

SMARTWIZ

GRADE12 PHYSICAL SCIENCE EXAM

MARKS: 150

TIME: 2.5 HOURS

SCHOOL _____

CLASS (eg. 4A) _____

SURNAME _____

NAME _____

MARKS	
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Instructions for Learners:

- Read all instructions carefully before you begin the exam.
- Write your full name and student number clearly on the answer sheet/book.
- Answer all questions unless otherwise instructed.
- Show all your work/calculations where necessary.
- Write neatly and clearly.
- Use only a blue or black pen. Do not use correction fluid or tape.
- Electronic devices (calculators, cell phones, etc.) are not allowed unless explicitly permitted.
- Raise your hand if you have any questions.
- Do not talk to other learners during the exam.
- Any form of dishonesty will result in immediate disqualification from the exam.

This exam consists of Eight pages, including the cover page.

SECTION A: PHYSICS (75 MARKS)

QUESTION 1: MULTIPLE CHOICE ($5 \times 2 = 10$)

Write only the **letter (A–D)** next to the question number.

1.1 The SI unit of power is:

- A. Watt B. Joule C. Ampere D. Volt

Answer: _____

1.2 Which one of the following is an example of uniform acceleration?

- A. Car turning a corner
B. Ball dropped from a height
C. Train moving at constant speed
D. Light bulb heating up

Answer: _____

1.3 In a transverse wave, particles of the medium move:

- A. In circles
B. Along the direction of wave motion
C. At rest
D. Perpendicular to the direction of wave motion

Answer: _____

1.4 Electric current is defined as:

- A. Charge per second
B. Voltage per second
C. Resistance per charge
D. Power per unit time

Answer: _____

1.5 Which component controls current in a circuit?

- A. Resistor B. Battery C. Ammeter D. Capacitor

Answer: _____

QUESTION 2: LINEAR MOMENTUM (15 MARKS)

A 2.5 kg trolley moving at $4 \text{ m} \cdot \text{s}^{-1}$ collides with a stationary 1.5 kg trolley. After the collision, the trolleys stick together and move as one body.

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

2.2 Calculate the total momentum before the collision. (2)

2.3 Determine the velocity of the combined mass after the collision. (4)

2.4 Is this collision elastic or inelastic? Justify your answer. (3)

2.5 Calculate the kinetic energy lost during the collision. (4)

QUESTION 3: WORK, ENERGY & POWER (15 MARKS)

A person lifts a 10 kg object vertically upward through a distance of 2 m in 3 seconds.

3.1 Calculate the work done on the object. (3)

3.2 Calculate the power used to do this work. (3)

3.3 If the object slips and falls from 2 m, what is its speed just before it hits the ground? (Ignore air resistance.) (3)

3.4 State the principle of conservation of mechanical energy. (2)

3.5 Is mechanical energy conserved in the falling object's motion? Explain. (4)

QUESTION 4: ELECTROMAGNETISM (10 MARKS)

4.1 State Faraday's Law of Electromagnetic Induction. (2)

4.2 Describe two ways to increase the induced emf in a coil. (2)

4.3 A coil with 100 turns is placed in a magnetic field. The magnetic flux changes by 0.4 Wb in 0.2 seconds. Calculate the average induced emf. (3)

4.4 Give one application of electromagnetic induction in everyday life. (1)

4.5 Explain the basic principle of how a generator works. (2)

QUESTION 5: DOPPLER EFFECT (10 MARKS)

A car moving towards a stationary observer emits a sound of 500 Hz. The speed of sound is $340 \text{ m}\cdot\text{s}^{-1}$ and the car moves at $30 \text{ m}\cdot\text{s}^{-1}$.

5.1 What is the Doppler effect? (2)

5.2 Calculate the frequency heard by the observer. (4)

5.3 How will the frequency change if the car moves away from the observer? (2)

5.4 Name one real-life use of the Doppler effect. (2)

SECTION B: CHEMISTRY (75 MARKS)

QUESTION 6: ENERGY CHANGES IN CHEMICAL REACTIONS (10 MARKS)

6.1 Define activation energy. (2)

6.2 The reaction below is exothermic:



Draw a fully labelled potential energy diagram. (4)

(Draw below)

6.3 How does a catalyst affect this reaction? (2)

6.4 Give one industrial example where a catalyst is used. (2)

QUESTION 7: RATES OF REACTION (10 MARKS)

7.1 State two factors that affect the rate of a chemical reaction. (2)

7.2 In an experiment, 2 g of magnesium reacts with HCl. The volume of hydrogen gas is measured every 10 seconds.

What is the average rate of reaction if 120 cm³ of gas is produced in 40 s? (3)

7.3 Sketch a graph of gas volume vs. time. (3)

(Label axes correctly)


(Draw below)



7.4 What happens to the rate if temperature increases? Why? (2)

QUESTION 8: CHEMICAL BONDING (10 MARKS)

8.1 Draw the Lewis structure of CO₂. (2)



8.2 Why is CO_2 a non-polar molecule even though it has polar bonds? (2)

8.3 Explain the difference between intermolecular and intramolecular forces. (3)

8.4 Name one type of intermolecular force found between water molecules. (1)

8.5 Which substance would have a higher boiling point — NH_3 or CH_4 ? Why? (2)

QUESTION 9: ELECTROCHEMISTRY (15 MARKS)

A galvanic cell is made using Zn and Cu electrodes.

9.1 Write the overall cell reaction. (2)

9.2 Which electrode is the anode? (1)

9.3 Define oxidation. (2)

9.4 Write the half-reaction at the cathode. (2)

9.5 Calculate the EMF of the cell using:
 $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$; $\text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$ (2)

9.6 Explain how a salt bridge functions in this cell. (2)

9.7 Name one use of a galvanic cell in real life. (1)

9.8 Why do electrons flow from Zn to Cu? (3)

QUESTION 10: ORGANIC CHEMISTRY (10 MARKS)

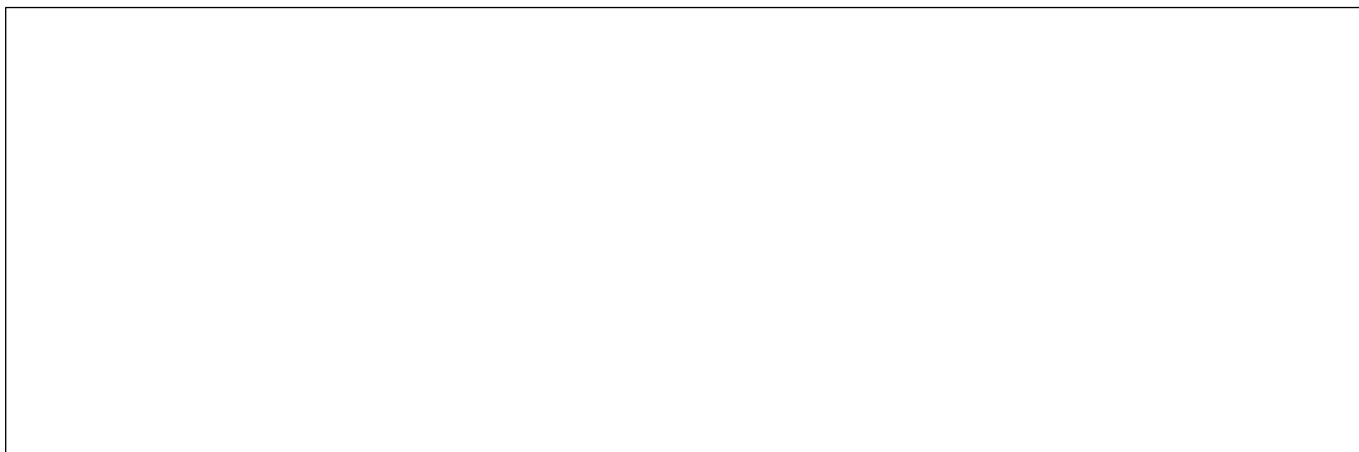
10.1 Write IUPAC name for the compound:



Answer: _____

10.2 Draw the structural formula for butanoic acid. (2)

(Draw below)



10.3 Define the term "functional group." (2)

10.4 How can you distinguish between an alcohol and a carboxylic acid using universal indicator? (2)

10.5 Which is more reactive: alkane or alkene? Explain. (3)

TOTAL : 150

MEMO

SECTION A: PHYSICS (75 MARKS)

QUESTION 1: MULTIPLE CHOICE ($5 \times 2 = 10$)

1.1 A ✓✓

1.2 B ✓✓

1.3 D ✓✓

1.4 A ✓✓

1.5 A ✓✓

QUESTION 2: LINEAR MOMENTUM (15)

2.1 Law: The total linear momentum of a closed system is conserved in the absence of external forces. ✓✓

2.2 Initial momentum = $p = mv = 2.5 \times 4 = 10 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ $p = mv = 2.5 \times 4 = 10$,
 $\text{kg} \cdot \text{m} \cdot \text{s}^{-1}$ $p = mv = 2.5 \times 4 = 10 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓✓

2.3 Total mass = $2.5 + 1.5 = 4.0$ $2.5 + 1.5 = 4.0$ $2.5 + 1.5 = 4.0$ kg

Velocity after collision:

 $v = 10/4 = 2.5 \text{ m} \cdot \text{s}^{-1}$ $v = \frac{10}{4} = 2.5$, $\text{m} \cdot \text{s}^{-1}$ $v = 10/4 = 2.5 \text{ m} \cdot \text{s}^{-1}$ ✓✓✓✓

2.4 Inelastic ✓

Because kinetic energy is **not conserved** and the objects stick together ✓✓

2.5

Initial KE:

 $KE_i = \frac{1}{2}(2.5)(4^2) = 20$ $KE_i = \frac{1}{2}(2.5)(4^2) = 20$ $KE_i = \frac{1}{2}(2.5)(4^2) = 20$ J ✓

Final KE:

 $KE_f = \frac{1}{2}(4)(2.5^2) = 12.5$ $KE_f = \frac{1}{2}(4)(2.5^2) = 12.5$ $KE_f = \frac{1}{2}(4)(2.5^2) = 12.5$ J ✓
Energy lost = $20 - 12.5 = 7.5$ $20 - 12.5 = 7.5$ $20 - 12.5 = 7.5$ J ✓✓

QUESTION 3: WORK, ENERGY & POWER (15)

3.1

 $W = F \cdot d = 10 \cdot 9.8 \cdot 2 = 196$ $W = F \cdot d = 10 \cdot 9.8 \cdot 2 = 196$ $W = F \cdot d = 10 \cdot 9.8 \cdot 2 = 196$ J ✓✓✓

3.2

$$P = Wt = 1963 = 65.33 \text{ W} \quad P = \frac{W}{t} = \frac{196}{3} = 65.33, \text{ } \text{W} \quad P = tW = 3196 = 65.33 \text{ W} \quad \checkmark\checkmark\checkmark$$

3.3

$$\text{Use } v = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \cdot 2} = 6.26 \text{ m/s} \quad v = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \cdot 2} = \sqrt{39.2} = 6.26, \text{ } \text{m/s} \quad v = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \cdot 2} = 6.26 \text{ m/s} \quad \checkmark\checkmark\checkmark$$

3.4

Mechanical energy is conserved when only conservative forces act. $\checkmark\checkmark$

3.5

Yes \checkmark — only gravitational potential energy converts to kinetic energy \checkmark

No energy lost to friction or air resistance $\checkmark\checkmark$

QUESTION 4: ELECTROMAGNETISM (10)

4.1

The induced emf is directly proportional to the rate of change of magnetic flux. $\checkmark\checkmark$

4.2

- Increase number of turns \checkmark
- Increase speed of motion/change \checkmark

4.3

$$\epsilon = N \Delta \Phi / \Delta t = 100 \cdot 0.40 / 0.2 = 200 \text{ V} \quad \epsilon = \frac{N \Delta \Phi}{\Delta t} = \frac{100 \cdot 0.4}{0.2} = 200, \text{ } \text{V} \quad \epsilon = \Delta t N \Delta \Phi = 0.2 \cdot 100 \cdot 0.4 = 200 \text{ V} \quad \checkmark\checkmark\checkmark$$

4.4

Electric generators \checkmark

4.5

Converts mechanical energy to electrical energy \checkmark

Using relative motion between a coil and magnetic field \checkmark

QUESTION 5: DOPPLER EFFECT (10)

5.1

Apparent change in frequency due to relative motion $\checkmark\checkmark$

5.2

Use:

$$f' = f \cdot \frac{v}{v - v_s} = 500 \cdot \frac{340}{340 - 30} = 500 \cdot \frac{340}{310} = 548.39 \text{ Hz}$$

$$f' = f \cdot \frac{v}{v - v_s} = 500 \cdot \frac{340}{310} = 548.39, \text{ Hz}$$

$$f' = f \cdot \frac{v}{v - v_s} = 500 \cdot \frac{340}{310} = 548.39 \text{ Hz} \checkmark \checkmark \checkmark \checkmark$$

5.3

Frequency decreases ✓

Because sound source is moving away ✓

5.4

- Police radar ✓
- Medical imaging ✓

SECTION B: CHEMISTRY (75 MARKS)

QUESTION 6: ENERGY CHANGES IN CHEMICAL REACTIONS (10)

6.1

Minimum energy required to start a reaction ✓✓

6.2

Diagram:

- Reactants higher than products ✓
- Activation energy labeled ✓
- ΔH shown (negative) ✓
- Products line correctly drawn ✓

6.3

Lowers activation energy ✓✓

6.4

Haber process ✓

Catalyst: Iron ✓

QUESTION 7: RATES OF REACTION (10)

7.1

Any two:

- Temperature ✓
- Concentration ✓
- Surface area ✓
- Catalyst ✓

7.2

Rate = $\frac{120}{40} = 3 \text{ cm}^3/\text{s}$ ✓✓✓

7.3

- Graph with correct shape (flattening curve) ✓
- Volume on y-axis ✓
- Time on x-axis ✓

7.4

Increases ✓

Because particles have more kinetic energy and more frequent successful collisions ✓

QUESTION 8: CHEMICAL BONDING (10)

8.1

CO₂: O=C=O ✓✓

8.2

Molecule is linear and symmetrical ✓

Dipoles cancel ✓

8.3

Intramolecular = within a molecule (e.g., covalent bond) ✓

Intermolecular = between molecules (e.g., hydrogen bonding) ✓✓

8.4

Hydrogen bonding ✓

8.5

NH₃ — has hydrogen bonding ✓✓

CH₄ has only weak London forces ✓

QUESTION 9: ELECTROCHEMISTRY (15)

- 9.1
 $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$ ✓✓
- 9.2
Anode = Zn ✓
- 9.3
Loss of electrons ✓✓
- 9.4
 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓✓
- 9.5
 $\text{EMF} = 0.34 - (-0.76) = 1.10 \text{ V}$ ✓✓
- 9.6
Maintains electrical neutrality by allowing ion flow ✓✓
- 9.7
Used in batteries ✓
- 9.8
Zn has lower reduction potential ✓
Releases electrons more easily ✓
Electrons flow from anode to cathode ✓✓✓
-

QUESTION 10: ORGANIC CHEMISTRY (10)

- 10.1
Butane ✓
- 10.2
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ ✓✓
- 10.3
Group of atoms responsible for chemical properties ✓✓
- 10.4
Acid: red/orange ✓
Alcohol: green or neutral ✓✓
- 10.5
Alkene ✓
More reactive due to double bond ✓✓

✓ **TOTAL: 150 MARKS**

