

SMARTWIZ

GRADE12 PHYSICAL SCIENCE EXAM

MARKS: 150

TIME: 2.5 HOURS

SCHOOL _____

CLASS (eg. 4A) _____

SURNAME _____

NAME _____

| MARKS | |
|-------|--|
|-------|--|

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 QUESTIONS ($5 \times 2 = 10$)

Choose the correct letter (A–D). Write it next to the question number.

1.1 Which physical quantity is conserved in an elastic collision?

- A. Velocity B. Momentum C. Acceleration D. Work

Answer: _____

1.2 Which one of the following will increase the resistance of a wire?

- A. Increase temperature B. Decrease length
C. Use thicker wire D. Use copper

Answer: _____

1.3 A satellite moving in a circular orbit experiences:

- A. No force
B. Centrifugal force
C. Constant speed but changing velocity
D. Constant acceleration and speed

Answer: _____

1.4 Which of the following is NOT a renewable energy source?

- A. Solar B. Wind C. Coal D. Hydro

Answer: _____

1.5 The energy stored in a stretched spring is:

- A. Potential energy B. Electrical energy
C. Chemical energy D. Kinetic energy

Answer: _____

QUESTION 2: VERTICAL PROJECTILE MOTION (15 MARKS)

A ball is thrown vertically upwards at $20 \text{ m} \cdot \text{s}^{-1}$ from the ground.

2.1 Calculate the time it takes to reach maximum height. (3)

2.2 Determine the maximum height it reaches. (3)

2.3 Calculate the total time it spends in the air. (2)

2.4 Sketch a velocity vs. time graph for the motion of the ball. Label values. (4)



2.5 State two assumptions made when using projectile motion equations. (3)

QUESTION 3: ELECTRICITY AND CIRCUITS (15 MARKS)

A 12 V battery is connected to two resistors, $3\ \Omega$ and $6\ \Omega$, in parallel.

3.1 Calculate the total resistance of the circuit. (3)

3.2 Determine the total current supplied by the battery. (3)

3.3 Calculate the current through the $3\ \Omega$ resistor. (3)

3.4 State Ohm's Law. (2)

3.5 Why is it better to wire household circuits in parallel than in series? (4)

QUESTION 4: WORK & ENERGY IN MECHANICAL SYSTEMS (10 MARKS)

A person pushes a 50 kg box up a frictionless ramp inclined at 30° to the horizontal for a distance of 4 m.

4.1 Calculate the gravitational potential energy gained by the box. (3)

4.2 Calculate the work done by the person. (3)

4.3 If the box slides back down, what is its velocity at the bottom? (Assume no friction) (4)

QUESTION 5: SOUND AND WAVES (10 MARKS)

A sound wave travels at $340 \text{ m}\cdot\text{s}^{-1}$ and has a wavelength of 0.85 m.

5.1 Calculate the frequency of the sound. (2)

5.2 Explain the difference between pitch and loudness. (3)

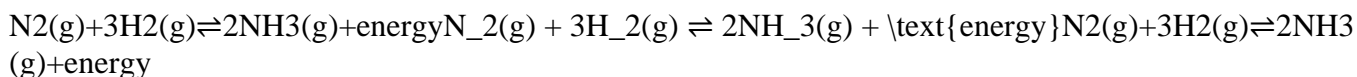
5.3 Give two properties of longitudinal waves. (2)

5.4 A person hears an echo 0.6 seconds after shouting. How far away is the wall? (3)

SECTION B: CHEMISTRY (75 MARKS)

QUESTION 6: CHEMICAL EQUILIBRIUM (10 MARKS)

Consider the reaction:



6.1 Is this reaction exothermic or endothermic? Give a reason. (2)

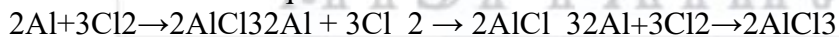
6.2 What will happen to the equilibrium if temperature increases? Explain. (3)

6.3 What will happen to the yield of NH_3 if pressure is increased? (2)

6.4 Define the term dynamic equilibrium. (3)

QUESTION 7: STOICHIOMETRY AND MOLE CONCEPTS (15 MARKS)

Given the balanced equation:



7.1 Calculate the number of moles in 13.5 g of Al. (2)

7.2 How many moles of Cl_2 are required to react completely with this amount of Al? (3)

7.3 Calculate the mass of AlCl_3 produced. (4)

7.4 If the reaction only produced 30 g of AlCl_3 , calculate the percentage yield. (3)

7.5 State the molar volume of a gas at STP. (1)

7.6 Calculate the volume of Cl_2 gas needed to react with 13.5 g of Al at STP. (2)

QUESTION 8: ORGANIC MOLECULES (10 MARKS)

8.1 Give the IUPAC name of $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$. (1)

Answer: _____

8.2 What homologous series does the above compound belong to? (1)

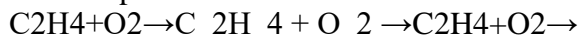
Answer: _____

8.3 Draw the structural isomer of butanol. (2)



8.4 Distinguish between saturated and unsaturated hydrocarbons. (2)

8.5 Complete the combustion reaction of ethene:



Balanced equation: _____ (2)

8.6 Name one environmental issue caused by incomplete combustion. (2)

QUESTION 9: REACTION RATES (10 MARKS)

9.1 Define reaction rate. (2)

9.2 Give two factors that increase the rate of reaction. (2)

9.3 Explain how a catalyst increases the rate. (2)

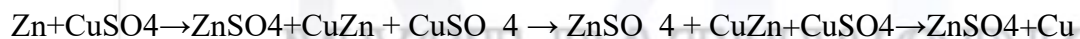
9.4 In a graph of time vs. product formed, what does the gradient represent? (1)

9.5 Why does a reaction slow down as it proceeds? (3)

QUESTION 10: REDOX REACTIONS (10 MARKS)

10.1 Define oxidation in terms of electron transfer. (2)

10.2 In the reaction:



Identify:

a) The reducing agent (1)

Answer: _____

b) The oxidizing agent (1)

Answer: _____

10.3 Write half-reactions for:

a) Oxidation ✓

b) Reduction ✓✓

(4 marks total)

10.4 How is this redox reaction used in everyday life? (2)

TOTAL : 150

MEMO

SECTION A: PHYSICS (75 MARKS)

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

- 1.1 B ✓✓
 1.2 A ✓✓
 1.3 C ✓✓
 1.4 C ✓✓
 1.5 A ✓✓

QUESTION 2: VERTICAL PROJECTILE MOTION (15 MARKS)

2.1 $t = v/g = 20/9.8 = 2.04 \text{ s}$ ✓✓✓

2.2 $h = v^2/2g = (20)^2/2 \cdot 9.8 = 20.41 \text{ m}$ ✓✓✓

2.3 Total time = $2 \cdot 2.04 = 4.08 \text{ s}$ ✓✓

2.4 Velocity-time graph: ✓ axes labeled

- Start at 20 m/s
- Linear decrease
- Crosses t-axis at 2.04 s
- Final velocity = -20 m/s at 4.08 s ✓✓✓✓

2.5 Assumptions:

- Air resistance is negligible ✓
- Constant acceleration due to gravity ✓
- Motion is vertical only ✓

QUESTION 3: ELECTRICITY AND CIRCUITS (15 MARKS)

3.1

$$\frac{1}{R} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2} \Rightarrow R = 2\Omega$$

$$\frac{1}{\Omega R} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2} \Rightarrow R = 2\Omega \quad \checkmark\checkmark\checkmark$$

3.2

$$I = \frac{V}{R} = \frac{12}{2} = 6A \quad \checkmark\checkmark\checkmark$$

3.3

$$V = 12V \quad V = 12V \text{ (same across parallel branches)}$$

$$I = \frac{V}{R} = \frac{12}{3} = 4A \quad \checkmark\checkmark\checkmark$$

3.4

Ohm's Law: The current through a conductor is directly proportional to the voltage across it, provided temperature remains constant. $\checkmark\checkmark$

3.5

- Each appliance gets full voltage \checkmark
- Fault in one does not affect others \checkmark
- Safer and easier to control individual devices \checkmark
- Reduced total resistance \checkmark

QUESTION 4: WORK & ENERGY IN MECHANICAL SYSTEMS (10 MARKS)

4.1

Vertical height:

$$h = 4 \cdot \sin(30^\circ) = 2m \quad \checkmark$$

$$GPE = mgh = 50 \cdot 9.8 \cdot 2 = 980J \quad \checkmark\checkmark$$

4.2 Work done = same as GPE (no friction) = **980 J** $\checkmark\checkmark\checkmark$

4.3

Use energy conservation:

$$KE = GPE = 980$$

$$\frac{1}{2}mv^2 = 980 \Rightarrow v = \sqrt{\frac{2 \cdot 980}{50}} = 6.26 \text{ m/s} \quad \checkmark\checkmark\checkmark\checkmark$$

QUESTION 5: SOUND AND WAVES (10 MARKS)

5.1

$$f = \frac{v}{\lambda} = \frac{340}{0.85} = 400 \text{ Hz} \quad \checkmark\checkmark$$

5.2

- Pitch = frequency ✓
- Loudness = amplitude ✓
- Independent properties ✓

5.3

- Particles vibrate parallel to wave direction ✓
- Require a medium ✓

5.4

Total distance = $340 \cdot 0.62 = 102 \text{ m}$ $\frac{340 \cdot 0.6}{2} = 102$, m $340 \cdot 0.6 = 102 \text{ m}$ ✓✓✓

SECTION B: CHEMISTRY (75 MARKS)

QUESTION 6: CHEMICAL EQUILIBRIUM (10 MARKS)

6.1

Exothermic ✓ — energy is released ✓

6.2

Equilibrium shifts left ✓

Less NH_3 is formed ✓

To oppose increase in temperature ✓

6.3

Shifts right ✓ — fewer gas molecules ✓

6.4

Forward and reverse reactions continue at equal rates ✓

Concentrations remain constant ✓

Occurs in a closed system ✓

QUESTION 7: STOICHIOMETRY (15 MARKS)

7.1

$M(\text{Al}) = 27 \text{ g/mol}$

$n = \frac{13.5}{27} = 0.5 \text{ mol}$ $n = \frac{13.5}{27} = 0.5$, mol $n = 13.5 = 0.5 \text{ mol}$ ✓✓

7.2

From mole ratio: 2 Al : 3 Cl₂

$$n(\text{Cl}_2) = 0.5 \cdot 3 = 0.75 \text{ mol} \quad n(\text{Cl}_2) = 0.5 \cdot \frac{3}{2} = 0.75 \text{ mol} \quad n(\text{Cl}_2) = 0.5 \cdot 2.3 = 0.75 \text{ mol} \quad \checkmark\checkmark\checkmark$$

7.3

0.5 mol Al produces 0.5 mol AlCl₃

$$M(\text{AlCl}_3) = 133.5 \text{ g/mol}$$

$$m = 0.5 \cdot 133.5 = 66.75 \text{ g} = 0.5 \cdot 133.5 = 66.75 \text{ g} \quad \checkmark\checkmark\checkmark\checkmark$$

7.4

$$\% \text{ yield} = \frac{30}{66.75} \cdot 100 = 44.94\% \quad \frac{30}{66.75} \cdot 100 = 44.94\% \quad \checkmark\checkmark\checkmark$$

7.5

$$22.4 \text{ dm}^3/\text{mol} \quad \checkmark$$

7.6

$$V = 0.75 \cdot 22.4 = 16.8 \text{ dm}^3 \quad V = 0.75 \cdot 22.4 = 16.8 \text{ dm}^3 \quad \checkmark\checkmark$$

QUESTION 8: ORGANIC MOLECULES (10 MARKS)

8.1

Propanol \checkmark

8.2

Alcohols \checkmark

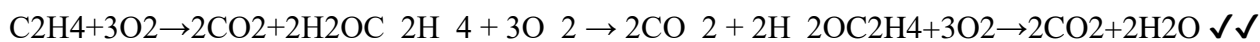
8.3

Isomer: CH₃-CH(OH)-CH₃ $\checkmark\checkmark$

8.4

Saturated = single bonds only \checkmark Unsaturated = contains double or triple bonds \checkmark

8.5



8.6

Carbon monoxide poisoning \checkmark Contributes to smog \checkmark

QUESTION 9: REACTION RATES (10 MARKS)

9.1

Change in concentration per unit time ✓✓

9.2

- Increase temperature ✓
- Increase concentration ✓

9.3

Lowers activation energy ✓

Provides alternative reaction pathway ✓

9.4

Gradient = rate of reaction ✓

9.5

Reactant concentration decreases ✓

Fewer collisions per unit time ✓

Reaction slows ✓

QUESTION 10: REDOX REACTIONS (10 MARKS)

10.1

Oxidation = loss of electrons ✓✓

10.2

a) Reducing agent = Zn ✓

b) Oxidizing agent = Cu^{2+} ✓

10.3

a) $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ ✓✓b) $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓✓

10.4

Used in galvanic cells / batteries ✓

Provides electricity for portable devices ✓

✓ TOTAL: 150 MARKS