Grade 10

PHYSICAL SCIENCES

EXAM

Time: 2 hours **Marks: 120**

INSTRUCTIONS AND INFORMATION

Read the following carefully before answering the questions that follow:

1. Answer **ALL** the questions. Answer Section A on the answer sheet provided
2. Number the questions exactly as the questions are numbered.
3. Start the answer to each question at the top of a new page.
4. All sketches are to be done in pencil and labelled in ink.
5. Write neatly and legibly.
6. You may use non-programmable calculators.
7. You may use mathematical instruments.
8. The diagrams in the question paper are not necessarily drawn to scale.
9. Give brief motivations, discussions, etc. where required.
10. Attach the answer sheet to the inside cover of your exam book.

SECTION A
Answer the following questions on the answer sheet provided.

QUESTION 1

There are four possible options for each answer in the following questions. Each question has only ONE correct answer. Choose the correct answer and write only A, B, C or D next to the question number.

1.1 In an exothermic reaction, the following occurs:

A the reacting substances gain chemical energy
B the surroundings gain thermal energy
C the products of the reaction have more mass than the reactants
D the temperature of the reacting mixture decreases. (2)

1.2 The industrial process for producing ammonia works more efficiently when:

A the temperature and pressure are low
B the temperature is low and the pressure is high
C the temperature is high and the pressure is low
D the temperature and pressure are high. (2)

1.3 The melting point of ice can be lowered by:

A increasing the pressure on ice
B raising the temperature
C the polarity of water molecules
D purifying water. (2)

1.4 James sets up a circuit to determine the conductivity of certain solids. What piece of apparatus is not required for the experiment?

A battery
B light bulb
C conducting wires
D stopwatch (2)

1.5 The outer electron structure of a magnesium ion is exactly the same as:

A sodium
B neon
C argon
D calcium. (2)

[10]

QUESTION 2

The following statements are **FALSE**. Write only the question number and the correct statement.

2.1 Ice and steam are physically identical compounds. (2)

2.2 The regions around the equator receive sunlight at a more oblique angle. (2)

2.3 Table salt crystals conduct electricity at room temperature. (2)

2.4 Mercury and fluorine are usually liquid at room temperature. (2)

2.5 All solid substances are more dense than their liquid form. (2)

[10]

QUESTION 3

Give one word or term for each of the following descriptions. Write only the word or term next to the question number.

3.1 A reaction in which a compound breaks down to form two or more different substances. (1)

3.2 The process caused by a gradual increase in the concentration of phosphorus, nitrogen and other plant nutrients in a lake. (1)

3.3 A reaction that results in the formation of an insoluble salt. (1)

3.4 The energy required to change water at 100 °C degrees to water vapour at 100 °C. (1)

3.5 The energy required to remove an electron from a neutral atom in the gaseous phase. (1)

[5]

TOTAL FOR SECTION A - 25 marks

SECTION B

Answer the questions form Section B in the answer book provided.

QUESTION 4

Julianne and Thabo are investigating temperature changes in chemical reactions. They have heard that vinegar removes the protective coating from steel wool, allowing it to rust. When iron combines with oxygen, heat is released. They use a Styrofoam cup with a lid to investigate this report.

Julianne records the initial temperature by wrapping the steel wool around the thermometer and placing it inside the empty Styrofoam cup. She records the temperature after 2 min. Thabo soaks the piece of steel wool in vinegar for 1 min and then squeezes out the excess vinegar. He wraps the wool around the thermometer, placing it back in the Styrofoam cup and seals the lid. He records the temperature after 15 min. The temperature has increased from 22 °C to 26 °C.

4.1	Suggest a suitable hypothesis for this investigation.	(1)
4.2	What is the independent variable?	(1)
4.3	What is the dependent variable?	(1)
4.4	What conditions must remain constant for this experiment to be accurate?	(1)
4.5	Write a balanced equation to show that iron reacts with oxygen to form iron oxide.	(3)
4.6	Is this an example of a synthesis or a decomposition reaction? Give a reason for your answer.	(2)
4.7	Is this reaction endothermic or exothermic? Give a reason for your answer.	(2)
4.8	Write a suitable conclusion to this experiment.	(2)
4.9	Predict what would occur if Julianne used pure oxygen instead of air in this reaction?	(2)
4.10	Name ONE exothermic reaction that is used in everyday life and a benefit of its use.	(2)

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QUESTION 5

Magnesium burns in oxygen to form magnesium oxide, a white powder. John and Miriam want to investigate whether the mass of this reaction will be conserved. They react a known mass of magnesium with oxygen in a closed crucible to prevent the loss of the product. Heat is given off.

5.1 State the Law of Conservation of Mass. (2)

5.2 Write a balanced chemical equation to represent this reaction. (3)

5.3 What type of bond exists between the atoms of the product? (1)

5.4 Classify this reaction as a synthesis or decomposition reaction. Give a reason for your answer. (2)

5.5 Classify this reaction as exothermic or endothermic. Give a reason for your answer. (3)

John re-weighs the crucible at the end of the experiment and calculates that the mass of magnesium oxide is greater than the mass of magnesium originally used.

5.6 Miriam states that this experiment does NOT agree with the Law of Conservation of Mass, since the crucible had a greater mass after the experiment. Explain why there was an increase in mass. (2)

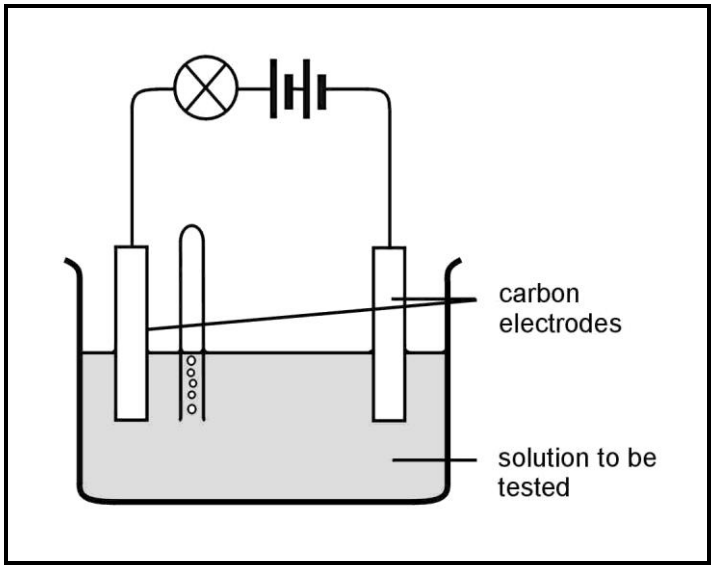
5.7 Magnesium burns with a brilliant white light. Name TWO safety measures that John and Miriam should take when performing this experiment. Give a reason for each answer. (4)

5.8 Chemicals can be dangerous, as one may not know how they react. Why is it important that every person performing experiments adheres to safety rules of the laboratory? (2)

[19]

QUESTION 6

Sanele and Roland want to investigate the electrical conductivity of a salt solution. They know that copper (II) chloride crystals do not conduct electricity when they are in the solid state. They set up the following apparatus:



They notice that the light bulb lights up. Gas bubbles form at the anode and collect in the inverted test tube. Copper is deposited on the carbon electrode.

6.1 Suggest a suitable investigative question. (2)

6.2 Explain how the burning light bulb indicates the flow of electricity. (2)

6.3 What is an electrolyte? (2)

6.4 Explain why solid copper chloride crystals do not conduct electricity. (2)

6.5 What happens when the copper chloride crystals are dissolved in water that allows them to conduct electricity? Explain your answer in terms of the position and motion of particles of copper chloride and water. (3)

6.6 Explain why the test tube is inverted into the copper chloride solution. (1)

6.7 Why were graphite electrodes used? (1)

6.8 Predict what you would expect to see if the concentration of the copper chloride solution was increased. (2)

[15]

QUESTION 7

Read the passage below and then answer the questions that follow.

Geyser Blankets

Many South Africans have been frustrated with the recent power shortages. Power stations are struggling to supply the ever-increasing demand for electricity. In a middle-class household, as much as 30% to 40% of the electricity bill may be due to the heating of water in an electric geyser. In an attempt to save electricity, some municipalities have offered to install free geyser blankets to all households and schools.

Electric geysers heat water using an electric element similar to one inside a kettle. It is controlled by a thermostat, which switches the element on when the water has cooled to a certain temperature and then switches the element off again when the water has heated to a specific temperature. Once the element is switched off, most of the heat is lost by heat transfer out of the geyser and the metal pipes.

A geyser blanket is a 50 mm layer of insulating material with an air gap. The material is usually made of glass fibre and it is covered with reflective foil sheeting on one side. Geyser blankets are wrapped around geysers and secured with an adhesive (sticky) tape. They are designed to minimise the heat lost through the body of the geyser. Studies have shown that there is as much as a 30% reduction in electricity used to heat water.

7.1 Jane reads the article above and makes the following statement:

"Geyser blankets reduce electricity consumption because they heat the water instead of using electricity to heat it."

This explanation is incorrect. Explain the error in the Jane's reasoning. (2)

7.2 Explain how a geyser blanket does reduce electricity usage. (2)

7.3 Explain how the material of a geyser blanket is suited to its function. (2)

7.4 A certain household's electricity bill is R280 a month. If R98 of this is spent on heating water in an electric geyser, calculate how much money they could save by using a geyser blanket. (2)

7.5 Suggest TWO ways that the distribution of free geyser blankets would help the social and/or economic development of a community. (4)

[12]

QUESTION 8

Iodine is an element that exists as two isotopes, one of which is $^{53}_{131}\mathrm{I}$. This form of iodine is poisonous as it is radioactive. It is used successfully in the treatment of thyroid cancer. The thyroid is the only organ in the body that absorbs iodine. When a patient is given radioactive iodine it is absorbed into the thyroid, where the cancer cells are killed from the inside out by this poisonous iodine.

8.1 What are isotopes of an element? (2)

8.2 How many protons and neutrons does the above isotope contain? (2)

8.3 Another isotope of iodine has 75 neutrons. Represent this isotope using the same notation as above. (2)

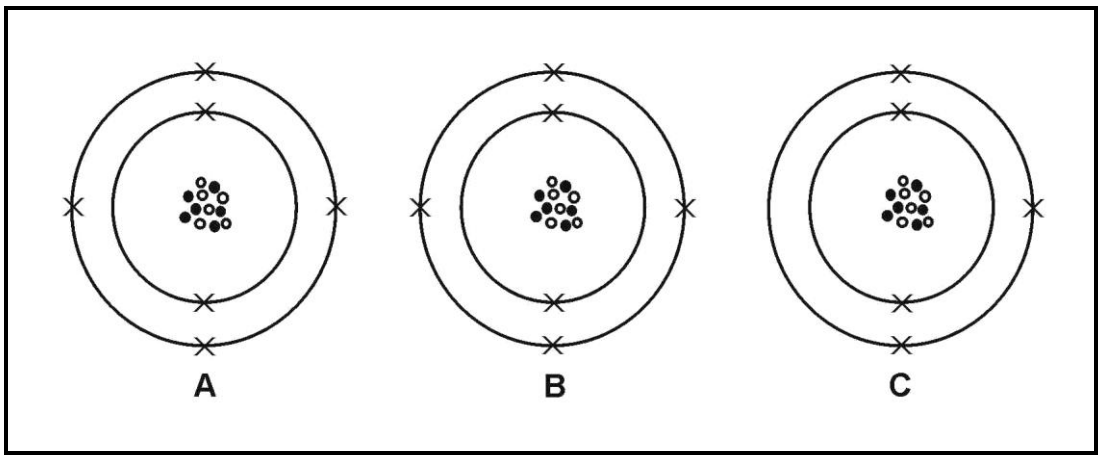
8.4 Do you think the isotopes of iodine will have similar chemical properties? Provide a reason for your answer. (2)

8.5 Explain how the use of iodine isotopes has led to advances in the medical industry. (2)

[10]

QUESTION 9

Consider the diagrams below showing three different neutral atoms A, B and C.



9.1 What is the name given to the collection of particles at the centre of the atom? (1)

9.2 What are the particles represented by the crosses on the diagram? (1)

9.3 Which two atoms are isotopes of the same element? Give a reason for your answer. (4)

9.4 If C reacted, what would be the charge on the ion that is formed? (2)

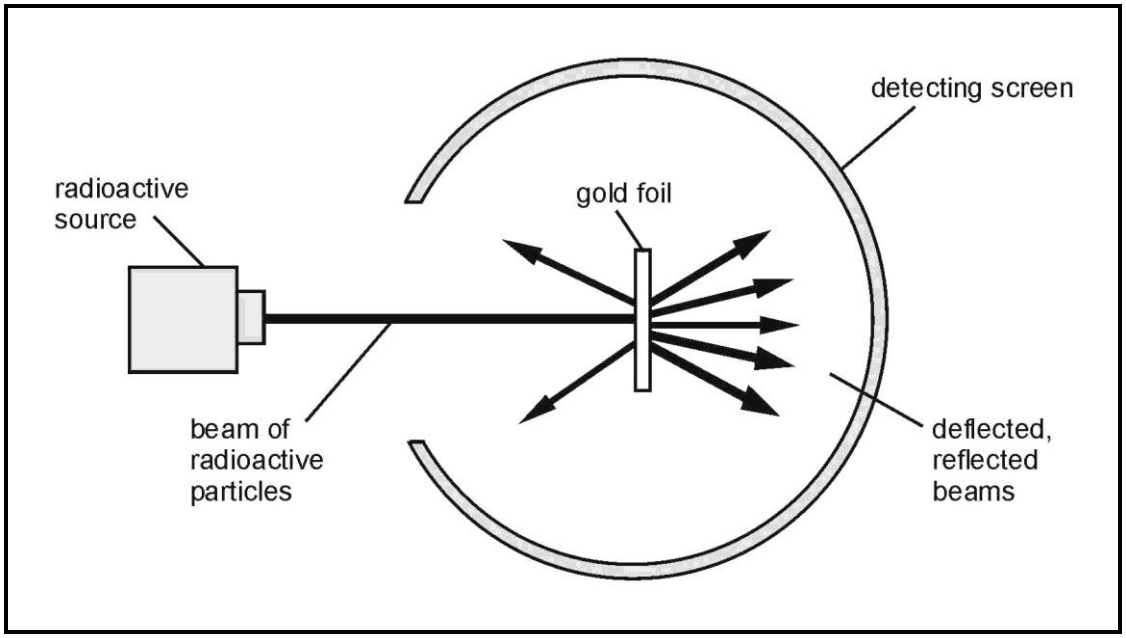
9.5 Which type of particle in an atom has a negative charge? (1)

9.6 Explain what occurs when an atom becomes a negative ion. (3)

[12]

QUESTION 10

In 1910, Ernest Rutherford directed positively charged radioactive particles into a thin sheet of gold to investigate what atoms were made of. He expected many of the particles to be deflected backwards, but noted that most of the particles passed straight through the sheet of gold, while only a few were deflected and bounced back. These results led to the further development of the atomic model.



10.1 Describe the model of the atom that the scientists believed was true before this experiment. (3)

10.2 Why did most of the particles pass straight through the thin sheet of gold? (2)

10.3 What caused some of the particles to be deflected? (2)

10.4 The results of this experiment led scientists to revise the structure of the atom. Refer to THREE aspects of the atom to describe how the model was revised. (3)

[10]

TOTAL FOR SECTION B - 95 marks

[TOTAL: 120 marks]

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9{,}8\ \text{m}\cdot\text{s}^{-2}$
Speed of light in a vacuum	c	$3{,}0 \times 10^{8}\ \text{m}\cdot\text{s}^{-1}$

TABLE 2: FORMULAE

MOTION	
$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

WEIGHT AND MECHANICAL ENERGY	
$F_g = mg$	$U = E_p = mgh$
$K = E_k = \frac{1}{2}mv^2$	

WAVES, LIGHT AND SOUND	
$v = f\lambda$ or $v = v\lambda$	$T = \frac{1}{f}$ or $T = \frac{1}{v}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTRICITY AND MAGNETISM	
$I = \frac{Q}{\Delta t}$	$V = \frac{W}{Q}$

THE PERIODIC TABLE OF ELEMENTS