SMARTWIZ

GRADE12 PHYSICAL SCIENCE EXAM

MARKS: 150

MARKS	

TIME: 2. 5 HOURS

SCHOOL _____

CLASS (eg. 4A) _____

SURNAME _____

NAME _____

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 × 2 = 10)

Choose the correct letter (A–D). Write only the letter.

1.1 Which of the following quantities is a vector?
A. Energy   B. Speed   C. Work   D. Displacement
Answer: _____

1.2 A body in free fall:
A. Loses mass
B. Has constant velocity
C. Accelerates downwards
D. Moves with zero net force
Answer: _____

1.3 Which principle explains how transformers work?
A. Coulomb's Law   B. Ohm's Law
C. Faraday's Law   D. Newton's 3rd Law
Answer: _____

1.4 Which wave phenomenon causes bending around a barrier?
A. Reflection   B. Refraction   C. Diffraction   D. Absorption
Answer: _____

1.5 The slope of a position vs. time graph represents:
A. Acceleration   B. Distance   C. Displacement   D. Velocity
Answer: _____

QUESTION 2: NEWTON'S LAWS AND APPLICATIONS (15 MARKS)

A box of mass 12 kg is placed on a flat surface. A horizontal force of 30 N is applied to it. The coefficient of kinetic friction is 0.2.

2.1 State Newton's Second Law. (2)

2.2 Calculate the frictional force acting on the box. (3)

2.3 Determine the net force on the box. (2)

2.4 Calculate the acceleration of the box. (3)

2.5 If the box takes 5 seconds to move, calculate the distance it covers. (Assume it starts from rest.) (3)

2.6 What happens to the acceleration if the applied force is removed? Explain. (2)

QUESTION 3: ELECTRIC FIELDS AND POTENTIAL DIFFERENCE (10 MARKS)

Two point charges, $Q_1 = +3$ μC and $Q_2 = -2$ μC, are 0.5 m apart in a vacuum.

3.1 Draw a labelled diagram showing the electric field pattern between the two charges. (3)
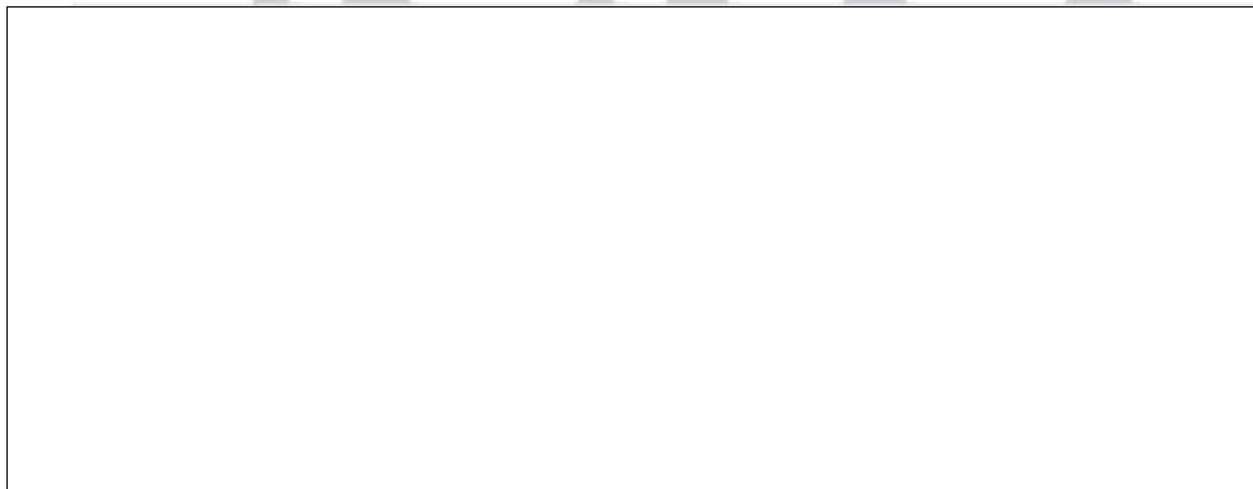
3.2 State Coulomb's Law. (2)

3.3 Calculate the electrostatic force between the charges. (3)
k=9×109 N\cdotpm²\cdotpC⁻²k = 9 \times 10^9 \text{ N·m²·C⁻²}k=9×109 N\cdotpm²\cdotpC⁻²

3.4 Is the force attractive or repulsive? Why? (2)

QUESTION 4: MOTION AND GRAPHS (10 MARKS)

The velocity-time graph below describes the motion of a car:

Time (s)	0	2	4	6	8	10
Velocity (m/s)	0	4	8	8	4	0

4.1 Describe the motion of the car between:
a) 0–4 seconds (2)

_____

b) 4–6 seconds (1)

_____

c) 6–10 seconds (2)

_____

4.2 Calculate the total distance covered in 10 seconds. (Use area under graph) (5)

_____
_____

QUESTION 5: OPTICAL PHENOMENA AND ELECTROMAGNETIC WAVES (10 MARKS)

5.1 List three differences between sound waves and light waves. (3)

_____

5.2 Light passes from air (n = 1.00) into water (n = 1.33) at an angle of 40°. Calculate the angle of refraction. (3)
Use Snell's Law:
$n_1 \sin \theta_1 = n_2 \sin \theta_2$

5.3 What is meant by total internal reflection? (2)

_____

5.4 State one application of total internal reflection. (2)

_____
_____

SECTION B: CHEMISTRY (75 MARKS)

_____

QUESTION 6: INTERMOLECULAR FORCES (10 MARKS)

6.1 Define intermolecular forces. (2)

_____

6.2 Name and describe the strongest type of intermolecular force. (3)

_____

6.3 Water has a higher boiling point than methane. Explain why. (3)

_____

6.4 List two types of van der Waals forces. (2)

_____

_____

QUESTION 7: CHEMICAL INDUSTRY AND PROCESSES (10 MARKS)

7.1 Name one industrial process used to manufacture ammonia. (1)

_____

7.2 Write the balanced equation for this process. (2)

_____

7.3 State two conditions that favour the **rate** of ammonia production. (2)

_____

7.4 State two conditions that favour the **yield** of ammonia. (2)

_____

7.5 Why is a catalyst used in this reaction? (3)

_____

_____

QUESTION 8: ACIDS AND BASES (15 MARKS)

A solution of HCl has a concentration of $0.01 \ mol \cdot dm^{-3}$.

8.1 Define a strong acid. (2)

8.2 Calculate the pH of the HCl solution. (3)

$\text{pH} = -\log[H^+]$

8.3 Define neutralisation. (2)

8.4 Write the balanced equation for the reaction between HCl and NaOH. (2)

8.5 If 25 cm³ of NaOH reacts completely with 20 cm³ of 0.01 mol·dm⁻³ HCl, calculate the concentration of NaOH. (6)

QUESTION 9: ORGANIC CHEMISTRY – FUNCTIONAL GROUPS AND REACTIONS (10 MARKS)

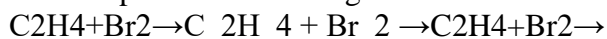9.1 Identify the functional groups in the following molecules:
a) CH_3COOH ✓
b) CH_3CH_2OH ✓
(2 marks)

9.2 Give the general formula of an alkene. (1)

9.3 Complete the following reaction:
$C_2H_4 + Br_2 \rightarrow$
Balanced product: _____ (2)

9.4 Describe a chemical test to distinguish between an alkene and an alkane. (2)

9.5 Define isomerism. (2)

9.6 Give an example of a positional isomer of but-1-ene. (1)

QUESTION 10: ELECTROLYSIS AND ELECTROCHEMISTRY (10 MARKS)

10.1 What is electrolysis? (2)

10.2 In the electrolysis of $CuCl_2$, write the half-reactions at:
a) Cathode ✓
b) Anode ✓
(4 marks)

10.3 What is the function of the electrolyte? (2)

10.4 Name one industrial use of electrolysis. (2)

TOTAL : 150

MEMO

SECTION A: PHYSICS (75 MARKS)

QUESTION 1: MULTIPLE CHOICE (10)

1.1 D ✓✓
1.2 C ✓✓
1.3 C ✓✓
1.4 C ✓✓
1.5 D ✓✓

QUESTION 2: NEWTON'S LAWS & APPLICATIONS (15)

2.1
Newton's Second Law: The net force acting on an object is equal to the rate of change of momentum OR $F = ma$ ✓✓

2.2
Frictional force = $f_k = \mu_k \cdot N = 0.2 \cdot (12 \cdot 9.8) = 0.2 \cdot 117.6 = 23.52\, \text{N}$ ✓✓✓

2.3
Net force = $F_{applied} - f_k = 30 - 23.52 = 6.48\, \text{N}$ ✓✓

2.4
Acceleration: $a = \frac{F_{net}}{m} = \frac{6.48}{12} = 0.54\, \text{m·s}^{-2}$ ✓✓✓

2.5
Use $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(0.54)(5)^2 = 6.75\, \text{m}$ ✓✓✓

2.6
Acceleration becomes zero (or negative if friction remains) ✓
Object slows down or stops due to friction ✓

QUESTION 3: ELECTRIC FIELDS (10)

3.1
Diagram:

- Field lines from + to – ✓
- Closer lines between charges ✓
- Arrows in correct direction ✓

3.2
Coulomb's Law: The electrostatic force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them ✓✓

3.3
$$F = k\frac{|Q_1 \cdot Q_2|}{r^2} = 9 \times 10^9 \cdot \frac{3 \times 10^{-6} \cdot 2 \times 10^{-6}}{(0.5)^2} = 0.216\, \text{N}$$ ✓✓✓

3.4
Attractive ✓ — opposite charges attract ✓

QUESTION 4: MOTION AND GRAPHS (10)

4.1
a) Acceleration — speed increasing linearly ✓
b) Constant speed ✓
c) Deceleration — speed decreasing ✓✓

4.2
Area under graph:

- Triangle 0–4s: $\frac{1}{2} \cdot 4 \cdot 8 = 16$ ✓
- Rectangle 4–6s: $2 \cdot 8 = 16$ ✓
- Trapezium 6–10s: $\frac{1}{2}(4)(8 + 0) = 16$ ✓
  Total $= 16 + 16 + 16 = 48\, \text{m}$ ✓✓✓

QUESTION 5: LIGHT & EM WAVES (10)

5.1

- Sound: mechanical wave; Light: electromagnetic ✓
- Sound: requires medium; Light: can travel in vacuum ✓
- Sound: longitudinal; Light: transverse ✓

5.2

Snell's Law:

$\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2} = \frac{1.00 \cdot \sin(40)}{1.33} = \frac{0.6428}{1.33} = 0.4832$ ✓✓✓

$\theta_2 = \arcsin(0.4832) = 28.94^\circ$ ✓✓✓

5.3

Total internal reflection occurs when light travels from a denser to a rarer medium at an angle greater than the critical angle and reflects entirely back into the medium ✓✓

5.4

Application: Optical fibres, binoculars, prisms ✓✓

SECTION B: CHEMISTRY (75 MARKS)

QUESTION 6: INTERMOLECULAR FORCES (10)

6.1
Forces between molecules ✓✓

6.2
Hydrogen bonding ✓
Occurs when H is bonded to N, O, or F ✓
Strong due to high polarity and small size ✓

6.3
Water forms hydrogen bonds ✓
Methane only has London forces ✓
Hydrogen bonding requires more energy to break ✓

6.4

- Dipole-dipole ✓
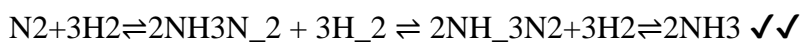- London dispersion forces ✓

QUESTION 7: CHEMICAL INDUSTRY & PROCESSES (10)

7.1
Haber process ✓

7.2

$N_2 + 3H_2 \rightleftharpoons 2NH_3$ ✓✓

7.3

- High temperature ✓
- Catalyst (iron) ✓

7.4

- High pressure ✓
- Moderate temperature ✓

7.5

Catalyst increases rate ✓
By lowering activation energy ✓
Without being used up ✓

QUESTION 8: ACIDS & BASES (15)
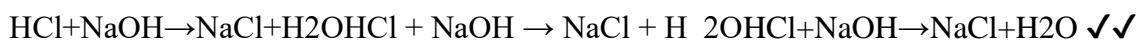
8.1
A strong acid completely ionises in solution ✓✓

8.2
$\text{pH} = -\log[0.01] = 2$ ✓✓✓

8.3
Reaction of acid and base to form salt and water ✓✓

8.4
$HCl + NaOH \rightarrow NaCl + H_2O$ ✓✓

8.5
$n(HCl) = 0.01 \cdot 0.020 = 2 \times 10^{-4} \text{ mol}$ ✓
From mole ratio: 1:1, so $n(NaOH) = 2 \times 10^{-4}$ mol
$C = \frac{n}{V} = \frac{2 \times 10^{-4}}{0.025} = 0.008\, \text{mol·dm}^{-3}$ ✓✓✓✓

QUESTION 9: ORGANIC CHEMISTRY (10)

9.1
a) Carboxylic acid ✔
b) Alcohol ✔

9.2
Alkene: C_nH_{2n} ✔

9.3
$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$ ✔✔

9.4
Add bromine water ✔
Alkene: turns colourless ✔
Alkane: remains orange ✔

9.5
Compounds with same molecular formula but different structures ✔✔

9.6
But-2-ene ✔

QUESTION 10: ELECTROLYSIS & CELLS (10)

10.1
Chemical change caused by electric current ✔✔

10.2
a) Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$ ✔✔
b) Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$ ✔✔

10.3
Allows movement of ions ✔
Completes circuit ✔

10.4
Electroplating ✔
Purifying metals ✔

✅ **TOTAL: 150 MARKS**