GRADE 12

# Physical Sciences

## Teacher Toolkit: CAPS Planner and Tracker

2018 TERM 2

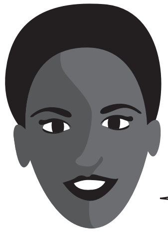
# CONTENTS

## 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.

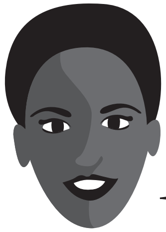


*But who will help me?*

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*** Learner's Book (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 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, except for the first week which has only has three. 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.

The tracker has been planned for a second term that is ten weeks long, with four-day first week. Eight weeks are allocated for covering the set curriculum, with Week 9 for catching up any work not done in this time and for revision. Week 10 is set aside for the mid-year examinations. Should you use this tracker in a second term of a different duration, or if your school's examination period is of a different length, you will need to adjust your programme accordingly.

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 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. Relevant CAPS page number
3. CAPS content, concepts and skills for the day
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 2 Topics*

The mid-year examinations usually take up 3 weeks of the time allocated to teaching and learning, so it is essential during this term to keep up to date with the CAPS schedule of work for Grade 12. The mid-year examinations offer an opportunity for the learners to practise writing under similar testing conditions which they will face in their

Preliminary and their final NSC Examinations. The results of these examinations form 20 % of the portfolio marks (10 % each for Physics and Chemistry) so it is important to remind the learners to revise all the work that will be examined at mid-year.

**Mechanics: Work, energy and power**

Work, energy and power are scalar quantities, whereas force, momentum and impulse are vector quantities. The study of work done by a force is limited to constant forces acting on an object. The formula to calculate the work done on an object is $W = F.\Delta x.\cos\theta$, where $F$ and $\Delta x$ are the magnitude of the force and displacement, respectively, and q is the angle between the force and the displacement of the object. Learners often substitute values that take into account the direction of the force and/or displacement instead of substituting the magnitude (absolute value) of the force and/or displacement. Remind learners that the cosine of q requires that they only substitute the magnitude of these quantities. (The reason for this is that mathematically work done is defined as the scalar (dot) product of force and displacement: $W = F\bullet\Delta x = |F||\Delta x|\cos\theta$.)

Be very consistent with the terminology you use when describing the work done on an object:

'Work is done on an object by a force.' Work is **never** done against a force, e.g. when the force of friction opposes the motion of an object, work is done by the force of friction on the object; work is not done against the force of friction.

The work done by friction on an object will be negative work, and the work done by the applied force will be positive work. Negative is work is done on an object when the force opposes its motion. Essentially this means that the work done by, e.g. friction, was transferred from mechanical energy of the object to other forms of energy such as heat in the environment.

Work done by the applied force is positive work because the object is displaced forward by the force. Both the component of force in the direction of its displacement, and the displacement are in the same direction.

The net (total) force acting on an object is the algebraic sum of the work done by all the forces acting on the object:

$$W_{\text{net}} = \Sigma W_i$$

where $W_i$ represents the work done by each of the forces acting on the object.

Remind learners how to analyse the forces acting on an object by drawing labelled force diagrams and free-body diagrams. They can choose to solve problems by either calculating the work done by each force, and finding the algebraic sum of these amounts of energy, or they can use the method of finding the net force acting on the object:

$$W_{\text{net}} = F_{\text{net}}.\Delta x.\cos\theta$$

where $F_{\text{net}}$ is the net (resultant) force acting on the object, $\Delta x$ is its displacement, and $\theta$ is the angle between the net force and the displacement of the object.

The work-energy theorem provides a very useful way to calculate the net work done:

$$W_{\text{net}} = \Delta K = K_f - K_i.$$

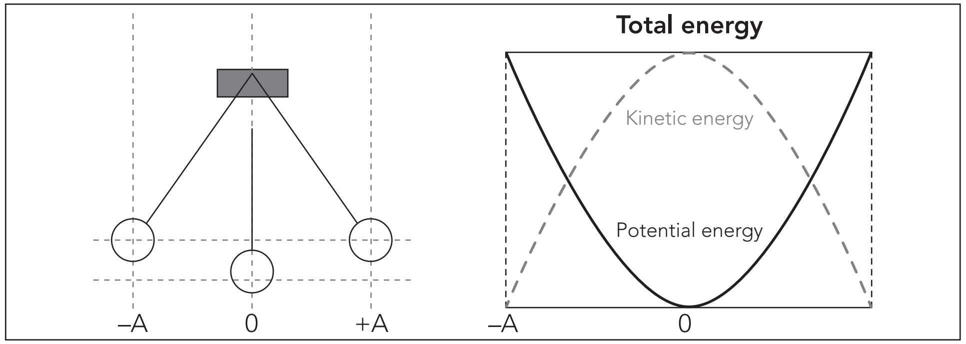
Note that learners should be able to solve problems by applying this theorem to work done on horizontal, vertical and inclined planes, with and without friction (frictionless and rough surfaces).

The Law of Conservation of Energy states that energy cannot be created or destroyed; it can only be transferred from one form of energy to another. This law applies everywhere in our universe.

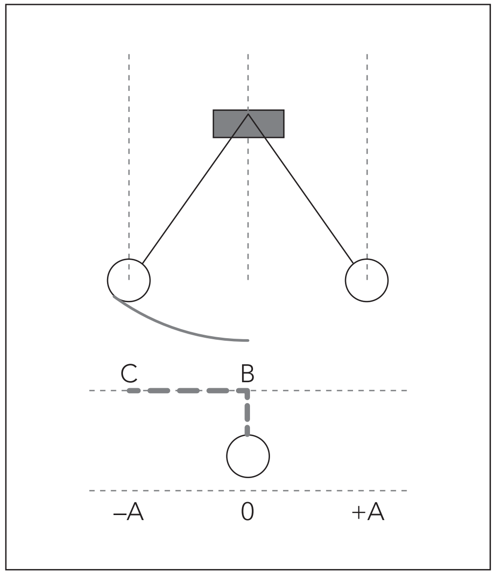
The Law of Conservation of Mechanical Energy states that the total mechanical energy of an isolated system remains constant.

It is important to note the distinct difference between these two laws. An isolated system is one in which no external forces operate. There are no dissipative forces present in an isolated system; e.g. no friction and no air resistance. In this case, $\Sigma(E_p + E_k)$ = constant at all times in the system.

One example of an isolated system is that of a pendulum, swinging freely, with no frictional force on the string, no elastic forces in the string, and no air resistance.



At its maximum height above its rest position (–A), the pendulum bob has maximum gravitational potential energy, and no kinetic energy because its instantaneous velocity is zero at this moment. As it swings down to its rest position (0), the potential energy of the bob is transferred to kinetic energy, so that at the lowest point of its swing, it has zero potential energy, and maximum kinetic energy. Similarly, on its way up to its maximum height on the other side (+A), kinetic energy is transferred to gravitational potential energy, until at maximum height it again has no kinetic energy, and maximum potential energy.




The work done (or energy transferred) by a conservative force is independent of the path taken by the object.

Considering the pendulum, we can see that the bob gains a certain amount of potential energy when it is lifted in its arc to its maximum position (from 0 to C). However, it would gain the same amount of potential energy if it was moved vertically up (from 0 to B) and then across to its maximum position (from B to C). Gravitational force is therefore a conservative force. The elastic force of a spring and electrostatic forces are also conservative forces.

The work done by non-conservative forces depends on the path taken. Examples of non-conservative forces are friction and air resistance.

The general formula to calculate the work done by non-conservative forces is:

$$W_{\text{nc}} = \Delta E_k + \Delta E_p$$

The syllabus requires learners to derive the Law of Conservation of Mechanical Energy for an isolated system from this equation:

In the absence of any non-conservative forces $W_{\text{nc}} = 0$

$$\Delta E_k + \Delta E_p = E_{kf} - E_{kI} + E_{pf} - E_{pI} = 0$$

$$E_{kf} + E_{pf} = E_{ki} + E_{pi}$$

$$\Sigma(E_k + E_p)_f = \Sigma(E_k + E_p)_I = constant$$

Power is the rate of doing work. Learners will use both formulae $P = \frac{W}{\Delta t}$ and $P_{\text{ave}} = F.v_{\text{ave}}$ to calculate power.

Note that the second formula only applies to objects moving at constant velocity along a rough surface.

The formula can be applied to motion along a horizontal surface, in the vertical direction or on an inclined plane, so long as the object is travelling at constant speed. The syllabus specifically mentions that learners must be able to calculate the power output by a pump in lifting water through a height.

Ten hours in total are allocated to this section of mechanics. During this time it is very useful to encourage the learners to work through homework exercises, as well as tackling problems from past NSC examinations.

### The Doppler effect

It is important to note that learners will only be asked to solve problems using the Doppler effect formula for either the source moving or the listener moving. They will never have to deal with both the source and listener moving. This simplifies matters considerably as shown in the derivations below.

The formula for the Doppler effect is:

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_s$$

If the listener is moving, the source is stationary, and the formula becomes:

$$f_L = \frac{v \pm v_L}{v} f_s$$

To solve the problem, learners need to consider whether the listener is moving towards or away from the source. If (s)he is moving towards the source, the pitch (frequency) will be higher, therefore the velocity of the listener is added to the velocity of sound in air. This will result in the listener hearing a higher frequency ($f_L$) than that of the source ($f_s$).

If the listener is stationary and the source is moving, the formula becomes:

$$f_L = \frac{v}{v \pm v_s} f_s$$

Once again learners need to consider whether the listener's frequency will be higher or lower than that of the source. When the source is moving towards the listener, (s)he will hear a higher pitch (frequency). In order for $f_L$ to be greater than $f_s$, the denominator must be less than the numerator. Therefore, the velocity of the source is subtracted, from the velocity of sound in air, and the result will give $f_l > f_s$.

Applications of the Doppler effect include traffic monitoring systems, measuring the rate of flow of blood and monitoring the foetal heartbeat. Take careful note that learners do not confuse an ultrasound scan of the foetus during pregnancy with the monitoring of the foetal heartbeat. The ultrasound scan does not rely on the Doppler effect. It works on the principles of reflection, refraction and absorption of sound waves, and makes use of these phenomena to produce an image of the echoes of the ultrasound by using computer software.

The red and blue shifts of the light from stars involve analysis of the elements' spectra as received from the stars. Learners need to know what line emission and line absorption spectra are before they can fully understand the significance of the shifts of light from the stars. It may be useful to briefly explain that each element has its own spectral line pattern due to the unique way in which its electrons are organised in their energy levels.

It is also important to point out that when the star is viewed through a telescope on Earth, it is unlikely that one would see red light or blue light from the star. The light must pass through a spectroscope to be diffracted into its line spectrum before anyone can say it has been red-shifted or blue-shifted. This process is carried out in observatories in South Africa and around the world, as well as by the Hubble telescope which is positioned out in space. The fact that many stars display red shifts leads us to conclude that those stars are moving away from the Earth, and therefore it suggests that the universe is expanding.

### Rate and extent of reactions

The molecular collision theory of chemical reactions states that the particles taking part in a reaction must have sufficient kinetic energy and be in the appropriate orientation when they collide with each other in order for bonds to be broken and re-formed in a chemical reaction.

The rate of a reaction is a measure of the change in the concentration of the reactants or the products per unit time. The rate can also be measured as the change in the mass (volume or number of moles) of the reactants or products per unit time. The important point to note is that it is the ratio of **the change** in the property per unit time. (It is not just, e.g. the mass per unit time.)

Learners should be able to list the factors that affect the rate of reactions, and to explain how they affect the rate with reference to the molecular collision theory.

It is useful to demonstrate how the rate of various reactions can be measured, e.g. by collecting a gas, or by measuring change in mass, so that when they tackle problems and graphs of data they have an understanding of how the experiments were conducted.

In the NSC we only deal with positive catalysts that increase the rate of reactions. Learners must be able to explain the mechanism by which positive catalysts work, and to be able to interpret data from Maxwell-Boltzmann curves for reactions at different temperatures, with or without a positive catalyst.

A total of 4 hours is allocated for this topic.

### Chemical equilibrium

Learners often confuse the topic of rate and extent of reactions with the topic of chemical equilibrium. It is therefore important to clarify the terms open and closed systems, reversible and irreversible reactions, and that in chemical equilibrium the rate of the forward reaction is equal to the rate of the reverse reaction. Chemical equilibrium is about the position at which this equality in the rates occurs, and how we can alter the conditions to shift the position of equilibrium.

The factors that affect chemical equilibrium are similar to those that affect the rates of reactions. This is what leads to some learners confusing these two topics. One way to help learners see the difference is to always display the chemical equilibrium equation, showing the reaction is reversible, and then to discuss the factors that could affect that particular reaction.

Writing the expression for the equilibrium constant ($K_C$) is usually accepted quite quickly by most learners; however, many of them insert a + sign between the concentration of the reactants and the products, instead of making these the product of the concentration of the reactants and the products. This error could have its origins in the fact that the equation of the reaction has + signs between the reactants and the products. It is worth spending a little time highlighting this common mistake and making sure your learners are sure of how to write the expression correctly.

The Haber process and the Contact process are specified as applications that can be examined in the NSC.

Demonstrate some of the colourful chemical equilibria, such as the cobalt chloride system, when you discuss Le Chatelier's Principle. It can help learners realise that all the ions are present in the test tube all of the time. The colour changes merely favour a greater concentration of one or other colour depending on conditions such as temperature.

The graphs of concentration or number of moles or mass or volume against time pose many problems for learners. Take care to direct learners to read the values on the axes of the graphs, to follow the progress of the graphs to find positions of chemical equilibrium, and to explain what happened whenever the equilibrium was disturbed. If they learn to analyse the graphs systematically before they begin to tackle the questions, they will usually have a better chance of success.

Be careful not to let this section of the work slow down your teaching plan as there is still a lot of work to cover before you get to the end of this term. Only 8 hours are allocated to teaching chemical equilibrium.

**Acids and bases**

This topic introduces many new terms to the learners, e.g. the difference between strong and weak acids or bases, and between concentrated and dilute acids and bases, monoprotic and diprotic acids, conjugate acid-base pairs, amphiprotic substances, auto-ionisation of water and the ionic product of water, to name a few. Each new term needs to be defined carefully, so that learners understand what it means and how to make use of the terms.

Learners often experience cognitive conflict when hearing that the equivalence point of an acid-base titration may not occur at the neutral point (pH = 7). The *equivalence point* occurs when the protons from the acid have been neutralised by hydroxide ions from the base – there is an equivalent amount of moles of acid and base present in the reaction vessel. The *neutral point* is when the pH of the substances in the reaction vessel solution is 7.

Learners should know how to select one of the following indicators for a successful titration: methyl orange, bromothymol blue or phenolphthalein. They should also be able to predict the approximate pH of dissolved salts, e.g. sodium carbonate will be slightly basic because the salt undergoes hydrolysis when added to water. It is the salt of a weak acid and a strong base, therefore it reacts with water to form a slightly basic solution (approximate pH = 10).

The practical for this term is based on this topic: How do you use the titration of oxalic acid against sodium hydroxide to determine the concentration of sodium hydroxide? It is advisable to allow two lessons for this practical – one lesson to set up the apparatus and record the results, and the next lesson to analyse the results and come to a conclusion.

This topic has been allocated 8 hours of teaching time.

## 2. Prepare resources

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

### 3. Plan for required assessment tasks

In Term 2 of Grade 12, the CAPS specifies one practical task and an examination for formal assessment. The Learner's Books and/or Teacher's Guides provide examples of CAPS-compliant formal assessment tasks and activities for revision or informal assessment. Two tests (Physics and Chemistry), together with the memorandum and analysis of cognitive levels of each, are provided in Section F *Assessment Resources* of this tracker. These could be used as the mid-year examination or for practice and informal assessment. The Provincial Department of Education might also provide a common paper.

Table 1 gives an overview of the practical task/investigation and examination in each of the LTSMs, and the weeks in which they are scheduled in the tracker. This will help you in your preparation. Where the LTSMs used at your school have the examination in the Learner's Book, it cannot be used because the learners will be able to prepare for it in advance, but it is useful for revision and informal assessment.

**Please note:** The DBE makes changes to the assessment requirements from time to time. When you receive official notification of such changes, you should change the assessment programme shown here to align with them.

**TABLE 1: FORMAL ASSESSMENT TASKS INCLUDED IN EACH SET OF APPROVED LTSMs FOR TERM 2**

| Name of book | Practical investigation | Examination<br>* Use for practice, not for formal assessment |
|---|---|---|
| *Solutions for All* | **Week 8**<br>*Titration with oxalic acid*<br>LB pp. 312–314 | **Week 10**<br>Mid-year examinations<br>Term 2 Control tests<br>TG pp. 436–448 |
| *Study and Master* | **Week 8**<br>*Titration with oxalic acid*<br>LB pp. 239–241<br>TG pp. D61–D64 | **Week 10**<br>Mid-year examinations<br>Term 2 Control tests<br>TG pp. B14–B35 |

## 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 resources, 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

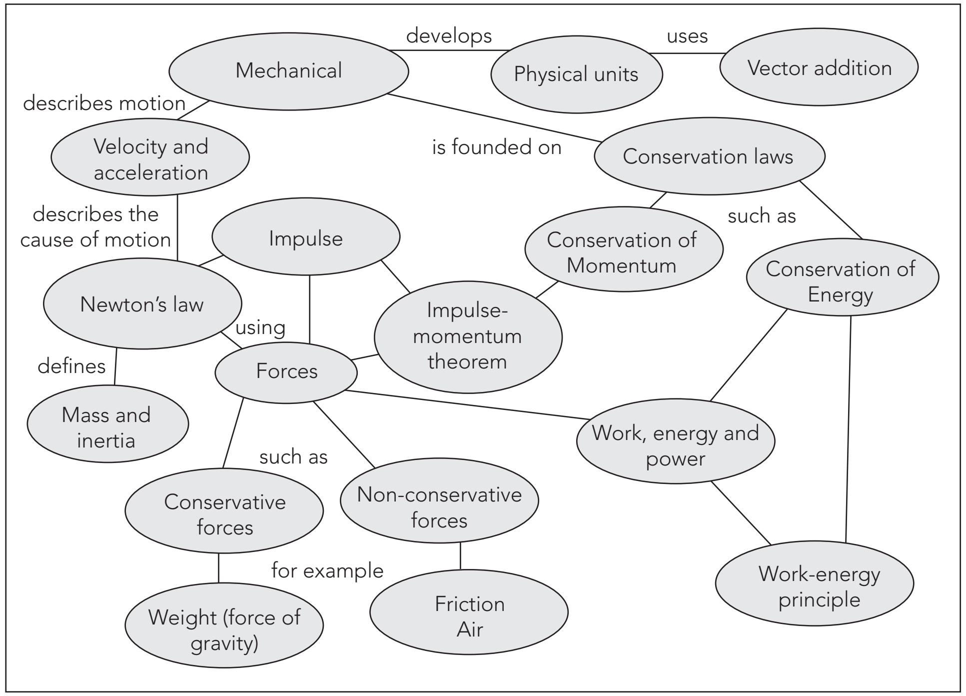
However well you know your work, it is easy to make small mistakes when in a classroom with learners asking questions. Always read through the content that you are going to cover to ensure that you are very familiar with the work. If possible, also do additional reading from other sources. Refer to Section 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 1. 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.

**FIGURE 1: CONCEPT MAP FOR MECHANICS**




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 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 2**

| Name of book | Practical investigation |
|---|---|
| *Solutions for All* | **Week 5**<br>*To determine the quantitative rate and draw the graph of the reaction of sodium thiosulfate and dilute hydrochloric acid*<br>LB pp. 195, 198 |
| *Study and Master* | **Week 5**<br>*To determine the quantitative rate and draw the graph of the reaction of sodium thiosulfate and dilute hydrochloric acid*<br>LB pp. 195, 198 |

## 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 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 2, learners may choose either to validate the law of conservation of linear momentum or to carry out a titration with oxalic acid to determine the concentration of dilute sodium hydroxide. Both Learner's Books have excluded the practical investigation of the law of conservation of momentum during this term, so we have focussed only on the titration practical as the formal practical investigation for the term. To prepare learners for the formal assessment in Chemistry, it is important to give them opportunities to complete other experiments and investigations during the term, e.g. investigating the quantitative rate of the reaction of sodium thiosulfate and dilute hydrochloric acid, and/or the effect of pH on the chemical equilibrium system of dichromate and chromate ions.

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 one 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, assessment tasks and page reference number
3. Learner's Book page number
4. Learner's Book activity/task
5. Teacher's Guide page number
6. ***Everything Science*** Learner's Book page number
7. ***Everything Science*** Teacher's Guide page number
8. 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*) |
| Demo. | Demonstration |
| ES | *Everything Science* |
| Ex. | Exercise |
| Exp. | Experiment |
| EY | Extend Yourself (*Solutions for All)* |
| 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 |
| TG | Teacher's Guide |
| TY | Test Yourself (*Study and Master*) |
| WS | Worksheet |
| * | Additional/alternative activity provided |

## 1. *Physical Sciences Solutions for All* (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* that 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* Week 1: Work, energy and power | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | **Revision of prior knowledge (from Grade 10)**<br>Gravitational potential energy, kinetic energy, the law of conservation of mechanical energy, and the law of conservation of energy<br>**Definition of work**<br>• Define the work done on an object by a force as: $W = F.\Delta x.cos\theta$<br>• Know that work is a scalar quantity which is measured in joules (J)<br>• Positive net work done on a system will increase the energy of the system and negative work done on the system will decrease the energy of the system | 56–59<br>62–65<br>99 | 166–171 | Check myself<br>CP 1<br>CP 2<br>CP 3<br>CP 4 | 119–124 | 219–226 | 135–140 | | | | | |
| **Resources:** Mindset Learn: What is work? (4:29); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/01-what-work<br>Mindset Learn: Appling the definition of work to calculations (5:54); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/02-applying-definition-work-calculations | | | | | | | | | | | | |
| **Homework:** Ex. 4.1 Q. 1–5 | | | 171–172 | Ex. 4.1<br>Q. 1–5 | 124–125 | 226<br>Ex. 5.1<br>Q. 1–4 | 137–140 | | | | | |
| 2 | **Net work done on an object**<br>• Calculate the net work done on an object by applying the definition of work to each force acting on the object while it is being displaced and then adding up (scalar) each contribution<br>**An alternative method of determining the net work**<br>• Draw a force diagram showing only forces that act along the plane (of the displacement)<br>• Ignore perpendicular forces<br>• Calculate the resultant (net) force along the plane<br>• Calculate the net work done on an object by taking the product of the resultant (net) force along the plane acting on the object and its displacement along the plane | 99 | 172–176 | CP 5 | 126 | 227–230 | 135–140 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed |
|---|---|---|---|---|---|---|---|---|
| **Resource:** Mindset Learn: Work and energy (7:56); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/03-work-and-energy | | | | | | | | |
| **Homework:** Ex. 4.2 Q. 1–4 | | | 176–177 | Ex. 4.2<br>Q. 1–4 | 127 | 227<br>Ex. 5.1<br>Q. 5–10 | 138–140 | |
| 3 | Review homework and practise two more examples: Ex. 4.2 Q. 5 & 6<br>**The work-energy theorem**<br>• Know that the net work done on an object causes a change in the object's kinetic energy<br>• This is known as the work-energy theorem: $W_{net} = E_{kf} - E_{ki}$<br>• Apply the work-energy theorem to objects on horizontal and inclined planes (frictionless and rough) | 99 | 177–181 | Ex. 4.2<br>Q. 5–6<br>CP 6<br>CP 7<br>Ex. 4.3<br>Q. 1–3 | 128–132 | 230–239 | | |
| **Resource:** Mindset Learn: The work-energy theorem (16:14); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/04-work-energy-theorem | | | | | | | | |
| **Homework:** Ex. 4.3 Q. 4–5 | | | 181–182 | Ex. 4.3<br>Q. 4–5 | 132–133 | 238<br>Ex. 5.2<br>Q. 1–3 | 140–141 | |

| **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 | TG | Date completed | | | | |
| 1 | • Apply the work-energy theorem to objects on horizontal and inclined planes (frictionless and rough)<br>**Conservation of energy with non-conservative forces present**<br>• Define conservative forces and give examples<br>• Define non-conservative forces and give examples<br>• Know that when only conservative forces are present, mechanical energy is conserved<br>• Know that when non-conservative forces are present, mechanical energy (the sum of kinetic and gravitational potential energy) is not conserved, but total energy of the system is still conserved | 99 | 182–188 | Ex. 4.3<br>Q. 6–7<br>CP 8 | 133–135 | 230–241 | | | | | | |
| **Resource:** Mindset Learn: Conservation of energy (7:38); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/05-conservation-energy | | | | | | | | | | | | |
| **Homework:** Ex. 4.4 Q. 1–5 | | | 188–189 | Ex. 4.4<br>Q. 1–5 | 135–136 | | | | | | | |
| 2 | **Conservation of energy with non-conservative forces present**<br>• Solve conservation of energy problems (with dissipative forces present) using the equation: $W_{nc} = \Delta E_p + \Delta E_k$<br>• Use the above relationship to show that in the absence of non-conservative forces: $W_{nc} = 0$ | 100 | 189–190 | Ex. 4.4<br>Q. 6–11 | 136–138 | 241–245 | | | | | | |
| **Homework:** Ex. 4.4 Q. 12–13 | | | 191 | Ex. 4.4<br>Q. 12–13 | 138–139 | 244–245<br>Ex. 5.3<br>Q. 1–3 | 142–144 | | | | | |
| 3 | **Power**<br>• Define power as the rate at which work is done<br>• Calculate the power involved when work is done | 100 | 192–195 | CP 9<br>CP 10<br>Ex. 4.5<br>Q. 1–5 | 139–140 | 245–246 | | | | | | |
| **Resource:** Mindset Learn: Power (11:80); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/06-power | | | | | | | | | | | | |
| **Homework: Ex. 4.5 Q. 6–10** | | | 195 | Ex. 4.5<br>Q. 6–10 | 140–141 | 249–250<br>Ex. 1–6 | 145–146 | | | | | |
| 4 | **Average power**<br>• Understand the average power required to keep an object moving at a constant speed along a rough horizontal surface or a rough inclined plane and do calculations using $P_{av} = Fv_{av}$ | 100 | 198–201 | CP 11<br>CP 12<br>Ex. 4.6<br>Q. 1–6 | 143–145 | 246–248 | | | | | | |
| **Homework:** Ex. 4.6 Q. 7–10 | | | 201–202 | Ex. 4.3<br>Q. 7–10 | 145–146 | | | | | | | |

| 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* Week 3: Work, energy and power, the Doppler effect | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | • Calculate the minimum power required of an electric motor to pump water from a borehole of a particular depth at a particular rate using: $W_{nc} = \Delta E_p + \Delta E_k$ | | 203–205 | CP 13<br>Ex. 4.7<br>Q. 1–4<br>EY 1–3 | 146–150 | 248–251 | | | | | | |
| **Homework:** EY 4–7 | | | 206 | EY<br>Q. 4–7 | 150–151 | 250–251<br>Ex. 5.5<br>Q. 1–6 | 147–148 | | | | | |
| 2 | **Doppler effect with sound and ultrasound**<br>• State the Doppler effect for sound and give everyday examples<br>• Explain (using appropriate illustrations) why a sound increases in pitch when the source of the sound travels towards a listener and decreases in pitch when it travels away<br>• Use the following equation to calculate the frequency of sound detected by a listener (L) when *either* the source or the listener is moving: $f_L = \frac{v \pm v_L}{v \pm v_S} f_s$ | 121 | 211–217 | CP 1<br>CP 2 | 152–157 | 253–258 | 150 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | | | | | |
| **Resource:** Mindset Learn: The Doppler effect in everyday life (9:43); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/01-doppler-effect-everyday-life | | | | | | | | | | | | |
| **Homework:** Ex. 5.1 Q. 1–2 | | | 217 | | 157–158 | 262–263<br>Ex. 6.1<br>Q. 1–5 | 150–152 | | | | | |
| 3 | • Use the following equation to calculate the frequency of sound detected by a listener (L) when *either* the source or the listener is moving:<br>$f_L = \frac{v \pm v_L}{v \pm v_S} f_s$<br>• Describe applications of the Doppler effect with ultrasound waves in medicine, e.g. to measure the rate of blood flow or the heartbeat of a foetus in the womb | 121 | 216–218 | Ex. 5.1<br>Q. 3–6 | 158–159 | 258–263 | | | | | | |
| **Resources:** Mindset Learn: Calculations using the Doppler effect (11:27); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/02-calculations-doppler-effect<br>Mindset Learn: Applications of the Doppler effect (15:40); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/03-applications-doppler-effect | | | | | | | | | | | | |
| **Homework:** EY Q. 1–3 | | | 222–223 | EY<br>Q. 1–3 | 161–162 | 266–267<br>Ex. 6.2<br>Q. 1–6 | 152–153 | | | | | |
| 4 | • State that light emitted from many stars is shifted toward the red, or longer wavelength/lower frequency, end of the spectrum due to movement of the source of light<br>• Apply the Doppler effect to these 'red shifts' to conclude that most stars are moving away from the Earth and therefore the universe is expanding | 121–122 | 219–222 | Ex. 5.2<br>Q. 1–4 | 159–160 | 263–267 | | | | | | |
| **Resource:** Mindset Learn: The expanding universe (8:54); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/04-expanding-universe | | | | | | | | | | | | |
| **Homework:** Ex. 5.2 Q. 5–8 | | | 222 | Ex. 5.2<br>Q. 5–8 | 160–161 | | | | | | | |

| **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* Week 4: Rate and extent of reaction | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | **Rate and extent of reaction**<br>• Explain what is meant by reaction rate<br>• List the factors that affect the rate of chemical reactions:<br>– surface area (solid)<br>– concentration (solution)<br>– pressure (gas)<br>– temperature<br>– catalyst<br>• Explain in terms of the collision theory how the various factors affect the rate of chemical reactions | 123 | 225–232 | CP 1<br>Ex. 6.1 | 163–169 | 269–285 | 155–156 | | | | | |
| **Resource:** Mindset Learn: Rates of reactions Lesson 1 (17:15); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/01-what-factors-affect-rate-reactions | | | | | | | | | | | | |
| **Homework:** Prepare for Informal Assessment Task: Determining factors that affect the rate of chemical reactions (Parts 1 and 2: Concentration of vinegar and temperature of vinegar reacting with baking soda; Part 4: Catalysts) | | | 229–231 | | | 270<br>Ex. 7.1<br>Q. 1 | 156–157 | | | | | |
| 2 | **Teacher demonstration**<br>• The effect of concentration on rate of reaction (vinegar + baking soda)<br>• The effect of temperature on rate of reaction (vinegar + baking soda)<br>• The effect of a catalyst ($H_2O_2$ + manganese dioxide, sugar cube + activated carbon, copper in Zn + dilute hydrochloric acid)<br>**Measuring the rates of reactions**<br>• Suggest suitable experimental techniques for measuring the rate of a given reaction including the measuring of gas volumes, turbidity (e.g. precipitate formation), change of the mass of the reaction vessel | 123 | 229–234 | CP 2 | 167–174 | 286–291 | 159–158 | | | | | |
| **Resource:** Mindset Learn: Measuring the rates of reactions (Rates of reactions Lesson 2) (21:05); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/02-how-measure-reaction-rates | | | | | | | | | | | | |
| **Homework:** Prepare for informal assessment to determine the quantitative rate of the reaction between sodium thiosulfate and dilute hydrochloric acid | | | 235–236 | | 172 | 272–273<br>Ex. 7.2<br>Q. 1–3 | 157–159 | | | | | |
| 2 | **Recommended experiment for informal assessment:**<br>To determine the quantitative reaction rate and draw graphs for the reaction between sodium thiosulfate and dilute hydrochloric acid | 123 | 235–236 | | 174–284 | 289–291 | 159–160 | | | | | |
| **Homework:** Ex. 6.2 Q. 1–4 | | | 237–238 | Ex. 6.2<br>Q. 1–4 | 173 | 285–286<br>Ex. 7.3<br>Q. 1 | 160–161 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | **Mechanism of reaction and catalysts**<br>• Define activation energy – the minimum energy required for a reaction to take place<br>• Colliding molecules must have, apart from the correct orientation, a kinetic energy equal to or bigger than the activation energy of a reaction before the reaction can take place<br>• Use a graph showing distribution of molecular energies (number of particles against their kinetic energy) to explain why only some molecules have enough energy to react and hence how adding a catalyst and heating the reactants affects the rate<br>• Explain (in simple terms) how some catalysts function by reacting with reactants in such a way that the reaction follows an alternative path of lower activation energy | 124 | 238–241 | CP 3<br>Ex. 6.3<br>Q. 1–2 | 174–175 | 291–294 | | | | | | |
| **Resource:** Mindset Learn: Reaction mechanism and catalysts (Rates of reaction Lesson 3) (15:43); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/03-reaction-mechanism-and-catalysts | | | | | | | | | | | | |
| **Homework:** EY Q. 1 | | | 242–243 | EY Q. 1 | 176–177 | 294–295<br>Ex. 7.4<br>Q. 1–3 | 162–163 | | | | | |
| 4 | Review Rates of reactions: EY Q. 2–3 | | 243–246 | EY<br>Q. 2–3 | 177–179 | 295–298<br>Ex. 7.5<br>Q. 1–7 | 163–167 | | | | | |
| **Homework:** Summarise and make notes on rate and extent of reaction | | | | | | | | | | | | |

| Reflection | |
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| **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?<br><br>**HOD:** **Date:** |

## *Solutions for All* Week 5: Chemical equilibrium

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | **Chemical equilibrium**<br>• Explain what is meant by:<br>– open and closed systems<br>– a reversible reaction<br>– dynamic equilibrium<br>• List the factors that affect the **position** of an equilibrium<br>**Application of equilibrium principles**<br>• State Le Chatelier's Principle<br>• Use Le Chatelier's Principle to identify and explain the effects of changes of pressure, temperature, and concentrations and amounts of each substance in an equilibrium mixture<br>• Investigate equilibrium and the factors influencing equilibrium system of $CoC\ell_2$ and $H_2O$ (recommended experiment for informal assessment) | 125 | 248–257<br>261–263 | CP 1<br>CP 2 | 180–183 | 299–304 | 169–171<br>172–178 | | | | | |
| **Resource:** Mindset Learn: Introduction to Chemical Equilibrium (17:19); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/01-introduction-chemical-equilibrium | | | | | | | | | | | | |
| **Homework:** Read 250–257; make a summary and notes | | | 250–257 | | 186–188 | 303<br>Ex. 8.1<br>Q. 1–2 | 171 | | | | | |
| 2 | • Discuss the design of the experiment to investigate the effects of pH on the equilibrium system of dichromate and chromate ions<br>• Perform the experiment and record the results (30 minutes)<br>• List the factors that affect the **position** of an equilibrium<br>**Application of equilibrium principles**<br>• State Le Chatelier's Principle<br>• Use Le Chatelier's Principle to identify and explain the effects of changes of pressure, temperature, and concentrations and amounts of each substance in an equilibrium mixture<br>• Explain the use of a catalyst and its influence on an equilibrium mixture | | 257<br>261–263 | Practical<br>CP 3<br>CP 4<br>CP 5 | 184<br>186–188 | 313–320 | | | | | | |
| **Resource:** Mindset Learn: Le Chatelier's Principle (16:22); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/04-le-chatelier's-principle | | | | | | | | | | | | |
| **Homework:** Ex. 7.1 Q. 1–5 | | | 259–260 | Ex. 7.1<br>Q. 1–5 | 184–185 | 332<br>Ex. 8.5<br>Q. 1, 3 | 179 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
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| | | | | | | LB | TG | | | | | |
| 3 | **Application of equilibrium principles**<br>• State Le Chatelier's Principle<br>• Use Le Chatelier's Principle to identify and explain the effects of changes of pressure, temperature, and concentrations and amounts of each substance in an equilibrium mixture<br>• Explain the use of a catalyst and its influence on an equilibrium mixture<br>• Apply the rate and equilibrium principles to important industrial applications, e.g. the Haber process | 126 | 263–266 | CP 6<br>CP 7 | 185 | 330–331<br>502–503 | | | | | | |
| **Homework:** Review and learn about the Haber and the Contact processes | | | 263–266 | | 189 | | | | | | | |
| 4 | **The equilibrium constant**<br>• Write down an expression for the equilibrium constant having been given the equation for the reaction<br>• Perform calculations based on $K_c$ values<br>**More equilibrium constant calculations**<br>• List the factors which influence the value of the equilibrium constant, $K_c$ | 125 | 267–272 | CP 8<br>CP 9<br>CP 10 | 189–191 | 304–313 | | | | | | |
| **Resource:** Mindset Learn: What is the equilibrium constant? (12:37); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/02-what-equilibrium-constant | | | | | | | | | | | | |
| **Homework:** Ex. 7.2 Q. 1–4; review pp. 270–271 (worked examples) | | | 269–271 | Ex. 7.2<br>Q. 1–4 | 191 | 312–313<br>Ex. 8.2<br>Q. 1–3 | 171–172 | | | | | |

**Reflection**

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| **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* Week 6: Chemical equilibrium, acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Explain the significance of high and low values of the equilibrium constant | 125 | 272–273 | CP 11<br>Ex. 7.3<br>Q. 1–6 | 191–194 | 312 | | | | | | |
| **Resource:** Mindset Learn: Using the equilibrium constant (15:11); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/03-using-equilibrium-constant | | | | | | | | | | | | |
| **Homework:** EY 2–3 | | | 278–279 | EY<br>Q. 2–3 | 193–194 | | | | | | | |
| 2 | **Application of equilibrium principles**<br>• Interpret (only simple) graphs of equilibrium | 125 | 274–276 | Ex. 7.4<br>Q. 1 | 194–196 | 320–328 | | | | | | |
| **Homework:** Ex. 7.4 Q. 2 EY Q. 1 | | | 277–278 | EX 7.4<br>Q. 2<br>EY Q. 2 | | 328–329<br>Ex. 8.3<br>Q. 1–2 | 173–175 | | | | | |
| 3 | **Application of equilibrium principles**<br>• Interpret (only simple) graphs of equilibrium | 126 | 280–281 | EY<br>Q. 4 | | 328–332 | 175–178 | | | | | |
| **Homework:** Summarise Chemical equilibrium | | | | | | 331<br>Ex. 8.4<br>Q. 1 | 178 | | | | | |
| 4 | **Acids and bases**<br>• Explain what is meant by acids and bases<br>• State acid-base models (Arrhenius, Lowry-Brønsted)<br>• Write the reaction equations of aqueous solutions of acids and bases<br>• Give conjugate acid-base pairs for given compounds | 127 | 283–289 | CP 1<br>CP 2 | 201–205 | 331–339 | 181–183 | | | | | |
| **Resources:** Mindset Learn: Arrhenius' theory of acids and bases (14:49); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/01-arrhenius%E2%80%99-acid-base-model<br>Mindset Learn: Lowry-Brønsted theory of acids and bases (10:20); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/02-lowry-bronsted-acid-base-model<br>Mindset Learn: Conjugate acid-base pairs (14:20); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/03-acid-base-conjugate-pairs | | | | | | | | | | | | |
| **Homework:** Ex. 8.1 Q. 1–2 | | | 289 | Ex. 8.1<br>Q. 1–2 | 205 | 339<br>Ex. 9.1<br>Q. 1–3 | 183–184 | | | | | |

| Reflection | |
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| **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* Week 7: Chemical equilibrium, acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Distinguish between concentrated and dilute acids<br>• Distinguish between strong and concentrated acids<br>• Compare strong and weak acids by looking at:<br>– pH<br>– conductivity<br>– reaction rate<br>• Name some common strong and weak acids and bases | 127–128 | 290–294 | CP 3<br>CP 4 | 206–207 | 340–345 | | | | | | |
| **Resources:** Mindset Learn: Neutralisation (5:46); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/04-neutralisation<br>Mindset Learn: Indicators and strengths of acids and bases (18:28); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/05-indicators-and-strength-acids-and-bases | | | | | | | | | | | | |
| **Homework:** Ex. 8.2 Q. 1–8 | | | 294 | | 207 | 344–345<br>Ex. 9.2<br>Q. 1–3 | 184–185 | | | | | |
| 2 | • Compare $K_a$ and $K_b$ values of strong and weak acids and bases<br>• Give the neutralisation reactions of common laboratory acids and bases | 127–128 | 294–298 | CP 5<br>CP 6<br>Ex. 8.3<br>Q. 1–6 | 208–211 | 345–354 | 187 | | | | | |
| **Resource:** Mindset Learn: Ionisation and dissociation constants (5:32); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/08-ionisation-and-dissociation-constants | | | | | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed |
|---|---|---|---|---|---|---|---|---|
| **Homework:** Ex. 8.4 Q. 1–4 | | | 301 | | 213–214 | 348<br>Ex. 9.3<br>Q. 1–2<br>354<br>Ex. 9.4<br>Q. 1–3 | 186<br>188 | |
| 3 | • Explain the pH scale<br>• How do indicators work?<br>• What is the range of methyl orange, bromothymol blue and phenolphthalein indicators?<br>• Calculate pH values of strong acids and strong bases<br>• Define the concept of $K_w$<br>• Explain the auto-ionisation of water | 127–128 | 299–304 | CP 7<br>CP 8<br>CP 9<br>CP 10 | 212–215 | 354–359 | 190 | |
| **Resource:** Mindset Learn: The pH scale (4:33); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/07-ph-scale | | | | | | | | |
| **Homework:** Ex. 8.5 Q. 1–6 | | 304–305 | | EX 8.5<br>Q. 1–6 | 215–216 | 356<br>Ex. 9.5<br>Q. 1–3 | 189–190 | |
| 4 | • Determine the approximate pH of salts in salt hydrolysis<br>• Do simple acid-base titrations | 127 | 305–310 | CP 11<br>CP 12<br>CP 13 | 217–220 | 357–362 | 190–192 | |
| **Homework:** Ex. 8.6 Q. 1–2, Ex. 8.7 Q. 1–4 | | | 310 | Ex. 8.6<br>Q. 1–2<br>Ex. 8.7<br>Q. 1–4 | 218<br>220 | 366<br>Ex. 9.6<br>Q. 1–2 | 193–194 | |

| Reflection | |
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| **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* Week 8: Acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Do calculations based on titration reactions | 127 | 310–312<br>314–315 | CP 14<br>Ex. 8.8<br>Q. 1–6 | 220–222 | 372–373<br>Ex. 9.7<br>Q. 1–5 | 194–196 | | | | | |
| **Resource:** Mindset Learn: Titration (9:60); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/06-titration | | | | | | | | | | | | |
| **Homework:** Prepare for the formal assessment | | | 314–314 | | 220 | | 192 | | | | | |
| 2 | **Prescribed experiment for formal assessment**<br>• Preparing a standard solution of oxalic acid for volumetric analysis<br>• Performing an acid-base titration to determine the concentration of a solution of sodium hydroxide by titrating it against a standard solution of oxalic acid | 127–128 | 312–314 | | 220 | 362–366 | 192–193 | | | | | |
| **Homework:** Ex. 8.8 Q. 7–10 | | | 315 | Ex. 8.8<br>Q. 7–10 | 223–224 | 366–367<br>Ex. 9.6<br>Q. 1–2 | 193–194 | | | | | |
| 3 | **Prescribed experiment for formal assessment**<br>Complete the report on the prescribed experiment | | | | | 362–366 | 192–193 | | | | | |
| **Homework:** Read Applications of acids and bases, i.e. the application of acids and bases in the chlor-alkali industry (chemical reactions only) and acids and bases in the chemistry of hair; CP16, CP17 | | | 320–322 | CP 16<br>CP 17 | 227 | 367–370 | 194 | | | | | |
| 4 | • Do acid-base experiments to determine the presence of acid in a compound, e.g. percentage ethanoic acid in vinegar | 128 | 316–319 | CP15<br>Ex. 8.9<br>Q. 1–3 | 224–226 | 371–372 | | | | | | |
| **Homework:** EY 1–10 Revision of acids and bases | | | 323–324 | EY<br>Q. 1–10 | | | | | | | | |

| 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* Week 9: Catch up, consolidation and revision: plan your week

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
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| | | | | | | LB | TG | Date completed | | | | |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
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| 4 | | | | | | | | | | | | |

| 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* Week 10: Mid-year examinations: plan your week

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
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| 4 | | | | | | | | | | | | |

### End-of-term reflection

**Once the tests and the formal practical have been marked and graded, 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 Physical Sciences 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? What can you do to 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? 2

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:**

## 2. *Study and Master Physical Sciences* (Cambridge University Press)

This Learner's Book contains many solved problems that teach learners how to tackle different 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*** **Week 1: Work, energy and power** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | **Revision of prior knowledge (from Grade 10)**<br>Gravitational potential energy, kinetic energy, the law of conservation of mechanical energy, and the law of conservation of energy<br>**Definition of work**<br>• Define the work done on an object by a force as: $W = F.\Delta x.cos\theta$<br>• Know that work is a scalar quantity which is measured in joules (J)<br>• Positive net work done on a system will increase the energy of the system and negative work done on the system will decrease the energy of the system | 56–59<br>62–65<br>99 | 147–149 | | | 219–226 | 135–140 | | | | | |
| **Resources:** Mindset Learn: What is work? (4:29); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/01-what-work<br>Mindset Learn: Appling the definition of work to calculations (5:54); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/02-applying-definition-work-calculations | | | | | | | | | | | | |
| **Homework:** *ES Ex. 5–1 Q. 1–4 | | | *ES 226 | *ES Ex. 5.1 Q. 1–4 | *ES 137–140 | 226 Ex. 5.1 Q. 1–4 | 137–140 | | | | | |
| 2 | **Net work done on an object**<br>• Calculate the net work done on an object by applying the definition of work to each force acting on the object while it is being displaced and then adding up (scalar) each contribution<br>**An alternative method of determining the net work**<br>• Draw a force diagram showing only forces that act along the plane (of the displacement)<br>• Ignore perpendicular forces<br>• Calculate the resultant (net) force along the plane<br>• Calculate the net work done on an object by taking the product of the resultant (net) force along the plane acting on the object and its displacement along the plane | 99 | 149–151 | | | 227–230 | 135–140 | | | | | |
| **Resource:** Mindset Learn: Work and energy (7:56); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/03-work-and-energy | | | | | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | | | | | |
| **Homework:** * ES Ex. 5.1: Q. 5–10 | | | *ES 227 | *ES Ex. 5.1 Q. 5–10 | *ES 138–140 | 227 Ex. 5.1 Q. 5–10 | 138–140 | | | | | |
| 3 | **The work-energy theorem**<br>• Know that the net work done on an object causes a change in the object's kinetic energy<br>• This is known as the work-energy theorem: $W_{net} = E_{kf} - E_{ki}$<br>• Apply the work-energy theorem to objects on horizontal and inclined planes (frictionless and rough) | 99 | 152–154 | TY 7: Q. 1–3 | D 36 | 230–239 | | | | | | |
| **Resource:** Mindset Learn: The work-energy theorem (16:14); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/04-work-energy-theorem | | | | | | | | | | | | |
| **Homework:** *ES Ex. 5.2 Q. 1–3 | | | | *ES Ex. 5.2 Q. 1–3 | *ES 140–141 | 238 Ex. 5.2 Q. 1–3 | 140–141 | | | | | |

**Reflection**

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|---|---|
| **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* Week 2: Work, energy and power

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Apply the work-energy theorem to objects on horizontal and inclined planes (frictionless and rough)<br>**Conservation of energy with non-conservative forces present**<br>• Define conservative forces and give examples<br>• Define non-conservative forces and give examples<br>• Know that when only conservative forces are present, mechanical energy is conserved<br>• Know that when non-conservative forces are present, mechanical energy (the sum of kinetic and gravitational potential energy) is not conserved, but total energy of the system is still conserved | 99 | 154–160<br>168–169 | Unit 3<br>Q. 4–6 | D 39–<br>D 40 | 230–241 | | | | | | |
| **Resource:** Mindset Learn: Conservation of energy (7:38); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/05-conservation-energy | | | | | | | | | | | | |
| **Homework:** TY 8: Q. 1–2 | | | 160 | TY 8:<br>Q. 1–2 | D 36–<br>D 37 | | | | | | | |
| 2 | **Conservation of energy with non-conservative forces present**<br>• Solve conservation of energy problems (with dissipative forces present) using the equation: $W_{nc} = \Delta E_p + \Delta E_k$<br>• Use the above relationship to show that in the absence of non-conservative forces: $W_{nc} = 0$ | 100 | 156–160<br>169 | TY 8:<br>Q. 3–4<br>Unit 3<br>Q. 11 | D 37 | 241–245 | | | | | | |
| **Homework:** *ES Ex. 5.3: Q. 1–3 | | | 160 | *ES Ex. 5.3:<br>Q. 1–3 | *ES<br>142–144 | 244–245<br>Ex. 5.3<br>Q. 1–3 | 142–144 | | | | | |
| 3 | **Power**<br>• Define power as the rate at which work is done<br>• Calculate the power involved when work is done | 100 | 162–163 | Unit 3<br>Q. 8 | D 40 | 245–246 | | | | | | |
| **Resource:** Mindset Learn: Power (11:80); http://learn.mindset.co.za/resources/physical-sciences/grade-12/work-energy-and-power/06-power | | | | | | | | | | | | |
| **Homework:** *ES Ex. 5.4: Q. 1–6 | | | *ES<br>249–250 | *ES<br>Ex. 5.4<br>Q. 1–6 | *ES<br>145–146 | 249–250<br>Ex. 1–6 | 145–146 | | | | | |
| 4 | **Average power**<br>• Understand the average power required to keep an object moving at a constant speed along a rough horizontal surface or a rough inclined plane and do calculations using: $P_{av} = Fv_{av}$ | 100 | 161–163<br>169 | Unit 3<br>Q. 7, 9 | D 40–<br>D 41 | 246–248 | | | | | | |
| **Homework:** TY 9: Q. 1–3 | | | 163 | TY 9:<br>Q. 1–3 | D 38 | | | | | | | |

| Reflection | |
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| **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* Week 3: Work, energy and power, the Doppler effect | | | | | | | | | | | | |
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| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | • Calculate the minimum power required of an electric motor to pump water from a borehole of a particular depth at a particular rate using: $W_{nc} = \Delta E_p + \Delta E_k$ | 100 | 164–166<br>169 | Unit 3<br>Q. 10 | D 41 | 248–251 | | | | | | |
| **Homework:** TY 10: Q. 1; Mechanics (Unit 3) Q. 1–3 | | | 166–168 | TY 19:<br>Q. 1<br>Unit 3<br>Q. 1–3 | D 39 | 250–251<br>Ex. 5.5<br>Q. 1–6 | 147–148 | | | | | |
| 2 | **Doppler effect with sound and ultrasound**<br>• State the Doppler effect for sound and give everyday examples<br>• Explain (using appropriate illustrations) why a sound increases in pitch when the source of the sound travels towards a listener and decreases in pitch when it travels away<br>• Use the following equation to calculate the frequency of sound detected by a listener (L) when *either* the source or the listener is moving: $f_L = \frac{v \pm v_L}{v \pm v_S} f_s$ | 121 | 171–174 | | | 253–258 | 150 | | | | | |
| **Resource:** Mindset Learn: The Doppler effect in everyday life (9:43); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/01-doppler-effect-everyday-life | | | | | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed |
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| **Homework:** TY 1: Q. 1–3 | | | 175 | TY 1: Q. 1–3 | D 43 | 262–263 Ex. 6.1 Q. 1–5 | 150–152 | |
| 3 | • Use the following equation to calculate the frequency of sound detected by a listener (L) when *either* the source or the listener is moving: $f_L = \frac{v \pm v_L}{v \pm v_S} f_s$<br>• Describe applications of the Doppler effect with ultrasound waves in medicine, e.g. to measure the rate of blood flow or the heartbeat of a foetus in the womb | 121 | 175–176 181–183 | Q. 1–8 | D 44– D 45 | 258–263 | | |
| **Resources:** Mindset Learn: Calculations using the Doppler effect (11:27); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/02-calculations-doppler-effect<br>Mindset Learn: Applications of the Doppler effect (15:40); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/03-applications-doppler-effect | | | | | | | | |
| **Homework:** Waves, sound and light: Q. 9–10 | | | 183 | Q. 9–10 | D 45 | 266–267 Ex. 6.2 Q. 1–6 | 152–153 | |
| 4 | • State that light emitted from many stars is shifted toward the red, or longer wavelength/lower frequency, end of the spectrum due to movement of the source of light<br>• Apply the Doppler effect to these 'red shifts' to conclude that most stars are moving away from the Earth and therefore the universe is expanding | 121–122 | 176–180 | TY 2: Q. 1–2 TY 3: Q. 1 | D 43– D 44 | 263–267 | | |
| **Resource:** Mindset Learn: The expanding universe (8:54); http://learn.mindset.co.za/resources/physical-sciences/grade-12/doppler-effect/04-expanding-universe | | | | | | | | |
| **Homework:** Summarise the Doppler effect with sound and light; Waves, sound and light: Q. 11–13 | | | 183 | Q. 11–13 | D 45 | | | |

| Reflection | |
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| **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* Week 4: Rate and extent of reaction | | | | | | | | | | | | |
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| **S #** | **CAPS concepts, practical activities and assessment tasks** | **CAPS pp.** | **LB pp.** | **LB act.** | **TG pp.** | ***Everything Science*** | | **Class** | | | | |
| | | | | | | **LB** | **TG** | **Date completed** | | | | |
| 1 | **Rate and extent of reaction**<br>• Explain what is meant by reaction rate<br>• List the factors that affect the rate of chemical reactions:<br>– surface area (solid)<br>– concentration (solution)<br>– pressure (gas)<br>– temperature<br>– catalyst<br>• Explain in terms of the collision theory how the various factors affect the rate of chemical reactions | 123 | 184–192 | | | 269–285 | 155–156 | | | | | |
| **Resource:** Mindset Learn: Rates of reactions Lesson 1 (17:15); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/01-what-factors-affect-rate-reactions | | | | | | | | | | | | |
| **Homework:** Prepare for Informal Assessment Task: Determining factors that affect the rate of chemical reactions (Parts 1 and 2: Concentration of vinegar and temperature of vinegar reacting with baking soda; Part 4: Catalysts) | | | 193–197 | | | 270<br>Ex. 7.1<br>Q. 1 | 156–157 | | | | | |
| 2 | **Teacher demonstration**<br>• The effect of concentration on rate of reaction (vinegar + baking soda)<br>• The effect of temperature on rate of reaction (vinegar + baking soda)<br>• The effect of a catalyst ($H_2O_2$ + manganese dioxide; sugar cube + activated carbon; copper in Zn + dilute hydrochloric acid)<br>**Measuring the rates of reaction**<br>• Suggest suitable experimental techniques for measuring the rate of a given reaction, including measuring gas volumes, turbidity (e.g. precipitate formation), change of the mass of the reaction vessel | 123 | 193–197 | D 47–<br>D 48 | | 286–291 | 159–158 | | | | | |
| **Resource:** Mindset Learn: Measuring the rates of reactions (Rates of reactions Lesson 2) (21:05); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/02-how-measure-reaction-rates | | | | | | | | | | | | |
| **Homework:** TY 1: Q. 1–3 | | | 200 | D 50 | | 272–273<br>Ex. 7.2<br>Q. 1–3 | 157–159 | | | | | |
| 2 | **Recommended experiment for informal assessment:**<br>To determine the quantitative reaction rate and draw graphs for the reaction between sodium thiosulfate and dilute hydrochloric acid | 123 | 195, 198 | D 48–<br>D 49 | | 289–291 | 159–160 | | | | | |
| **Homework:** Complete the analysis of results | | | 195, 198 | D 48–<br>D 49 | | 285–286<br>Ex. 7.3<br>Q. 1 | 160–161 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
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| | | | | | | LB | TG | | | | | |
| 3 | **Mechanism of reaction and catalysts**<br>• Define activation energy – the minimum energy required for a reaction to take place<br>• Colliding molecules must have, apart from the correct orientation, a kinetic energy equal to or bigger than the activation energy of a reaction before the reaction can take place<br>• Use a graph showing distribution of molecular energies (number of particles against their kinetic energy) to explain why only some molecules have enough energy to react and hence how adding a catalyst and heating the reactants affects the rate<br>• Explain (in simple terms) how some catalysts function by reacting with reactants in such a way that the reaction follows an alternative path of lower activation energy | 124 | 201–203 | | | 291–294 | | | | | | |
| **Resource:** Mindset Learn: Reaction mechanism and catalysts (Rates of reaction Lesson 3) (15:43); http://learn.mindset.co.za/resources/physical-sciences/grade-12/rate-and-extent-reaction/03-reaction-mechanism-and-catalysts | | | | | | | | | | | | |
| **Homework:** TY 2: Q. 1–2 | | | 204 | TY 2:<br>Q. 1–2 | D 50 | 294–295<br>Ex. 7.4<br>Q. 1–3 | 162–163 | | | | | |
| 4 | Review Rates of reactions *ES Ex. 7.5 Q. 1–7 | | 184–204<br>*ES<br>295–298 | *ES<br>Ex. 7.5<br>Q. 1–7 | *ES<br>163–167 | 295–298<br>Ex. 7.5<br>Q. 1–7 | 163–167 | | | | | |
| **Homework:** Summarise and make notes on Rate and extent of reactions | | | 184–204 | | | | | | | | | |

| Reflection | |
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| **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* Week 5: Chemical equilibrium

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
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| | | | | | | LB | TG | Date completed | | | | |
| 1 | **Chemical equilibrium**<br>• Explain what is meant by:<br>– open and closed systems<br>– a reversible reaction<br>– dynamic equilibrium<br>• List the factors that affect the **position** of an equilibrium<br>• Investigate equilibrium and the factors influencing equilibrium system of $CoC\ell_2$ and $H_2O$ (recommended experiment for informal assessment) | 125 | 205–208 | | | 299–304 | 169–171<br>172–178 | | | | | |
| **Resource:** Mindset Learn: Introduction to Chemical Equilibrium (17:19); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/01-introduction-chemical-equilibrium | | | | | | | | | | | | |
| **Homework:** Read pp. 205–208; make a summary and notes | | | 205–208 | | | 303<br>Ex. 8.1<br>Q. 1–2 | 171 | | | | | |
| 2 | • Discuss the design of the experiment to investigate the effects of pH on the equilibrium system of dichromate and chromate ions, and then perform the experiment and record the results (30 minutes)<br>• List the factors that affect the **position** of an equilibrium<br>**The equilibrium constant**<br>• Write down an expression for the equilibrium constant having been given the equation for the reaction<br>• Perform calculations based on $K_c$ values | | 208–213 | | | 313–320 | | | | | | |
| **Resource:** Mindset Learn: What is the equilibrium constant? (12:37); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/02-what-equilibrium-constant | | | | | | | | | | | | |
| **Homework:** TY 3: Q. 1–2 | | | 213 | | | 332<br>Ex. 8.5<br>Q. 1, 3 | 179 | | | | | |
| 3 | **Application of equilibrium principles**<br>• State Le Chatelier's Principle<br>• Use Le Chatelier's Principle to identify and explain the effects of changes of pressure, temperature, and concentrations and amounts of each substance in an equilibrium mixture<br>• Explain the use of a catalyst and its influence on an equilibrium mixture<br>• Apply the rate and equilibrium principles to important industrial applications, e.g. the Haber process | 126 | 213–216 | | | 330–331<br>502–503 | | | | | | |
| **Resource:** Mindset Learn: le Chatelier's Principle (16:22); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/04-le-chatelier's-principle | | | | | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed | | | | |
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| **Homework:** Act. 6: Q. 1 | | | 219–220 | Act. 6: Q. 1 | | | | | | | | |
| 4 | **More equilibrium constant calculations**<br>• List the factors which influence the value of the equilibrium constant, $K_c$<br>**Application of equilibrium principles**<br>• Interpret (only simple) graphs of equilibrium | 125–126 | 217–222 | Act. 6: Q. 2–3<br>TY 4: Q. 1–3 | | 304–313 | | | | | | |
| **Homework:** TY 4: Q. 4–5 | | | 222 | TY 4 Q. 4–5 | | 312–313<br>Ex. 8.2<br>Q. 1–3 | 171–172 | | | | | |

**Reflection**

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| **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* Week 6: Chemical equilibrium, acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Class | | | | |
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| | | | | | | | | Date completed | | | | |
| 1 | • Explain the significance of high and low values of the equilibrium constant<br>**Application of equilibrium principles**<br>• Interpret (only simple) graphs of equilibrium | 125–126 | 214–217 | | | 312 | | | | | | |
| **Resource:** Mindset Learn: Using the equilibrium constant (15:11); http://learn.mindset.co.za/resources/physical-sciences/grade-12/chemical-equilibrium/03-using-equilibrium-constant | | | | | | | | | | | | |
| **Homework:** Chemical change (Units 1–3) Q. 6–7 | | | 254–255 | Units 1–3 Q. 6–7 | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* LB | *Everything Science* TG | Date completed |
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| 2 | Chemical change (Units 1–3) Q. 8–10 | 125 | 255–257 | Units 1–3 Q. 8–10 | | 320–328 | | |
| **Homework:** Chemical change (Units 1–3) Q. 11 | | | 258 | Units 1–3 Q. 11 | | 328–329 Ex. 8.3 Q. 1–2 | 173–175 | |
| 3 | Chemical change (Units 1–3)<br>Q. 1 a–j; Q. 2 a–j; Q. 3 a–j; Q. 4 first table a–j; Q. 5 | 126 | 250–254 | | | 328–332 | 175–178 | |
| **Homework:** Summarise Chemical equilibrium | | | | | | 331 Ex. 8.4 Q. 1 | 178 | |
| 4 | **Acids and bases**<br>• Explain what is meant by acids and bases<br>• State acid-base models (Arrhenius, Lowry-Brønsted)<br>• Write the reaction equations of aqueous solutions of acids and bases<br>• Give conjugate acid-base pairs for given compounds | 127 | 223–226 | TY 5: Q. 3 | | 331–339 | 181–183 | |
| **Resources:** Mindset Learn: Arrhenius' theory of acids and bases (14:49); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/01-arrhenius%E2%80%99-acid-base-model<br>Mindset Learn: Lowry-Brønsted theory of acids and bases (10:20); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/02-lowry-bronsted-acid-base-model<br>Mindset Learn: Conjugate acid-base pairs (14:20); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/03-acid-base-conjugate-pairs | | | | | | | | |
| **Homework:** TY 5: Q. 1–2, 4 | | | 226 | TY 5 Q. 1–2, 4 | | 339 Ex. 9.1 Q. 1–3 | 183–184 | |

| Reflection | |
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| **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* Week 7: Chemical equilibrium, acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Distinguish between concentrated and dilute acids<br>• Distinguish between strong and concentrated acids<br>• Compare strong and weak acids by looking at:<br>– pH<br>– conductivity<br>– reaction rate<br>• Name some common strong and weak acids and bases | 127–128 | 233–235 | | | 340–345 | | | | | | |
| **Resources:** Mindset Learn: Neutralisation (5:46); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/04-neutralisation<br>Mindset Learn: Indicators and strengths of acids and bases (18:28); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/05-indicators-and-strength-acids-and-bases | | | | | | | | | | | | |
| **Homework:** Read 223–226, 233–235 and make notes on Acids and bases | | | 223–226, 233–235 | | | 344–345<br>Ex. 9.2<br>Q. 1–3 | 184–185 | | | | | |
| 2 | • Compare $K_a$ and $K_b$ values of strong and weak acids and bases<br>• Give the neutralisation reactions of common laboratory acids and bases | 127–128 | 228–232<br>245–247 | TY 6:<br>Q. 1–2 | | 345–354 | 187 | | | | | |
| **Teacher demonstration:**<br>**Resource:** Mindset Learn: Ionisation and dissociation constants (5:32); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/08-ionisation-and-dissociation-constants | | | | | | | | | | | | |
| **Homework:** Continue to make notes on Acids and bases, pp. 228–232, 245–247 | | | 228–232<br>245–247 | | | 348<br>Ex. 9.3<br>Q. 1–2<br>354<br>Ex. 9.4<br>Q. 1–3 | 186<br>188 | | | | | |
| 3 | • Explain the pH scale<br>• How do indicators work?<br>• What is the range of methyl orange, bromothymol blue and phenolphthalein indicators?<br>• Calculate pH values of strong acids and strong bases<br>• Define the concept of $K_w$<br>• Explain the auto-ionisation of water | 127–128 | 241–245 | | | 354–359 | 190 | | | | | |
| **Resource:** Mindset Learn: The pH scale (4:33); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/07-ph-scale | | | | | | | | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
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| | | | | | | LB | TG | | | | | |
| **Homework** | | 304–305 | 247 | TY 8: Q. 1–2 | | 356 Ex. 9.5 Q. 1–3 | 189–190 | | | | | |
| 4 | • Determine the approximate pH of salts in salt hydrolysis<br>• Do simple acid-base titrations | 127 | 236–239 | TY 7: Q. 1–3 | | 357–362 | 190–192 | | | | | |
| **Homework:** Chemical change (Units 1–3) Q. 12–14 | | | 257 | Units 1–3 Q. 12–14 | | 366 Ex. 9.6 Q. 1–2 | 193–194 | | | | | |

| Reflection | |
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| **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* Week 8: Acids and bases

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
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| | | | | | | LB | TG | Date completed | | | | |
| 1 | • Do calculations based on titration reactions | 127 | 256–257 | Units 1–3 Q. 15, 17, 18 | | 372–373 Ex. 9.7 Q. 1–5 | 194–196 | | | | | |
| **Resource:** Mindset Learn: Titration (9:60); http://learn.mindset.co.za/resources/physical-sciences/grade-12/acids-and-bases/06-titration | | | | | | | | | | | | |
| **Homework:** Prepare for the formal assessment | | | 239–241 | | | | 192 | | | | | |

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Date completed | | | | |
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| | | | | | | LB | TG | | | | | |
| 2 | **Prescribed experiment for formal assessment**<br>• Preparing a standard solution of oxalic acid for volumetric analysis<br>• Performing an acid-base titration to determine the concentration of a solution of sodium hydroxide by titrating it against a standard solution of oxalic acid | 127–128 | 239–241 | | | 362–366 | 192–193 | | | | | |
| | **Homework:** Chemical change Units 1–3 Q. 1 k–q; Q. 2 k–p; Q. 3 k–p; Q. 4 second table a–g | | 250–254 | Units 1–3 | | 366–367 Ex. 9.6 Q. 1–2 | 193–194 | | | | | |
| 3 | **Prescribed experiment for formal assessment**<br>Complete the report on the prescribed experiment | | 239–241 | | | 362–366 | 192–193 | | | | | |
| | **Homework:** Read Applications of acids and bases, i.e. the application of acids and bases in the chlor-alkali industry (chemical reactions only) and acids and bases in the chemistry of hair | | 247–249 | | | 367–370 | 194 | | | | | |
| 4 | • Do acid-base experiments to determine the presence of acid in a compound, e.g. percentage of ethanoic acid in vinegar | 128 | 258 | Units 1–3 Q. 16 | | 371–372 | | | | | | |
| | **Homework:** Complete the notes on Acids and bases | | 223–258 | | | | | | | | | |

| Reflection | |
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| **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* Week 9: Catch up, consolidation and revision: plan your week | | | | | | | | | | | | |
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| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
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| Reflection | |
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| **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* Week 10: Mid-year examinations: plan your week

| S # | CAPS concepts, practical activities and assessment tasks | CAPS pp. | LB pp. | LB act. | TG pp. | *Everything Science* | | Class | | | | |
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### End-of-term reflection

**Once the tests and the formal practical have been marked and graded, 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 Physical Sciences 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? What can you do to 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? 2

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

| CAPS concepts, practical activities and assessment tasks | Additional information and enrichment activities |
|---|---|
| **Week 1: Work, energy and power** | |
| **Work, energy and power** | Be aware that your learners may have some misconceptions about this topic.<br><br>**Common misconceptions about energy**<br>• Energy is 'a thing'.<br>• The terms 'energy' and 'force' are interchangeable.<br>• An object at rest has no energy.<br>• Gravitational potential energy is the only type of potential energy.<br>• Gravitational potential energy depends only on the height of an object.<br>• Doubling the speed of an object doubles its kinetic energy.<br>• Things 'use up' energy.<br>• Energy can be changed completely from one form to another without energy loss.<br>• Energy is truly lost in many energy transformations.<br>• If energy is conserved, why are we running out of it?<br><br>**A strategy for successful implementation of a conceptual approach**<br>• Recognise preconceptions that exist.<br>• Probe for learners' misconceptions through demonstrations and questions, e.g. lift a cereal bar (or energy bar) up through a vertical height and let it remain at rest in its new position. Ask the learners whether this object has any energy. Did it have energy when it was at rest on the ground? Has its energy increased when it was raised up and put in its new position? If you eat it will you gain more energy from the cereal bar if you choose to eat it at this higher position?<br>• Ask the learners to clarify their thoughts and describe their understanding.<br>• Provide contradictions to learners' misconceptions through questions, implications and demonstrations.<br>• Encourage discussion, urging learners to apply physical concepts in their reasoning.<br>• Foster the replacement of the misconception with new concepts through<br>  – questions<br>  – thought experiments<br>  – hypothetical situations with and without underlying physical laws<br>  – experiments or demonstrations designed to test hypotheses.<br>• Re-evaluate learners' understanding by posing conceptual questions.<br><br>From 'Helping Students Learn Physics Better', available at phys.udallas.edu/C3P/Preconceptions.pdf |
| **The work-energy theorem** | The work-energy theorem relates the net work done to the change in kinetic energy of an object.<br><br>$W_{net} = \Delta K$<br><br>Learners must be made aware that this theorem deals with the net (total) work done on an object.<br><br>Net work done = $F_{net}\Delta x\cos\theta$<br><br>The theorem often offers a quicker way of solving problems. |

| CAPS concepts, practical activities and assessment tasks | Additional information and enrichment activities |
|---|---|
| **Week 2: Work, energy and power** | |
| **Conservation of energy, conservation of mechanical energy** | One of the fundamental statements in physics is that **energy is always conserved**.<br><br>Energy can change forms, e.g. from mechanical energy to thermal energy, or from electrical energy to mechanical energy.<br><br>**In an isolated system, total mechanical energy remains constant.** This is a statement of the Law of Conservation of Mechanical Energy.<br><br>Demonstrate the transformations of potential and kinetic energy using a pendulum, and emphasising that if there was no air resistance and no friction at the place where the string is clamped, a pendulum would be an example of an isolated system. In this case mechanical energy is conserved (remains constant). All the potential energy when the bob is at its maximum height is transformed into kinetic energy at the lowest point of its swing (i.e. at the rest position of the pendulum bob). |
| **Conservative and non-conservative forces** | When a conservative force does work on an object, the amount of energy transferred does not depend on the path along which the object moved. Examples of conservative forces are electrostatic forces, gravitational forces and elastic forces.<br><br>Friction and air resistance are non-conservative forces. The amount of energy transferred depends on the path of the displacement through which the force acts. Non-conservative forces always result in energy being 'dissipated', e.g. the work done by friction increases the thermal energy of the system (increases the temperature when heat is transferred).<br><br>Learners should be able to solve problems using the formula:<br><br>$W_{nc} = \Delta E_p + \Delta E_k$<br><br>**Note:** This formula refers to the CHANGE in potential and kinetic energy.<br><br>If there are no non-conservative forces acting, then $W_{nc} = 0$. |
| **Power** | Power is the rate of doing work or the rate at which energy is transferred. Learners need to pay attention to which quantity they are asked to calculate e.g. the net power or the power of the applied force etc. |
| **Week 3: Work, energy and power, the Doppler effect** | |
| **Average power** | The average power of a machine can be calculated by finding the product of the force it exerts on an object, and the constant velocity at which the object moves. Learners should again take care to note that this formula only applies to objects moving at constant velocity. |
| **The Doppler effect** | The frequency of the sound emitted by an object which moves relative to the listener remains constant. The Doppler effect is the **apparent** change in frequency which the listener hears as a change in pitch of the sound, when there is relative motion between the source of the sound and the listener.<br><br>When using the Doppler effect formula help the learners think through the mathematics as they decide which 'sign' (+ or –) to use in the calculation. If the source of the sound is moving towards the listener, its pitch will be higher. Therefore, the numerator must be larger than the denominator when substituting into the formula.<br><br>https://www.youtube.com/watch?v=h4OnBYrbCjY (3 minutes) |

| CAPS concepts, practical activities and assessment tasks | Additional information and enrichment activities |
|---|---|
| **The Doppler effect of light from stars** | In Grade 10, learners were introduced to the fact that each element has its own unique electronic structure and this fact is supported by the unique line spectrum for each element. Remind them of the 'fingerprint' of each of the elements by showing them the line spectra of a few elements (or substances). There is no time to spend too long on the topic of line spectra at this time, so just touch on it, and mention that later in the course, there will be time to find out how line spectra are produced. In the meantime, all that is required is an understanding that we use spectral analysis to gather information about each star's composition, and we can also find out in what direction the star is moving relative to the Earth.<br><br>Light from the stars can also be Doppler-shifted – either to a higher frequency (towards the 'blue' side of the spectrum) if the star is moving towards the Earth, or to a lower frequency (towards the 'red' side of the spectrum). We therefore talk about red- or blue-shifted light from stars moving relative to the Earth. This does not mean that we actually see the light from these stars as red or blue. It simply means that the line absorption spectrum of light from the star will show that the spectrum of an element, such as hydrogen, has it spectral lines shifted by a very small amount either towards shorter frequencies or longer frequencies (blue- or red-shifted). Most of the stars show a slight shift towards the red side of the spectrum, which tells us that those stars are moving away from the Earth. This fact implies that the universe is expanding.<br><br>https://www.youtube.com/watch?v=y5tKC3nEx2I |
| **Week 4: Rate and extent of reaction** | |
| **Rate and extent of reaction** | The collision theory of reactions explains the mechanism of how a chemical reaction is able to take place. In Grade 11, the energy profile of a reaction was introduced, with the terms energy of the reactants and products, activation energy, and heat of reaction. Learners also distinguished between endothermic and exothermic reactions.<br><br>The rate of a reaction is measured by the rate at which the concentration of the reactants (or the products) decreases (or increases). It helps learners to see and experiment with different methods of measuring the rate of reactions, e.g. collecting the gas given off and measuring the volume of gas collected per minute (or per second).<br><br>Another issue with which some learners struggle is the 'actual' rate at any point in time, and the average rate of a reaction. By measuring the volume of gas collected at 10-s intervals and plotting the graph of volume of gas against time, these differences can be made explicit. The average rate is the total volume divided by the total time taken, whereas the instantaneous (actual) rate of reaction is the gradient of the graph at any particular point in time.<br><br>Mindset Learn videos are helpful in showing learners some of the reactions and in explaining these concepts. There is limited time in class to show the videos and teach your learners. It may be useful to give the learners the URL for these videos to watch them after class. |

| CAPS concepts, practical activities and assessment tasks | Additional information and enrichment activities |
|---|---|
| **Week 5: Chemical equilibrium** | |
| **Chemical equilibrium** | Chemical equilibrium is not a continuation of the topic 'Rates of reactions'. It is a new concept. These two concepts are linked by the overarching idea of chemical change.<br><br>When a system is at chemical equilibrium, there is no observable change in the system because the rate of the forward reaction is equal to the rate of the reverse reaction. The amount of substances present in the reaction mixture remains constant, so the system appears to be 'static'. It seems that nothing is happening because there is no observable change.<br><br>Learners tend to link the 'unchanging' chemical equilibrium system to the notion of a static balanced system – a system in which everything has 'stopped' and is 'stationary' until the 'balance' is disturbed.<br><br>Be careful about how you explain and describe chemical equilibrium. It is useful to use the term 'dynamic' equilibrium and to distinguish carefully between a dynamic 'ever-changing' system and the static equilibrium set up by (for example) a system of levers. Continually refer to the fact that both reactions continue to occur and that their rates are equal.<br><br>Learners also tend to treat the two reactions as two independent events, whereas the two reactions are the same reaction just occurring in different directions. Because their rates are equal at chemical equilibrium, these two reactions are interdependent.<br><br>Le Chatelier's Principle presents similar problems. Learners mistakenly believe that chemical equilibrium is re-established only when all the extra reactant that was introduced to disturb the system has been completely 'used up'. We need to guide them to an understanding of a new position of equilibrium which may now lie in the reverse direction. Nothing gets used up in chemical equilibria because both reactions continue to occur simultaneously.<br><br>Some of the factors that affect chemical equilibrium are similar to those that affect the rate of reactions – and here again, learners must be made aware of the different emphasis of this new concept. We are dealing with factors that influence the position of the equilibrium, rather than factors that affect how quickly (or slowly) the reaction proceeds. |
| **Week 6: Chemical equilibrium, acids and bases** | |
| **The equilibrium constant** | Only when a chemical system is in chemical equilibrium can we calculate the value of the equilibrium constant at that particular temperature. The value of the constant gives an indication of the extent of a reaction. The higher the value of $K_c$, the more complete the reaction at a particular temperature.<br><br>Learners hold onto the idea that chemical equations must be balanced, and very often they incorrectly transfer this idea of 'balance' to chemical equilibrium. The expression for $K_c$ leads them to the faulty belief that it is a simple arithmetic formula to calculate the ratio of the amount of products to the amount of reactants, and that all these amounts are equal at equilibrium.<br><br>Another misconception is that a high value of $K_c$ implies that the forward reaction has a high rate. This is obviously not possible by itself, since the reverse reaction would also have the same high rate for the system to be in equilibrium. The high value of Kc merely gives information about the equilibrium position, not the rates of the reactions. |

| CAPS concepts, practical activities and assessment tasks | Additional information and enrichment activities |
|---|---|
| **Acids and bases** | The topic of acids and bases is an example of a particular chemical equilibrium system related to the varying concentration of hydronium ions in solution. Learners should be able to recall both theories of acids and bases (Arrhenius and Lowry-Brønsted). It is a good idea to introduce the Lowry-Brønsted theory first because it is the accepted theory. The concept of acid-base pairs results from the Lowry-Brønsted theory.<br><br>It is also worth noting that acids do not 'donate' protons easily. It takes a considerable amount of energy to rip a proton away from HCℓ (1,4 × 106 $J.mol^{-1}$). Stephen J Hawkes, Oregon State University[1], says 'When that much energy is required, it makes no more sense to speak of HCℓ "donating" a proton than of "donating" your purse to a mugger. It creates a false concept of the action of an acid, as if it somehow expelled the proton by means of some internal force. A base must tear the $H^+$ from the powerful attractive forces holding it to an acid, breaking its bonding by superior force.'<br><br>Hawkes suggests that acids and bases should be defined as follows:<br>**An acid is a substance from which a proton can be removed.**<br>**A base is a substance that can remove a proton from an acid.**<br><br>The topic of acids and bases requires a good understanding of the terminology: strong and weak acids, as opposed to concentrated and dilute acids; end point and neutral point, etc.<br><br>1 *Journal of Chemistry Education* Vol. 69, No. 7, July 1992, pp. 542–543 |
| **Week 7: Chemical equilibrium, acids and bases** | |
| **Titrations** | When tackling titration calculations take note that using the abbreviated formula<br>$\frac{n_a}{n_b} = \frac{c_aV_a}{c_bV_b}$<br>is only valid when dealing with aqueous solutions of acids and bases. If the titration involved the neutralisation of an antacid tablet (base) against a dilute acid, the use of this formula will be inappropriate.<br><br>The number of moles of the base will be found using the formula:<br>$n = \frac{m}{M}$<br>Teach learners to think through how they are calculating values, and too be aware of when to apply the different formulae.<br><br>Note that learners can be asked to determine the percentage purity of substances from data collected during a titration. |
| **Week 8: Acids and bases** | |
| **Prescribed experiment** | There are two parts to this experiment:<br>• The preparation of a standardised solution of oxalic acid.<br>• The titration of the oxalic acid against sodium hydroxide to determine the concentration of the sodium hydroxide solution.<br><br>The learners need to be well prepared and well organised in order to complete the practical work within the time limit imposed by a 1-hour lesson. It would therefore be useful to set out the necessary apparatus at each work station in advance. |
| **Week 9: Catch up and consolidation** | |
| Revision | It would be useful for the learners to practise through past paper questions from November 2014, March 2015 and November 2015 during this week. |

## F. ASSESSMENT RESOURCES

### 1. Sample item analysis sheet

*PHYSICAL SCIENCES TERM 2 GRADE 12*

*SUGGESTED ITEM ANALYSIS RECORD SHEET FOR FORMAL ASSESSMENT*

| Term 2 | | Investigation Process skills | | | | Mark Prac 20 | Physics test | | | | | Chemistry test | | | | Mark Test 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Learner surname | Learner name | A | B | C | TOT | | Q. 1 | Q. 2 | Q. 3 | Q. 4 | TOT | Q. 1 | Q. 2 | Q. 3 | TOT | |
| | | 16 | 27 | 4 | 45 | | 8 | 12 | 13 | 17 | 50 | 10 | 36 | 4 | 50 | |
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## 2. Physical Sciences Grade 12: End-of-Term 2 Physics Test

**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions:

1. This question paper consists of 6 questions, an information sheet and an answer sheet. The information sheet may be detached for easy use.
2. Answer **all** the questions.
3. Start each question on a new page.
4. Number the questions exactly as they are numbered in the paper.
5. Write neatly and legibly.
6. **Question 1** consists of 8 multiple choice questions. There is only one correct answer to each question. On the answer sheet, place a cross (X) over the letter (A, B, C or D) that corresponds to the most correct answer to each question.
7. You may use non-programmable calculators.
8. The diagrams in the question paper are not necessarily drawn to scale.
9. Give brief motivations, discussions, etc. where required.
10. **Show all working clearly in all calculations.**
11. Round up answers to **two** decimal places where necessary.

## Question 1

### Multiple choice questions

In each of the following questions, four possible answers are provided. There is only one correct answer to each question. On the answer sheet, place a cross (X) over the letter (A, B, C or D) that corresponds to the most correct answer to each question.

1.1 Which ONE of the following forces is a conservative force?

A air resistance

B tension

C net (resultant) force

D gravitational force (2)

1.2 Two bodies undergo an ELASTIC collision in the absence of friction. Which ONE of the following combinations of momentum and kinetic energy of the system is CORRECT?

| | *MOMENTUM* | *KINETIC ENERGY* |
|---|---|---|
| A | conserved | conserved |
| B | conserved | not conserved |
| C | not conserved | not conserved |
| D | not conserved | conserved |

(2)

1.3 The speed of a bicycle increases from 2 $m \cdot s^{-1}$ to 4 $m \cdot s^{-1}$. Its kinetic energy increases by a factor of …

A $\sqrt{2}$

B 2

C 4

D 8 (2)

1.4 A workman lifts boxes of identical mass from the ground onto a bench. At first, it takes him 2 s to lift each box. Later in the day it takes him 3 s. Which of the following is true when the workman lifts the boxes for the second time on that day?

A Less work is done in lifting each box.

B More work is done in lifting each box.

C Smaller power is produced in lifting each box.

D Greater power is produced in lifting each box. (2)

1.5 Which ONE of the following DOES NOT make use of the Doppler effect?

A Blood flow meters used in hospitals.

B An ultrasound scan of the foetus in the womb.

C A 'speed trapping' device used by traffic police to monitor vehicle speeds.

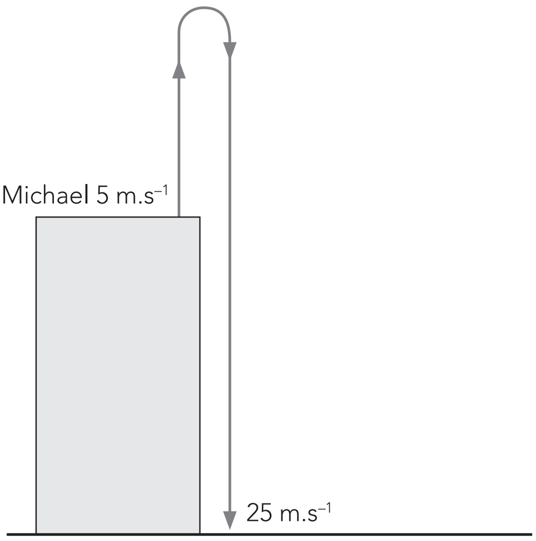
D Measuring the shift of red spectral lines in distant stars. (2)

$5 \times (2) =$ **[10]**

## Question 2

**NB:** Take 'up' as the positive direction in this question.

Michael stands on the roof overlooking the street. He throws a 200 g ball up at a velocity of 5 $m \cdot s^{-1}$. It hits the street below the balcony with a speed of 25 $m.s^{-1}$.




2.1 Write down the magnitude and direction of the acceleration of the ball when it reaches it maximum height. (2)

2.2 Calculate the height of the roof above the street. (4)

2.3 Calculate the time taken from when the ball was thrown up until it hit the street below. (4)

When Michael's ball hits the ground, it is in contact with the ground for 0,15 s before bouncing upwards at a speed of 20 $m.s^{-1}$.

2.4 Define *(linear) momentum.* (2)

2.5 Calculate the change in momentum of the ball as it hits the ground and bounces up again. (4)

2.4 Draw a labelled free-body diagram to show the forces acting on the ball <u>at its time of impact with the ground</u>. (2)

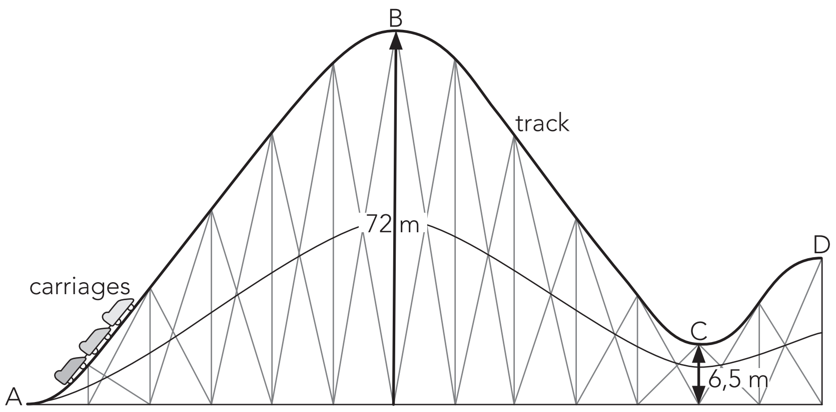
2.5 Calculate the magnitude and direction of the net (resultant) force experienced by the ball during the time of contact with the ground. (3)

2.6 Give the magnitude and direction of the force exerted by the ground on the ball at the time of impact. (3)

2.7 Sketch a velocity-time graph for the ball, from the time Michael threw it, until the time it reached its maximum height after the first bounce. Show all significant velocity and time values on the axes. (5)

**[29]**

**Question 3**




The diagram above shows part of a roller coaster track. The carriages are pulled from A to B at a constant speed by an electric motor of power output 52 kW.

At B (72 m higher than A) the carriages have effectively no kinetic energy. They run freely down the frictionless track from B to C (which is at a height of 6,5 m above A). The total mass of the carriages is 3 400 kg.

| | | |
|---|---|---|
| 3.1 | Define power. | (2) |
| 3.2 | Calculate the gravitational potential energy gained by the carriages when they reach point **B**. | (3) |
| 3.3 | Calculate the time taken for the carriages to rise from **A** to **B**. | (4) |
| 3.4 | Calculate the speed of the carriages at **C**. | (5) |
| 3.5 | State the Law of Conservation of Momentum. | (2) |
| 3.6 | At C the carriages collide with and link to a fourth carriage of mass 1 000 kg. Calculate the speed of the four linked carriages immediately after the collision. | (4) |

**[20]**

**Question 4**

A 4 kg block is released from rest from a height of 3 m. It slides down a frictionless slope to point P as shown in the diagram below. It then moves along a frictionless horizontal portion PQ and finally moves up a second rough plane which is inclined at 30° to the horizontal.


The block comes to rest at point R. The frictional force between the surface and the block as it travels from Q to R is 8 N.

| | | |
|---|---|---|
| 4.1 | State the principle of conservation of mechanical energy. | (2) |
| 4.2 | Using ENERGY PRINCIPLES only, calculate the speed of the block at P. | (4) |
| 4.3 | Explain why the kinetic energy at P is the same as that at Q. | (2) |
| 4.4 | State the work-energy theorem in words. | (2) |
| 4.5 | Calculate the height RS. | (7) |

**[17]**

**Question 5**

5.1 A motor pumps water from a well 18 m deep, and expels the water at a constant speed of 12 $m \cdot s^{-1}$. The water pours out of the pipe at a rate of 1 000 $kg \cdot min^{-1}$.
Calculate the power of the motor. (7)

5.2 If the pump is adjusted to expel water at a lower speed, and it operates at the same power as calculated in 5.1, how does the maximum amount of water pumped per minute change?
Explain briefly. (3)

**[10]**

**Question 6**

A mosquito flaps its wings at 600 vibrations per second which produces the annoying buzz.
The speed of sound in air is 340 $m.s^{-1}$.

6.1 What is the frequency of the buzz generated by the mosquito's wings? (1)

6.2 How would you know from the sound of its buzz whether the mosquito is flying towards you as you lie in bed in a dark room? (2)

6.3 Name the effect that changes the sound of the mosquito's buzz when it flies towards you. (1)

6.4 Using a sketch to show the compressions of the air made by the mosquito as it flies towards you, explain how the sound of the mosquito's buzz changes. (4)

After a few more minutes the sound of the mosquito's buzz changes to 598 Hz even though it is still flapping its wings at 600 vibrations per second. You are lying still in your bed in the dark room.

6.5 Calculate the speed of the mosquito relative to you when you hear the sound at 598 Hz. (4)

6.6 Is it good or bad news for you that the sound has changed to 598 Hz? Briefly explain your answer. (2)

**[14]**

**TOTAL MARKS: 100**

**TIME: 2 HOURS**

**END OF TEST**

## Physical Sciences Grade 12: End-of-Term 2 Physics Test

ANSWER SHEET

NAME: ______________________________

**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 2 Physics Test Memorandum

### Question 1

| | | | | | |
|---|---|---|---|---|---|
| 1.1 | D ✓✓ | 1.2 | A ✓✓ | 1.3 | C ✓✓ |
| 1.4 | C ✓✓ | 1.5 | B ✓✓ | | **[10]** |

### Question 2

2.1 9,8 $m.s^{-2}$ ✓ down ✓ (2)

2.2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(25)^2 = (-5)^2$ ✓ $+ 2(9,8)\Delta y$ ✓
$\Delta y = 30,61$ m ✓ (4)

2.3 $v_f = v_i + a\Delta t$ ✓
$25 = -5$ ✓ $- 9,8\Delta t$ ✓
$\Delta t = 3,06$s s ✓ (4)

2.4 (Linear) momentum is the product of mass and velocity. ✓ (1)

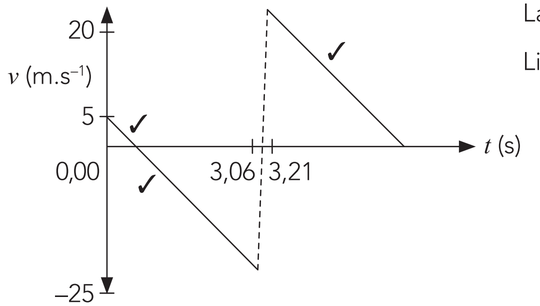
2.5 $\Delta p = mv_f - mv_i$
= (0,2) ✓ (–20 – 25) ✓
= –9
= 9 kg $m.s^{-1}$ ✓ up ✓ (from the ground) (5)

2.6
✓ Upward force of street ball Up ↑ > Down ↓
✓ Weight of force of gravity (–1 if arrows are not touching) (2)

2.7 $F_{net} = \frac{\Delta p}{\Delta t}$ ✓ (method)
$= \frac{-9}{0,15}$ ✓ (substitutions; c.o.e.)
= –60 N ✓ or 60 N (accuracy; SI unit) (3)

2.8 $F_{ground} = F_{net} + F_g$ ✓ (method)
= 60 + (0,2)(10) ✓✓ (substitutions)
= 92 N ✓ (accuracy; SI unit) (3)

Note that the question says 'take **up** as the positive direction': –1 if this instruction is not followed




Labelled axes ✓

Lines parallel ✓

(5)

**[29]**

### Question 3

3.1 Power is the rate of doing work. ✓✓
OR Power is the rate of transferring energy. ✓✓ (2)

3.2 $Ep$ = mgh ✓
= (3 400)(10)(72) ✓
= 2 399 040 J ✓ (3)

3.3 $p = \frac{W}{\Delta t}$ ✓
$\Delta t = \frac{W}{P}$ (method)
$= \frac{2\,399\,040}{52\,000}$ ✓ ✓ (substitution; conversion)
= 46,14 s ✓ (accuracy; SI unit) (4)

3.4 Using the conservation of mechanical energy:
$Ep_{\text{at C}}$ = mgh
= (3 400)(9,8)(6,5) ✓ (substitutions)
= 216 580 J (accuracy; ignore SI units)
$Ek_{\text{at C}} = \Delta Ep$ ✓ (method)
= 2 399 040 – 216 580 ✓ (method; c.o.e. from 3.2)
= 2 182 460 J
$\frac{1}{2} \times 3\,400 \times v^2 = 2\,182\,460$ ✓ (substitution of $\frac{1}{2}(3\,400)v^2$)
$v = 35,83$ $m.s^{-1}$ ✓ (accuracy; SI unit) (5)

Note that the equations of motion **cannot be used** to solve this problem because the track does not follow one straight line (it is curved).

3.5 The total momentum of an isolated system remains constant. ✓✓ (2)

3.6 $m_1 v_{i1} + m_2 v_{i2} = (m_1 + m_2) v_f$ ✓ (method)

(3 400)(35,83) ✓✓ + 0 = (4 400)$v_f$ ✓ (substitution; c.o.e. from 3.4)

$v_f$ = 27,69 m.s$^{-1}$ ✓ (accuracy; SI unit) (4)

**[20]**

**Question 4**

4.1 The mechanical energy of an isolated system remains constant. ✓✓ (2)

4.2 $\Sigma(E_p + E_k)$at the top = $\Sigma(E_p + E_k)_{\text{at P}}$ ✓ (method)

(4)(9,8)(3) + 0 ✓ = 0 + $\frac{1}{2}$(4)$v^2$ ✓ (substitutions)

$v$ = 7,67 m.s$^{-1}$ ✓ (accuracy; SI unit) (4)

4.3 The system is isolated OR There is no dissipative (non-conservative) force between P and Q ✓ therefore all the mechanical energy is conserved. ✓ (2)

4.4 The net (total) work done is equal to the change in kinetic energy of the object. ✓✓ (2)

4.5 $W_{\text{net}} = \Delta E_k = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓ (applying the work-energy theorem)

$F_{\text{net}}.\Delta x.\cos\theta = 0 - \frac{1}{2}(4)(7{,}67)^2$ ✓ (substitutions; c.o.e. from 4.2)

$F_{\text{net}}.\Delta x.\cos 180°$ ✓ = –117,6 (substituting 180°)

$-(mg\sin\theta + F_{\text{friction}})$ ✓ $.\Delta x = -117{,}6$ (method of finding Fnet)

$((4)(9{,}8)\sin 30° + 14).\Delta x = -117{,}6$

$\Delta x$ = –3,5 m ✓ (accuracy)

$\sin 30° = \frac{RS}{\Delta x}$ ✓ (method)

RS = 3,5 sin30°

= 1,75 m ✓ (accuracy) (7)

**[17]**

**Question 5**

5.1 $W$ = energy transferred to the water (in one minute)

= $\Delta E_p + \Delta E_k$ ✓ (method)

= (1 000)(9.8)(18) ✓ + $\frac{1}{2}$(1 000)(12)$^2$ ✓ (substitutions)

= 176 400 + 72 000

= 248 400 ✓ J (accuracy; ignore SI units)

$P = \frac{W}{\Delta t}$ ✓ (method)

$= \frac{248\ 400}{60}$ ✓ (conversion)

= 4 140 W ✓ (accuracy; SI units) (7)

5.2 <u>**Alternative 1**</u>

The pump is able to transfer 4 140 J of energy per second

(4 140)(60) = 248 400 = $m$(9,8)(18) + $\frac{1}{2}mv^2$ ✓ where $v < 12$

Therefore $\frac{1}{2}mv^2 < \frac{1}{2}(1\ 000)(12)^2$ ✓

The maximum mass per minute **increases**. ✓

<u>**Alternative 2**</u>

The total amount of energy transferred in one minute remains constant ✓ (248 400 J).

The kinetic energy of the water decreases ✓ (because velocity decreases).

Therefore, the mass of water pumped per minute **increases**. ✓ (3)

**[10]**

**Question 6**

6.1 600 Hz ✓ (1)

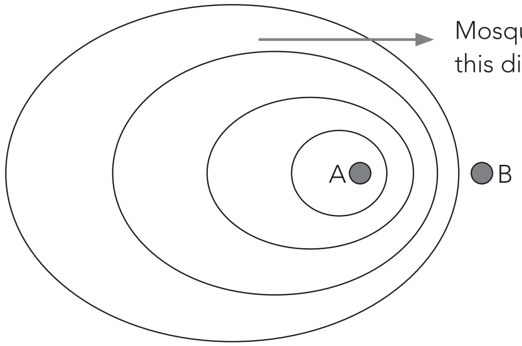
6.2 If the pitch of the buzz is higher ✓ than the mosquito's buzz when it is stationary, ✓ then the mosquito is flying towards you.

OR Whenever the pitch of its buzz becomes higher, ✓✓ it is flying towards you. (2)

6.3 The Doppler effect ✓ (1)

6.4 As the mosquito A flies towards you B, the compressions of the sound waves, set up by its flapping wings, bunch up in front of it. ✓

The person B hears these waves as if they have a higher frequency, so they have a higher pitch. ✓




✓ Diagram must show position of A (mosquito) and B (listener) and appropriate distribution of wavefronts (4)

6.5 $f_L = \frac{v \pm v_L}{v \pm v_S} f_s$ ✓

$598$ ✓ $= \frac{340}{340 + v_S}(600)$ ✓

$340 + v_S = \frac{340}{598}(600)$

$v_S = 1{,}14 \text{ m.s}^{-1}$ ✓ (4)

6.6 It is good news. ✓ The mosquito is flying away from you because you are now hearing the buzz as if it has a lower frequency (pitch). ✓ (2)

**[14]**

## 4. Cognitive Analysis for Physical Sciences Grade 12: End-of-Term 2 Physics Test

| QUESTION | LEVEL 1: Recall | LEVEL 2: Comprehension | LEVEL 3: Analysis, Application | LEVEL 4: Evaluation, Synthesis | Vertical projectile motion | Momentum, impulse | Work, energy, power | The Doppler effect | Total (content) | Total (levels) | Question totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **TARGET** | **15** | **35** | **40** | **10** | **15** | **20** | **50** | **15** | **100** | **100** | **100** |
| **ACTUAL** | **15** | **34** | **39** | **12** | **15** | **22** | **47** | **16** | **100** | **100** | **100** |
| 1.1 | 2 | | | | | | 2 | | 2 | 2 | |
| 1.2 | | 2 | | | | 2 | | | 2 | 2 | |
| 1.3 | | | 2 | | | | 2 | | 2 | 2 | |
| 1.4 | | | 2 | | | | 2 | | 2 | 2 | |
| 1.5 | 2 | | | | | | | 2 | 0 | 2 | **10** |
| 2.1 | | 2 | | | 2 | | | | 2 | 2 | |
| 2.2 | | 4 | | | 4 | | | | 4 | 4 | |
| 2.3 | | 2 | 2 | | 4 | | | | 4 | 4 | |
| 2.4 | 1 | | | | | 1 | | | 1 | 1 | |
| 2.5 | | 2 | 3 | | | 5 | | | 5 | 5 | |
| 2.6 | | 2 | | | | 2 | | | 2 | 2 | |
| 2.7 | | 3 | | | | 3 | | | 3 | 3 | |
| 2.8 | | | 3 | | | 3 | | | 3 | 3 | |
| 2.9 | | | | 5 | 5 | | | | 5 | 5 | **29** |
| 3.1 | 2 | | | | | | 2 | | 2 | 2 | |
| 3.2 | | 3 | | | | | 3 | | 3 | 3 | |
| 3.3 | | 1 | 3 | | | | 4 | | 4 | 4 | |
| 3.4 | | 1 | 4 | | | | 5 | | 5 | 5 | |
| 3.5 | 2 | | | | | 2 | | | 2 | 2 | |
| 3.6 | | 4 | | | | 4 | | | 4 | 4 | **20** |
| 4.1 | 2 | | | | | | 2 | | 2 | 2 | |
| 4.2 | | 4 | | | | | 4 | | 4 | 4 | |
| 4.3 | | | 2 | | | | 2 | | 2 | 2 | |
| 4.4 | 2 | | | | | | 2 | | 2 | 2 | |
| 4.5 | | | 7 | | | | 7 | | 7 | 7 | **17** |
| 5.1 | | | 3 | 4 | | | 7 | | 7 | 7 | |
| 5.2 | | | | 3 | | | 3 | | 3 | 3 | **10** |
| 6.1 | 1 | | | | | | | 1 | 0 | 1 | |
| 6.2 | | 2 | | | | | | 2 | 0 | 2 | |
| 6.3 | 1 | | | | | | | 1 | 0 | 1 | |
| 6.4 | | | 4 | | | | | 4 | 0 | 4 | |
| 6.5 | | | 4 | | | | | 4 | 0 | 4 | |
| 6.6 | | 2 | | | | | | 2 | 0 | 2 | **14** |

## 5. Physical Sciences Grade 12: End-of-Term 2 Chemistry Test

**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions:

1. This question paper consists of 6 questions, an information sheet and an answer sheet. The information sheet may be detached for easy use.
2. Answer **all** the questions.
3. Start each question on a new page.
4. Number the questions exactly as they are numbered in the paper.
5. Write neatly and legibly.
6. **Question 1** consists of 8 multiple choice questions. There is only one correct answer to each question. On the answer sheet, place a cross (X) over the letter (A, B, C or D) that corresponds to the most correct answer to each question.
7. You may use non-programmable calculators.
8. The diagrams in the question paper are not necessarily drawn to scale.
9. Give brief motivations, discussions, etc. where required.
10. **Show all working clearly in all calculations.**
11. Round up answers to **two** decimal places where necessary.

**Question 1**

In each of the following questions, four possible answers are provided. There is only one correct answer to each question. On the answer sheet, place a cross (X) over the letter (A, B, C or D) that corresponds to the most correct answer to each question.

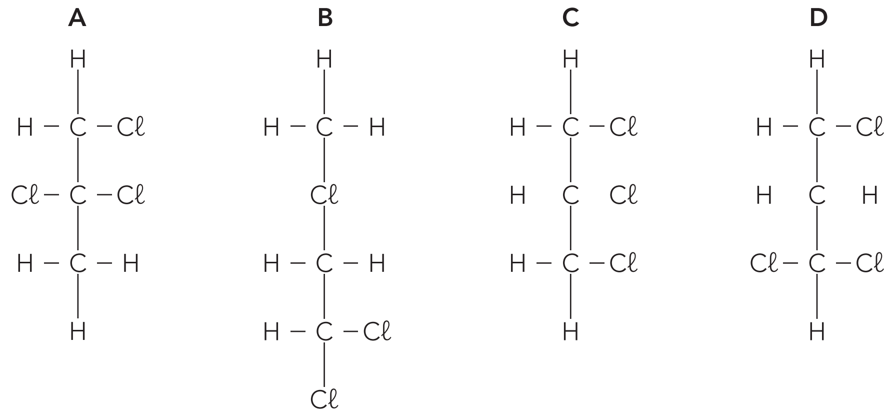
1.1 Which one of the following represents the name and molecular formula of the compound that has six carbon atoms per molecule and belongs to the same homologous series as $C_3H_8$?

A Hexene $C_6H_{14}$
B Hexene $C_6H_{12}$
C Hexane $C_6H_{14}$
D Hexane $C_6H_{12}$ (2)

1.2 The formula of the organic product formed when methanol reacts with ethanoic acid is:

A $C_2H_4O_2$
B $C_3H_5O_2$
C $C_3H_6O_2$
D $C_4H_8O_2$ (2)

1.3 Which is the correct structure for 1,2,2-trichloropropane?




(2)

1.4 The combustion of propanol is represented by $pC_3H_7O + qO_2 \rightarrow rH_2O + sCO_2$

What are the coefficients $p$, $q$, $r$ and $s$, respectively, in the balanced equation?

| | $p$ | $q$ | $r$ | $s$ |
|---|---|---|---|---|
| A | 1 | 1 | 3 | 7 |
| B | 2 | 1 | 7 | 6 |
| C | 3 | 13 | 7 | 9 |
| D | 4 | 17 | 14 | 12 |

(2)

1.5 Consider the organic compounds (**I** to **IV**) shown below.

| | | | |
|---|---|---|---|
| **I** | $CH \equiv C - CH_2 - CH_3$ | **II** | $CH_3 - CH = CH - CH_3$ |
| **III** | $CH_3 - C \equiv C - CH_3$ | **IV** | $CH_3 - CH_2 - C \equiv CH$ |

Which of the compounds above are structural isomers?

A I and II
B I and III
C I and IV
D II and III (2)

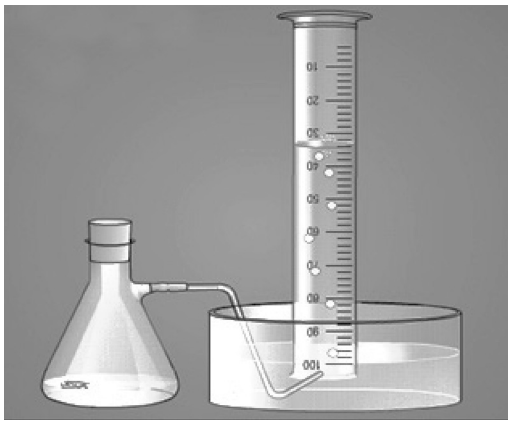
5 × (2) = **[10]**

## Question 2

A class is set the task of investigating the factors affecting the rate of reaction of magnesium ribbon with dilute hydrochloric acid. The balanced equation for the reaction is given:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

The hydrogen gas produced in the reaction is collected by the downward displacement of water as shown in the diagram.



The results of two of the experiments are shown in the tables below.

**John:** Experiment to determine the effect of temperature on the rate of reaction between Mg and 1,0 $mol.dm^{-3}$ $HC\ell$

| Temperature (°C) | Volume of hydrogen collected in 20 s ($cm^3$) | | | |
|---|---|---|---|---|
| | Reading 1 | Reading 2 | Reading 3 | Average |
| 10 | 9,6 | 9,2 | 10,0 | 9,6 |
| 20 | 19,5 | 18,7 | 19,1 | 19,1 |
| 30 | 38,9 | 38,2 | 37,5 | 38,2 |
| 40 | 74,9 | 77,2 | 75,6 | 75,9 |

**Tasneem:** Experiment to determine the effect of concentration of $HC\ell$ on the rate of reaction between Mg and $HC\ell$

| Concentration of $HC\ell$ ($mol.dm^{-3}$) | Volume of hydrogen collected in 20 s ($cm^3$) | | | |
|---|---|---|---|---|
| | Reading 1 | Reading 2 | Reading 3 | Average |
| 0,5 | 20,2 | 20,2 | 20,2 | 20,2 |
| 1,0 | 40,0 | 39,9 | 40,1 | 40,0 |
| 1,5 | 59,9 | 60,0 | 60,1 | 60,0 |
| 2,0 | 80,1 | 80,1 | 80,1 | 80,1 |

2.1 State the independent variable in **John's** experiment. (1)

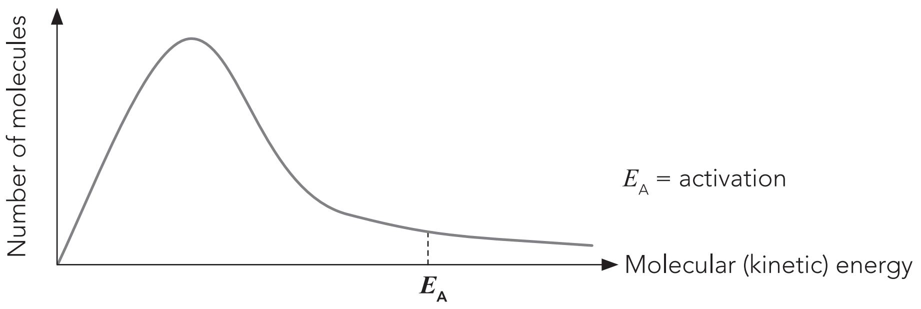
2.2 State a suitable conclusion for the experiment conducted by **John**. (2)

2.3 State TWO variables that **Tasneem** needs to control in her experiment and explain why she needs to control these variables. (4)

2.4 **Tasneem's** results indicate that the rate of reaction is directly proportional to the concentration of the hydrochloric acid. Consider **Tasneem's** average results and hence prove mathematically that her results are directly proportional. (3)

2.5 Copy the graph given below which shows the distribution of molecular energies at low temperature. Indicate on the graph how this distribution would change at a higher temperature.

**Graph to show the distribution of molecular energies at low temperature ($T_1$)**




(2)

2.6 Refer to the graph of the distribution of molecular energies to explain FULLY how the temperature of hydrochloric acid affects the rates of the reaction when **John** reacts Mg with 1,0 mol.dm$^{-3}$ HCℓ. (4)

**[16]**

**Question 3**

Nitrogen (IV) oxide (nitrogen dioxide, $NO_2$) is one of the products that are produced in a motor car' exhaust system. This brown gas, that is mainly responsible for the smog that hangs over cities, undergoes the following equilibrium reaction.

**$N_2O_4(g) \rightarrow 2NO_2(g) \quad \Delta H > 0$**

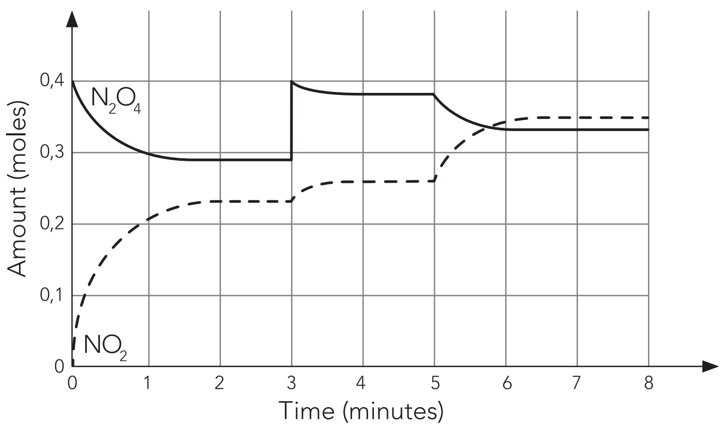
3.1 What are the requirements for a chemical equilibrium to be established? (2)

3.2 Explain the term *chemical equilibrium*. (2)

3.3 State Le Chatelier's Principle. (2)

3.4 0,4 moles of $N_2O_4$ gas are introduced into a sealed 2 dm$^3$ reaction vessel. The system was allowed to reach equilibrium and then some changes were made to the equilibrium. The number of moles of reactant and product were recorded as these changes were made.

The following graph shows the change in the amount (number of moles) of the substances in the reaction mixture over a time period of 8 minutes.




3.4.1 How long did the system take to reach chemical equilibrium for the first time? (2)

3.4.2 What adjustment was made to the system to cause the change shown on the graph at 3 minutes? (1)

3.4.3 Explain why the system adjusted itself in the way shown in the graph during the 4th minute (between 3 and 4 minutes). (2)

3.4.4 What was done at $t$ = 5 minutes to cause the changes on the graph? (2)

3.4.5 Explain your answer to 3.4.4. (3)

**[16]**

## Question 4

Ammonia is manufactured by the Haber process. In this process nitrogen and hydrogen react in the presence of an iron oxide catalyst to form ammonia.

$$N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g) \quad \Delta H < 0$$

In a particular reaction, 2,07 moles of nitrogen and 7,00 moles of hydrogen are initially placed in a 0,5 $dm^3$ reaction vessel which contains a mesh of the iron oxide catalysts.

At equilibrium the temperature is 300 °C and 1,00 mole of hydrogen remains in the reaction vessel.

4.1 Write an expression for the equilibrium constant $K_c$. (2)

4.2 Determine the number of moles of ammonia which are present in the reaction vessel when chemical equilibrium has been reached. (3)

4.3 Determine the concentration of ammonia in the reaction vessel at chemical equilibrium. (3)

4.4 Determine the value of the equilibrium constant for this reaction at 300 °C. (4)

4.5 The Haber process takes place in the presence of a catalyst (iron oxide).

4.5.1 Give the meaning of the phrase *positive catalyst*. (1)
4.5.2 Explain what effect it will have on the chemical equilibrium system if more iron oxide was added to the equilibrium system. (1)

4.6 Apply Le Chatelier's Principle to the process of producing ammonia when the system is in dynamic chemical equilibrium in the closed reaction vessel. More hydrogen gas is introduced to the chemical equilibrium system.

4.6.1 a) What happens to the concentration of ammonia? Write only *increases, decreases* or *remains the same.* (1)
b) Explain how the concentration of ammonia is affected. (3)
4.6.2 a) What happens to the value of the equilibrium constant? Write only *increases, decreases* or *remains the same.* (1)
b) Explain how the equilibrium constant is affected. (1)

**[20]**

## Question 5

5.1 Nitric acid ionises in water as shown in the equation:

$$HNO_3(aq) + H_2O(\ell) \leftrightarrows H_3O+(aq) + NO_3^-(aq)$$

5.1.1 Explain the difference between the terms *ionise* and *dissociate*. (2)
5.1.2 Write an appropriate balanced equation to illustrate the process of *dissociation*. (2)

5.2 The equilibrium constant ($K_a$) for the ionisation of nitric acid (as shown in the equation above) reaction is VERY high. What can you deduce from this information about the strength of nitric acid? Clearly explain your answer. (3)

5.3 25 $cm^3$ of 0,2 $mol.dm^{-3}$ nitric acid is titrated against 32 $cm^3$ of sodium carbonate solution. Assume complete dissociation of the sodium carbonate solution. The equation for this reaction is shown below:

$$2HNO_3(aq) + Na_2CO_3(aq) \rightarrow 2NaNO_3(aq) + CO_2(g) + H_2O(\ell)$$

5.3.1 Calculate the pH of the nitric acid solution. (3)
5.3.2 Calculate the concentration of the sodium carbonate solution. (4)
5.3.3 Define the term *equivalence point.* (2)
5.3.4 Select an appropriate indicator to measure the end point of the titration. (2)

| Indicator | Colour and pH range | | Colour and pH range | |
|---|---|---|---|---|
| Methyl orange | red | 0–4,5 | orange | > 4,5 |
| Bromothymol blue | yellow | 0–6,9 | blue | > 7 |
| Phenolphthalein | colourless | 0–10,9 | purple | > 10,9 |

5.3.5 Explain your choice of indicator in 5.3.4. (2)

**[20]**

## Question 6

6.1 Define a Brønsted-Lowry acid. (1)

6.2 Copy the equation shown below, and identify the conjugate acid-base pairs in this reaction:

$$\mathbf{NH_3(g) + H_2O(\ell) \leftrightarrows NH_4^+ (aq) + OH^-(aq)}$$ (2)

6.3 Water is an *ampholyte*.

6.3.1 Explain what is meant by the term *ampholyte*. (2)

6.3.2 Write ONE equation to show the process of water acting as an ampholyte. (2)

6.3.3 Give the name for the specific process whereby water acts upon itself as an ampholyte in the equation shown in 6.3.2. (1)

6.4 The pH of a solution of ammonium chloride ($NH_4C\ell$) in distilled water is less than 7.

6.4.1 Name THE PROCESS which causes the pH of a solution of ammonium chloride to be less than 7. (1)

6.4.2 Explain WHAT IS HAPPENING to make the pH of a solution of ammonium chloride in distilled water less than 7. Make use of an equation to support your answer. (4)

6.5 Determine the percentage purity of a 5 g tablet of magnesium carbonate which reacts with 200 $cm^3$ of 0,15 $mol.dm^{-3}$ hydrochloric acid. Assume that all the magnesium carbonate in the tablet reacted completely with the hydrochloric acid. (5)

**[18]**

**TOTAL MARKS: 100**

**TIME: 2 HOURS**

**END OF TEST**

# Physical Sciences Grade 12: End-of-Term 2 Chemistry Test

ANSWER SHEET

NAME: ______________________________

**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 |

## 6. Physical Sciences Grade 12: End-of-Term 2 Chemistry Test Memorandum

### Question 1

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.1 | C ✓✓ | 1.2 | C ✓✓ | 1.3 | A ✓✓ | |
| 1.4 | D ✓✓ | 1.5 | A ✓✓ | | | 5 × (2) = **[10]** |

### Question 2

2.1 Temperature ✓ (1)

2.2 An increase in temperature increases the rate of the reaction by increasing amounts. ✓✓ (2)

2.3 The magnesium strips must of the same mass and dimensions, e.g. same length of magnesium ribbon OR same mass of magnesium powder. ✓ This is required because surface area can affect the rate of reaction.

The temperature (of the acid) must be kept constant ✓ because temperature affects the rate of reactions.

In order to have a fair test, ✓ variables which could also affect the rate of the reaction must be controlled so that the only variable that is manipulated (concentration in this case) is able to influence the outcome (results) of the experiment. ✓ (4)

2.4 If the variables are directly proportional, volume = ($k$) × (concentration)

OR $\frac{volume}{concentration}$ = a constant ✓ (method)

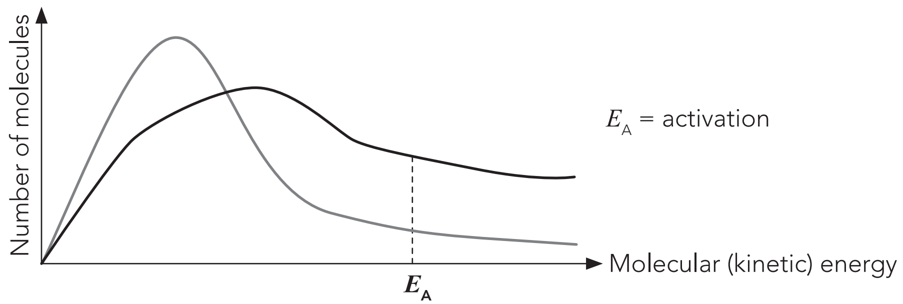
| Conc. | Volume | K |
|---|---|---|
| mol.dm | cm | |
| 0,5 | 20,2 | 40,40 |
| 1,0 | 40,0 | 40,00 |
| 1,5 | 60,0 | 40,00 |
| 2,0 | 80,1 | 40,05 |
| | Average | 40,11 |

✓ (calculations)

Volume = 40,11 × concentration ✓ (correct equation)

Therefore, the volume of gas given off in 20 s is directly proportional to the concentration of the acid. (3)

2.5




✓ Lower maximum number of molecules
✓ Greater number of molecules with more $E_k$ than $E_A$. (2)

2.6 When the temperature is increased the **average kinetic energy** of the molecules increases. ✓ This means that **more molecules have higher kinetic energies** at higher temperature than were present at lower temperatures ✓ and therefore there are **more molecules with energy greater than the activation energy** for the reaction. ✓ When molecules collide they are more likely to have **sufficient energy required to break bonds** and combine to form products, i.e. to react. Having greater kinetic energy also means that the molecules are moving **at higher velocity (speed)**, therefore their chances of having **more collisions** are increased because they are moving around more quickly. ✓

ANY FOUR OF THESE ARGUMENTS PRESENTED IN LOGICAL ORDER (4)

**[16]**

### Question 3

3.1 A closed system ✓ and a reversible reaction. ✓ (2)

3.2 Chemical equilibrium exists when the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓ (2)

3.3 When any system at equilibrium is subjected to change in concentration, temperature, volume or pressure, then the system readjusts itself to counteract the effect of the applied change and a new equilibrium is established. ✓✓ (2)

3.4.1 2 ✓ minutes ✓ (2)

3.4.2 More $N_2O_4$ gas was added to the system. ✓ (1)

3.4.3 The system was disturbed when more $N_2O_4$ was added to it. According to Le Chatelier's Principle the system adjusted itself to reduce the effect of the change, ✓ therefore the equilibrium position shifted to increase the production of $NO_2$ until equilibrium was re-established. ✓ (2)

3.4.4 The temperature ✓ was increased. ✓ (2)

3.4.5 The equilibrium shifted to favour the production of $NO_2$. ✓ An increase in temperature favours the endothermic reaction ✓ which is the forward reaction (until equilibrium is re-established). ✓ (3)

**[16]**

## Question 4

4.1 $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓✓ (2)

4.2 If 1 mol of hydrogen remains at equilibrium, then 6 mol of hydrogen has been combined to form ammonia. ✓

Since 3 mol of hydrogen produce 2 mol of ammonia. ✓

Then 6 mol of hydrogen produced 4 mol ammonia. ✓ (3)

4.3 $c = \frac{n}{V}$ ✓

$= \frac{4}{0{,}5}$ ✓

$= 8$ mol.dm$^{-3}$ ✓ (3)

4.4 $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

$c(N_2) = \frac{(2{,}07 - 2{,}00)}{0{,}5} = 0{,}14$ mol.dm$^{-3}$

$= \frac{[8]^2 ✓}{[0{,}14] ✓ [2]^3 ✓}$

$= 57{,}14$ ✓ (4)

4.5.1 A positive catalyst is a substance that increases the rate of a chemical reaction without being chemically changed by the reaction. ✓ (1)

4.5.2 A catalyst does not affect the position of chemical equilibrium because it increases the rate of both reactions equally. ✓ (1)

4.6.1 a) Increases. ✓ (1)

b) The increase in the concentration of hydrogen ✓ disturbs the system causing it to respond to minimise the effect of the change ✓ until equilibrium is re-established. The forward reaction is favoured and more ammonia is produced. ✓ (3)

4.6.2 a) Remains the same. ✓ (1)

b) Only a change in temperature affects the value of the equilibrium constant. ✓ (1)

**[20]**

## Question 5

5.1.1 Ionisation occurs when a molecular substance reacts with water to form hydronium ions and an anion ✓ whereas dissociation occurs when an ionic substance splits up into its ions when it dissolves in water. ✓ (2)

5.1.2 Any ionic substance split into its ions with correct formula and charges on the ions, e.g.

$CuSO_4(s)$ ✓ → $Cu^{2+}(aq) + SO_4^{2-}(aq)$ ✓ (2)

Candidates can omit states (s) and (aq)

5.2 If $K_a$ is very high, the ionisation of nitric acid is almost complete (the equilibrium position lies to the 'right'), ✓ therefore very few molecules of nitric acid remain so there is a high concentration of hydronium ions. ✓ This makes nitric acid a strong acid. ✓ (3)

5.3 5.3.1 pH = $-\log_{10}[H_3O^+]$ ✓

$= -\log_{10}(0{,}2)$ ✓

$= 0{,}70$ ✓ (3)

5.3.2 $n_{HNO_3} = cV$

$= (0{,}2)(0{,}025)$ ✓

$= 0{,}005$ mol

2 mol of $HNO_3$ neutralise 1 mol of $Na_2CO_3$ ✓

$nNa_2CO_3 = 0{,}0025$ mol ✓

$c = \frac{0{,}0025}{0{,}032} = 0{,}078$ mol.dm$^{-3}$ ✓ (0,08 mol.dm$^{-3}$) (4)

5.3.3 The equivalence point occurs when there are an equivalent number of moles of acid and base, so that the acid has neutralised the base. (2)

5.3.4 Methyl orange ✓ (2)

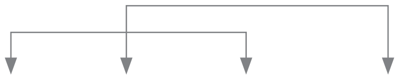
5.3.5 Nitric acid is a strong acid, and sodium carbonate is a weak base. ✓ The end point of the titration will lie in the acid range ✓ rather than at the neutral point. It is likely to be at about pH 5–6 ✓ which coincides with the change in colour of the indicator. (2)

**[20]**

**Question 6**

6.1 A substance which is able to donate (release) protons. ✓ (1)

6.2




**$NH_3(g) + H_2O(\ell) \leftrightarrows NH_4^+(aq) + OH^-(aq)$ ✓✓** (2)

6.3 6.3.1 *An ampholyte* is a substance which can act as an acid, by donating protons, ✓ and as a base, by accepting protons. ✓ (2)

6.3.2


**$H_20(\ell) + H_2O(\ell) \leftrightarrows H_30^+(aq) + OH^-(aq)$ ✓✓** (2)

6.3.3 Autoprotolysis ✓ (1)

6.4 6.4.1 Hydrolysis ✓ (1)

6.4.2 Ammonium chloride is the salt of a weak base (NHOH) and a strong acid (HCℓ). ✓

The ammonium ion hydrolyses in water (reacts with water molecules): ✓

**$NH_4^+(aq) + H_2O(\ell) \leftrightarrows NH_3(aq) + H_3O^+(aq)$ ✓**

As can be seen by this reaction, the concentration of $H_3O^+$ ions increases, therefore ammonium chloride forms a slightly acidic solution. ✓ (4)

6.5 **$2HC\ell + MgCO_3 \rightarrow MgC\ell_2 + CO_2 + H_2O$**

Therefore $n_a : n_b = 2 : 1$ ✓

Candidates may state the mole ratio without showing the equation

$n_{HC\ell} = cV$

$= (0{,}15)(0{,}20)$

$= 0{,}03$ mol ✓

$N_{MgCO_3} = \frac{1}{2}(0.03)$

$= 0.015$ ✓

$m = nM$

$= (0{,}015)(24 + 12 + 48)$

$= 1{,}26$ g ✓

% purity $= \frac{1{,}26}{5} \times 100\%$

$= 25{,}20\%$ ✓ (5)

**[18]**

## 7. Cognitive Analysis for Physical Sciences Grade 12: End-of-Term 2 Chemistry Test

| Question | 1 | 2 | 3 | 4 | Organic chemistry | Rate & extent of reaction | Chemical equilibrium | Acid & bases | Total (content) | Total (levels) | Question totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **TARGET** | **15** | **40** | **35** | **10** | **10** | **15** | **35** | **40** | **100** | **100** | **100** |
| **ACTUAL** | **16** | **37** | **36** | **11** | **10** | **16** | **36** | **38** | **100** | **100** | **100** |
| 1.1 | 2 | | | | 2 | | | | 2 | 2 | |
| 1.2 | | 2 | | | 2 | | | | 2 | 2 | |
| 1.3 | | 2 | | | 2 | | | | 2 | 2 | |
| 1.4 | | | 2 | | 2 | | | | 2 | 2 | |
| 1.5 | | | 2 | | 2 | | | | 2 | 2 | 10 |
| 2.1 | | 1 | | | | 1 | | | 1 | 1 | |
| 2.2 | | 2 | | | | 2 | | | 2 | 2 | |
| 2.3 | | 2 | | | | 2 | | | 2 | 2 | |
| 2.4 | | | 4 | | | 4 | | | 4 | 4 | |
| 2.5 | | 4 | | | | 4 | | | 4 | 4 | |
| 2.6 | | | | 3 | | 3 | | | 3 | 3 | 16 |
| 3.1 | 2 | | | | | | 2 | | 2 | 2 | |
| 3.2 | 2 | | | | | | 2 | | 2 | 2 | |
| 3.3 | 2 | | | | | | 2 | | 2 | 2 | |
| 3.4.1 | | 2 | | | | | 2 | | 2 | 2 | |
| 3.4.2 | | 1 | | | | | 1 | | 1 | 1 | |
| 3.4.3 | | | 2 | | | | 2 | | 2 | 2 | |
| 3.4.4 | | | 2 | | | | 2 | | 2 | 2 | |
| 3.4.5 | | | | 3 | | | 3 | | 3 | 3 | 16 |
| 4.1 | | 2 | | | | | 2 | | 2 | 2 | |
| 4.2 | | 3 | | | | | 3 | | 3 | 3 | |
| 4.3 | | 3 | | | | | 3 | | 3 | 3 | |
| 4.4 | | | 4 | | | | 4 | | 4 | 4 | |
| 4.5 | | 2 | | | | | 2 | | 2 | 2 | |
| 4.6.1 | | | 4 | | | | 4 | | 4 | 4 | |
| 4.6.2 | | | 2 | | | | 2 | | 2 | 2 | 20 |
| 5.1.1 | 2 | | | | | | | 2 | 0 | 2 | |
| 5.1.2 | | 2 | | | | | | 2 | 0 | 2 | |
| 5.2 | | 3 | | | | | | 3 | 0 | 3 | |
| 5.3.1 | | 3 | | | | | | 3 | 0 | 3 | |
| 5.3.2 | | | 4 | | | | | 4 | 0 | 4 | |
| 5.3.3 | 3 | | | | | | | 3 | 0 | 3 | |
| 5.3.4 | | 1 | | | | | | 1 | 0 | 1 | |
| 5.3.5 | | | 2 | | | | | 2 | 0 | 2 | 20 |
| 6.1 | 1 | | | | | | | 1 | 0 | 1 | |
| 6.2 | | 2 | | | | | | 2 | 0 | 2 | |
| 6.3.1 | 2 | | | | | | | 2 | 4 | 2 | |
| 6.3.2 | | | 2 | | | | | 2 | 0 | 2 | |
| 6.3.3 | | | 1 | | | | | 1 | 0 | 1 | |
| 6.4.1 | | | 1 | | | | | 1 | 0 | 1 | |
| 6.4.2 | | | 4 | | | | | 4 | 0 | 4 | |
| 6.5 | | | | 5 | | | | 5 | 0 | 5 | 18 |

## 8. Physical Sciences Grade 12: Practical Assessment: Titration: Technical Information

***How can the concentration of sodium hydroxide be determined by titrating oxalic acid against sodium hydroxide?***

*FOR EACH GROUP*

**Apparatus**

250 $cm^3$ volumetric flask

Weighing boat

Glass funnel

Spatula

Plastic propette

300 $cm^3$ distilled water in a plastic squeeze bottle with a thin delivery tube

200 $cm^3$ sodium hydroxide (of 'unknown' concentration) in a labelled beaker

**Note:** If you do not have access to weighing boats, replace these with a 10 cm × 10 cm piece of plastic bag for the learners to place their oxalic acid on. They need to pick up the edges of the plastic and tilt it carefully into the funnel. Using plastic, rather than paper, makes it easier for them to wash every grain of oxalic acid into the flask.

**Access to the following:**

Mass meter (or triple beam balance)

Oxalic acid dehydrate ($(COOH)_2.2H_2O$)

### INSTRUCTIONS FOR PREPARATION

**Prepare a 0,1 mol.dm$^{-3}$ solution of sodium hydroxide**

Each group will require about 200 $cm^3$ of the sodium hydroxide solution to be able to carry out three titrations. Some groups may need to repeat their measurements so it would be a good idea to prepare 250 $cm^3$ for each group, and to keep the remainder of the solution in storage until all the learners have completed their practical work and handed it in. Make up the standard solution of sodium hydroxide using the largest size of volumetric flask you have available, and store it in clean 2 litre bottles.

| Calculations | N | Volume ($cm^3$) | Mass (g) |
|---|---|---|---|
| Number of groups ($N$) | | | |
| Amount of NaOH(aq) for each group | | 250 | |
| Volume of NaOH(aq)<br>$V = N \times 250$ $cm^3$ | | | |
| Mass of NaOH required<br>$m = 0{,}1 \times 40 \times V$ | | | |

**Making a standard solution:**

1. Measure the required mass of sodium hydroxide using the balance and the weighing boat.
2. Put the glass funnel into the neck of the volumetric flask.
3. Add the mass of sodium hydroxide to the funnel, and wash the last few crystals from the weighing boat into the funnel.
4. Gently wash the sodium hydroxide into the flask by spraying water onto it and letting the solution fall into the flask. Continue doing this until all the crystals of sodium hydroxide have been washed into the flask.
5. Swirl the contents of the flask to completely dissolve all the crystals of sodium hydroxide.
6. Add distilled water to the flask, swirling to mix the contents, until the solution rises to about 1 cm below the mark on the neck of the flask.

7. When sodium hydroxide dissolves in water the temperature of the solution rises significantly. Wait for about 15 minutes for the content of the flask to cool to room temperature.
8. Use the propette to add the last few drops of water carefully until the bottom of the meniscus of the solution is in direct line with the mark when viewed at eye level.
9. Insert the stopper in the neck of the volumetric flask.

**Filling the storage bottles:**

1. Rinse the storage bottle with distilled water, and throw the water down the sink.
2. Rinse the storage bottle with about 100 $cm^3$ of sodium hydroxide solution, and throw the rinsing solution down the sink.
3. Fill the storage bottle with the sodium hydroxide solution.
4. Label the bottle: NaOH(aq): Sample 1
5. Continue with the other bottles, labelling them Sample 2, 3, etc.
6. When the learners work with the solutions, they must use NaOH(aq) from the **same** bottle each time in order to get an accurate result.
7. 2 litres of solution will be sufficient for 8–10 groups of learners.

**Setting up the burettes:**

1. A burette holder usually has to clamps for burettes. It is therefore useful to set up the retort stands with two sets of apparatus at each so that two groups can work at one station.

   To avoid confusion, give each group its entire set of apparatus so that no two groups need to share anything.
2. The retort stand must be secured in its base so that it stands rigidly (without wobbling).
3. Test the burette clamps for rigidity. When both burettes are clamped into position, they should stand vertically (perpendicular to the table top).

   If you test each clamp before the practical session, you will be confident that very few learners will encounter any difficulties.

**Safety measures**

There is no need for learners to wear safety gloves during this practical. The concentrations of the oxalic acid and sodium hydroxide are low enough not to cause any burns to the skin (unless the skin has been wounded or cut prior to the practical). However, it is always useful to have a mild solution of sodium bicarbonate available in a plastic bucket so that learners can neutralise any acid spills, and then run tap water over their hands.

If a learner's skin comes in contact with the sodium hydroxide solution, run tap water over the skin to remove it.

Learners should wear safety goggles to protect their eyes from the acid and the base.

## 9. Physical Sciences Grade 12: Practical Assessment: Titration

***How can the concentration of sodium hydroxide be determined by titrating oxalic acid against sodium hydroxide?***

### *Background*

A titration is an experimental procedure which is used to determine the concentration of an unknown solution of acid or base by reacting it with an equivalent amount of base or acid of known concentration.

If we are using oxalic acid to find the concentration of sodium hydroxide, then we must use a *standard* solution of oxalic acid. A standard solution has a known concentration at a particular temperature.

The titration therefore has two parts:

1. Preparation of a standard solution of oxalic acid
2. The titration of the standard solution of oxalic acid against the solution of sodium hydroxide (with unknown concentration)

### Preparation of a standard solution of oxalic acid

A volumetric flask is a glass flask which is used to prepare standard solutions. It has a mark on its neck which measures the exact volume e.g. 250 $cm^3$. The meniscus of the solution should be exactly in line with the mark when it is viewed directly at eye level.

Because the volume of glass is sensitive to temperature, the solution should be kept at the temperature stated on the flask (usually 20 °C). To ensure that the contents of the flask are not heated by your hand, the flask should be held gently and firmly by its neck.

### Apparatus

250 $cm^3$ volumetric flask
Mass meter (or triple beam balance)
Weighing boat
Glass funnel
Spatula
Plastic propette
300 $cm^3$ distilled water in a plastic squeeze bottle with a thin delivery tube
Oxalic acid dehydrate ($(COOH)_2.2H_2O$)
200 $cm^3$ sodium hydroxide (of unknown concentration) in a labelled beaker

### Method

1. Calculate the mass of oxalic acid required to prepare 250 $cm^3$ of a standard solution of 0,1 $mol.dm^3$ oxalic acid, using the formula:

   $$\text{Concentration} = \frac{\text{Mass}}{\text{Molar mass} \times \text{Volume}}$$

2. Measure the required mass of oxalic acid using the balance and the weighing boat.
3. Put the glass funnel into the neck of the volumetric flask.
4. Add the mass of oxalic acid to the funnel, and wash the last few crystals from the weighing boat into the funnel.
5. Gently wash the oxalic acid into the flask by spraying water onto it and letting the solution fall into the flask. Continue doing this until all the crystals of oxalic acid have been washed into the flask.
6. Swirl the contents of the flask to completely dissolve all the crystals of oxalic acid.
7. Add distilled water to the flask, swirling to mix the contents, until the solution rises to about 1 cm below the mark on the neck of the flask.
8. Use the propette to add the last few drops of water carefully until the bottom of the meniscus of the solution is in direct line with the mark when viewed at eye level.
9. Insert the stopper.

*Titration of a standard solution of oxalic acid against sodium hydroxide*

**Apparatus**

Burette in a burette stand
Distilled water in a squeezy wash bottle
Conical flask
Funnel (to fit burette)
50 $cm^3$ (ml) pipette

**Chemicals**

Standard solution of oxalic acid
Solution of sodium hydroxide
Phenolphthalein indicator solution

**Method**

**Setting up the burette which contains the acid**

1. Remove the burette from its stand, and half-fill it with distilled water.
2. Tip it from top to bottom to rinse the burette with the distilled water.
3. Drain the distilled water, and add about 20 $cm^3$ of oxalic acid to the burette.
4. Repeat the rinsing process using oxalic acid, then drain the acid.
5. Set the burette into its stand. Make sure that it stands vertically, and that its tap is closed.
6. Place a beaker under the burette.
7. Place the funnel into the top of the burette, and add oxalic acid until the meniscus is about 3 cm above the zero mark of the burette.
8. Open the tap of the burette while placing your finger in the tip (to block the flow of the solution). The solution will fill the space below the tap. There should be no air bubbles in this space. If there are air bubbles, release your finger from the tip and allow the acid to flow for a moment. The sudden flow will wash air bubbles out of this section of the burette.
9. Check the burette tube for air bubbles. Tap the glass gently to remove air bubbles and let them rise through the solution. Top up the burette until the meniscus of the solution is about 2–3 cm above the zero mark.
10. Open the burette tap to let solution run out until the bottom of the meniscus is exactly on the zero mark at eye level.

**Setting up the conical flask with sodium hydroxide**

11. Measure 50 $cm^3$ of sodium hydroxide into the conical flask.
12. Add 2–3 drops of phenolphthalein to the conical flask.
13. Set the conical flask below the burette.

**Performing the titration of acid against base**

14. Run a few $cm^3$ into the conical flask while swirling the contents of the flask continuously.

    Proceed as described in Steps 15–16 until the contents of the flask show a change in colour when acid is added.
15. Close the tap. Wash the last drop of acid from the tip of the burette into the conical flask, and swirl the contents of the flask.
16. To determine the end point, add the acid at just a few drops each time, and swirl vigorously during and after each addition. Try to determine the position when the colour of the contents changes completely when one drop is added.
17. Record the volume of oxalic acid added.
18. *Repeat the titration two more times to determine the volume more precisely.*

**Analysis of results**

1. Calculate the exact concentration of the oxalic acid solution by using the exact mass of oxalic acid, and mark the volumetric flask with this concentration. (2)
2. Draw up a table of the volume of oxalic acid required to neutralise 50 $cm^3$ sodium hydroxide. (5)
3. Determine the <u>average of the best two results</u> for the volume of acid added. (3)
4. Write a balanced chemical equation for the reaction. (3)
5. Determine the concentration of the sodium hydroxide solution. (5)

**Questions**

1. Explain why phenolphthalein was chosen as the indicator for this titration. (2)
2. Explain why the last drop of acid is washed into the flask using distilled water. (3)
3. Explain why the addition of distilled water to the flask does not change the outcome of this experiment. (2)
4. Give two precautions which must be taken when preparing the standard solution of oxalic acid. (2)
5. Give two precautions that must be taken when filling the burette with oxalic acid. (2)

**Application**

A standard solution of 0,2 $mol.dm^3$ sodium carbonate is titrated against dilute sulfuric acid.

32 $cm^3$ of sodium carbonate completely neutralised 25 $cm^3$ of sulfuric acid.

Determine the concentration of the sulfuric acid. (8)

**40 MARKS**

**END OF FORMAL ASSESSMENT**

## 10. Physical Sciences Grade 12: Practical Assessment: Titration Memorandum

***How can the concentration of sodium hydroxide be determined by titrating oxalic acid against sodium hydroxide?***

*Analysis of results*

1. Calculation of mass of oxalic acid $(COOH)_2.2H_2O$ required to make 250 $cm^3$ of 0,2 $mol.dm^{-3}$ oxalic acid:

   Mass = Concentration × Molar mass × Volume ✓ (method)

   = (0,2)(2(12 + 32 + 2) + 2(2 + 16)) ✓ (0,250) ✓ (conversion; correct molar mass)

   = 6,4 g ✓ (accuracy) (4)

   Actual concentration of oxalic acid solution

   Actual mass of oxalic acid:

   $\text{Concentration} = \frac{\text{Mass}}{\text{Molar mass} \times \text{Volume}}$

   $= \frac{\text{Mass}}{(128)(0,25)}$ ✓ (using the mass of oxalic acid)

   = ……… $mol.dm^{-3}$ ✓ (accuracy) (2)

2. Table of volume of oxalic acid added to 50 $cm^3$ of sodium hydroxide.

| Volume of oxalic acid added ✓ ($cm^3$) ✓ | | |
|---|---|---|
| TRIAL 1 ✓ | TRIAL 2 ✓ | TRIAL 3 ✓ |
| | | |

(5)

3. Average of the <u>two best results</u>:

   ✓ Choose the most precise results (the two results which are closest to each other)

   ✓ Average = $\frac{1}{2}$(sum of the two results)

   ✓ Accuracy + SI units (3)

4. $(COOH)_2(aq) + 2NaOH$ ✓ → $2COONa + 2H_2O$ ✓ (✓ balancing) (3)

5. $n_{acid} : n_{base} = 1 : 2$ ✓ (method)

   $n_{acid} = (c_{acid})(V_{acid})$ ✓ (method)

   = (actual concentration of acid) (average volume from Q. 2)

   = ……… ✓ moles (accuracy)

   $n_{base} = 2 \times n_{acid}$ = ……… ✓ (method)

   $c_{base} = \frac{n}{V}$

   $= \frac{(\ldots\ldots\ldots)}{0,050}$

   = ……… $mol.dm^{-3}$ ✓ (accuracy) (5)

**Questions**

1. Oxalic acid is a weak acid; sodium hydroxide is a strong base. ✓ The end point lies in the range of a weak base, therefore since phenolphthalein changes colour in this range it is the most suitable indicator. ✓ (2)
2. Every drop of acid contains some oxalic acid, ✓ and we are trying to measure the exact number of moles of acid that will react with the fixed amount of sodium hydroxide in the conical flask. ✓ (2)
3. The flask contains a fixed number of moles of sodium hydroxide which we added when we put 50 $cm^3$ of sodium hydroxide in the flask. ✓ Adding distilled water doesn't add any other type of substance to the flask ✓ so it has no effect on the reaction. (2)
4. Any <u>TWO</u> of the following:
   - Hold the volumetric flask by its neck – to keep it at constant temperature.
   - Wash every crystal of oxalic acid into the flask.
   - Use the propette to add the last few drops of water to the flask so that the bottom of the meniscus of the solution is exactly in line with the mark on the neck of the flask.
   - Measure the volume at the bottom of the meniscus of the solution. (2)

5. Any <u>TWO</u> of the following:
- Rinse the burette with distilled water first.
- Rinse the burette with the oxalic acid solution first.
- Remove air bubbles from the burette tube.
- Remove the air bubbles from the space below the burette tap.
- Fill the burette with the bottom of the meniscus of the solution at the zero mark. (2)

**Application**

<u>Balanced equation</u>

$H_2SO_4(aq) + 2NaHCO_3(aq)$ ✓ → $Na_2SO_4(aq) + CO_2(g) + H_2O(\ell)$ ✓ (✓ balancing)

<u>Mole ratio</u>: $n_{acid} : n_{base} = 1 : 2$ ✓

$n_{base} = cV$

$= (0,2)(0,32)$ ✓

$= 0,064$ moles

$n_{acid} = \frac{1}{2} \times 0,064$

$= 0,032$ ✓ moles

$c_{acid} = \frac{n}{V}$

$= \frac{0,032}{0,025}$ ✓

$= 1,28 \text{ mol.dm}^{-3}$ ✓ (8)