

IVA GLOBAL SCHOOL
AUGUST 2026



Physical Science
Grade 12
Preliminary Exam - PHYSICS

Time: 3 hours
Examiner: Mr M Thomson

TOTAL: 200 marks
Moderated by: Mr J Naidu

This paper consists of 30 pages.

INSTRUCTIONS

Time: 3h

200 MARKS

1. This paper consists of 30 pages.
 - Pages 29 and 30 are datasheets.
2. Please write your name and surname on the first page of your paper.
3. Number your answers EXACTLY as seen on the question paper.
4. Give all answers correct to 2 decimal places.
5. **The datasheet is provided on the last 2 pages.**
6. The use of a scientific calculator is allowed.
7. SHOW ALL necessary steps in calculations.
8. Scan EVERY PAGE of your test. Any missing pages will not be accepted after the test is concluded.
9. When sending the scanned pdf to your invigilator, make the title of the file "NAME SURNAME Science Cycle Test".

QUESTION 1: MULTIPLE CHOICE

Four options (A – D) are provided as possible answers to the following questions. Each question has only ONE correct answer. MARK THE CORRECT ANSWER WITH AN “X” IN THE ANSWER TABLE BELOW:

Question	Answer			
1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D

[10 x 2 = 20]

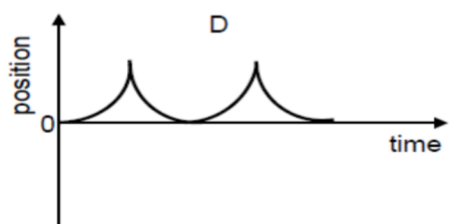
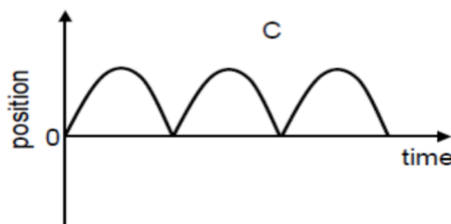
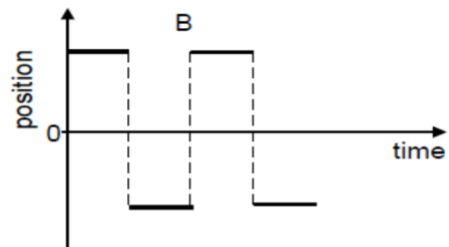
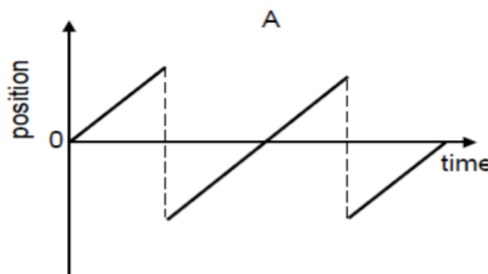
1.1. Which one of the following pairs consists of one vector quantity and one scalar quantity?

- A. power and distance
- B. acceleration and velocity
- C. time and work
- D. speed and impulse

(2)

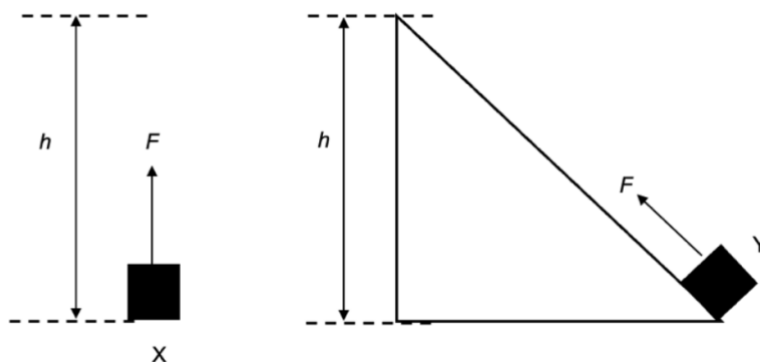
- 1.2. The driver of a sportscar is test driving it over a 500 km course. The car's average speed for the course is 200 km.h^{-1} . The car travels at 100 km.h^{-1} for the first 150 km. What is the average velocity of the car for the remainder of the course?
- A. 350 km.h^{-1}
 B. 300 km.h^{-1}
 C. 200 km.h^{-1}
 D. 250 km.h^{-1} (2)
- 1.3. Lewis and Max are racing each other. They both start from rest, but Lewis has double the acceleration of Max. Lewis covers a distance, x in a time, t . How long will it take Max to cover the same distance?
- A. $0,5 t$
 B. $0,71 t$
 C. $1,41 t$
 D. $2 t$ (2)
- 1.4. A ball is released from a height above the floor. The ball falls vertically and bounces off the floor a number of times. Ignore the effects of friction and assume that the collision of the ball with the floor is elastic. Take the point of release of the ball as the reference point and downward direction as positive.

Which ONE of the following is a CORRECT representation of the position-time graph for the motion of the ball?



(2)

- 1.5. Two boxes X and Y have the same mass. Box X is lifted through a vertical height h by a force of magnitude F . Box Y is pulled up a slope by a force of the same magnitude to reach the same vertical height, as shown.



Which of the following is correct?

	Change in the potential energy of the boxes	Amount of work done by F
A	Same for X and Y	Same for X and Y
B	Same for X and Y	$Y > X$
C	$Y < X$	$Y < X$
D	$Y > X$	$Y > X$

(2)

- 1.6. The electric field surrounding a point charge, $+q$, has magnitude E . Another point charge with double the magnitude is then placed as shown.

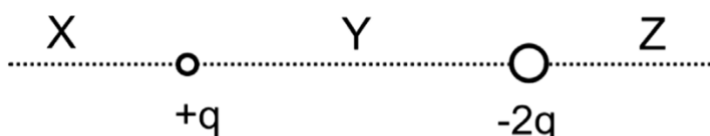


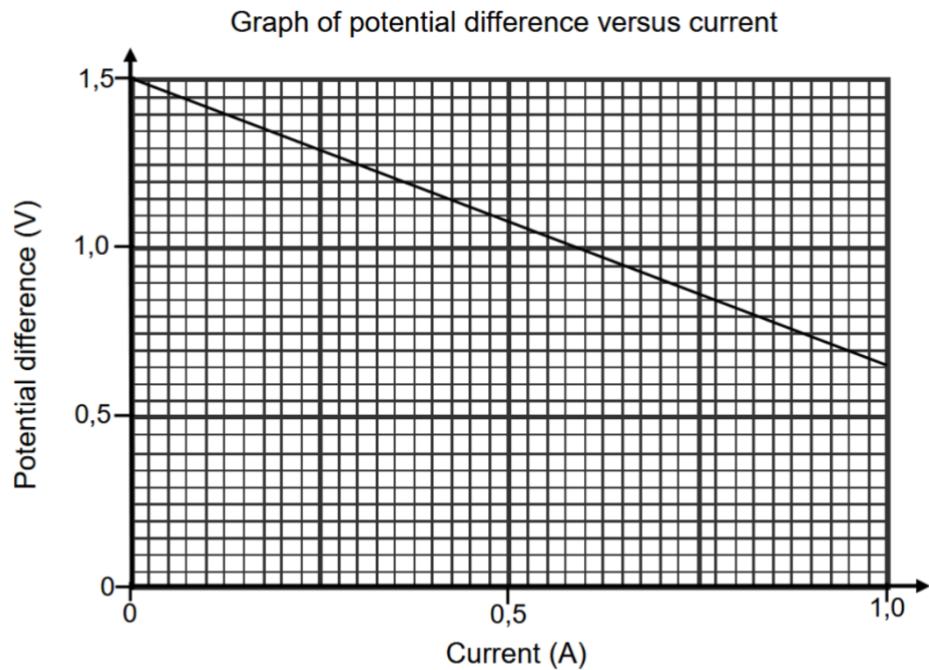
Diagram not drawn to scale

In which region of space, X, Y or Z, could the net electric field possibly be zero?

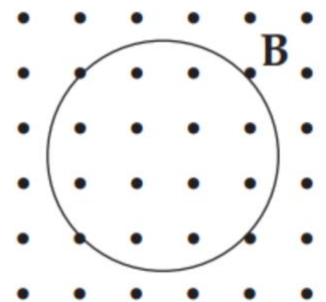
- A. X
- B. Y
- C. Z
- D. It can never be zero

(2)

- 1.7. Using the graph given below, showing the reading on a voltmeter connected across a battery, and the equation $\text{emf} = I(R+r)$, determine the internal resistance of the battery used in the circuit.

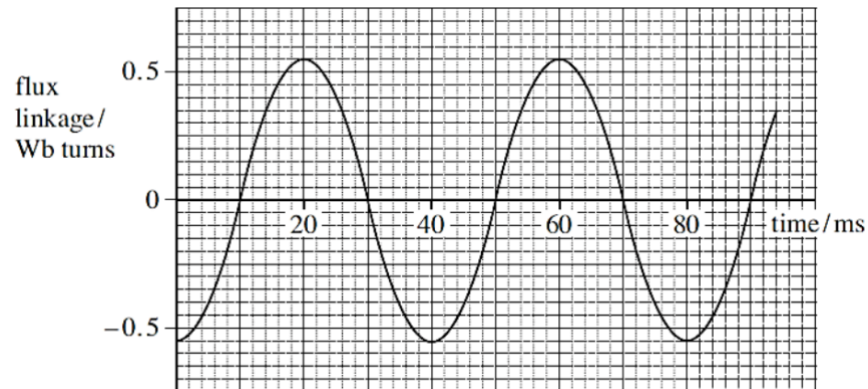


- A 0,15 Ω B 0,85 Ω C 0,2 Ω D 1,5 Ω (2)
- 1.8. The metal loop of wire shown alongside is situated in a magnetic field B pointing out of the plane of the page. If B decreases uniformly in strength, the induced electric current within the loop is...

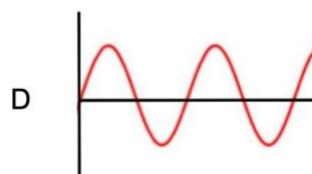
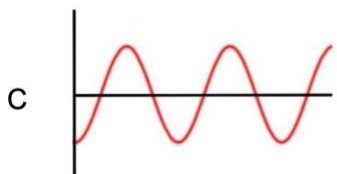
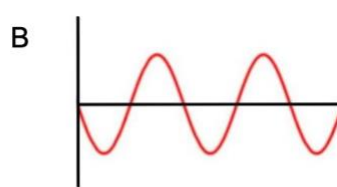
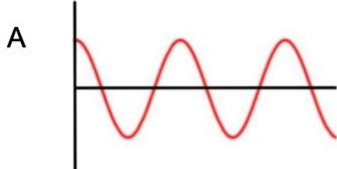


- A. clockwise and decreasing
B. clockwise and increasing
C. anticlockwise and decreasing
D. anticlockwise and increasing (2)

1.9. The graph below shows magnetic flux linkage vs time.



Which of the following induced emf graphs correctly shows the induced emf vs time graph for the same generator ?



(2)

1.10. Light with a wavelength of 600 nm is shone onto a piece of metal and photoelectrons are just able to be ejected from its surface. The wavelength of the incoming light is then changed to 500 nm.

What effect does this have on the photoelectrons ?

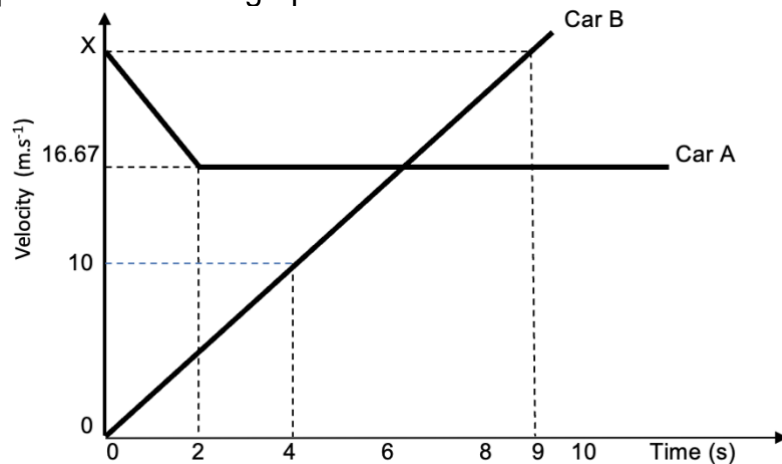
- A. less ejected but with the same velocity
- B. same number ejected but at a lower velocity
- C. same number ejected but at a higher velocity
- D. no photoelectrons are able to be emitted

(2)

[10 x 2 = 20]

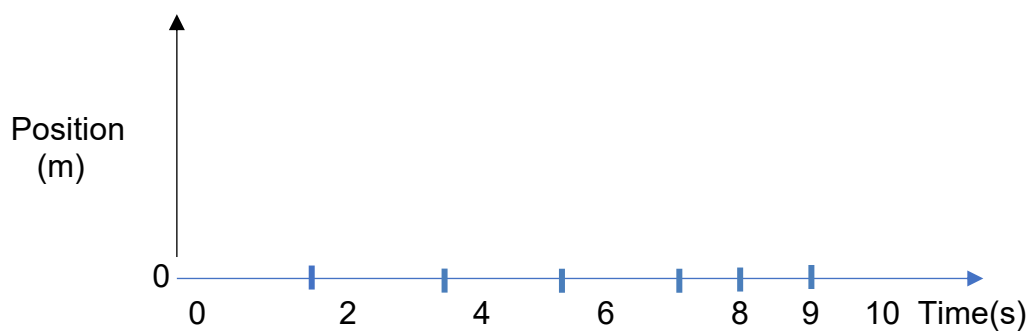
QUESTION 2: KINEMATICS

A car **B** is stationary at a traffic light and starts to accelerate constantly when the light turns green. At the same time a car **A** passes, going in the same direction as **B**. Car **A**, travelling at 70 km.h^{-1} , realises that he is exceeding the speed limit slows down to within the speed limit and continues after **2s** to travel with constant velocity. The motion of the two cars are represented on the graphs below:



- 2.1 Define *acceleration*. (2)
- 2.2 Convert 70 km.h^{-1} to m.s^{-1} . (2)
- 2.3 Make use of the graph and determine the acceleration of Car A needed to bring it into the speed limit. (3)
- 2.4 Make use of the graphs and determine which car, A or B, is in front after **9 s** of travelling. (7)

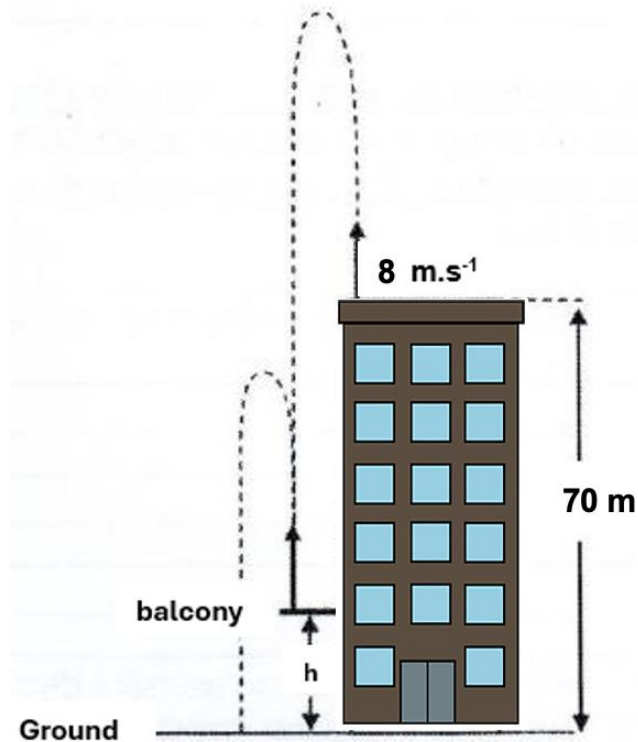
- 2.5 Use the axis below and draw a position vs time sketch graph that will represent the motion of the cars for the **9 s** travelled. Use the traffic light as the point of reference. (4)



[18]

QUESTION 3: VERTICAL PROJECTILE MOTION

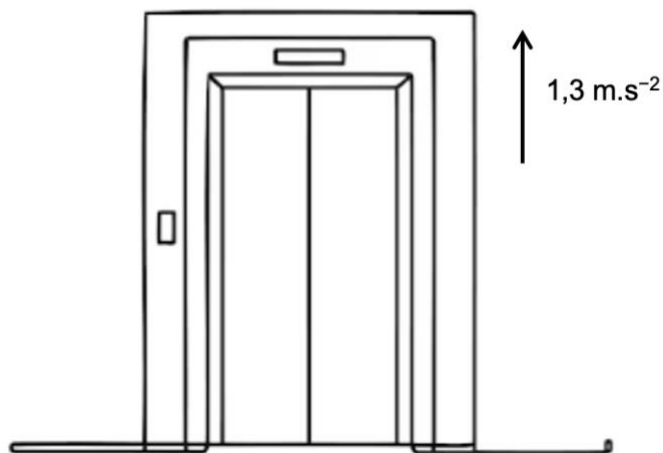
- 3.1. Oneile, standing on the top of a building which is **70 m** high, throws a ball vertically upwards at **8 m.s⁻¹**. The ball strikes a balcony below after **4 s**. The ball then bounces off the balcony and lands on the ground as illustrated below.



- 3.1.1. Define *displacement*. (2)
- 3.1.2. Calculate the ball's velocity as it strikes the balcony. (3)
- 3.1.3. State the *Principle of Conservation of Mechanical Energy*. (2)

- 3.1.4. Use the principle mentioned above (**NOT equations of motion**) to calculate the height of the balcony above the ground (h in the diagram). (4)
- 3.1.5. The ball is in contact with the balcony for **0,1 s** and then rebounds with a velocity **15%** lower than the velocity with which it hits the balcony. Determine the final velocity of the ball when it hits the ground after it rebounds from the balcony. (4)

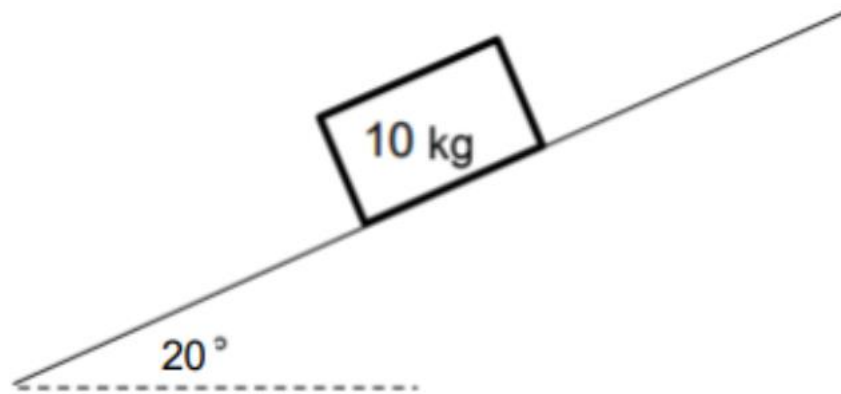
- 3.2. A lift accelerates upwards at a rate of $1,3 \text{ m.s}^{-2}$. As the lift starts to move from rest, a light bulb falls from the ceiling of the lift. Determine how long it takes for the light bulb to reach the lift's floor. The height from the ceiling of the lift to the floor of the lift is $2,8 \text{ m}$. (6)



[21]

QUESTION 4: NEWTON'S LAWS

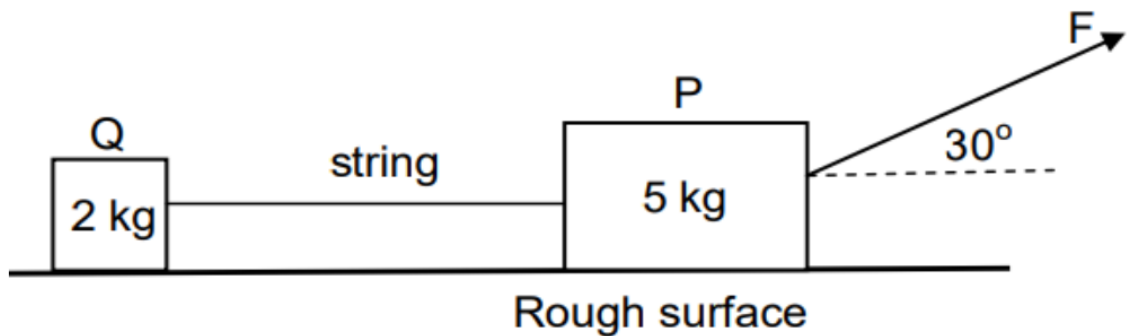
- 4.1. A box (mass **10 kg**) is at rest on a rough slope that makes an angle of **20°** with the horizontal, as shown in the diagram below.



- 4.1.1. Define *frictional force*. (2)
- 4.1.2. Calculate the magnitude of the frictional force acting on the box. (3)
- 4.1.3. The angle of the slope is 20° and the coefficient of static friction between the box and the surface is **0,6**. (4)
Calculate the minimum force that would have to be applied to the box parallel to the slope for the box to start sliding down the slope. Include the direction of the applied force in your answer.

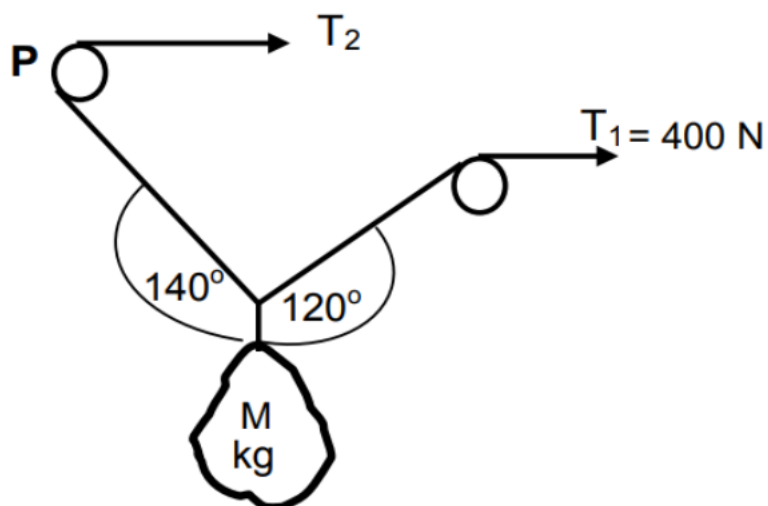
- 4.1.4. The angle of the slope is increased. Calculate at what angle the box will begin to slide without an external applied force. (2)

- 4.2. The two boxes below move to the right with a constant acceleration of $0,8 \text{ m}\cdot\text{s}^{-2}$. The kinetic frictional force between the surface and box **Q** is **5 N** and the coefficient of friction between box **P** and the surface is **0,15**.



- 4.2.1. State *Newton's second law of motion* in words. (2)
- 4.2.2. Write an expression in terms of **F** for the normal force acting on the **5 kg** box. (2)
- 4.2.3. Calculate the magnitude of force **F**. (4)

- 4.3. The diagram below shows a rope and pulley arrangement of a device being used to suspend a boulder of mass M . The boulder is at rest. Assume that the ropes are light and inextensible and that the pulley is light and frictionless.



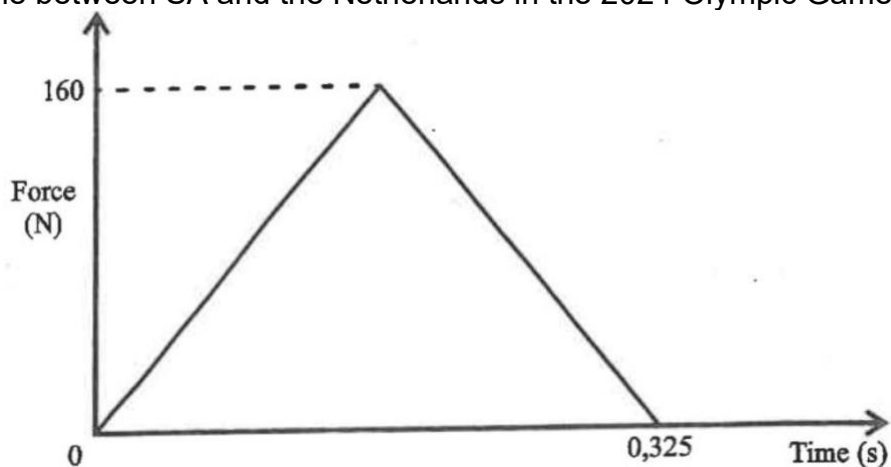
Calculate the boulder's mass M .

(5)

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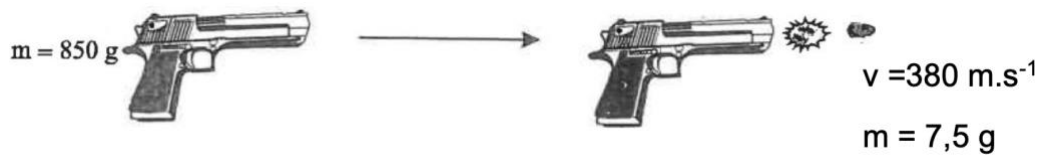
QUESTION 5: MOMENTUM, IMPULSE & POWER

- 5.1. The graph below shows the force exerted on a stationary hockey ball during the game between SA and the Netherlands in the 2024 Olympic Games.



- 5.1.1. Define the term *impulse*. (2)
- 5.1.2. Calculate the impulse experienced by the hockey ball. (3)
- 5.1.3. Determine the mass of the hockey ball if it leaves the hockey stick with a speed of $172,50 \text{ m}\cdot\text{s}^{-1}$. (3)

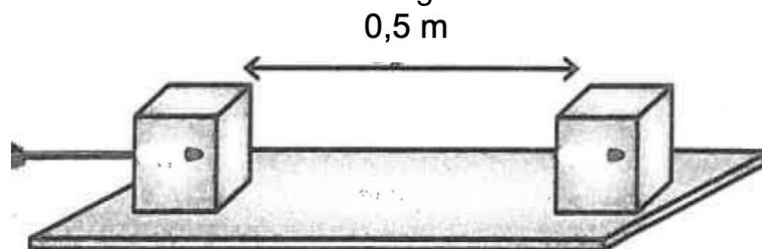
- 5.2. During the pistol shooting competition a competitor wants to calculate the recoil velocity of the gun so that he can adequately prepare for the event.



The fully loaded gun has a mass of 850 g and it fires a bullet of mass 7,5 g at the target. Determine the recoil velocity of the gun for the competitor.

(4)

- 5.3. At the archery, an arrow with mass 120 g, is shot horizontally at a speed of 550 m.s⁻¹ towards the wooden target block which is stationary and has a mass of 1,5 kg. The arrow stays embedded in the block causing it to slide 0,5 m along the rough horizontal surface before coming to rest.



- 5.3.1. State the *Law of conservation of linear momentum*.

(2)

- 5.3.2. Calculate the speed of the arrow and block immediately after the collision.

(3)

5.3.3. Use relevant calculations to prove whether the collision was elastic or inelastic. (5)

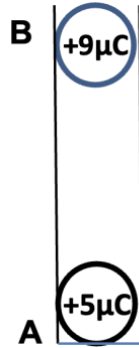
5.3.4. State the *work energy theorem*. (2)

5.3.5. Calculate the magnitude of the frictional force that brings the arrow and block to rest. (4)

[28]

QUESTION 6: ELECTROSTATIC FIELDS

A metal coated pith ball A, carrying a charge of $+5 \mu\text{C}$ is placed in the bottom of a glass tube. A second pith ball B, carrying a charge of $+9 \mu\text{C}$ is now dropped in the glass tube. Each pith ball has a mass of $0,05 \text{ g}$. It is found that pith ball B hovers above the pith ball A as indicated in the diagram below:



- 6.1 State *Coulomb's law of Electrostatic force*. (2)

- 6.2 Why does the pith ball B hover above pith ball A? (1)

- 6.3 Draw a free body diagram showing the forces acting on pith ball B. (2)

- 6.4 Calculate the distance between the two pith balls. (6)

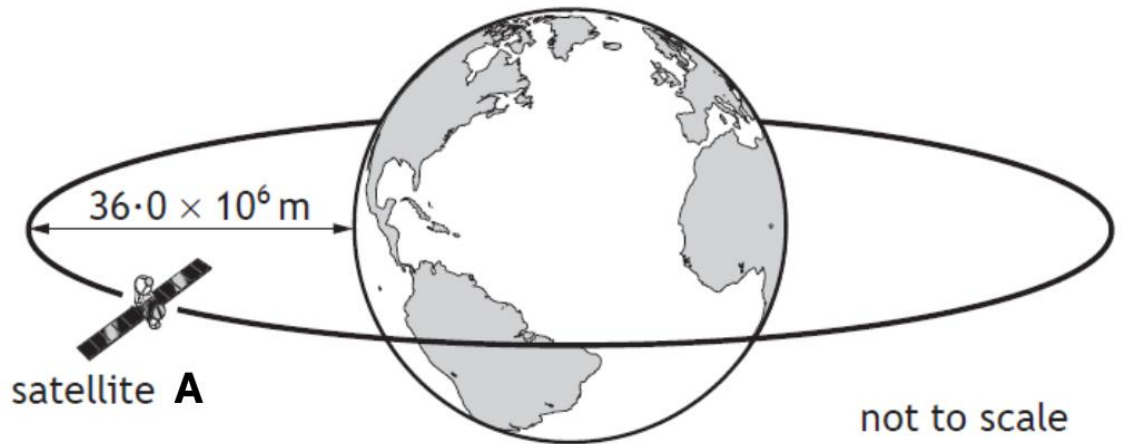
6.5 Determine the strength of the electric field **2 cm** above the **+9 μC** charge. (3)

6.6 Pith ball B is now pushed down the glass tube until it makes contact with pith ball A after which it is repelled. How will this affect the height that pith ball B will come to rest above pith ball A? State INCREASE, DECREASE or SAME HEIGHT and explain your choice. (4)

[18]

QUESTION 7: NEWTON'S LAW OF UNIVERSAL GRAVITATION

- 7.1. A communications satellite, **A**, orbits the Earth at a height of $36,0 \times 10^6 \text{ m}$ above the surface of the Earth.



- 7.1.1. State *Newton's Law of Universal Gravitation*. (2)
- 7.1.2. The gravitational force of attraction between the Earth and the satellite is **57 N**. Calculate the mass of the satellite. (4)
- 7.1.3. An identical satellite, **B**, orbits another planet, β , that is **twice** the **mass** of Earth at **half** the **distance** from its centre. By what factor will satellite **B**'s weight compare with satellite **A**'s weight in their respective positions. (3)

[9]

QUESTION 8: ELECTRIC CIRCUITS

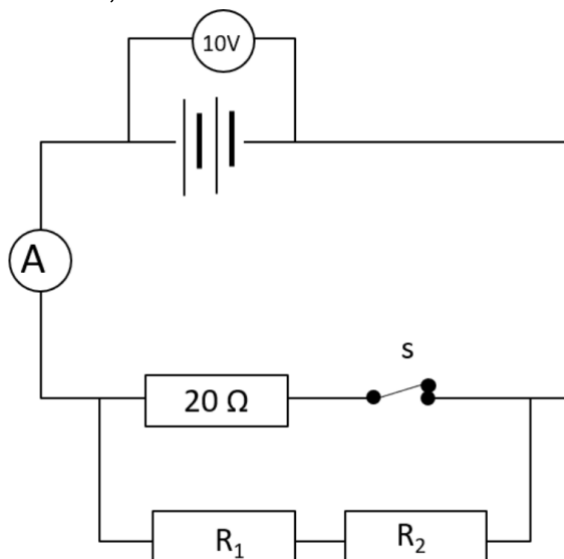
8.1. A battery powers a lightbulb with a resistance of $6\ \Omega$. The potential difference across the lightbulb is $2\ \text{V}$.

8.1.1. Define *potential difference*. (2)

8.1.2. Calculate the current in the lightbulb. (3)

8.1.3. Calculate the amount of charge that passes through the lightbulb in **4 minutes**. (3)

8.2. In the circuit below the battery has an emf of $12\ \text{V}$ and significant internal resistance. When the switch, S, is **closed**, the ammeter read $2\ \text{A}$ and the voltmeter read $10\ \text{V}$.



8.2.1. Define *emf*. (2)

8.2.2. Calculate the internal resistance of the battery. (3)

8.2.3. Calculate the current in the **20 Ω** resistor. (3)

The power in the resistor labelled R1 is 5,85 W.

8.2.4. Determine the resistance of the resistor labelled R1. (4)

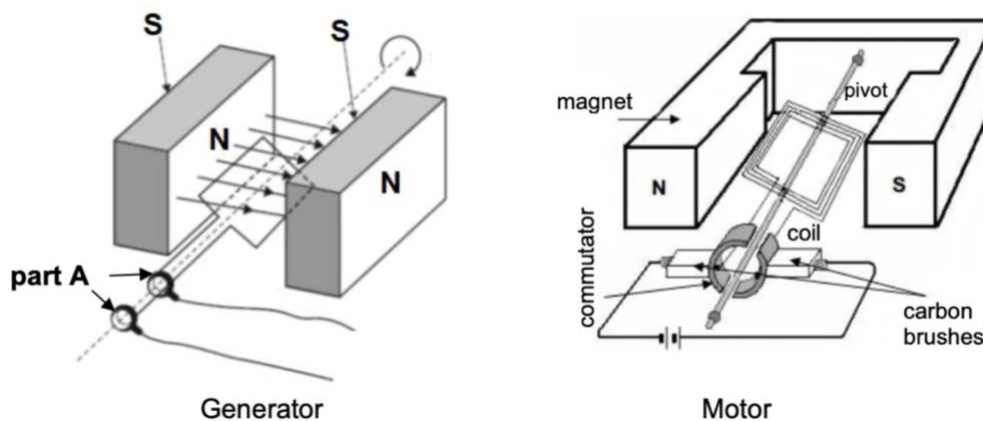
8.2.5. Determine the resistance of the resistor labelled R2. (4)

8.2.6. Will the reading on the voltmeter across the battery increase, decrease or stay the same when the switch, S, is opened? Refer to at least one equation to explain your answer. (4)

[28]

QUESTION 9: ELECTRODYNAMICS

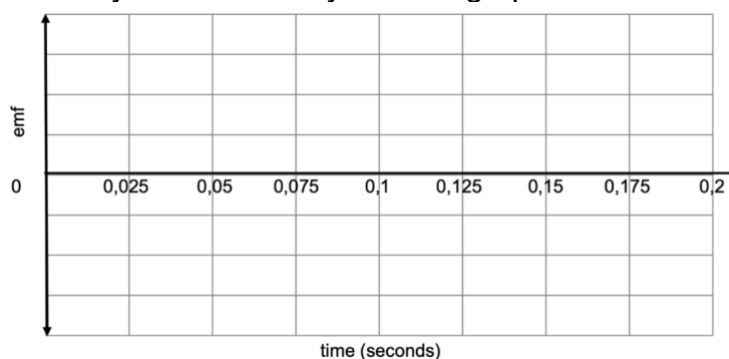
9.1. The sketch below shows a small simple generator and motor.



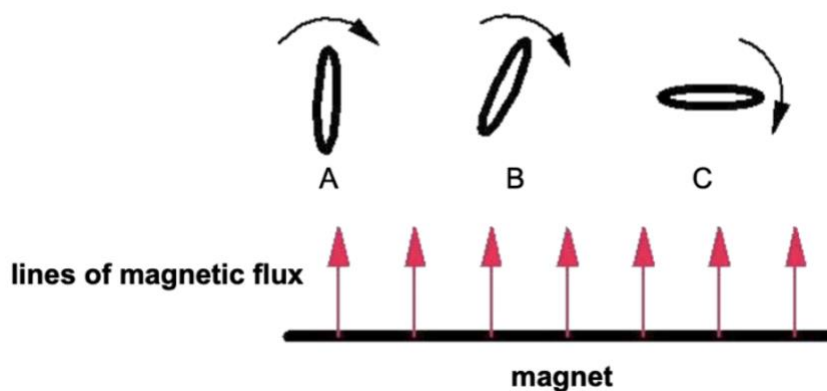
- 9.1.1. Name the parts labelled **A** (2)
- 9.1.2. State the direction the coil in the motor will rotate. Simple state either **CLOCKWISE** or **ANTI-CLOCKWISE**. (2)
- 9.1.3. Name the rule you used to determine the direction of movement of the coil in 9.1.2. (1)

The coil makes one complete turn in **0,1 s** and then speeds up to make a second complete turn in **0,05 s**. Assume that the speed of rotation for the first complete turn is constant and that the speed of rotation for the second complete turn is constant. Assume that the coil instantly changes speed at the end of the first turn.

- 9.2. Sketch a graph showing the relationship between **emf** and **time** for the generator for the two turns described above. Start your graph with the emf at zero. (**You do not need to give numerical values on the Y-axis**). Below is an example of the axes you can use in your own graph: (4)



- 9.3. Consider the coil in positions A, B and C with magnetic field direction from the bottom to the top of the page, as shown below.

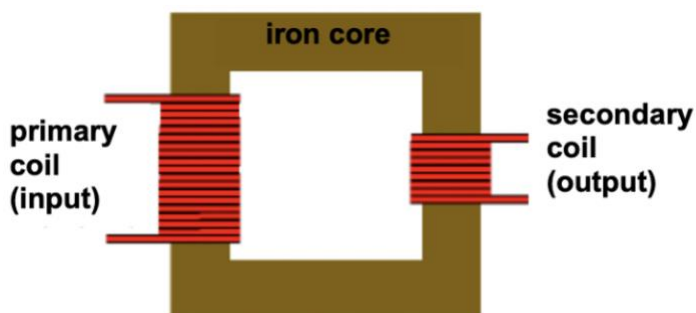


Write down only the letter A, B or C next to each question, to answer each question below.

In which position (A, B or C) is...

- 9.3.1. The magnetic flux the greatest? (1)
- 9.3.2. The magnetic flux the smallest? (1)
- 9.3.3. The rate of change of magnetic flux the greatest? (1)
- 9.3.4. $\theta = 90^\circ$? (given the equation $\phi = BA\cos\theta$) (1)
- 9.3.5. The induced emf **between** minimum and maximum? (1)

9.4. Refer to the device shown below:

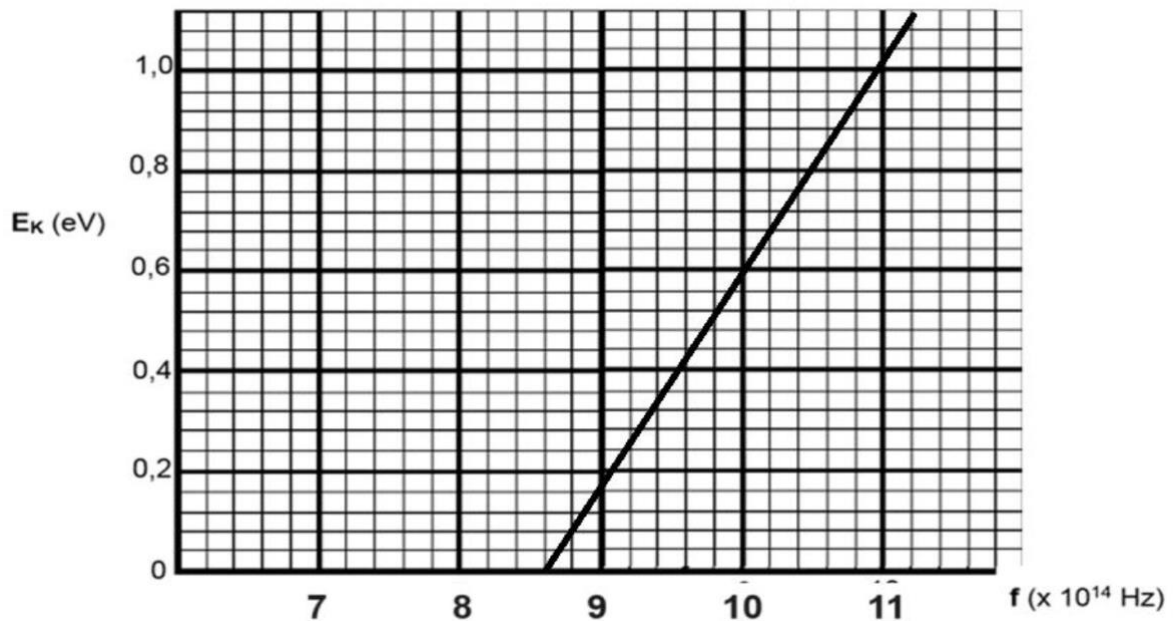


- 9.4.1. Name the device seen above. (2)
- 9.4.2. State the purpose of this device. (2)
- 9.4.3. There are 300 turns in the primary coil and 15 turns in the secondary coil. The input potential difference is 220 V. Calculate the output potential difference. (3)

[21]

QUESTION 10: PHOTONS AND ELECTRONS

The graph below represents the maximum kinetic energy of an electron (E_k) ejected from the surface of a metal as the frequency (f) of light shone on it is increased.



10.1 Define *threshold frequency*. (2)

10.2 What is the threshold frequency of this metal? (2)

10.3 A table of the work functions of four metals is shown below.

Metal	Potassium	Uranium	Copper	Gold
Work function (eV)	2,30	3,55	4,65	5,10

Determine which metal was used to produce the graph seen above. (5)

10.4 The intensity of the incident light is increased without changing the frequency.

10.4.1. State and explain any change in the maximum kinetic energy of emitted electrons. (2)

10.4.2. State and explain any change in the rate of emission of electrons. (2)

[13]

THE END

TOTAL: 200 MARKS

EXAMINATION DATA SHEET FOR THE PHYSICAL SCIENCES
(PHYSICS)

TABLE 1 PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity on Earth	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Universal gravitational constant	G	$6,7 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Coulomb's constant	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Magnitude of charge on electron	e	$1,6 \times 10^{-19} \text{ C}$
Mass of an electron	m_e	$9,1 \times 10^{-31} \text{ kg}$
Planck's constant	h	$6,6 \times 10^{-34} \text{ J}\cdot\text{s}$
1 electron-volt	eV	$1,6 \times 10^{-19} \text{ J}$

TABLE 2 PHYSICS FORMULAE

MOTION

$v = u + at$ or $v_f = v_i + a\Delta t$	$s = \left(\frac{v+u}{2}\right)t$ or $\Delta x = \left(\frac{v_f+v_i}{2}\right)\Delta t$
$v^2 = u^2 + 2as$ or $v_f^2 = v_i^2 + 2a\Delta x$	$s = ut + \frac{1}{2}at^2$ or $\Delta x = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$

FORCE AND MOMENTUM

$F_{net} = ma$	$F_{net} = \frac{\Delta p}{\Delta t}$ or $F_{net}\Delta t = m\Delta v$	$J = \Delta p = mv - mu$ or $J = \Delta p = mv_f - mv_i$
$p = mv$	$F_g = mg$	$F_{fs}^{max} = \mu_s F_N$ $F_{fk} = \mu_k F_N$

WORK, ENERGY AND POWER

$W = Fs$ or $W = F\Delta x$ or $W = F\Delta x \cos\theta$	$P = \frac{W}{t}$	$P = Fv$
$E_p = mgh$	$E_K = \frac{1}{2}mv^2$	$W_{net} = \Delta E_K$
$\% \text{ efficiency} = \frac{\text{power}_{out}}{\text{power}_{in}} \times 100$		

GRAVITATIONAL AND ELECTRIC FIELDS

$F = G \frac{m_1 m_2}{r^2}$	$g = \frac{F}{m}$	$g = G \frac{M}{r^2}$
$F = k \frac{q_1 q_2}{r^2}$	$E = \frac{F}{q}$	$E = k \frac{Q}{r^2}$

ELECTRIC CIRCUITS

$I = \frac{q}{t}$	$V = \frac{W}{q}$
$R = \frac{V}{I}$	$emf = I(R_{ext} + r)$ or $emf = V_{load} + V_{internal\ resistance}$
$R_S = R_1 + R_2 + \dots$	$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$P = \frac{W}{t} \quad \text{or} \quad W = Pt$	
$W = VIt \quad \text{or} \quad W = I^2 R t \quad \text{or} \quad W = \frac{V^2}{R} t$	
$P = VI \quad \text{or} \quad P = I^2 R \quad \text{or} \quad P = \frac{V^2}{R}$	

ELECTRODYNAMICS

$\Phi = BA \cos \theta$	$emf = -N \frac{\Delta \Phi}{\Delta t}$	$F = IB \ell \sin \theta$
$V_p I_p = V_s I_s$	$\frac{N_s}{N_p} = \frac{V_s}{V_p}$	

PHOTONS AND ELECTRONS

PHOTONS AND ELECTRONS		
$c = f \lambda$	$E = hf$	or $E = \frac{hc}{\lambda}$
$E = W_0 + E_{K(max)}$	$W_0 = hf_0$	$E_{K(max)} = \frac{1}{2} m v_{max}^2$