PHYSICAL SCIENCES

Worksheet Booklet

GRADE 10 TERM 2

TOPIC 11: Particles substances are made of

GRADE 10: WORKSHEET

1. What is meant by the term:
   a. compound. (3)
   b. electrolysis. (2)
2. The following questions are about covalent molecular substances.
   a. What is meant by a molecule? (2)
   b. How are molecules formed? (1)
   c. What types of elements form molecules when they combine? (2)
   d. Describe the structure of a covalent molecular substance. (3)
3. a. Describe the structure of a covalent network substance. (3)
   b. Describe two properties of network solids and explain why they have these properties. (4)
4. a. What is meant by the term allotropes? (2)
   b. Diamond and graphite are allotropes of carbon and they have very different properties. Write down two properties of each allotrope. (4)
   c. In terms of their structure, explain why diamond and graphite have such different properties. (6)
5. a. Describe how ionic bonding occurs. (2)
   b. Between what type of elements does ionic bonding occur? (2)
   c. What type of structure always results from ionic bonding? (1)
   d. List two properties of ionic compounds and explain why they have these properties. (6)
6. a. What is meant by the term delocalised electrons? (4)
   b. List three properties of metals that result from metallic bonding. (6)
7. Write down the correct names for the following substances:
   a. $K_2Cr_2O_7$
   b. CS2
   c. HNO_3
   d. K_3PO_4
   e. $(NH_4)_2CO_3$ (5)
8. Draw circle diagrams to represent the following molecules:
   a. H_2S
   b. $CC\ell_4$
   c. NF_3 (7)

TOPIC 11: Particles substances are made of

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 47 MARKS

1. a. Describe the differences between covalent molecular substances and covalent network substances, in their structure. (4)

   b. List two differences in the properties of covalent molecular structures and covalent network structures. (4)

2. a. Describe the differences in the structures of ionic compounds and metals. (4)

   b. List two differences between in the properties of ionic substances and metals. (4)

3. The table below gives some properties of substances A to D.

Substance	Melting point (°C)	Hard/soft	Electrical conductivity
A	−75	Gas	Non-conductor
B	1 538	Hard	Good conductor
C	1 710	Hard	Non-conductor
D	1 087	Hard	Conducts when molten

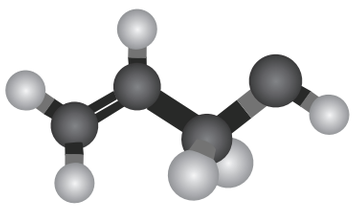
   Match the letters A to D to the following substances:
   Lead sulfate
   Sulfur dioxide
   Silicon dioxide
   Iron (8)

4. Write down the chemical formula for each of the following substances:
   a. copper(I) oxide
   b. diphosphorus trioxide
   c. chromium(III) sulphite
   d. nitrogen dioxide
   e. aluminium hydrogen carbonate (10)

5. Draw circle representations for the following molecules:
   a. C_2H_4 (3)
   b. $PC\ell_3$ (2)

6. The molecular formula of a compound is $C_6H_{12}O_2$. Write down the empirical formula of this compound. (2)

7. Below is a ball and stick model of a certain molecule. The colour code is: black – carbon, white – hydrogen, red – oxygen.



   a. Write down the molecular formula of the compound. (2)
   b. Write sown the number of single bonds in the compound. (2)
   c. Write down the number of double bonds in the compound. (2)

GRADE 10: WORKSHEET MEMORANDUM

1. a. A compound is made up of atoms of two or more elements✓ which are bonded together✓ and which combine in a specific ratio.✓ (3)

   b. Electrolysis is a process by which a compound can be split into its constituent elements ✓by means of an electric current. ✓ (2)

2. a. A molecule consists of two or more atoms✓ which are chemically bonded and behave a single unit.✓ (2)

   b. Molecules are formed when two atoms share a pair of electrons. ✓ (1)

   c. Molecules are formed when two non-metal atoms combine.✓✓ (2)

   d. A covalent molecular structure consists of individual molecules✓ which are held together by weak✓ intermolecular forces.✓ (3)

3. a. A covalent network structure consists of atoms ✓which are covalently bonded together✓ to form giant molecules.✓ (3)

   b. Network solids have high melting points and boiling points✓ because the covalent bonds between the atoms are extremely strong.✓
   Network solids generally don't conduct electricity✓ because there are no delocalised electrons.✓ Graphite is an exception. (4)

4. a. Allotropes are different physical forms✓ of the same element.✓ (2)

   b. Diamond has a very high melting point and boiling point✓ and is extremely hard.✓
   Graphite also has a very high melting point and boiling point✓ but it is soft.✓ (4)

   c. In diamond each carbon atom is bonded to four other atoms ✓by very strong covalent bonds ✓(*this why it is so hard and has a high melting point*) and forms a three-dimensional crystal lattice in which there are no delocalised electrons (*doesn't conduct electricity*).✓
   In graphite each carbon atom is bonded covalently to three other atoms to form large flat molecular sheets. ✓Every carbon atom has a delocalised electron✓ (*thus is an electrical conductor*), and these electrons hold the sheets together by means of weak intermolecular forces✓ (*the reason why it is soft*). (6)

5. a. Ionic bonding occurs when there is a transfer of electrons✓ from one atom to another.✓ (2)

   b. Ionic bonding occurs between metals ✓ and non-metals.✓ (2)

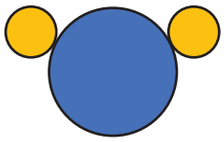
   c. A crystal lattice. ✓ (1)

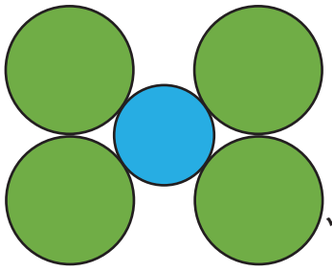
   d. Ionic compounds have high melting points and boiling points.✓This occurs because ionic bonds are very strong✓ (they are also hard and brittle for this reason). A lot of energy is required to separate the ions. ✓
   Ionic compounds do not conduct electricity when solid, but they do when they are in the molten state. ✓This is because when they are in the solid state, the ions occupy fixed positions in a crystal lattice and there are no charges that are free to move,✓
   When they are molten, or in solution, the ions are free to move and charge carriers.✓ (6)

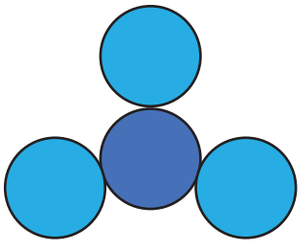
6. a. Delocalised electrons are electrons that are spread out over an entire structure ✓and are not associated with any particular atom.✓ They are free to move from valence orbital to valence orbital ✓and do so in a random way.✓. (4)

   b. Three properties of metals that result from metallic bonding are:
   - they conduct electricity ✓✓
   - they are malleable and ductile ✓✓
   - they have relatively high melting points and boiling points.✓✓ (6)

7. a. Potassium dichromate ✓
   b. Carbon disulphide ✓
   c. Hydrogen nitrate (nitric acid)✓
   d. Potassium nitrate ✓
   e. Ammonium carbonate ✓ (5)

8. a.  ✓ ✓ (2)

   b.  The chlorine atoms (green) are bigger than the carbon atoms. ✓ ✓ (3)

   c.  The fluorine atoms and nitrogen atoms are approximately the same size. ✓ ✓ (2)

TOPIC 11: Particles substances are made of

GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM — TOTAL: 47 MARKS

1. a. Covalent molecular substances are made up of individual molecules✓ which are held together by weak intermolecular forces.✓ Covalent network substances are made up of atoms (or molecules)✓ which are bonded by strong covalent bonds.✓ (4)

   b. Difference 1: network substances have very high melting and boiling points while molecular substances have low melting and boiling points.✓✓
   Difference 2: network substances are generally very hard (graphite excepted) while molecular substances are generally soft. ✓✓ (4)

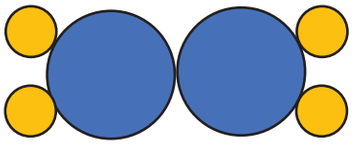
2. a. Difference 1: ionic compounds consist of positive and negative ions while metals consist of positive ions only. ✓✓
   Difference 2: in ionic compounds the forces holding the substance together are electrostatic forces between positive and negative ions.✓ In metals the forces are between delocalised electrons and positive metal ions.✓
   Difference 3: in metals there are delocalised electrons while in ionic compounds there are no delocalised electrons. ✓✓ANY TWO (4)

   b. Difference 1: ionic substances are hard and brittle, while metals are generally soft and can be shaped easily.✓✓
   Difference 2: Metals conduct electricity in the solid or liquid state, ionic substances conduct electricity only when molten or in aqueous solution.✓✓ (4)

3. Substance **A** has a low melting point which indicates weak intermolecular forces, so **A** must be a covalent molecular substance – it must be **sulfur dioxide**. It is also the only gas out of the four substances. ✓✓
   Substance **B** has a high melting and it is hard, so it has strong interparticle forces. It can be either a covalent network substance, an ionic substance or a metal. The fact that it conducts electricity in the solid state means that it is a metal. **B is iron**.✓✓
   Substance **C** has a high melting and it is hard, so it has strong interparticle forces. It can be either a covalent network substance, an ionic substance or a metal. The fact that it is a non-conductor of electricity means that it is a covalent network structure. **C is silicon dioxide**. ✓✓
   Substance D is lead sulfate. ✓✓ The reasoning (other than the fact that it is the only one left), is that it has a high melting point, it is hard and it conducts electricity when molten means that it is an ionic substance. (8)

4. a. Cu_2O ✓✓
   b. P_2O_3 ✓✓(diphosphorus means 2 P and trioxide means 3 O)
   c. $Cr_2(SO_3)_3$ ✓✓
   d. NO_2 ✓✓ (dioxide means 2 O)
   e. $A\ell(HCO_3)_3$ ✓✓ ($A\ell$ forms $A\ell^{3+}$ ions, while hydrogen carbonate is HCO_3^-) (10)

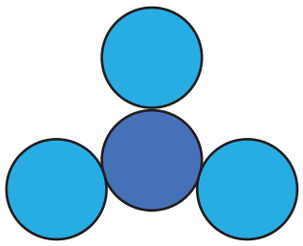
5. a.



✓ ✓ ✓

(3)

b.



✓ ✓

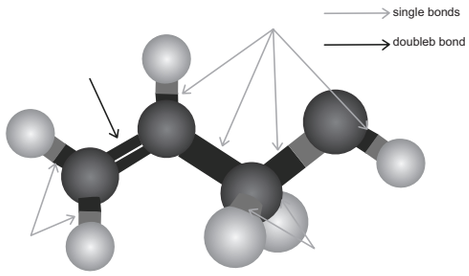
(2)

6. Empirical formula is C_3H_6O ✓✓
Remind leaners that the empirical formula is the lowest of the elements involved. We divide by 2 to get the simplest ratio. (2)

7. a. C_3H_6O ✓✓ (2)

b. There are 8 single bonds. ✓✓ (2)

c. There is 1 double bond. ✓✓ (2)



TOPIC 12: Physical and chemical change

GRADE 10: WORKSHEET

1. List 4 observations that could indicate that a chemical change is taking place. (4)
2. Carbon dioxide undergoes sublimation.
   a. Is this a physical or chemical change? Give a reason for your answer. (3)
   b. Describe the changes that take place in terms of rearrangement of molecules during this change. (3)
   c. Describe the energy change that occurs during this change. (3)
3. Write down which of the following are chemical changes and which are physical changes.
   a. Baking a cake
   b. Breaking a glass bottle
   c. Boiling water
   d. Rusting iron
   e. Burning wood (5)
4. Write down which of the following are synthesis reactions and which are decomposition reactions.
   a. Hydrogen gas and oxygen gas combine to form water.
   b. Ammonia breaks up into nitrogen and hydrogen.
   c. Ammonium hydroxide is heated and it changes into ammonia and water.
   d. Sulfur trioxide (SO_3) is heated and produces sulfur dioxide (SO_2) and oxygen. (8)
5. A piece of magnesium ribbon is placed in a blue solution of copper sulfate. The solution becomes colourless. Magnesium sulfate and a brownish red deposit of copper forms on the bottom of the container. Is this a chemical or physical change? Give reasons for your answer. (4)
6. a. State the law of conservation of mass. (3)
   b. By using relative atomic masses, show that mass is conserved in the following chemical reaction:
   $Fe + 2HC\ell \rightarrow FeC\ell_2 + H_2$ (7)
7. Use the law of conservation of mass to answer this question. 4,8 g of magnesium metal reacts completely with 12,8 g of oxygen gas. What is the mass of magnesium oxide produced? Give a reason for your answer. (4)
8. Give the chemical formula for each of the following. A substance in which
   a. the ratio of C:H is 1:4. (2)
   b. the ratio of C:O is 1:1 (2)
   c. the ratio of Na:O is 2:2 (2)

TOPIC 12: Physical and chemical change

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 60 MARKS

1. Water vapour condenses to form water.
   a. Is this a chemical or physical change? (1)
   b. Describe how the molecules rearrange when this change occurs. (3)
   c. Describe the energy change that occurs during this process. (2)
2. Consider the rusting of iron.
   a. Is this a physical or chemical change? (1)
   b. Give reasons why you chose the answer given in a. (2)
3. Which of the following reactions are synthesis reactions and which are decomposition reactions? Give a reason for each answer.
   a. $2H_2O \rightarrow 2H_2 + O_2$ (3)
   b. $NH_4NO_3 \rightarrow NH_3 + HNO_3$ (3)
   c. $2SO_2 + O2 \rightarrow 2SO_3$ (3)
   d. $Mg + O_2 \rightarrow 2MgO$ (3)
4. Tabulate 3 differences between physical and chemical changes. (6)
5. a. Which requires more energy:
      I changing ice to water, or
      II breaking water down into hydrogen and oxygen? (2)
   b. Give reasons why this is so. (4)
   c. Which is a physical change and which is a chemical change? (2)
6. Verify the law of conservation of mass by using relative atomic masses for the following chemical reaction:
   $$BaC\ell_2 + H_2SO_4 \rightarrow BaSO_4 + 2HC\ell$$ (7)
7. Use circle diagrams to show the rearrangement of atoms in the following chemical reaction:
   $$H_2 + C\ell_2 \rightarrow 2HC\ell$$ (4)
8. A reaction is carried out by burning 10 g of carbon completely in oxygen gas. This produces 35,6 g of carbon dioxide. In another experiment 15,2 g of carbon is burned completely in oxygen gas and this produces 55,84 g of carbon dioxide.
   Use this data to show that the law of constant composition is verified. (9)
9. A sample of calcium oxide (CaO) is found to contain 40 g of calcium and 16 g of oxygen. If another sample of calcium oxide is analysed, it is found to contain 100 g of calcium. Calculate the mass of oxygen that this sample contains. (5)

GRADE 10: WORKSHEET MEMORANDUM

1. There could be:
   - a change in temperature ✓
   - release of a gas ✓
   - a change in colour ✓
   - a precipitate is formed ✓ (4)

2. a. It's a physical change. ✓ There is no new substance being formed. ✓ There is only a rearrangement of the molecules.✓ (3)

   b. In solid carbon dioxide there is a structure✓ in which the molecules are held in fixed positions. ✓When it becomes a gas, there is no structure in the arrangement of the molecules, they are moving about randomly.✓ (3)

   c. The molecules of the solid absorb energy which enables them to vibrate more strongly. ✓The forces between molecules are no longer strong enough to keep them together.✓ The forces holding them in place are broken and they are completely free to move.✓ (3)

3. a. Physical ✓
   b. Physical ✓
   c. Physical ✓
   d. Chemical ✓
   e. Chemical ✓ (5)

4. a. Synthesis ✓✓
   b. Decomposition ✓✓
   c. Decomposition ✓✓
   d. Decomposition ✓✓ (8)

5. This is a chemical change. ✓ The blue colour disappears and the solution becomes colourless. ✓ This is an indication of a chemical change. ✓A new, reddish brown substance forms which wasn't there before – another indication of a chemical change.✓ (4)

6. a. In a chemical reaction, ✓the total mass of the reactants ✓is equal to the total mass of the products.✓ (3)

a. $Fe + 2HCl \rightarrow FeCl_2 + H_2$

Reactants:

Fe: $M_r = 56$ ✓

HCℓ: m = 2(1 + 35,5)

= 73 ✓

Total mass = 56 + 73

= 129 ✓

Products:

$FeCl_2$: $M_r = 56 + (2 \times 35,5)$

= 127 ✓

H_2: $M_r = 2 \times 1$

= 2 ✓

Total mass = 127 + 2

= 129 ✓

Mass reactants = mass products ✓ (7)

7. Total mass reactants = 12,8 + 4,8 ✓

= 17,6 g ✓

∴ total mass products = 17,6 = mass of magnesium oxide. ✓

This is according to the law of conservation of mass. ✓ (4)

8. a. CH_4 ✓✓

b. CO ✓✓

c. Na_2O_2 ✓✓ (6)

GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM — TOTAL: 60 MARKS

1. a. Physical change ✓ (1)

   b. There are very weak (non-existent) forces between molecules in water vapour. ✓The molecules are totally free to move. ✓. When the vapour turns to liquid, the forces keep the molecules together but they can flow over each other. ✓ (3)

   c. The water molecules lose energy ✓and when the temperature is low enough, they will have lost enough energy for the molecules to hold on to each other and form a liquid.✓ (2)

2. a. Chemical change. ✓ (1)

   b. The brown crust (rust) that forms on the metal is a new substance. ✓ There is a change in colour from grey to reddish brown. ✓ (2)

3. a. Decomposition ✓ One substance changes into two others. ✓✓. (3)

   b. Decomposition ✓ One substance changes into two others. ✓✓ (3)

   c. Synthesis ✓ Two substances combine to from a single substance. ✓✓ (3)

   d. Synthesis ✓ Two substances combine to form a single substance. ✓✓ (3)

4.

Physical change	Chemical change
No new substances are formed✓	New substances are formed✓
Low change in energy ✓	High energy change ✓
The mass, number of atoms and number of molecules are conserved✓	Only the mass and number of atoms are conserved ✓

(6)

5. a. II Breaking water down into hydrogen and oxygen ✓✓ (2)

   b. When ice changes to water, weak✓ intermolecular forces have to be broken slightly.✓ When water is broken down into hydrogen and oxygen, strong covalent bonds have to be broken✓ and this requires much more energy. ✓ (4)

   c. I is a physical change ✓, II is a chemical change. ✓ (2)

6. $BaC\ell_2 + H_2SO_4 \rightarrow BaSO_4 + 2HC\ell$

Reactants:

$BaC\ell_2$: $M_r = 137,33 + (2 \times 35,5)$
$= 208,33$ ✓

H_2SO_4: $M_r = (2 \times 1) + 32 + (4 \times 16)$
$= 98$ ✓

Total reactants $= 208,33 + 98$
$= 306,33$ ✓

Products:

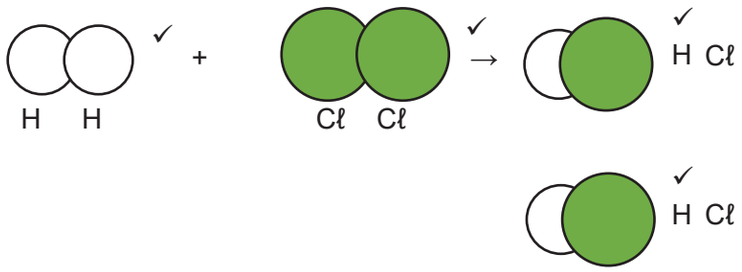
$BaSO_4$: $M_r = 137,33 + 32 + (4 \times 16)$
$= 233,33$ ✓

$HC\ell$: $m = 2(1 + 35,5)$
$= 73$ ✓

Total products $= 233,33 + 73$
$= 306,33$ ✓

$\therefore$ Total products = total reactants ✓ (7)

7. $H_2 + C\ell_2 \rightarrow 2HC\ell$



(4)

8. The law of constant composition states that the ratio of the atoms of elements in a specific compound is always the same.

First compound:

mass of carbon = 10 g

mass of oxygen = 35,6 – 10
= 25,6 g ✓

ratio C:O = $\frac{10}{12}:\frac{25,6}{32}$ ✓✓
= 0,83: 0,8
= 1: 1 ✓

We divide the mass of each element by the relative atomic or molecular mass, because we want the mole ratio. The learners do not know about moles at this stage, so they just need to understand that this has to be done.

Second compound:

mass of carbon = 15,2 g

mass of oxygen = 55,84 – 15,2
= 40,64 ✓

ratio C:O = $\frac{15,2}{12}:\frac{40,64}{32}$ ✓✓
= 1,27: 1,27
= 1:1 ✓

∴ the ratio of carbon to oxygen is the same for both compounds, which verifies the law of constant composition. ✓ (9)

9. Ratio of Ca:O in first sample = $\frac{40}{40}:\frac{16}{16}$ ✓
= 1: 1 ✓

The ratio in the second sample must also be 1:1✓

Ratio of Ca:O in second sample = $\frac{100}{40}:\frac{x}{16}$ ✓
∴ 100 X 16 = 40x
x = 40

The second sample contains 40 g of oxygen.✓ (5)

GRADE 10: WORKSHEET

1. List four observations that indicate that a chemical reaction has taken place. (4)
2. The representations for two chemical reactions are shown below.

   I $Fe_2O_3 + Zn \rightarrow ZnO + Fe$

   II potassium hydroxide + sulfuric acid $\rightarrow$ potassium sulfate + water

   a. Write down balanced reaction equations for I and II. (9)

   b. Use equation II to show that mass is conserved during this reaction. (7)
3. Consider the following unbalanced reaction equation:

   $A\ell_2O_3(s) + HNO_3(aq) \rightarrow A\ell(NO_3)_3(aq) + H_2O(l)$

   a. Write down a balanced reaction equation for this reaction, including phase symbols. (4)

   b. What does the phase symbol (aq) mean? (2)

   c. What chemical law is verified by a balanced reaction equation? (2)
4. Write down chemical formulae for each of the following compounds:

   a. aluminium oxide

   b. sodium dichromate

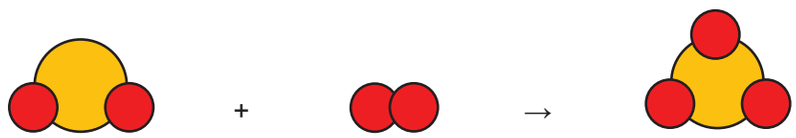
   c. iron(III) nitrate

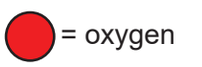
   d. potassium sulfite

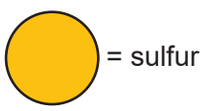
   e. calcium sulfide (5)
5. a. Balance the following chemical equation:

   $H_2(g) + C\ell_2(g) \rightarrow HC\ell(g)$ (2)

   b. Show that the number of atoms is conserved in this reaction. (4)
6. Write down a balanced chemical equation for the reaction between aluminium carbonate powder and dilute sulfuric acid. The products are aluminium sulfate, carbon dioxide and water. (5)
7. Write down a balanced reaction equation for the reaction represented by the following coloured circle diagram:







(3)

8. Draw circle diagrams to represent the following reaction:

   $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ (3)

TOPIC 13: Representing chemical change

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 37 MARKS

1. Consider the two reactions:

   I $H_2(g) + O_2(g) \rightarrow H_2O(l)$ and

   II potassium carbonate is heated to form potassium oxide and carbon dioxide gas.

   a. Write down a balanced reaction equation for reaction I. (2)

   b. Write down a balanced reaction equation for reaction II, including phase symbols. (4)

   c. State which reaction is a decomposition reaction and which is a synthesis reaction. (2)

2. Give the correct chemical names for the compounds represented by the following formulae:

   a. nitrogen trihydride
   b. magnesium phosphate
   c. diphosphorus trioxide
   d. aluminium fluoride (4)

3. Write down balanced reaction equations for the following:

   a. methane gas reacts with oxygen to form carbon dioxide and water.
   b. carbon monoxide gas reacts with oxygen to form carbon dioxide.
   c. sulfur dioxide reacts with water to form sulphurous acid. (10)

4. a. Write down a balanced reaction equation for the following:
      $ZnO(s) + HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2O(l)$ (2)

   b. Show that mass is conserved in this reaction. (7)

5. Write down balanced reaction equations for the following:

   a. $Fe(s) + HC\ell(aq) \rightarrow FeC\ell_3(aq) + H_2(g)$ (4)

   b. $BaC\ell_2(aq) + K_2SO_4(aq) \rightarrow BaSO_4(s) + + KC\ell(aq)$ (2)

GRADE 10: WORKSHEET MEMORANDUM

1. • There is a change in temperature ✓
   • There is a change in colour ✓
   • A gas is given off ✓
   • A precipitate is formed✓ (4)

2. a. I Fe_2O_3 + 3Zn✓ → 3ZnO✓ + 2Fe✓
   II 2KOH✓✓ + H_2SO_4 ✓→ K2SO4✓ + $2H_2O$✓✓ (9)

   b. Reactants:
   Fe_2O_3: M_r = (2 X 56) + (3 X 16)
   = 160 ✓
   3Zn: m = 3 X 65
   = 195 ✓
   Total reactants = 355 ✓

   Products:
   3ZnO: m = 3(65 + 16)
   = 243 ✓
   2Fe: m = 2 X 56
   = 112 ✓

   Total products = 355 ✓
   Mass of products = mass of reactants.✓ (7)

3. a. $Al_2O_3(s)$✓ + $6HNO_3(aq)$✓ → $2Al(NO_3)_3(aq)$✓ + $3H_2O(l)$✓ (4)

   b. (aq) means 'in aqueous solution' i.e. in water. ✓✓ (2)

   c. The law of conservation of matter is verified by a balanced chemical equation. (2)

4. a. Al_2O_3 ✓
   b. $Na_2Cr_2O_7$ ✓
   c. $Fe(NO_3)_3$ ✓
   d. K_2SO_3 ✓
   e. CaS ✓ (5)

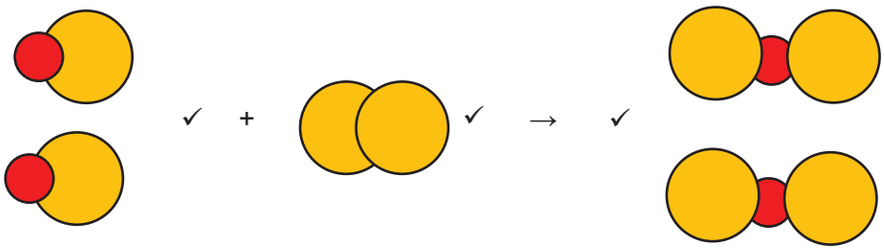
5. a. $H_2(g)$ + $Cl_2(g)$ → $2HCl(g)$ ✓ phases ✓ (2)

   b. Reactants:
   H: 2 atoms ✓
   Cl: 2 atoms ✓
   Products
   H: 2 X 1 = 2 atoms✓
   Cl: 2 X 1 = 2 atoms✓ (4)

6. $Al_2(CO_3)_3(s)$✓ + $3H_2SO_4(aq)$ ✓ → $Al_2(SO_4)_3(aq)$✓ + $3CO_2(g)$ ✓ + $3H_2O(l)$✓ (5)

7. $SO_2(g)$ ✓ + $O_2(g)$✓ → $2SO_3(g)$ ✓ (3)

8.



(3)

GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM — TOTAL: 37 MARKS

1. a. $H_2(g) + O_2(g)$ ✓ → $2H_2O(l)$ ✓ (2)

   b. $K_2CO_3(s)$✓ → $K_2O(s)$✓ + $CO_2(g)$✓ phases ✓ (4)

   c. I is synthesis ✓ II is decomposition ✓ (2)

2. a. NH_3 ✓

   b. $Mg_3(PO_4)_2$ ✓

   c. P_2O_3 ✓

   d. $A\ell F_3$ ✓ (4)

3. a. $CH_4(g)$ ✓ + $2O_2(g)$ ✓ → $CO_2(g)$ ✓ + $2H_2O(g)$ ✓

   b. $CO(g)$ ✓ + $O_2(g)$ ✓ → $CO_2(g)$ ✓

   c. $SO_2(g)$✓ + $H_2O(l)$✓ → $H_2SO_3(g)$ ✓ (10)

4. a. $ZnO(s) + 2HNO_3(aq)$✓ → $Zn(NO_3)_2(aq) + H_2O(l)$✓ (2)

   b. Reactants:

   $ZnO: M_r = 65 + 16$
   $= 81$ ✓
   $HNO_3: m = 2[1 + 14 + (3 \times 16)]$
   $= 126$ ✓

   Total reactants: $= 81 + 126$
   $= 207$✓

   Products:

   $Zn(NO_3)2: m = [65 + 2(14 + 3 \times 16)]$
   $= 189$ ✓
   $H_2O: M_r = (2 \times 1) + 16$
   $= 18$ ✓

   Total products $= 189 + 18$
   $= 207$ ✓

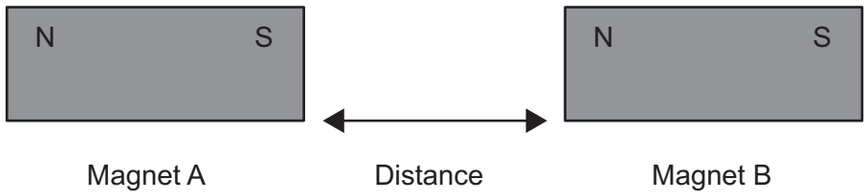
   Mass of products = mass of reactants ✓ (7)

5. a. $2Fe(s)$ ✓ + $6HC\ell(aq)$ ✓ → $2FeC\ell_3(aq)$ ✓ + $3H_2(g)$ ✓ (4)

   b. $BaC\ell_2(aq) + K_2SO_4(aq)$✓ → $BaSO_4(s) + 2KC\ell(aq)$ ✓ (2)

GRADE 10: WORKSHEET

1.



1.1 Would magnet A attract or repel magnet B? (1)

1.2 What would happen to the force of magnet A on magnet B if the distance between them is increased? (1)

1.3 Draw the magnetic field between the two magnets. (3)

2. What would happen to the poles of a magnet if the magnet were to be cut into two halves (as shown in the diagram below)?

(2)

3.1 Explain what is meant by "a magnetic field". (2)

3.2 Explain how the magnetic field lines indicate the strength of the magnetic field. (2)

3.3 Study the following information about these three magnets:

Pole B attracts Pole P. Pole Q repels Pole X.

Would the following poles *attract* or *repel* if they were brought close to one another?.

a. Pole B and Pole X. (1)

b. Pole A and pole Q. (1)

c. Pole B and pole Y. (1)

4. Which of the following statements is true concerning magnetic fields?

A They always begin on a north pole and travel to the south pole.
B They show both the direction and the strength of the magnetic field.
C They show the direction in which a positive charge will experience force.
D They only cross when multiple magnets are present. (2)

5. The earth's magnetic field is shaped like that of a bar magnet around it. The magnetic poles of the earth are not aligned with its geographic poles.

5.1 Explain what is meant by "the geographic north pole". (2)

5.2 Sketch the magnetic field of the earth. (3)

5.3 To which pole does the north pole of a compass needle point? (1)

5.4 Comment on this statement: "The north pole is actually a south pole". Is this statement true or false? Justify your answer. (4)

6. Migratory birds and sea turtles sense variations in the strength and inclination of the earth's magnetic field as they travel large distances across the world to mating grounds or beaches each year.

6.1 At which two places on the earth is its magnetic field the strongest? (2)

6.2 One theory which explain how birds manage to sense the magnetic field is that they contain very small particles of iron oxide (magnetite) in their beaks. Describe how the presence of iron oxide in its beak helps a bird to navigate. (4)

TOPIC 14: Magnetism

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 24 MARKS

1. Choose the most correct answer (A, B, C or D) for each of the following questions.

   1.1 Which of the following materials is not ferromagnetic?

   A iron
   B nickel
   C copper
   D chromium (2)

   1.2 Which of the following statements about magnetic fields is false?

   A The direction of a magnetic field is the direction towards which the north pole of a compass points due to the magnetic force on it.
   B Magnetic fields exist inside and outside magnets.
   C Magnetic field lines cross one another when there are more than two magnets present.
   D The magnetic field strength at the north pole of a magnet has the same size as that at its south pole. (2)

   1.3 The magnetic north pole is

   A located at the south pole.
   B is a south pole.
   C located at the top of the earth's spin axis.
   D located at the bottom of the earth's spin axis. (2)

2. The science class were asked to investigate the relative strength of the magnetic field at the north pole of a bar magnet before it was cut in half, and after it was cut in half. They measured the relative strength by counting the number of paper clips that could be suspended from the north pole of the magnet, and its "half magnet".

   2.1 Draw a neat sketch of the magnetic field of a bar magnet. (3)

   2.2 Explain how the paper clips are attracted to the bar magnet. (2)

   2.3 Give one reason why this method of using paper clips is a fairly good indicator of the field strength. (3)

   2.4 Give one reason why this method could produce faulty results. (2)

   2.5 Predict the outcome of this experiment. Justify your answer. (4)

   One group of learners found it very difficult to cut their bar magnet in half. They decided to place it on a stone (outside) and to saw through the magnet with an electrically powered saw. The bar magnet vibrated significantly during this process. When they tested their "half magnets" they found that no paper clips could be suspended from either of the pieces, whereas before cutting the magnet it had suspended 6 paper clips.

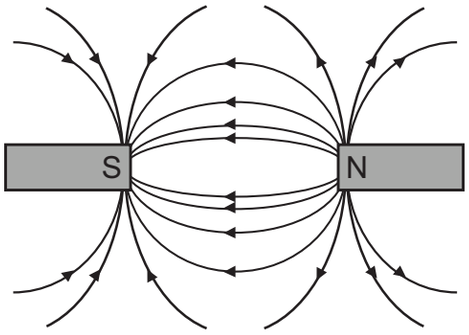
   2.6 Explain what could have happened to cause these results. (4)

GRADE 10: WORKSHEET MEMORANDUM

1.1 Attract ✓ (1)

1.2 Force of magnet A on magnet B decreases. ✓ (1)

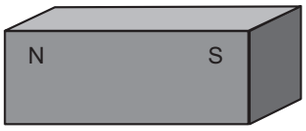
1.3

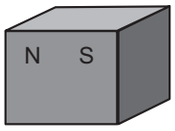


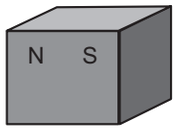
✓Correct pattern of field lines between magnets
✓Directed from north to south pole
✓South pole on left

(3)

2.







(2)

✓ ✓

3.1 A magnetic field is a region ✓in which a magnet or magnetic material experiences a magnetic force.✓ (2)

3.2 The magnetic field strength is greatest in those places where the field lines are closest to one another. ✓✓ (2)

3.3 a. repel ✓ (1)

b. attract ✓ (1)

c. attract ✓ (1)

4. B ✓✓

A is incorrect – magnetic field lines are continuous – they exist inside the magnet as well as outside.

C is incorrect – magnets have no effect on a stationary positive (or negative) charge.

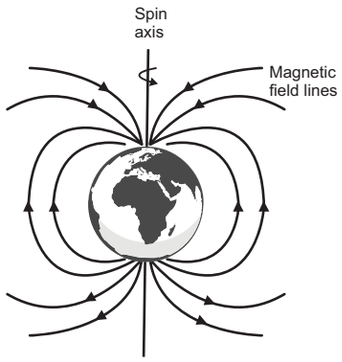
D is incorrect – magnetic field lines never cross. (2)

5.1 The geographic north pole is the point at the top of the earth's spin axis.✓✓ (2)

5.2 The magnetic field axis is about 11o to the left of the earth's spin axis. ✓

Magnetic field lines point inwards at the magnetic north. ✓

Correct pattern (similar to that of a bar magnet). ✓



(3)

5.3 towards magnetic north. ✓ (1)

5.4 The statement is ambiguous (unclear) because it does not tell you whether it is referring to the geographic or the magnetic north pole. ✓
It is true that the magnetic north pole is actually a south pole. ✓
It is false if it is referring to the geographic north pole ü because that is defined as geographic north. ✓ (4)

6.1 The magnetic ✓ north and south poles. ✓ (2)

6.2 Iron oxide (magnetite) is ferromagnetic. ✓ It experiences (magnetic) force in the earth's magnetic field. ✓ The bird is able to fly in the correct direction and to the correct position on earth because it can sense the earth's magnetic field ✓ and the inclination of the field lines. ✓ (Birds are taught where to fly by their parents and the flock).
NB Direction is linked to the of direction of the field – force of attraction / repulsion due to the field.
Position is linked to the inclination of the field. (4)

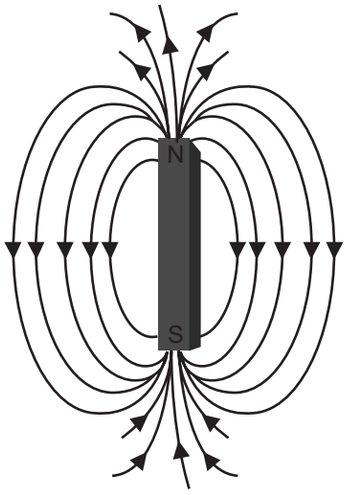
GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM — TOTAL: 24 MARKS

1.1 C ✓✓
Iron, nickel and chromium are ferromagnetic materials. (2)

1.2 C ✓✓
Magnetic field lines never cross one another. (2)

1.3 B ✓✓
The lines of magnetic field point inwards at the magnetic north pole, therefore it is a south pole. The north pole of a magnet is actually the north seeking pole. It points towards the magnetic north pole. (2)

2.1



(3)

2.2 Paper clips are made of iron✓ which is ferromagnetic✓ so they are attracted to magnets. (2)

2.3 The more paper clips the magnet is able to attract placed end to end, the greater the weight of the paper clips✓✓ and therefore the greater the force of attraction at that pole. ✓ (3)

2.4 a. The paper clips must all be placed end to end, and not placed randomly at the magnet's pole. ✓ We need to measure the force by the amount of weight the magnet's field can support at the pole. ✓

OR

b. Each time a paper clip is used it retains some of its magnetism. ✓ If the same paper clips are re-used to hang from the poles, you will have an inflated result (making the magnetic field seem stronger than it actually is. ✓ (2)

2.5 The halves of the magnet will support fewer paper clips. ✓✓ They have less magnetic material in them than the original magnet. ✓ It would contradict the law of conservation of energy if the half magnets had equal or greater magnetic field intensities. ✓ (4)

2.6 The two half magnets have been "demagnetised" (lost their magnetic fields). ✓ That is why they don't attract or support any paper clips✓ (they either have no magnetic field or its too weak for them to hold a paper clip in place.) The vibrations of the saw have disturbed the arrangement of the particles✓ inside the material so that they are no longer aligned ✓ (in their magnetic domains). (4)

GRADE 10: WORKSHEET

Choose the correct answer A, B, C or D for questions 1 and 2.

1. A plastic rod and a dry cloth are uncharged. The plastic rod is rubbed with the dry cloth and they both become charged. The rod becomes negatively charged because some particles move from the cloth to the rod.

   What is the charge on the cloth and which particles moved in the charging process?

	CHARGE ON ROD	PARTICLES THAT MOVED
A	Positive	Protons
B	Positive	Electrons
C	Negative	Protons
D	Negative	Electrons

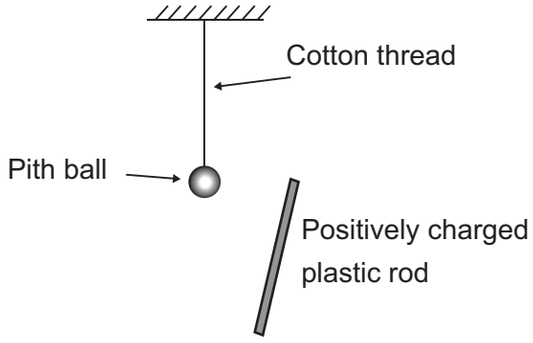
(2)

2. A positively charged plastic rod attracts small pieces of paper because …….

   A the paper pieces are negatively charged.
   B the paper pieces are neutral.
   C the paper pieces are very small.
   D the paper pieces become polarised.

(2)

3. A pith ball is a polystyrene sphere coated with metal paint.
   A plastic rod is charged by rubbing it with a cloth. It is held next to an uncharged pith ball that is suspended on light cotton thread.



3.1 Describe how the plastic rod becomes positively charges when it is rubbed with a cloth. (2)

3.2 Describe what happens in the metal paint on the pith ball when the positively charged plastic rod is brought near to it. (2)

3.3 The ball is attracted to the rod. Explain why this happens, given that the pith ball is uncharged. (2)

3.4 Predict what you would see if the pith ball touches the positively charged rod. (2)

3.5 Explain your prediction in 3.4. (2)

4. Two identical pith balls are suspended on light, inelastic cotton threads. Pith ball A has a positive charge of 5,4 nC. Pith ball B carries a negative charge of 8,2 nC.
   - 4.1 State the principle of quantization of charge. (2)
   - 4.2 Calculate the extra number of electrons added to pith ball B. (4)
   - 4.3 Describe the type of force that pith ball B exerts of pith ball A.
     The pith balls are brought up together, and then they are separated again to hang at the same original distance apart. (1)
   - 4.4 State the law of conservation of charge. (2)
   - 4.5 Use the law of conservation of charge to calculate the charge on pith ball B after it has touched pith ball A and is separated, and hangs back at its original position. (4)
   - 4.6 How many electrons were transferred from pith ball B to pith ball A when the pith balls touched each other? (4)
5. Draw a diagram to show why it is dangerous to take shelter under a lone tree in open veld during a thunderstorm. Write a brief description to explain your reasoning. (6)
6. Explain each of the following phenomena using your knowledge of electrostatics.
   - 6.1 When the air is very dry, your hand feels a small sharp electric shock when you touch a metal door knob after walking along the carpet to the door. (3)
   - 6.2 When a charged plastic ruler is brought close to small pieces of paper the paper pieces are attracted to the ruler. (3)

TOPIC 15: Electrostatics

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 34 MARKS

FORMULA: $Q=nq$ CONSTANT: $q = 1{,}6 \times 10^{-19}\ C$

q = Charge on an electron.

1. Choose the most correct answer (A, B, C or D) for each of the following questions.

1.1 A positively charged rod is brought near to the following objects.

i. Small uncharged pieces of paper
ii. A thin stream of water
iii. A positively charged balloon
iv. A negatively charged cloth

Which of these objects will not be attracted to the rod?

A i) ii) and iii)
B i) iii)
C ii) iii)
D iii) (2)

1.2 When a charged object becomes polarised, it

A gains electrons
B loses electrons
C gains a north and a south pole
D experiences a shift in charge (2)

1.3 A neutral object has

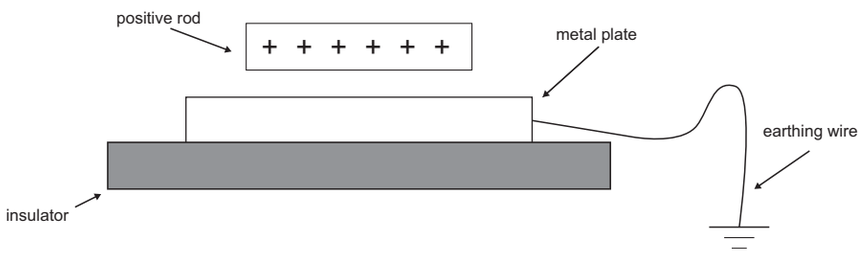
A no charges
B no magnetic field
C more neutrons than protons and electrons
D no imbalance in charge (2)

1.4 Two identical positively charged pith balls are brought up to touch one another, and then moved apart to their original distance. Initially the first pith ball A carried twice as much charge as the second pith ball B. When they have separated both pith balls each carry a charge of +6 nC. What was the original charge on the pith balls?

	Pith ball A	Pith ball B
A	12	0
B	8	4
C	6	6
D	3	3

(2)

2. A positively charged plastic rod is placed above a thick metal plate. The metal plate is connected to the earth by a wire. The metal plate rests on an insulator.



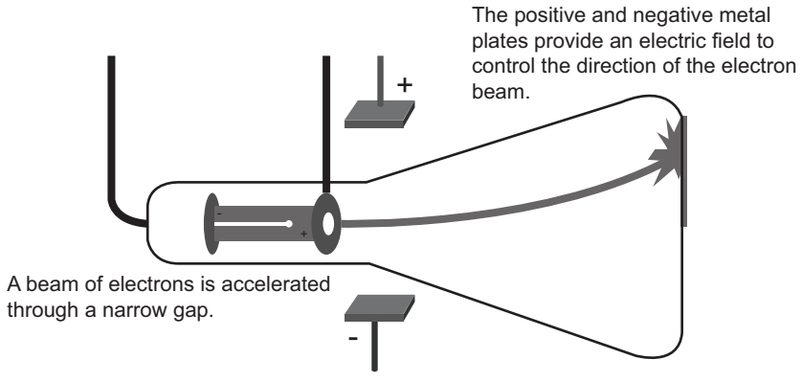
A learner disconnects the earthing wire and then removes the positively charged rod. The experiment is repeated. On the second attempt, the learner removes the positive rod, and then disconnects the earthing wire.

2.1 Initially the metal plate is earthed. Explain what happens when the positively charged rod is placed above the metal plate while the earthing wire remains attached to it. (4)

2.2 When the earthing wire is disconnected and then the positively charge rod is removed, what charge (if any) remains on the metal plate? Explain your answer. (4)

2.3 On the second attempt, the positive rod is removed first, and then the earthing wire is disconnected. What is the charge (if any) on the metal plate now? Explain your answer. (4)

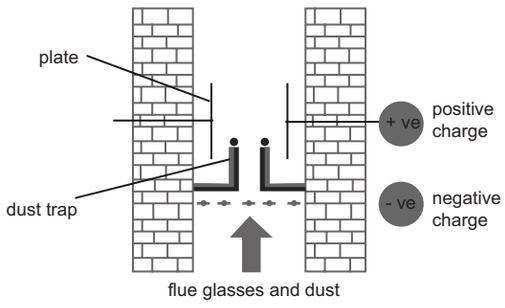
3. Inside a cathode ray tube such as those that were used in the "old fashioned TV sets" the direction of a beam of electrons is controlled by oppositely charged plates. Study the simplified diagram shown below.



3.1 Explain how the direction of the beam of electrons is controlled by the positive and negative plates. (4)

3.2 These types of TV sets collect dust particles on their screens. Explain why dust particles tend to stick to the screens of these types of TV sets. (4)

4. An electrostatic smoke precipitator collects smoke (carbon) particles and dust from a coal-fired furnace. The diagram below shows how the particles are collected. The flue gases and dust enter through a grid which is negatively charged. They then pass through positively charged plates, and fall into the dust trap. The dust trap is cleaned frequently so that the precipitator does not become clogged up.



Explain how the precipitator works in terms of electrostatic principles. (6)

GRADE 10: WORKSHEET MEMORANDUM

1. B ✓✓
   The cloth becomes positively charged when it loses electrons to the rod. (2)

2 D✓✓
The positively charged rod attracts negative charge (electrons) in the paper pieces, causing the molecules inside the paper to become polarised. The negative parts of the molecules are attracted to the rod.
Options B and C are true but i\each of them is not the reason why the paper pieces are attracted to the rod, therefore they are incorrect answers to this question. (2)

3.1 Electrons are transferred from the rod to the cloth. ✓ The rod has less electrons than protons in it therefore it is positively charged.✓ (2)

3.2 The metal paint has free electrons (electrons which are free to move around). ✓ When the positive rod is brought near to it, the electrons in the paint move to one side of the pith ball near the positive rod. ✓ (2)

3.3 The movement of electrons to one side of the pith ball causes the ball to be polarised. ✓
The negative side of the ball is attracted to the positive rod. ✓ (2)

3.4 The pith ball will touch the rod and then spring away (be repelled) by it. ✓✓ (2)

3.5 When the pith ball touches the rod it will transfer electrons to the rod✓(it will share charge with the rod). Both pith ball and rod will have a positive charge (lack of electrons) ✓ so they repel each other. (2)

4.1 Every charge in the universe consists of integer multiples of the electron charge✓✓ (2)

4.2 Q = nq✓
$8,2 \times 10^{-9}$ ✓= n x $1,6 \times 10^{-19}$✓
n = $5,13 \times 10^{10}$ ($5,125 \times 10^{10}$) (4)

4.3 attraction ✓ (towards A) (1)

4.4 The net charge of an isolated system✓ remains constant during any physical process.✓ (2)

4.5

Total charge = 5,4 + (-8,2)✓	method	
= -2,8✓ nC	accuracy	
Charge on each pith ball = ½ ✓x 2,8	method	
= 1,4 nC ✓ ($1,4 \times 10^{-9}$ C)	accuracy	
	SI units (nC or C)	(4)

4.6

Q = nq		
$1,4 \times 10^{-9} = n \times 1,6 \times 10^{-19}$ ✓	substitutions	
$n = 8,75 \times 10^{9}$ ✓	accuracy	
Number of electrons transferred = ($5,125 \times 10^{10}$) – ($8,75 \times 10^{9}$) ✓	method	
= $4,25 \times 10^{9}$ ✓	accuracy	(4)

5. Lightning strikes when there is a large imbalance of charge between the earth and the base of the cloud.✓
The negative charge on the base of the cloud repels electrons deeper into the earth ✓ causing the surface and the tree tops to be positively charged. ✓ If you shelter under a tree you are very likely to be struck because the tree attracts the lightning strike due to its height above the ground. ✓

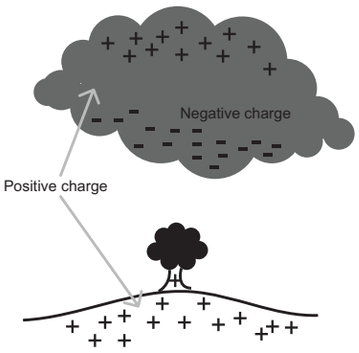


Diagram: Clouds charged negatively at base✓
Tree and surface oppositely charged✓ (6)

6.1 When the air is very dry not much water vapour is present, so charge will remain on objects for longer. ✓ As you walk along charge builds up on your body (and your hand) because your feet (shoes) are rubbing electrons on (or off) the carpet. ✓The door handle is metal – it conducts the excess charge away from your hand. ✓ You feel this as an electric shock. (3)

6.2 When a charged plastic ruler is brought close to small pieces of paper the molecules on the surface of the paper are become polarised. ✓✓ Opposite charge attracts ✓ so the paper pieces are attracted to the ruler. (3)

GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM TOTAL: 34 MARKS

1.1 D ✓✓
Like charges repel each other.
Neutral objects are attracted to charged objects by polarisation of their molecules. (2)

1.2 D ✓✓
Polarisation is a shift in charge inside the molecule (or object). (2)

1.3 D ✓✓
A neutral object has an equal number of positive and negative charges. It has no imbalance of charge. (2)

1.4 B ✓✓
Charge on each = 6 nC
Total charge = 6 + 6 = 12 nC
Both pith balls were initially positively charges so Option A is incorrect.
Option C is incorrect because they were not equally charged.
Option D is an impossible answer. (2)

2.1 Extra electrons✓ are attracted by the positive rod✓ from the earth✓ through the wire to the top surface of the metal.✓ (4)

2.2 Negative.✓✓
Extra electrons✓ moved from earth through the wire onto the metal.✓ (4)

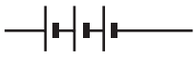
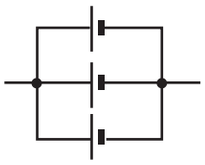
2.3 No charge.✓✓
The extra electrons move back to earth through the wire✓✓ when the rod is removed. (4)

3.1 Electrons are negatively charged particles.✓ They are attracted to the positively charged plate (repelled by the negatively charged plate)✓ so the beam of electrons can be moved up and down by changing the amount✓ and the type of charge✓ on the plates. (4)

4. The dust and smoke particles gain electrons✓ and become negatively charged when they pass through the negative grid.✓ Opposite charges attract each other. ✓ The dust and smoke particles are attracted to the positively charged plates. ✓ They lose their extra electrons and become positively charged. ✓ The positive plates repel them away ✓ so they fall into the dust trap.✓ (6)

GRADE 10: WORKSHEET

1. The three cells (batteries) shown in the following two diagrams are identical. Each cell has an emf of 1,5 V.

Diagram A   Diagram B

1.1 Which diagram (A or B) shows the three cells connected in series? (1)

1.2 Explain what is the emf of a cell. (2)

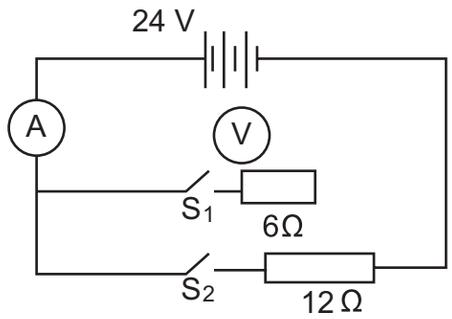
1.3 Calculate the total emf of the battery of three cells connected in series. (2)

1.4 Calculate the total emf of the battery of three cells connected in parallel. (2)

1.5 Give one advantage of connecting cells in parallel. (1)

2. A 12 V battery supplies a maximum of 120 J of energy when charge passes through it. Calculate the amount of charge passing through the battery. (4)

3. When three cells are connected in series, the total emf of the battery is 24 V. Two resistors are connected in parallel with switches S_1 and S_2 as shown in the diagram below, and connected to the battery. An ammeter (A) reads the current passing through the battery and voltmeter(V) reads the potential difference across the 6 Ω resistor. The cells and ammeter have negligible resistance. The voltmeter has a very high resistance.



3.1 Calculate the emf of each cell. (2)

3.2 Determine the reading on the voltmeter when switch S_1 is open. (1)

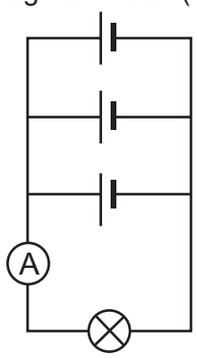
3.3 Determine the reading on the voltmeter when S_1 is closed. (1)

3.4 Determine the reading on the voltmeter when S_1 and S_2 are closed. (1)

3.5 Calculate the equivalent resistance of the two resistors in parallel. (4)

3.6 Calculate the reading on the ammeter when switches S_1 and S_2 are closed. (4)

4. Three 2 V cells are connected in parallel to an ammeter and a light bulb, as shown in the diagram alongside. The current through ammeter (A) is 6 A.



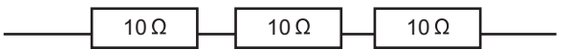
4.1 Calculate the emf of the battery. (2)

4.2 Calculate the resistance of the light bulb. (4)

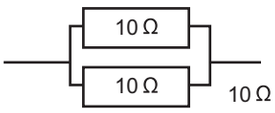
4.3 Determine the current passing through each cell. (2)

4.4 Give one advantage of connecting cells in parallel. (1)

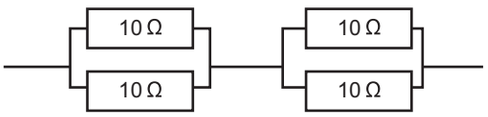
5. All the resistors in the following diagrams are identical. Each resistor has a resistamnce of 10 Ω. Calculate the effective resistance of each combination of resistors.

5.1 

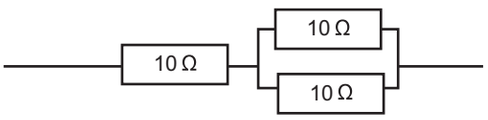
(2)

5.2 

(3)

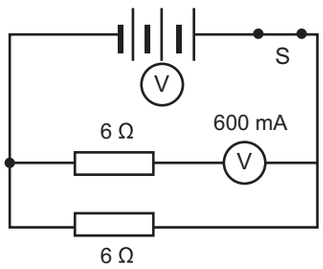
5.3 

(3)

5.4 

(3)

6. Three identical cells are connected in series to make a battery. The battery is connected to two identical 6 Ω resistors which are in parallel. When the switch S is closed the ammeter reads the current in one of the parallel branches as 600 mA.



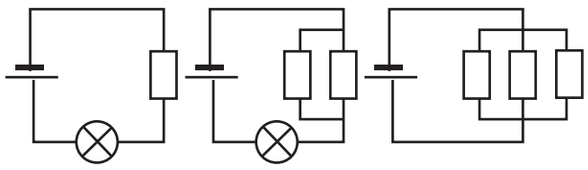
6.1 Determine the current through the other parallel branch. (2)

6.2 Calculate the potential difference across the battery. (4)

6.3 Calculate the current passing through the battery. (2)

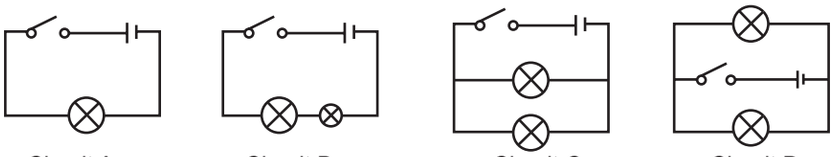
7. Study the three circuit diagrams shown below.
The cells, light bulbs and resistors are identical in each circuit.

Circuit 1 Circuit 2 Circuit 2



In which circuit will the light bulb glow the brightest? Show your reasoning. (4)

8. Four circuit diagram are shown below. Each circuit uses an identical cell, and identical light bulbs.



Circuit A Circuit B Circuit C Circuit D

The switch in each of the four circuits is closed.

8.1 In which circuit(s) are the light bulbs brightest? (A, B, C and/or D) (3)

8.2 Compare the brightness of the bulb in Circuit A with the brightness of the bulbs in Circuit C. (2)

8.3 Compare Circuit C with Circuit D. (2)

9.1 Explain what is meant by “the current is 2 A”. (4)

9.2 Calculate the charge that passes through the resistor when a steady current of 2 A is maintained for 2 minutes. (4)

9.3 Explain what is meant by “the potential difference across the resistor is 4 V”. (4)

9.4 Calculate the energy transferred by the charge when a steady current of 2 A is maintained for 2 minutes. (4)

9.5 Explain what is meant by resistance in an electric circuit. (2)

9.6 Calculate the resistance of the resistor. (4)

GRADE 10: CONSOLIDATION QUESTIONS — TOTAL: 40 MARKS

Formulae:

$$R = \frac{V}{I} \qquad V = \frac{W}{Q} \qquad I = \frac{Q}{\Delta t}$$

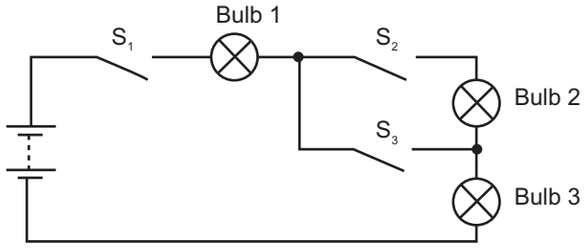
$$Rseries = R_1 + R_2 + R_3 + ...$$

$$\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

For two resistors in parallel $R_{parallel} = \frac{R_1 R_2}{R_1 + R_2}$

1. Choose the most correct answer (A, B, C or D) for each of the following questions.

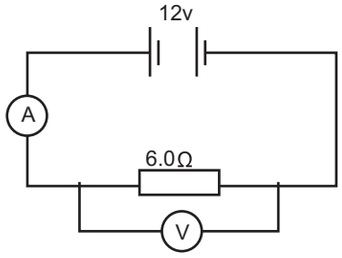
1.1 The diagram shows a circuit containing three bulbs and three switches.



Bulb 1 and Bulb 3 are lit, but Bulb 2 is not lit.
Which switch/es is/are closed?

A S only
B S_2 only
C S_1 and S_3
D S_2 and S_3 (2)

Refer to the circuit shown below to answer both Question 1.2 and 1.3.



The ammeter reads 2,0 A and the voltmeter reads 12 V.

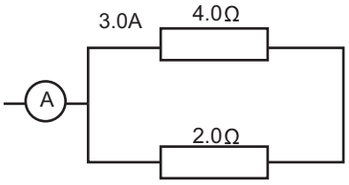
1.2 How much charge passes through the resistor in 10 seconds?

A 2,0 C
B 20 C
C 12 C
D 120 C (2)

1.3 How much energy is transferred by the resistor in 10 seconds?

A 2,4 J
B 14,4 J
C 240 J
D 144O J (2)

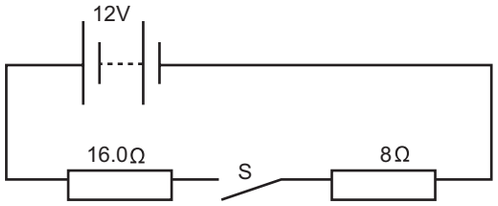
1.4 The diagram below shows part of an electrical circuit.



The current in the 4,0 Ω resistor is 3,0 A.
What is the current through the ammeter?

A 4,5 A
B 6,0 A
C 9,0 A
D 12,0 A (2)

2. The electric circuit shown below contains a battery, two resistors, a switch and another component.



2.1 Name the other component. (1)

2.2 Which quantity does this instrument measure? (1)

2.3 The switch is closed so that current passes through the circuit. What flows in the circuit to create the current? Choose one of the following quantities:

charge	potential difference	energy	resistance

(1)

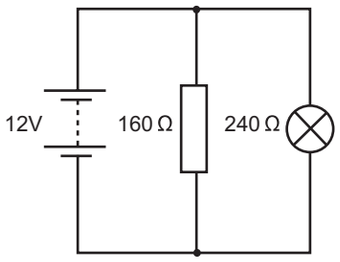
2.4 Calculate the equivalent resistance of the two resistors. (3)

2.5 Calculate the current in the circuit. (4)

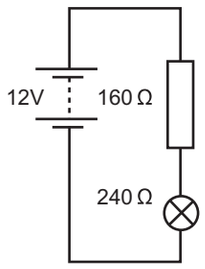
2.6 When is the reading the switch is opened, what is the potential difference across the 16 Ω resistor? (2)

3. Circuit 1 and Circuit 2 consist of a 12 V battery connected to a 160 Ω resistor and a light bulb with a resistance of 240 Ω.

Circuit 1



Circuit 2



3.1 Describe the arrangement of the resistor and light bulb in Circuit 1. (1)

3.2 Calculate the equivalent resistance of Circuit 1. (4)

3.3 Calculate the current through the light bulb in Circuit 1. (4)

3.4 Calculate the equivalent resistance of Circuit 2. (2)

3.5 Calculate the current through the light bulb in Circuit 2. (3)

3.6 Calculate the potential difference across the light bulb in Circuit 2. (3)

3.7 In which circuit (1 or 2) does the light bulb shine the brightest? Justify your answer. (3)

GRADE 10: WORKSHEET MEMORANDUM

1.1 Diagram A✓ (1)

1.2 The emf of a cell is the potential difference across its terminals✓ when no current passes through it. ✓ (2)

1.3 Total emf of three cells in series = 1,5 + 1,5 + 1,5 ✓ method
= 4,5 V✓ accuracy; Si units (2)

1.4 Total emf of three cells in parallel = 1,5 V✓✓ accuracy; Si units (2)

1.5 Cells in parallel share the work load ✓so they provide energy for (three times as long) longer than cells in series. (1)

2.
$V = \frac{W}{Q}$ ✓ method
12✓ = $\frac{120}{Q}$ ✓ substitutions
$Q = \frac{120}{12}$
= 10 C✓ accuracy; SI units (4)

3.1 Total emf = 24 V
Each cell's emf = $\frac{total\ emf}{number\ of\ cell\ in\ series}$ ✓ method (can be implied)
= $\frac{24}{3}$
= 8 V✓ accuacy; SI units (2)

3.2 24 V✓ accuracy; SI units (1)

3.3 24 V✓ accuracy; SI units (1)

3.4 24 V✓ accuracy; SI units (1)

3.5
$\frac{1}{R_{eq}} = \frac{1}{R^1} + \frac{1}{R_2}$ ✓ method
$= \frac{6 \times 12}{6+12}$ ✓ substitutions
$= \frac{72}{18}$
$R_{eq} = \frac{12}{3}$ ✓ finding Req by finding the inverse
= 4 Ω✓ accuarcy; SI units

ALTERNATIVE METHOD =
$R_{eq} = \frac{R_1 R_2}{R_{1+} R_2}$ ✓ method (can be implied)
$= \frac{6 \times 12}{6+12}$ ✓ substitutions
$= \frac{72}{18}$ ✓
= 4 Ω✓ accuarcy; SI units (4)

3.6 $R = \frac{V}{I}$ ✓ method

4✓ = $\frac{24}{I}$ I✓ substitutions (c.o.e.)

I = $\frac{24}{4}$

= 6 A✓ accuracy; SI units (4)

4.1 9 V ✓✓accuarcy; SI units (2)

4.2 $R = \frac{V}{I}$ ✓ method

= $\frac{9}{6}$ ✓✓ substitutions

= 1,5 Ω✓ accuracy; SI units (4)

4.3 I = $\frac{6}{3}$ ✓ method (cells share the current)

= 2 A ✓ accuarcy; SI units (2)

4.4 The cells share the work load therefore they provide energy for (three times) longer. ✓ (1)

5.1 $R_{series} = R_1 + R_2 + R_3$✓ methoid

= 10 + 10 + 10

= 30 Ω✓ accuarcy; SI units (2)

5.2 $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ method

= $\frac{1}{10} + \frac{1}{10}$ ✓ substitutions

= $\frac{2}{10}$

R_{eq} = $\frac{2}{10}$

= 5 Ω✓ accuarcy; SI units

ALTERNATIVE METHOD

R_{eq} = $\frac{R_1 R_2}{R_1 + R_2}$ ✓ method (can be implied)

= $\frac{10 \text{ x } 10}{10 + 10}$ ✓ substitutions

= $\frac{100}{20}$

= 5 Ω✓ accuarcy; SI units (3)

5.3 From the answer in 5.2, we know that two 10 Ω resistors in parallel have an equivalent resistance of 5 Ω✓. (Allow c.o.e.)

R_{eq} = 5 + 5✓ parallel circuits in series

= 10 Ω✓ accuracy; SI units (3)

5.4 R_{eq} = 10 + 5 10 Ω in series✓ with parallel resistors✓

= 15 Ω✓ accuarcy; SI units (3)

6.1 600 mA (0,6 A)✓✓ (2)

6.2

R= $\frac{V}{I}$ ✓	method	
6 ✓= $\frac{v}{0.600}$ ✓	substitutions; conversion of mA to A	
V = 3,6 V✓	accuracy; SI units	(4)

6.3 I = 600 + 600 ✓

= 1 200 mA (1,2 A) ✓ (2)

7. Circuit 3 ✓
When resistors are added in parallel the total resistance of the circuit decreases.✓
The current increases when there is less resistance. ✓
The light bulb glows brighter when more current passes through it.✓ (4)

8.1 Circuits A✓ C✓ and D✓ (3)

8.2 The bulb in Circuit A is brighter than the bulbs in Circuit B. ✓ Circuit A has less resistance (OR the current in Circuit A is greater than the current in Circuit B) ✓ (2)

8.3 Circuit C is the same as Circuit D. ✓ Two light bulbs in parallel with the battery (cell) and switch. ✓ (2)

9.1 The rate ✓ of flow of charge ✓is 2 C✓ per second. ✓ (4)

9.2

I= $\frac{Q}{\Delta t}$ ✓	method	
2✓ = $\frac{Q}{2 \text{ x } 60}$ ✓	substitutions; conversion of minutes to seconds	
Q = 240 C✓	accuracy; SI units	(4)

9.3 The energy transferred✓ per unit charge across the ends of the resistor✓ is 4 J✓ per second. ✓ (OR 4 J·s^{-1}✓✓). (4)

9.4

V= $\frac{W}{Q}$ ✓	method	
4✓ = $\frac{W}{240}$ ✓	substitutions; c.o.e. from 9.2	
W = 960 J✓	accuracy; SI units	(4)

9.5 The resistance is the opposition to the flow of charge. ✓✓ (2)

9.6

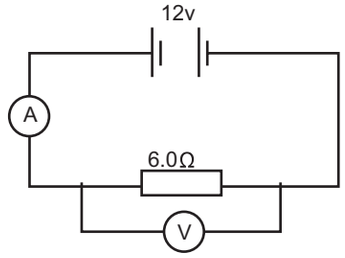
R= $\frac{V}{I}$ ✓	method	
= $\frac{4}{2}$ ✓✓	substitutions	
= 2 Ω✓	accuracy; SI units	(4)

GRADE 10: CONSOLIDATION QUESTIONS MEMORANDUM — TOTAL: 40 MARKS

1.1 C✓✓

The current must pass through Bulb 1 and Bulb 3, therefore S1 and S3 must be closed. (2)

Refer to the circuit shown below to answer both Question 1.2 and 1.3.



The ammeter reads 2,0 A and the voltmeter reads 12 V.

1.2 B✓✓

$$I = \frac{Q}{\Delta t}$$

$$2{,}0 = \frac{Q}{10}$$

Q = 20 C (2)

1.3 C✓✓

V= W/Q

12 = W/20

W = 240 J (2)

1.4 C✓✓

$$R = \frac{V}{I}$$

$$4{,}0 = \frac{V}{3{,}0}$$

V = 12,0 V

$$R = \frac{V}{I}$$

$$2{,}0 = \frac{12{,}0}{I}$$

I = 6,0 A

$I_{total} = I_1 + I_2$

= 3,0 + 6,0

= 9,0 A (2)

2.1 Ammeter ✓ (1)

2.2 Current ✓ (1)

2.3 Charge ✓ (1)

2.4

Req = R1 + R2✓	method	
= 16,0 + 8,0✓	substitutions	
= 24,0 Ω✓	accuracy; SI units	(3)

2.5

R= $\frac{V}{I}$ ✓ method

24,0 ✓= $\frac{12}{1}$ ✓substitutions

I= $\frac{12,0}{24,0}$

= 0,5 A✓ accuracy; SI units (4)

2.6

R= $\frac{V}{I}$

16,0 = $\frac{V}{0,5}$ ✓ substitutions

V = 8,0 V✓ accuracy; SI units

OR Using the method of potential dividers:

16,0 : 8,0 = 2: 1

The pd divides into 3 parts.

The 16,0 Ω resistor has $\frac{2}{3}$ ✓of 12,0 V = 8,0 V✓ (2)

3.1 in parallel✓ (1)

3.2

$\frac{1}{R_{eq}}$ = $\frac{1}{R_1} + \frac{1}{R_2}$ ✓ method

= $\frac{1}{160} + \frac{1}{240}$ ✓ substitutions

= 1/80 inverting the answer

R_{eq} ✓ = 80 Ω✓ accuracy; SI units

OR ALTERNATIVE METHOD

R_{eq} = $\frac{R_1 R_2}{R_1 + R_2}$ ✓ method

= $\frac{160 \text{ x } 240}{160 + 240}$ substitutions

= 80 Ω✓ accuracy; SI units (4)

3.3

R= $\frac{V}{I}$ ✓ method

80,0 ✓= $\frac{12,0}{I}$ ✓ substitutions

I= 12,0/80,0

= 0,15 A✓ accuracy; SI units (4)

3.4

R_{eq} = R_1 + R_2✓ method

= 160 + 240

= 400 Ω✓ accuracy; SI units (2)

3.5

$$R = \frac{V}{I}$$

$$400{,}0\ \checkmark = \frac{12{,}0}{I}\ \checkmark \qquad \text{substitutions}$$

$$I = \frac{12{,}0}{400{,}0}$$

$$= 0{,}03\ \text{A}\checkmark \qquad \text{accuracy; SI units} \qquad (3)$$

3.6

$$R = \frac{V}{I}$$

$$240{,}0\ \checkmark = \frac{V}{0{,}03}\ \checkmark \qquad \text{substitutions}$$

$$V = 240{,}0 \times 0{,}03$$

$$= 7{,}2\ \text{V}\checkmark \qquad \text{accuracy; SI units} \qquad (3)$$

3.7 Circuit 1✓

The pd across the light bulb is much greater in Circuit 1✓ therefore more energy is transferred per unit charge through the bulb in Circuit 1. ✓

OR The current through the bulb in Circuit 1 is $\frac{240}{400} \times 0{,}15\checkmark = 0{,}09\ \text{A}\checkmark$ which is three times greater than the current in Circuit 2. (3)