2	
2.3		3			3	Learners must understand saturated and unsaturated nature of C and E; recall test for saturation
2.4		4			4	
2.5		1	1	2	4	Higher level synthesis of information, with explanation of reasoning
2.6		2	2		4	Explanation of reasoning requires analysis and application of knowledge
2.7		1			1	
2.8	1				1	
2.9.1		2			2	
2.9.2	1				1	Higher level evaluation – recall test for chloride
2.9.3			3		3	Application of knowledge to compare reaction of alkane with that of haloalkane
2.10.1		2			2	Routine comprehension
2.10.2			2		2	Application of knowledge
2.10.3	1				1	
2.11		2	2		4	Comprehension for the two products; balancing correctly is a higher level application question
Question 3						
3.1	1				1	
3.2			2		2	
3.3		1			1	
TOTAL	**10**	**24**	**12**	**4**	**50**	
%	**16**	**42**	**34**	**8**	**100**	
% CAPS	**15**	**40**	**35**	**10**	**100**	

5. Physical Sciences Grade 12: End-of-term 1 Physics test

Question 1

Multiple choice questions

In each of the following questions, four possible answers are provided. On the Answer Sheet, place a cross (X) over the letter (A, B, C or D) which corresponds to the most correct answer to each question.

1.1 A ball with mass ***m*** strikes the floor perpendicularly with a speed ***v***. If it bounces up from the floor with the same speed ***v***, the magnitude of the change in momentum is …

A 0
B ½ ***mv***
C ***mv***
D 2 ***mv*** (2)

1.2 Which of the following correctly **defines** *impulse*?

Impulse is **defined** as …

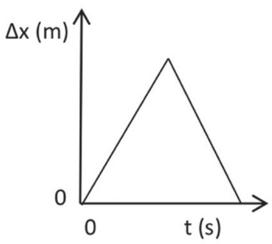
A the product of force and time.
B the product of net force and time.
C the product of net force and time for which the force acts on the object.
D the change in momentum of an object. (2)

1.3 A ball is thrown vertically upwards. Which one of the following physical quantities has a **non-zero value** at the instant that the ball changes direction?

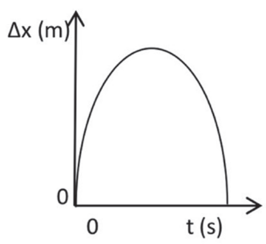
A acceleration
B kinetic energy
C momentum
D velocity (2)

1.4 A learner throws a ball up into the air and catches it on its return.

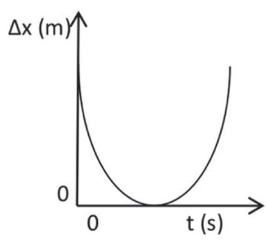
Which of the following position–time (Δx–t) graphs correctly shows the motion of the ball?



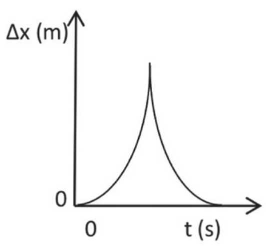
A



B



C



D (2)

[8]

SHOW ALL WORKING IN THE FOLLOWING THREE QUESTIONS

Question 2

A 5 000 kg truck, travelling at 20 $m \cdot s^{-1}$, crashes into a 1 500 kg delivery van, travelling at 14 $m \cdot s^{-1}$ in the opposite direction. The two vehicles lock together after the collision.

2.1 State the law of conservation of linear momentum. (2)

2.2 Calculate the combined velocity of the vehicles immediately after the crash. (4)

2.3 By means of calculations, determine whether this is an inelastic or an elastic collision. (4)

2.4 Which vehicle (truck, van or neither) exerts the greater force on the other?

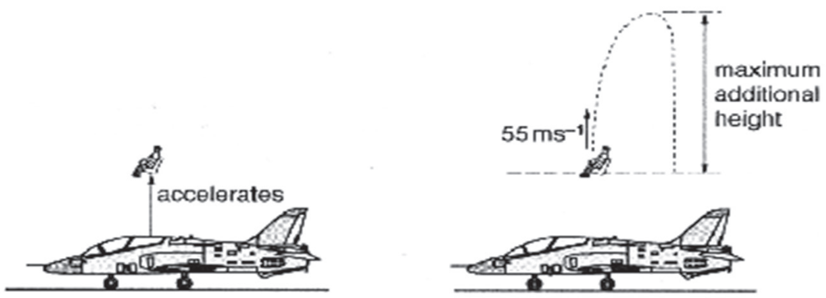
Explain briefly. (2)

[12]

Question 3

Ejection seats are designed to fire an aircraft pilot out of the plane at high velocity. One type of ejection system uses a constant explosive blast in the seat which accelerates the seat upwards for 0,25 s.

The seat was tested in a plane standing on the runway.



The combined mass of the seat and pilot is 280 kg. When the ejection takes place, the mass accelerates upwards to a maximum vertical velocity of 55 $m \cdot s^{-1}$.

The following information about the motion of the pilot–seat combination during a blast was recorded.

	Average time taken (s)	Speed of pilot–seat combination ($m \cdot s^{-1}$)	Change in momentum ($kg \cdot m \cdot s^{-1}$)
a)	0,066	15	
b)	0,160	35	
c)	0,250	55	

3.1 Calculate the magnitude of the change in momentum of the pilot–seat combination from rest, for each velocity recorded. (2)

3.2 Plot a graph of change in momentum vs time on the graph paper provided on the Answer Sheet. (5)

3.3 Determine the gradient of the graph. (2)

3.4 What physical quantity does the gradient of the graph represent? (1)

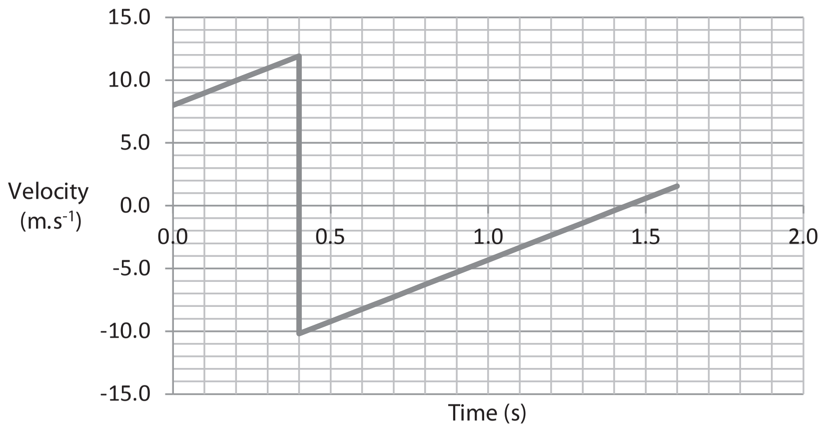
3.5 Explain, with reference to an equation or principles of physics, why the pilot's seat is cushioned with thick foam. (3)

[13]

Question 4

A ball of mass 200 g was thrown down at 8 $m \cdot s^{-1}$ from the balcony of a building onto the concrete floor beneath. The ball hit the ground and bounced vertically up. Down is taken as the positive direction.

Velocity–time graph to represent the motion of a ball released from a balcony



Refer to the information given above and in the graph, to answer the following questions.

4.1 What is the velocity as the ball hits the floor for the first time? (2)

4.2 With what speed did the ball rebound (bounce) from the floor for the first time? (1)

4.3 Use the graph to determine the magnitude of the acceleration of the ball during the first 0,4 s. (3)

4.4 Use the graph to determine the height of the balcony above the ground. (4)

4.5 What was the position of the ball relative to the balcony at t = 1,44 s? (4)

4.6 Draw a sketch graph to represent the change of position of the ball over the time interval of 1,44 s using the initial position of the ball as the origin of the reference system. (3)

[17]

TOTAL MARKS: 50

TIME: 1 HOUR

END OF TEST

PHYSICAL SCIENCES GRADE 12

END-OF-TERM 1 PHYSICS TEST: ANSWER SHEET

NAME: ______________________________ **CLASS:** ______________

Question 1

Multiple choice questions

1.1	A	B	C	D	
1.2	A	B	C	D	
1.3	A	B	C	D	
1.4	A	B	C	D	
				TOTAL	

Question 3

6. Physical Sciences Grade 12: End-of-term 1 Physics test memorandum

Question 1

Multiple choice questions

1.1 D ✓✓ (2)

1.2 C ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

[8]

Question 2

2.1 The linear momentum of an isolated system (of interacting bodies) remains constant. ✓✓ (2)

2.2 Choose the original direction of the truck as the positive direction.

$\Sigma p_i = \Sigma p_f$ ✓ (method)

(5 000)(20) + (1 500)(–14) ✓= (5 000 + 1 500)v ✓ (substitutions)

v = 12,15 $m \cdot s^{-1}$ in the direction of the truck ✓ (accuracy; SI units; direction) (4)

2.3

Initially	Finally
$\Sigma E_{k\ initial}$ = ½ (5 000)(20)^2 + ½ (1 500)(–14)^2 ✓ = 147 000 J	$\Sigma E_{k\ final}$ = ½ (5 000 + 1 500)(12,15)^2 ✓ (c.o.e.) = 479 773,10 J

✓ accuracy on both calculations (c.o.e.)

$\Sigma E_{k\ initial} \neq \Sigma E_{k\ final}$ therefore it is an inelastic collision. ✓ (4)

2.4 Neither. They both exert force of the same magnitude on each other. ✓
Newton's third law. ✓ (2)

[12]

Question 3

3.1 Δp = mΔv

a) Δp = mΔv

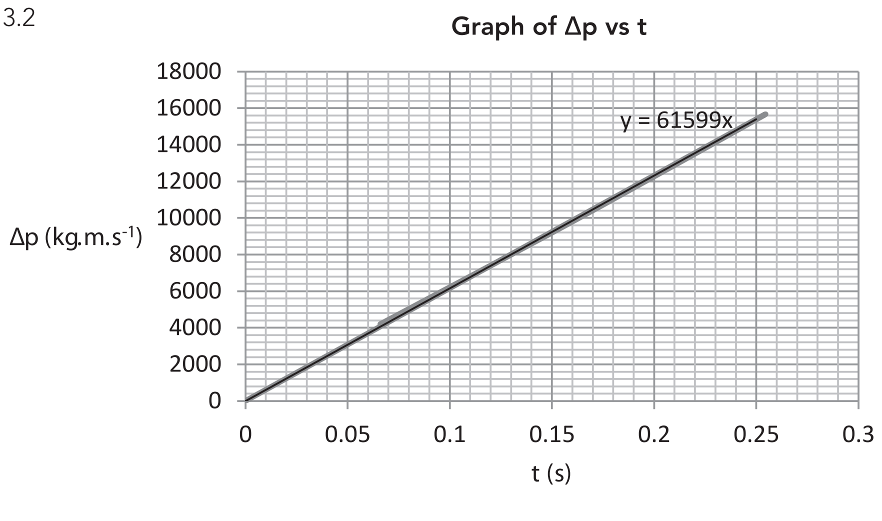
= (280)(15 – 0)

= 4 200 $kg \cdot m \cdot s^{-1}$ ✓ (accuracy; SI units)

b) Δp = (280)(35) = 9 800 $kg \cdot m \cdot s^{-1}$ ✓ (accuracy for both answers)

c) Δp = (280)(55) = 15 400 $kg \cdot m \cdot s^{-1}$ (2)

3.2



Title for graph: Change in momentum vs (or against) time taken OR as shown above ✓

Correct choice of axes (time on the horizontal axis) ✓

Correct labels and appropriate scales on both axes ✓

Accurate plotting of points (check 3 for accuracy) ✓

Best-fit straight line graph ✓ (5)

3.3 gradient = $\frac{\Delta p}{\Delta t}$ ✓ (method)

= $\frac{9\,800}{0,16}$ (appropriate values chosen from graph or table)

= 61 250 ✓ (accuracy – for appropriate values chosen) (2)

3.4 Net force (acting on the pilot–seat combination) ✓ (1)

3.5 A large force acts on the pilot–seat combination (see calculation in 3.3).
The foam cushion compresses (squashes) therefore increasing the amount of time it takes ✓ for the momentum of the pilot to change, and reducing the net force that acts on him. ✓
$F_{net} = \frac{\Delta p}{\Delta t}$ ✓ (3)

[13]

Question 4

4.1 12,0 $m{\cdot}s^{-1}$ ✓ down ✓ (2)

4.2 10,2 $m{\cdot}s^{-1}$ ✓ (Accept 10,0) (1)

4.3 *Method 1: Finding the gradient of the graph*

acceleration = gradient of v –t graph ✓ (method)

= $\frac{\Delta v}{\Delta t}$

= $\frac{(12 - 8)}{0,4}$ ✓ (substitutions)

= 10 $m{\cdot}s^{-2}$ ✓ (accuracy)

Method 2: Using the equations of motion

$v_f = v_i + a\Delta t$ ✓ (method)

12 = 8 + a (0,4) ✓ (substitutions)

a = 10 $m{\cdot}s^{-2}$ ✓ (accuracy) (3)

4.4 *Method 1: Finding the area under the v–t graph*

Height = area under the v-t graph ✓ (method)

= (8 x 0,4) ✓ + ½ (0,4)(12 – 8) ✓ (substitutions)

= 4,0 m ✓ (accuracy)

Method 2: Using the equations of motion

$\Delta x = v_i \Delta t + ½ a \Delta t^2$ ✓ (method)

= (8 x 0,4) ✓ + ½ (10)(0.4)^2 ✓ (substitutions) [c.o.e. 4.3]

= 4,0 m ✓ (accuracy) (4)

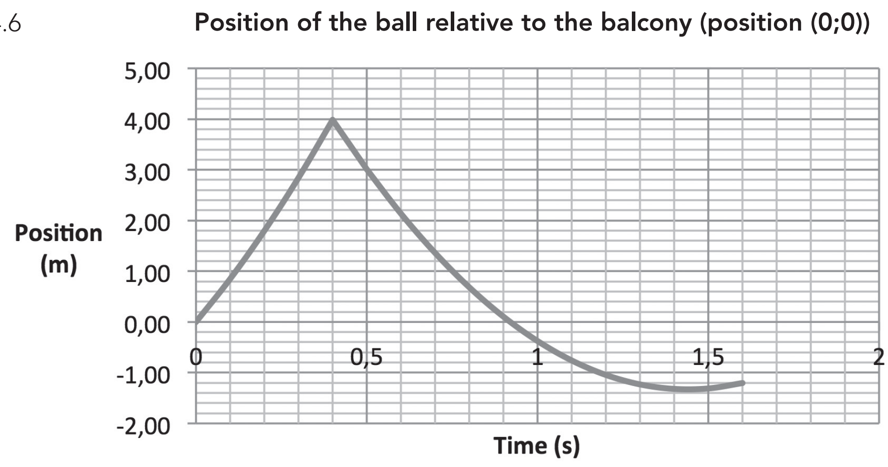
4.5 Height of ball at first bounce = area under v–t graph from 0,4 s to 1,44 s ✓ (method)

= ½ (10)(1,44) ✓ (substitutions)

= 5,2 m

The ball is (5,2 – 4,0) ✓ = 1,2 m above the balcony. ✓ (method) (accuracy) (4)

4.6



- Starts at (0;0) rises to (0,4;4,00) with slight parabolic curve ✓
- Decreases from (0,4;4,00) to about 1,2 m below the x-axis ✓
- Parabolic curve (as shown above) ✓

DO NOT penalise for no scale: the shape and main positions should be present. (3)

[17]

TOTAL MARKS: 50

7. Cognitive Analysis for Physical Sciences Grade 12: End-of-term 1 Physics test

Please note that these levels are not all the same for every learner, every school and every teacher and textbook. A great deal depends on what is handled in class before the examination. However, in assessing cognitive level, a judgement is made based on a learner of average ability who has all the resources needed for the subject and who has covered the curriculum.

	L1	L2	L3	L4		
Question	**Recall**	**Comprehension**	**Analysis Application**	**Synthesis Evaluation**	**Total**	**Comment**
Question 1						
1.1		2			2	Learners must realise that velocity has changed direction
1.2	2				2	
1.3		2			2	Routine comprehension
1.4		2			2	Routine comprehension
Question 2						
2.1	2				2	
2.2			4		4	Application of the law
2.3			4		4	Application of knowledge re: elastic collisions
2.4			2		2	Application of Newton's third law
Question 3						
3.1		2			2	Routine comprehension
3.2	2	3			5	Routine graphing – recall & comprehension
3.3			2		2	Application: finding the gradient of a graph
3.4			1		1	Analysis of data
3.5				3	3	Explanation involves synthesis and evaluation
Question 4						
4.1	1	1			2	Routine reading from graph; including SI units and direction shows comprehension of vector nature of velocity
4.2	1				1	Reading from a graph
4.3		3			3	Routine: finding the gradient of v–t graph
4.4			4		4	Analysis of data to select relevant information
4.5			4		4	Analysis of data
4.6				3	3	Evaluation of data and synthesis: higher level question
TOTAL	**8**	**15**	**21**	**6**	**50**	
%	**16**	**30**	**42**	**12**	**100**	
% CAPS	**15**	**35**	**40**	**10**	**100**	

8. Physical Sciences Grade 12: Practical assessment: preparation of esters: Technical information

Apparatus (per group)

3 test tubes
Test tube rack
Plastic pipette
10 cm^3 or 20 cm^3 plastic syringe
50 cm^3 or 100 cm^3 beaker
250 cm^3 beaker
Tripod
Gauze mat
Burner
Matches or hand-held gas lighter
Spatula (if using salicylic acid)

Chemicals

Methanoic acid
Ethanoic acid
Propanoic acid
Salicylic acid
Ethanol
Propanol
Butanol
Concentrated sulfuric acid
Sufficient 1,0 $mol.dm^{-3}$ solution of sodium carbonate (about 150 cm^3 per group)
A small bucket of about 1,0 $mol.dm^{-3}$ sodium carbonate (to neutralise any acid spills or contact)

Precautions

- Learners must not sniff the contents of any of the organic substances directly. Show them how to waft the odour towards their nose and gently smell the substances.
- The laboratory should be well ventilated at all times.
- Learners should wear protective plastic gloves and safety goggles.
- Concentrated sulfuric acid is a very dangerous substance. If the learners are inexperienced at carrying out experiments safely, then it is a good idea to place the 5–10 drops of sulfuric acid into their test tubes yourself before they begin the procedure.
- Concentrated sulfuric acid is a dehydrating agent. When the acid and alcohol are added to it, the concentrated sulfuric acid will warm up, and it may spit or give off fumes. Learners should know this before they start the procedure. They must add the other substances gently and slowly to prevent overheating of the sulfuric acid.
- Ensure that you have a small bucket of weak sodium carbonate solution available to neutralise contact that any learner has with acids.
- Remain vigilant as the learners work with the burners and check that these are extinguished at the end of the practical.

9. Physical Sciences Grade 12: Practical assessment: preparation of esters

Learner's instructions and questions

Name: ______________________________ Class: ______________

Esters are produced by reacting carboxylic acids and alcohols in the presence of concentrated sulfuric acid. These fragrant substances have many different uses: food flavouring, the perfume industry, medicinal and aromatherapy being some of them.

Aim of the investigation: Prepare esters from the reaction of carboxylic acids with alcohols, and identify the esters by their smell.

Resources available

List the acids and alcohols that are available.

Carboxylic acids	Alcohols
Ethanoic acid	**Ethanol**

A. *Table of esters and their fragrances*

Complete the table below by filling in the names of the carboxylic acids and alcohols that are used to prepare these esters.

Ester	Odour	Acid	Alcohol
isoamyl ethanoate	banana	ethanoic acid	amyl alcohol
ethyl ethanoate	nail polish remover		
methyl salicylate	wintergreen		
ethyl butanoate	pineapple		
benzyl butanoate	cherry	butanoic acid	benzyl alcohol
ethyl propanonate	rum	propanoic acid	ethanol
ethyl benzoate	fruity		
benzyl ethanoate	peach	ethanoic acid	benzyl alcohol
methyl butanoate	apple		
n-propyl ethanoate	pear		

[6]

Procedure

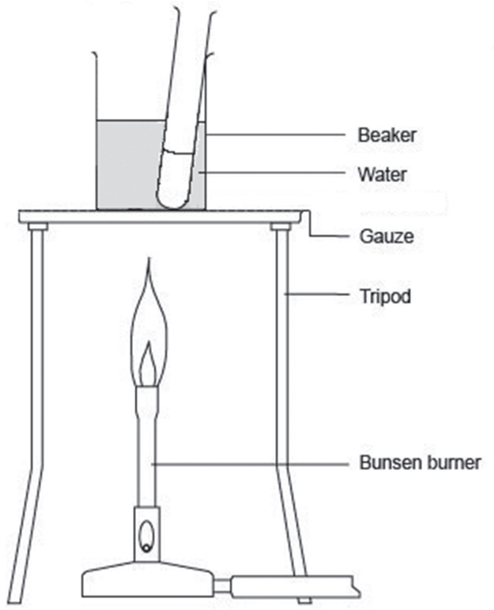
NB Smell the contents of the organic substance by wafting its odour towards your nose. **Do not inhale** the odour by sniffing directly over the test tube or beaker.

1. Wear safety goggles and protective plastic gloves throughout this procedure.
2. Set up a burner, a tripod and gauze.
3. Half fill a 250 cm^3 beaker with tap water.
4. Place three test tubes in a rack.
5. Using a plastic pipette add 5–10 drops of concentrated sulfuric acid to each of the test tubes.
6. Using a plastic syringe slowly add 10 cm^3 of the carboxylic acid (selected for your group) to each of the three test tubes.
7. Record the odour and appearance of the carboxylic acid.

Carry out the following steps (8–15) for each of the three alcohols (selected for your group).

8. Wash the plastic syringe with tap water, and then rinse it with distilled water.
9. Using the clean plastic syringe, add 10 cm^3 of one of the alcohols to one of the test tubes.
10. Record the odour and appearance of the alcohol.

11. Place the test tube into the 250 cm^3 beaker half-filled with water.
12. Place the beaker onto the tripod and heat the water gently for about 8–10 minutes. If the contents of the test tube begin to boil, remove the burner until the contents have stopped boiling.
13. Remove the test tube from the hot water.
14. Pour the contents of the test tube into a small beaker containing 20 cm^3 of sodium carbonate solution.
15. Record the odour and appearance of the product.



B. *Safety precautions or special procedures observed during the practical*

State the reason why this procedure was necessary during the practical.

	Procedure or precaution	Reason (2 marks per correct reason)
1	Wear goggles.	
2	Place the test tube in a beaker of water and heat gently.	
3	Add 5–10 drops of concentrated sulfuric acid to the test tube.	
4	Waft the odour towards your nose. Do not smell the ester directly by placing your nose over the test tube.	
5	Add the contents of the test tube to sodium carbonate solution.	

[10]

C. *Observations and equations*

- Fill in the observations for each substance and its odour before and after the reactions.
- Write word equations and structural chemical equations for the first ester which you and your group prepared.

Reaction 1	Substance	Odour
Before	Ethanoic acid	
	Ethanol	
After		

(3)

Word equation: (2)

Structural equation:

(4)

Reaction 2	Substance	Odour
Before		
After		

(3)

Reaction 3	Substance	Odour
Before		
After		

(3)

[15]

D. Questions to answer after the practical work

Sulfuric acid acts as a catalyst during this reaction.

1. Define the term: catalyst. (2)

2. Give another property of sulfuric acid and explain how it promotes the reaction. (1)

3. Name the acid and the alcohol that could be used to prepare octyl ethanoate (an ester that smells like honey). (2)

Acid:
Alcohol:

[5]

TOTAL MARKS: 36

END OF PRACTICAL

10. Physical Sciences Grade 12: Practical assessment: preparation of esters memorandum

Resources available

Carboxylic acids	Alcohols
Names of the acids available	Names of the alcohols available

A. Table of esters and their fragrances

Ester	Odour	Acid	Alcohol	
Isoamyl ethanoate	banana	ethanoic acid	amyl alcohol	
ethyl ethanoate	fingernail polish remover	***ethanoic acid***	***ethanol***	✓
methyl salicylate	wintergreen	***salicylic acid***	***methanol***	✓
ethyl butanoate	pineapple	***butanoic acid***	***ethanol***	✓
benzyl butanoate	cherry	butanoic acid	benzyl alcohol	
ethyl propanonate	rum	propanoic – acid	ethanol	
ethyl benzoate	fruity	***benzoic acid***	***ethanol***	✓
benzyl ethanoate	peach	ethanoic acid	benzyl alcohol	
methyl butanoate	apple	***butanoic acid***	***methanol***	✓
n-propyl ethanoate	pear	***ethanoic acid***	***propanol***	✓

1 mark each x (6) = **[6]**

B. Safety precautions or special procedures observed during the practical

	Procedure or precaution	Reason ANY ONE OF THE FOLLOWING ✓✓ each Maximum (10)
1	Wear goggles.	The contents of the test tube could boil (bubble over). ✓✓ The vapours which are given off could sting (affect) your eyes. ✓✓
2	Place the test tube in a beaker of water and heat gently.	The beaker of water acts as a water bath distributing the heat evenly to the contents of the test tube. ✓✓ Heat gently so that the contents of the test tube do not boil. ✓✓ Alcohol is flammable. ✓✓
3	Add 5–10 drops of concentrated sulfuric acid to the test tube.	Concentrated sulfuric acid is a very dangerous substance – it dehydrates cell tissues – placing it at the bottom of the test tube reduces your chances of coming in contact with it. ✓✓
4	Waft the odour towards your nose. Do not smell the ester directly by placing your nose over the test tube.	This is always the procedure when smelling substances in the laboratory. Vapour may damage nasal tissues – you are less exposed to harmful substances in this way. ✓✓
5	Add the contents of the test tube to sodium carbonate solution.	Sodium carbonate will neutralise any remains of the carboxylic acid, so that the odour of the acid no longer influences the odour of the ester. ✓✓

2 marks each x (5) = **[10]**

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C. *Observations and equations*

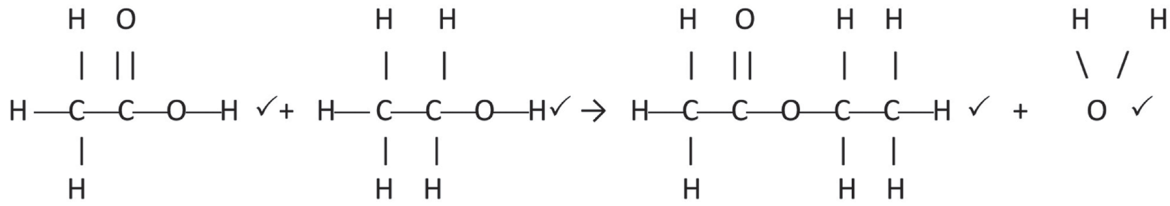
Reaction 1	Substance	Odour	
Before	ethanoic acid	vinegar	✓
	ethanol	alcohol	✓
After	ethyl ethanoate	nail polish remover (or paint)	✓

(3)

Word equation:

Ethanoic acid + ethanol → ethyl ethanoate ✓+ water ✓ (2)

Structural equation:



(4)

Refer to the table below for the names of the acids and alcohols, their odours, and the names and odours of their esters.

Acid	Odour	Alcohol	Odour	Ester	Odour
ethanoic acid	vinegar	amyl alcohol	camphor	Isoamyl ethanoate	banana
ethanoic acid	vinegar	***ethanol***	pleasant perfume-like odour	ethyl ethanoate	fingernail polish remover
salicylic acid	white powder; no odour	***methanol***	antiseptic odour (highlyu toxic)	methyl salicylate	wintergreen
butanoic acid	human vomit or rancid butter	***ethanol***	pleasant perfume-like odour	ethyl butanoate	pineapple
butanoic acid	human vomit or rancid butter	benzyl alcohol	mild floral odour	benzyl butanoate	cherry
propanoic – acid	body odour	ethanol	pleasant perfume-like odour	ethyl propanonate	rum
benzoic acid	faint pleasant odour like vanilla	***ethanol***		ethyl benzoate	fruity
ethanoic acid	vinegar	benzyl alcohol	mild floral odour	benzyl ethanoate	peach
butanoic acid	human vomit or rancid butter	***methanol***	antiseptic odour (highly toxic)	methyl butanoate	apple
ethanoic acid	vinegar	***propanol***	mild alcohol-like odour	n-propyl ethanoate	pear

Fill in the appropriate answers in the two tables below, referring to the information in the table above.

Reaction 2	Substance	Odour	
Before			✓
			✓
After			✓

(3)

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Reaction 3	Substance	Odour	
Before			✓
			✓
After			✓

(3)

[15]

D. Questions to answer after the practical work

1. A substance that speeds up the rate of the reaction ✓ without being chemically changed by the process. ✓ (2)
2. Sulfuric acid is a dehydrating agent. ✓ (1)
3. Octanol ✓
   Ethanoic acid ✓ (2)

[5]

TOTAL MARKS: 36

(Reduce to a mark out of 20)

Adapted from: www.nuffieldfoundation.org/practical-chemistry/making-esters-alcohols-and-acids

G. ADDITIONAL WORKSHEETS FOR LEARNERS

Worksheet 1: Momentum and Newton's second law of motion

1. A ball (mass 0,35 kg) strikes a wall with a speed of 20 $m \cdot s^{-1}$, rebounding with a speed of 18 $m \cdot s^{-1}$. The collision with the wall lasts for 0,05 s.
   a) Calculate the initial momentum of the ball.
   b) Calculate the final momentum of the ball.
   c) Calculate the change in momentum of the ball.
   d) Draw a vector diagram showing the initial momentum, final momentum and change in momentum of the ball.
   e) State Newton's second law of motion in terms of momentum.
   f) Calculate the net force acting on the ball during its collision with the wall.
   g) Determine the net force acting on the wall during the collision. Justify your answer.
   h) Explain why the wall does not move during the collision.
2. A car (mass 1 200 kg) accelerates from 20 $m \cdot s^{-1}$ to 40 $m \cdot s^{-1}$ in 8 s.
   a) Calculate the change in momentum of the car.
   b) Draw vector diagrams to show the initial momentum, the final momentum, and the change in momentum of the car.
   c) Calculate the net force acting on the car.
3. The maximum acceleration of a car (mass 800 kg) is 12,5 $m \cdot s^{-2}$ forwards.
   a) Calculate the change in momentum of the car in 4 s.
   b) Calculate the maximum net force acting on the car.
   c) Calculate the maximum acceleration of the car when it carries a load of 200 kg.
4. A football player kicks a soccer ball (mass 450 g) away from him with a speed of 15 $m \cdot s^{-1}$. His foot is in contact with the ball for 0,6 s.

   The change in momentum of the ball is 8,1 $kg \cdot m \cdot s^{-1}$ away from the player.
   a) Calculate the initial speed of the ball.
   b) Calculate the magnitude of net force of the player's foot on the ball.

Answers for Worksheet 1

1. Choose the positive direction of motion to be towards the wall.

a. $p_i = mv$

$= (0{,}35)(20)$

$= 7{,}00\ kg{\cdot}m{\cdot}s^{-1}$ toward the wall

b. $p_f = mv$

$= (0{,}35)(-18)$

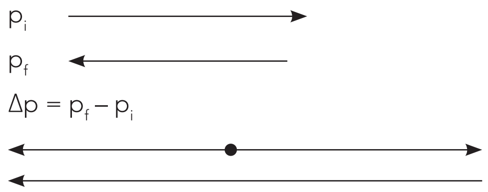
$= -6{,}30$

$= 6{,}30\ kg{\cdot}m{\cdot}s^{-1}$ away from the wall

c. $\Delta p = p_f - p_i$

$= -6{,}30 - 7{,}00$

$= 13{,}30\ kg{\cdot}m{\cdot}s^{-1}$ away from the wall

d. 

e. The net force is directly proportional to the rate of change of momentum and in the same direction as the change in momentum.

f. $F_{net} = \frac{\Delta p}{\Delta t}$

$= \frac{-13{,}30}{0{,}05}$

$= 665$ N away from the wall

g. 665 N towards the wall. Newton's third law states that if a body A exerts a force on body B, then body B simultaneously exerts force of the same magnitude but in the opposite direction on body A.

h. The wall does not move because its mass is infinitely larger than that of the ball, therefore even though it has the same change in momentum as the ball, its acceleration (change in velocity) is negligible.

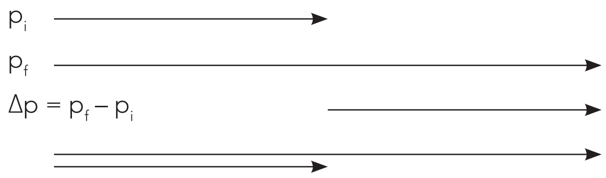
2. a. $\Delta p = p_f - p_i$

$= mv_i - mv_f$

$= m\Delta v$

$= (1\ 200)(40 - 20)$

$= 2\ 400\ kg{\cdot}m{\cdot}s^{-1}$ forwards

b. 

c. *Method 1:*

$F_{net} = \frac{\Delta p}{\Delta t}$

$= \frac{2\ 400}{8}$

$= 600$ N forwards

Method 2:

$F_{net} = ma$

$= \frac{(1\ 200)(40 - 20)}{8}$

$= 600$ N forwards

3. a. $\Delta p = p_f - p_i$

$= mv_f - mv_i$

$= m\Delta v$

$= (800)(50)$

$= 40\ 000\ kg{\cdot}m{\cdot}s^{-1}$ forwards

$a = \frac{\Delta v}{\Delta t}$

$12{,}5 = \frac{\Delta v}{4}$

$\Delta v = 50\ m{\cdot}s^{-1}$ forward

b. $F_{net} = \frac{\Delta p}{\Delta t}$

$= \frac{40\ 000}{4}$

$= 10\ 000$ N forwards

c. $F_{net} = ma$

$10\ 000 = (800 + 200)a$

$a = 10\ m{\cdot}s^{-2}$ forwards

4. a. $\Delta p = p_f - p_i$

$= mv_f - mv_i$

$-8{,}1 = (0{,}45)(-15) - (0{,}45)v_i$

$v_i = 3\ m{\cdot}s^{-1}$

b. $F_{net} = \frac{\Delta p}{\Delta t}$

$= \frac{8{,}1}{0{,}6}$

$= 8{,}5$ N

Worksheet 2: Conservation of momentum

1. Two boys on roller skates push off from each other. Tebogo, whose mass is 50 kg, moves away with a velocity of 0,8 $m \cdot s^{-1}$ east, and John, whose mass is 40 kg, moves in the opposite direction with a velocity of 1 $m \cdot s^{-1}$.
   a. Calculate Tebogo's momentum.
   b. Calculate John's momentum.
   c. What is the sum of their momenta before they pushed apart?
   d. What is the sum of their momenta after pushing apart?
2. Two trolleys, A with a mass of 4 kg, and B with a mass of 6 kg, are at rest on a bench with a compressed spring between them. When the spring is released, it pushes the trolleys apart. Trolley A moves with a velocity of 1,2 $m \cdot s^{-1}$ north. With what velocity does trolley B move?
3. A boy of mass 60 kg stands in a boat of mass 100 kg. He jumps forwards out of the boat and the boat moves back with a speed of 2,4 $m \cdot s^{-1}$. With what speed did the boy jump out of the boat?
4. A 50 kg cannon is used to fire a 4 kg shell at 200 $m \cdot s^{-1}$. With what velocity does the cannon recoil?
5. A boy, mass 80 kg, stands on a 60 kg trolley as it moves forward over a smooth, horizontal surface at 5 $m \cdot s^{-1}$. The boy then jumps forwards at 8 $m \cdot s^{-1}$. What is the new velocity of the trolley?
6. Lebo, whose mass is 40 kg, is skating along on some smooth ice at 2 $m \cdot s^{-1}$ when suddenly Mamello (mass 60 kg), moving at 1,5 $m \cdot s^{-1}$, collides head-on with her. Lebo holds onto Mamello's shoulders to prevent either of them from falling. Will they move after the collision? If so, in what direction and at what speed?
7. A stationary billiard ball A of mass 0,20 kg is struck by a ball bearing B of mass 0,25 kg, moving at 0,4 $m \cdot s^{-1}$. The ball bearing is left stationary. What is the speed of the billiard ball after collision?

Answers for Worksheet 2

1. Tebogo: mass = 50 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = 0{,}8\ m{\cdot}s^{-1}$ east

   John: mass = 40 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = 1{,}0\ m{\cdot}s^{-1}$ west

   a) $p_{Tebobgo} = mv$
      $= (50)(0{,}8)$
      $= 40\ kg{\cdot}m{\cdot}s^{-1}$ east

   b) $p_{John} = mv$
      $= (40)(1{,}0)$
      $= 40\ kg{\cdot}m{\cdot}s^{-1}$ west

   c) $\Sigma (p_{Tebobgo} + p_{John})_{initial} = (50)(0) + (40)(0)$
      $= 0\ kg{\cdot}m{\cdot}s^{-1}$

   d) Take east as the positive direction.
      $\Sigma (p_{Tebobgo} + p_{John})_{final} = (40) + (-40)$
      $= 0\ kg{\cdot}m{\cdot}s^{-1}$

2. Trolley A: mass = 4 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = 1{,}2\ m{\cdot}s^{-1}$ north

   Trolley B: mass = 6 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = ?$

   Choose north as the positive direction.

   By the law of conservation of momentum

   $\Sigma p_{initial} = \Sigma p_{final}$
   $(4)(0) + (6)(0) = (4)(1{,}2) + (6)v_f$
   $v_f = -0{,}8\ m{\cdot}s^{-1}$
   $v_f = 0{,}8\ m{\cdot}s^{-1}$ south

3. Boy: mass = 60 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = ?$

   Boat: mass = 100 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = 2{,}4\ m{\cdot}s^{-1}$

   Choose forward as the positive direction.

   By the law of conservation of momentum

   $\Sigma p_{initial} = \Sigma p_{final}$
   $(60)(0) + (100)(0) = (60)v_i + (100)(-2{,}4)$
   $v_f = -0{,}4\ m{\cdot}s^{-1}$
   $v_f = 0{,}4\ m{\cdot}s^{-1}$ forward

4. Cannon: mass = 50 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = ?$

   Shell: mass = 4 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = 200\ m{\cdot}s^{-1}$ forward

   Choose forward as the positive direction.

   By the law of conservation of momentum

   $\Sigma p_{initial} = \Sigma p_{final}$
   $(50)(0) + (4)(0) = (50)v_i + (4)(200)$
   $v_f = -16\ m{\cdot}s^{-1}$
   $v_f = 16\ m{\cdot}s^{-1}$ backward

5. Boy: mass = 80 kg $v_i = 5\ m{\cdot}s^{-1}$ $v_f = 8\ m{\cdot}s^{-1}$ forward

Trolley: mass = 60 kg $v_i = 5\ m{\cdot}s^{-1}$ $v_f = ?$

Choose forward as the positive direction.

By the law of conservation of momentum

$$\Sigma p_{initial} = \Sigma p_{final}$$

$$(80)(5) + (60)(5) = (80)(8) + (60)v_f$$

$$v_f = 1{,}0\ m{\cdot}s^{-1} \text{ forward}$$

6. Lebo: mass = 40 kg $v_i = 2\ m{\cdot}s^{-1}$ right $v_f = ?$

Mamello: mass = 60 kg $v_i = 1{,}5\ m{\cdot}s^{-1}$ left $v_f = ?$

Choose right as the positive direction.

By the law of conservation of momentum

$$\Sigma p_{initial} = \Sigma p_{final}$$

$$(40)(2) + (60)(-1{,}5) = (40 + 60)v_f$$

$$v_f = 0{,}4\ m{\cdot}s^{-1} \text{ right}$$

7. Billiard ball A: mass = 0,20 kg $v_i = 0\ m{\cdot}s^{-1}$ $v_f = ?$

Ball bearing B: mass = 0,25 kg $v_i = 0{,}4\ m{\cdot}s^{-1}$ $v_f = 0\ m{\cdot}s^{-1}$

Choose original direction of ball bearing as the positive direction.

By the law of conservation of momentum

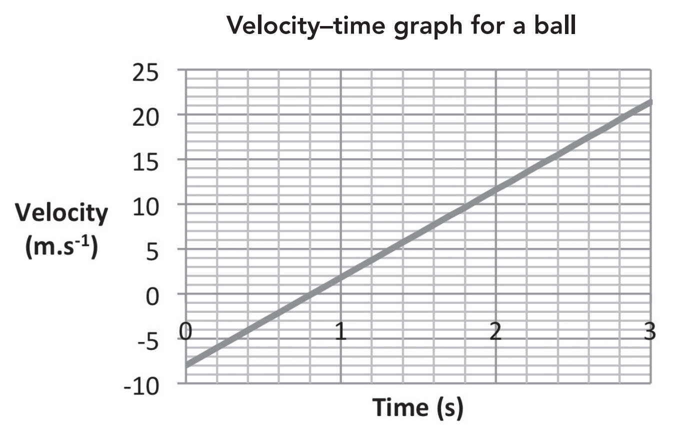
$$\Sigma p_{initial} = \Sigma p_{final}$$

$$(0{,}20)(0) + (0{,}25)(0{,}4) = (0{,}20)v_f + (0{,}25)(0)$$

$$v_f = 0{,}5\ m{\cdot}s^{-1} \text{ in the original direction of the ball bearing}$$

Worksheet 3: Vertical projectile motion

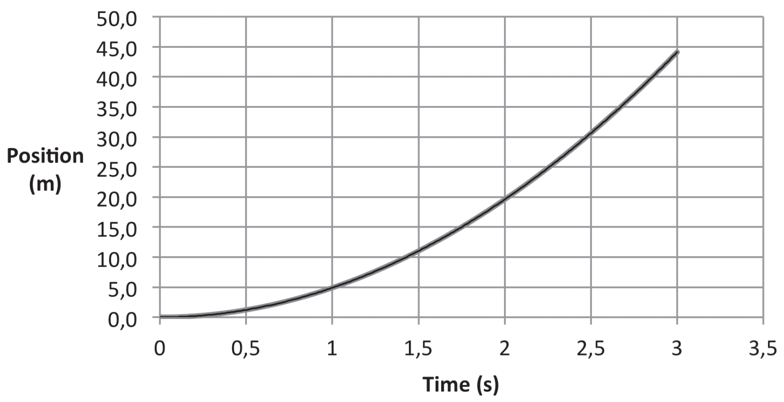
1. A stone dropped from a bridge strikes the water 1,85 s later.
   a. Calculate the height from which the stone was dropped.
   b. Calculate the speed with which the stone hits the water.
2. A boy throws a ball vertically upwards at 7 $m \cdot s^{-1}$.
   a. What maximum height does the ball reach?
   b. How long does it take for the ball to return to his hand?
   c. What is its velocity at 0,2 s?
   d. At what times does the ball have a speed of 3 $m \cdot s^{-1}$?
3. A stone is thrown downwards with an initial speed of 4,0 $m \cdot s^{-1}$. It strikes the water with a speed of 6,4 $m \cdot s^{-1}$.
   a. How long does it take for the stone to strike the surface of the water?
   b. From what height is the stone released?
4. A parachutist in free fall reaches a maximum speed of 15 $m \cdot s^{-1}$ before her parachute opens.
   a. Describe what is meant by the parachutist is 'in free fall'.
   b. For how long does she fall before opening her parachute?
   c. What maximum distance does she fall during this time?
   d. Draw a free-body diagram of the force which acts on her during free fall.
   e. Draw a free-body diagram of the force which acts on her when she opens the parachute.
5. The velocity–time graph of a ball is shown below:



   a. Determine the initial velocity of the ball.
   b. Determine the maximum height of the ball above its original position.
   c. Determine the displacement of the ball at 3 s.
   d. Sketch a position–time graph of the ball motion.
   e. Sketch an acceleration–time graph of the ball's motion.

6. The position–time graph of a stone free-falling from rest is shown below.

Position–time graph for a stone in free fall



a. Determine the position of the stone at 1,75 s.

b. Describe the shape of the graph.

c. Write down a mathematical relationship between position Δx and time t for this graph.

d. At 1,0 s the stone has fallen exactly 4,9 m. Using these values determine the acceleration of the stone during free fall.

e. Sketch an acceleration–time graph for the stone's motion.

f. Sketch a velocity–time graph for the stone's motion.

7. The lunar landing module is descending towards the Moon's surface. Its initial speed is 0,5 $m.s^{-1}$ when it is at a height of 25,25 m above the Moon's surface. The module strikes the ground 1,7 s later.

a. Calculate the acceleration due to gravity on the Moon.

b. Calculate the speed of the lunar landing module when it hits the ground.

c. Sketch a graph of velocity–time for the module's motion.

d. Sketch a graph of height against time for the module's motion.

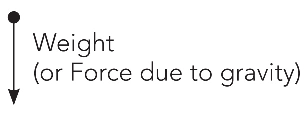
Answers for Worksheet 3

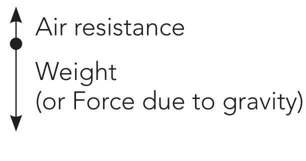
Choose downward as positive.

1. $v_i = 0\ m{\cdot}s^{-1}$ $a = 9{,}8\ m{\cdot}s^{-2}$ $\Delta t = 1{,}85$
   a. $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
      $= (0)(1{,}85) + \frac{1}{2}(9{,}8)(1{,}85)^2$
      $= 16{,}77\ m$
   b. $v_f = v_i + a\Delta t$
      $= 0 + (9{,}8)(1{,}85)$
      $= 18{,}13\ m{\cdot}s^{-1}$

2. $v_i = -7\ m{\cdot}s^{-1}$ $a = 9{,}8\ m{\cdot}s^{-2}$ $v_f = 0\ m{\cdot}s^{-1}$
   a. $v_f^2 = v_i^2 + 2a\Delta y$
      $0 = (-7)^2 + 2(9{,}8)\ \Delta y$
      $\Delta y = 2{,}5\ m$
   b. $v_f = v_i + a\Delta t$
      $0 = (-7) + 9{,}8\ \Delta t$
      $\Delta t = 0{,}46\ s$
   c. $v_f = (-7) + (9{,}8)(0{,}2)$
      $= -5{,}04\ m{\cdot}s^{-1}$
      $= 5{,}04\ m{\cdot}s^{-1}$ upwards
   d. $v_f = v_i + a\Delta t$
      $-3 = (-7) + (9{,}8)\ \Delta t$
      $\Delta t = 0{,}41\ s$
      $v_f = v_i + a\Delta t$
      $3 = (-7) + (9{,}8)\ \Delta t$
      $\Delta t = 0{,}41\ s$

3. $v_i = 4\ m{\cdot}s^{-1}$ $a = 9{,}8\ m{\cdot}s^{-2}$ $v_f = 6{,}4\ m{\cdot}s^{-1}$
   a. $v_f = v_i + a\Delta t$
      $6{,}4 = (4) + (9{,}8)\ \Delta t$
      $\Delta t = 0{,}24\ s$
   b. $v_f^2 = v_i^2 + 2a\Delta y$ OR $\Delta y = v_i\ \Delta t + \frac{1}{2}\ a\ \Delta t^2$
      $(6{,}4)^2 = (4)^2 + 2(9{,}8)\ \Delta y$ $= (4)(0{,}24) + \frac{1}{2}(9{,}8)(0{,}24)^2$
      $\Delta y = 1{,}27\ m$ $= 1{,}24\ m$ (round up error is accepted)

4. a. While she is falling the only force acting on her is the force due to gravity.
   b. $v_i = 0\ m{\cdot}s^{-1}$ $a = 9{,}8\ m{\cdot}s^{-2}$ $v_f = 15\ m{\cdot}s^{-1}$
      $v_f = v_i + a\Delta t$
      $15 = (0) + (9{,}8)\ \Delta t$
      $\Delta t = 1{,}53\ s$
   c. $v_f^2 = v_i^2 + 2a\Delta y$ OR $\Delta y = v_i\ \Delta t + \frac{1}{2}\ a\ \Delta t^2$
      $(15)^2 = (0)^2 + 2(9{,}8)\ \Delta y$ $= (0)(1{,}53) + \frac{1}{2}(9{,}8)(1{,}53)^2$
      $\Delta y = 11{,}5\ m$ $= 11{,}5\ m$
   d. 

   e. 

5. a. $-8\ m \cdot s^{-1}$ i.e. $8\ m \cdot s^{-1}$ upwards

b. Maximum height = area under v-t from t = 0 s to t = 0,80 s

= ½ (8)(0,80)

= 3,2 m

c. Position of the ball at 3 s = ½ (21,5)(3,0 – 0,8) = 23,7 m

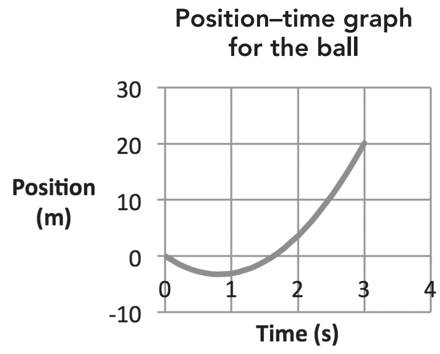
Initial position of the ball = 3,2 m below maximum height

Displacement of ball = change in position

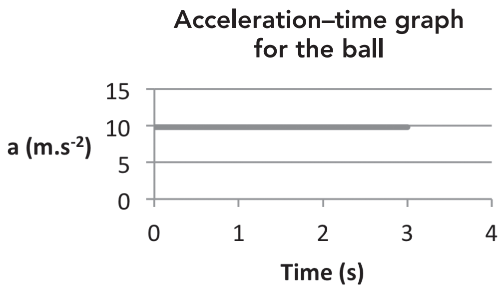
= 23,7 – 3,2

= 20,7 m below original position (down)

d.



e.



6. a. 15,0 m below its original position.

b. The graph is a parabola (going through the origin).

c. $\Delta y = m\Delta t^2$ OR $\Delta y \propto \Delta t^2$

d. $v_i = 0\ m.s^{-1}$ $\Delta y = 4,9\ m$ $\Delta t = 1,0\ s$

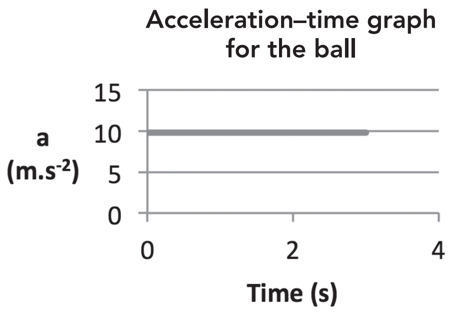
$\Delta y = v\,\Delta t + ½\,a\,\Delta t^2$

$4,9 = (0)(1,0) + ½\,a\,(1,0)^2$

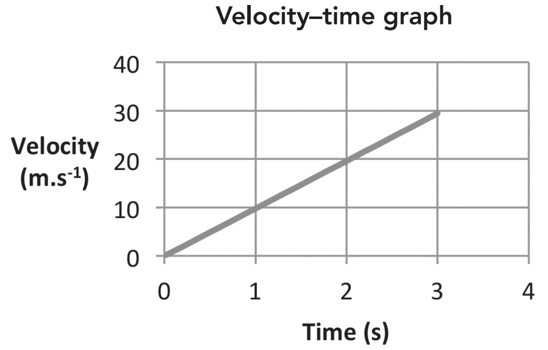
$4,9 = ½\,a$

$a = 9,8\ m.s^{-2}$ downwards

e.



f.



7. $v_i = 0{,}5\ m.s^{-1}$ $\Delta y = 195\ m$ $\Delta t = 15{,}0\ s$

a. $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$195{,}0 = (0{,}5)(15{,}0) + \frac{1}{2} a\ (15{,}0)^2$

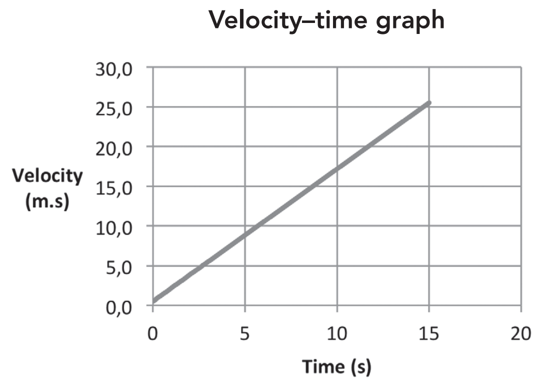
$a = 1{,}67\ m.s^{-2}$ downwards

b. $v_f = v_i + a\Delta t$

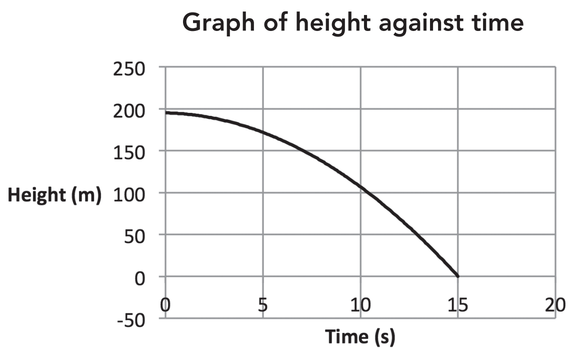
$= (0{,}5) + (1{,}67)(15)$

$= 25{,}55\ m.s^{-1}$

c.



d.



Worksheet 4: Measuring the acceleration due to gravity

NAME: ______________________ **CLASS:** ______________

A ticker tape is attached to a 200 g mass piece and threaded into a ticker timer. The ticker timer is started just before the mass piece is dropped from a vertical height of 5,0 m. The ticker tape is analysed by grouping sections of the tape into 0,2 s intervals and measuring the change in position in each interval. The table below shows these results for a section of the tape.

Interval (0,2 s)	ΔPosition (m)
1	0.19
2	0.58
3	0.97
4	1.36
5	1.75

1. Plot a best-fit graph of the change in position against interval number for these results.
   NB. The graph will not pass through the origin. (7)

2. Determine the gradient of the graph (in terms of m per time interval). (4)

3. Each time interval lasts 0,2 s.
   Calculate the value of the gradient of the graph in metres per second ($m.s^{-1}$). (3)

4. The value calculated in Q. 3 represents the average change in velocity of the free falling object. Calculate the average acceleration of the free falling object using the definition of acceleration. (3)

5. Comment on the value of the acceleration determined in Q. 4.

How does it compare with the accepted value of the acceleration due to gravity?

What % accuracy does this result represent? (3)

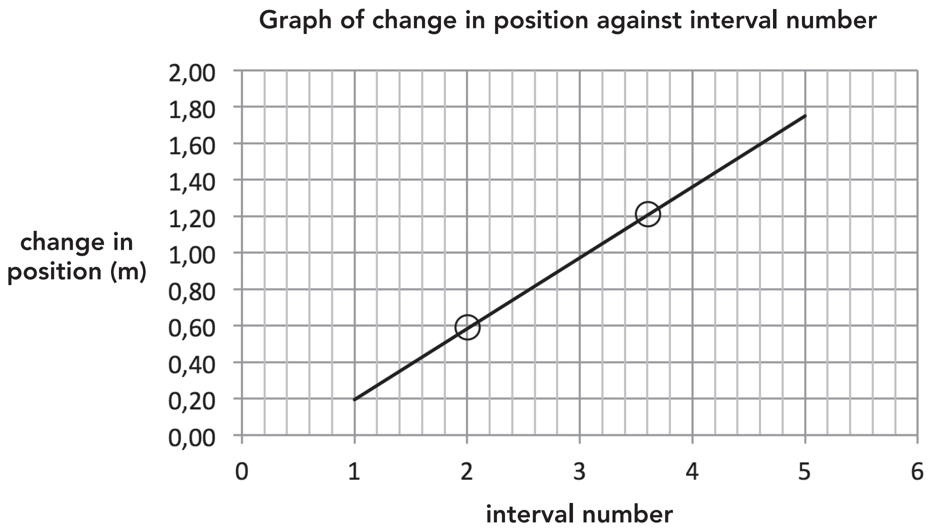
6. Suggest a reason why the experimental value determined by this experiment differs from the accepted value. (2)

7. Suggest how the reliability of the result can be improved. (2)

TOTAL MARKS: 24

Answers for Worksheet 4

1.



- Appropriate title for the graph ✓
- Choice of axes (interval number on horizontal) ✓
- Scale on y-axis ✓
- Scale on x-axis ✓
- Axes titles ✓
- Accurate plotting of data points ✓
- Line of best fit (drawn with a ruler – NB does not pass through the origin) ✓ (7)

2. Gradient = $\frac{\Delta x}{\text{Interval}}$ ✓ (method)

$= \frac{1{,}20 - 0{,}60 ✓}{3{,}6 - 2{,}0 ✓}$ = 0,375 m per interval ✓ (choice of two points; accuracy) (4)

3. Gradient = $\frac{0{,}375 ✓}{0{,}2 ✓}$ (method; c.o.e. Q. 2)

= 1,875 $m \cdot s^{-1}$ ✓ (accuracy, SI units) (3)

4. Acceleration = $\frac{\Delta v}{\Delta t}$ ✓ (method)

$= \frac{1{,}875}{0{,}2}$ ✓ (substitutions; c.o.e. Q. 4)

= 9,375 $m \cdot s^{-2}$ ✓ (accuracy; SI units) (3)

5. The experimental result is **less than 9,8 $m \cdot s^{-2}$**. ✓ (comparison)

% accuracy = $\frac{\text{(experimental value)}}{\text{(accepted value)}}$ x 100% ✓ (method)

$= \frac{9{,}4}{9{,}8}$ x 100

= 95,9% ✓ (accuracy) (3)

6. ANY VALID REASON

The ticker timer placed a dot on the tape (every 0,02 seconds) ✓ thus slowing the object down. ✓

There was a frictional force acting on the tape as it passed through the ticker timer, ✓therefore it accelerated at a lower rate. ✓ (2)

7. Repeat the experiment at least three time using the same mass piece each time. ✓ Take the average of the results. ✓ (2)

TOTAL MARKS: 24

Worksheet 5: Momentum and impulse formative test

The combined mass of a sandbag on a trolley is 4,0 kg. The sandbag and trolley move initially at constant speed to the left. A bullet of mass 150 g is fired with a velocity of 200 m·s^{-1} and embeds itself in the sandbag. Immediately after the collision the trolley + sandbag + bullet combination travels at a constant velocity of 5,0 m·s^{-1} backwards (towards B, to the right in sketch).

1. Define *linear momentum.* (1)
2. Calculate the initial momentum of the bullet. (3)
3. State the law of conservation of linear momentum. (2)
4. Calculate the initial speed of the trolley + sandbag. (4)
5. Calculate the change in momentum of the bullet. (3)
6. Explain why the change in momentum of the trolley + sandbag has the same magnitude as that of the bullet. (2)
7. Calculate the net force exerted by the bullet on the trolley-sandbag combination if the collision lasted for 0,05 s. (3)
8. Use calculations to show that this is an *inelastic* collision. (4)
9. A learner says that *the sandbag acted in a similar way when it stopped the bullet as the crumple zone of a vehicle acts during a collision.* He claims that *the bullet could exert more force if it struck and embedded itself in a concrete wall.*

   Apply principles of physics and/or a relevant equation to discuss the validity of the learner's statements. (3)

TOTAL MARKS: 25

TIME: 30 MINUTES

END OF TEST

Answers for Worksheet 5

1. The linear momentum of a body is the product of its mass and velocity. ✓ (1)

2. $p = mv$ ✓ (method)
   $= (0,15)$ ✓ (200) (conversion from g to kg)
   $= 30\ kg{\cdot}m{\cdot}s^{-1}$ right ✓ (accuracy, SI units, direction) (3)

3. The linear momentum of an isolated system✓ of interacting bodies remains constant. ✓ (2)

4. $m_{bullet}v_{i\ bullet} + m_{trolley+sandbag}v_{i\ trolley+sandbag} = (m_{bullet} + m_{trolley+sandbag})v_f$ ✓ (method)
   $(0,15)(200) + (4,0)v$ ✓ $= (4,0 + 0,15)(5,0)$ ✓ (substitutions)
   $v = -2,31$
   $= 2,31\ m{\cdot}s^{-1}$ left ✓ (accuracy, SI units) (4)

5. $\Delta p = mv_f - mv_i$ ✓ (method)
   $= (0,15)(5,0) - (0,15)(200)$ ✓ (substitutions)
   $= 0,75 - 30,00$
   $= -29,25$
   $= 29,25\ kg{\cdot}m{\cdot}s^{-1}$ left ✓ (accuracy, SI units, direction) (3)

6. *Method 1: Using Newton's third law*
   The force exerted by the bullet on the sandbag–trolley combination has the same magnitude as the force exerted by the sandbag–trolley combination on the bullet (N III). ✓
   Since $F_{net}.\Delta t = \Delta p$ (momentum-impulse theorem)
   and F_{net} and Δt remain constant during the collision ✓
   therefore Δp has the same magnitude for both objects.
   Method 2: Using the law of conservation of momentum
   $m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
   $-m_2v_{f2} + m_2v_{i2} = m_1v_{f1} - m_1v_{i1}$ ✓
   $-(m_2v_{f2} - m_2v_i) = m_1v_{f1} - m_1v_{i1}$
   $-\Delta p_2 = \Delta p_1$ ✓ therefore they both have the same magnitude. (2)

7. $F_{net} = \frac{\Delta p}{\Delta t}$ ✓ (method)
   $= \frac{29,25}{0,05}$ [c.o.e. from Q. 5] ✓ (substitutions)
   $= 585$ N right ✓ (accuracy, SI unit, direction) (3)

8. Method (finding the sum of initial kinetic energy and final kinetic energy ✓

Initial kinetic energy	Final kinetic energy
$= \Sigma(\frac{1}{2}mv_i^2)$	$= \Sigma(\frac{1}{2}mv_f^2)$
$= \frac{1}{2}(0,15)(200)^2 + \frac{1}{2}(4,0)(-2,31)^2$	$= \frac{1}{2}(0,15 + 4,0)(5,0)^2$
$= 3\ 010,67$ J ✓ (accuracy [c.o.e.])	$= 51,875$ J ✓ (accuracy [c.o.e.])

   $\Sigma(\frac{1}{2}mv_i^2) \neq \Sigma(\frac{1}{2}mv_f^2)$ ✓ therefore this is an inelastic collision. (4)

9. A concrete wall will stop the bullet in a shorter length of time. ✓
   The bullet exerts greater force on the wall because the time is shorter AND the change in momentum is greater ✓ since $F_{net} = \frac{\Delta p}{\Delta t}$ ✓ (3)

TOTAL MARKS: 25

Cognitive analysis for momentum and impulse formative test

	L1	L2	L3	L4	
Question	Recall	Comprehension	Analysis Application	Synthesis Evaluation	Total
1	1				1
2	1	1	1		3
3	2				2
4		2	2		4
5		1	1	1	3
6			2		2
7	1	1	1		3
8		2	2		4
9			1	2	3
TOTAL	5	7	10	3	25
%	20	28	40	12	100
CAPS %	15	35	40	10	100

CHART OF ORGANIC CHEMISTRY REACTIONS

1 C	meth
2 C	eth
3 C	prop
4 C	but
5 C	pent
6 C	hex
7 C	hept
8 C	oct