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PHYSICAL SCIENCES PAPER 1

PRELIMINARY EXAMINATION SEPTEMBER 2023

GRADE 12

Time: 3 HOURS

Marks: 200

Examiner: N Nqadini

Moderators: Z Dlamini

MEMORANDUM

QUESTION 1 MULTIPLE CHOICE

1.1 C

1.2 D

1.3 D

1.4 A

1.5 C

1.6 B

1.7 B

1.8 B

1.9 A

1.10 D

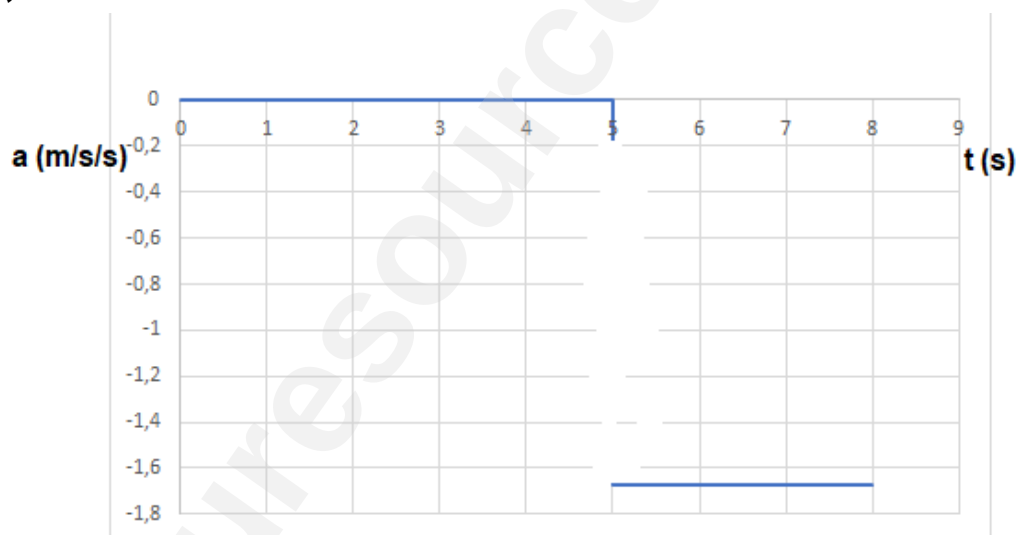
QUESTION 2 KINEMATICS

2.1 length of path travelled ✓✓ (2)

2.2 $(5 \times 5) \checkmark + (5 \times 1,5) \checkmark = 32,5 \text{ m SOUTH} \checkmark$ (3)

2.3
$$a = \frac{\Delta v}{\Delta t} \checkmark = \frac{0 - 5}{8 - 5} \checkmark = \frac{1,67 \frac{\text{m}}{\text{s}}}{\text{s}} \text{ north} \checkmark \checkmark$$
 (4)

2.4 ✓✓ (2)



2.5
$$s = 32,5 + 50 = 82,5 \text{ m} \checkmark$$

$$-82,5 \checkmark = 0,5 x - 10 x (X - 8) \checkmark$$

$$24,5 \text{ s} \checkmark$$
 (4)

2.6 the rate of change of position or the rate of displacement or the rate of change of displacement ✓✓ (2)

2.7 $v = \frac{50}{20,63} \checkmark = 2,42 \frac{m}{s} \text{ north } \checkmark \checkmark$ (3)

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QUESTION 3 KINEMATICS

3.1

3.1.1 $F_{net} = ma \checkmark$ (3)

$$a = \frac{2000}{1250} \checkmark = 1.6 \text{ m} \cdot \text{s}^{-2} \checkmark$$

3.1.2 $v = u + at \checkmark$ (3)

$$36 = 0 + 1,6 t \checkmark$$

$$t = 22,5 \text{ s} \checkmark$$

3.1.3

$$s = \left(\frac{v+u}{2} \right) t \checkmark \quad (4)$$

$$s = \left(\frac{36+0}{2} \right) 22,5 \checkmark$$

$$s = 405 \text{ m} \checkmark$$

plane will take off safely ✓

3.2

3.2.1 At 12 s ✓ (1)

- 3.2.2
- The velocity of the man gradually decreased from $54\text{m}\cdot\text{s}^{-1}$ to $8\text{m}\cdot\text{s}^{-1}$ ✓ (2)
 - afterwards the man continued descending at $8\text{m}\cdot\text{s}^{-1}$ downwards. ✓

3.3

3.3.1 $8\text{m}\cdot\text{s}^{-1}$ downwards ✓✓ (2)

3.3.2 $v^2 = u^2 + 2as$ (3)

$$v = \sqrt{8^2 + 2(9,8)(32)} = 26,29 \text{ m/s} \checkmark$$

$$v = u + at$$

$$t = \frac{26,29 - 8}{9,8} \checkmark = 1,87\text{s} \checkmark$$

3.3.3

ball to hit the ground $1,87 - 0,8 = 1,07\text{s} \checkmark$

$$\text{Distance to cover in } 1,07\text{s}: s = ut + \frac{1}{2}at^2 \quad (4)$$

$$s = \frac{1}{2}(2,4)(1,07 \times 1,07) \checkmark = 1,35 \text{ m} \checkmark.$$

the friend will not catch the phone ✓

3.4

3.4.1 **NO** ✓ (1)

3.4.2 Some of the kinetic energy of the phone is transferred to heat and sound energy ✓ (1)

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QUESTION 4 MOMENTUM, WORK and ENERGY

4.1 $CD = \frac{0,9}{\sin 30} \checkmark = 1,8 \text{ m} \checkmark \checkmark$ (3)

4.2 the sum of gravitational potential and kinetic energy at a point. $\checkmark \checkmark$ (2)

4.3 $(75 \times 9,8 \times 0,9) \checkmark + (400 \times 1,8) \checkmark = 1381,5 \text{ J} \checkmark \checkmark$ (4)

4.4 $(Ek + Ep)_A \checkmark = (Ek + Ep)_C \checkmark$
 $1381,5 \checkmark = 75 \times 9,8 \times h \checkmark$ (5)

$$h = 1,88 \text{ m} \checkmark$$

4.5

4.5.1 The total linear momentum of an isolated system remains constant (is conserved). $\checkmark \checkmark$ (2)

4.5.2 $mu = (mx + my)v \checkmark$
 $25 \times 5 = 50v \checkmark$ (4)
 $v = 2,5 \frac{\text{m}}{\text{s}} \checkmark \text{right} \checkmark$

4.5.3 a collision in which only momentum is conserved. $\checkmark \checkmark$ (2)

4.5.4

$$F_{\text{net}} = \frac{\Delta p}{\Delta t} \checkmark$$

$$F_{\text{net}} = (25 \times 2,5) - \frac{(25 \times 5)}{0,25} \checkmark = 250 \text{ N left} \checkmark$$
 (3)

4.5.5 **EQUAL TO** $\checkmark$
 Newton's Third Law $\checkmark$

(2)

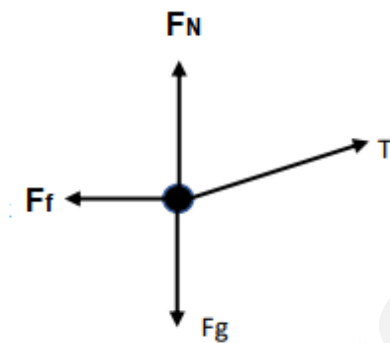
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QUESTION 5 NEWTON'S LAWS

- 5.1 When a net force is applied to an object of mass, m , the object will accelerate in the direction of the net force. The acceleration is directly proportional to the net force and inversely proportional to the mass of the object. ✓✓ (2)

5.2

- 5.2.1 (4)



one mark for each correctly drawn

force

- 5.2.2 (3)

$$F_g - T = 2a \quad \checkmark$$

$$T = (2 \times 9,8) - (2 \times 1,32) \quad \checkmark = 16,96 \text{ N} \quad \checkmark$$

- 5.2.3 (4)

$$Tx - F_k = 8a \quad \checkmark$$

$$F_k = 16,96 \cos 15 \quad \checkmark - (8 \times 1,32) \quad \checkmark = 5,82 \text{ N} \quad \checkmark$$

- 5.2.4 (3)

$$F_N = 8 \times 9,8 \quad \checkmark - 16,96 \sin 15 \quad \checkmark = 74,01 \text{ N} \quad \checkmark$$

5.3 **DECREASE.** ✓ Tension in the string to increase, normal force to decrease.
Normal force is directly proportional to friction, so it will decrease also. ✓ (2)

5.4

5.4.1 the rate at which work is done or the rate at which energy is transferred. ✓✓ (2)

5.4.2 $P = Fv$ ✓ (3)

$$P = 10 \times 9,8 \times 0,4 \checkmark = 39,2 \text{ W} \checkmark$$

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QUESTION 6 FIELDS

6.1

6.1.1 Every particle with mass in the universe attracts every other particle with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. ✓✓ (2)

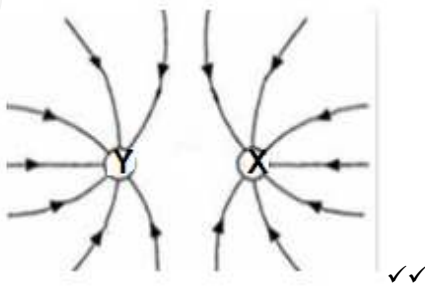
6.1.2
$$g = \frac{GM}{r^2}$$
 (3)

$$7,5 \checkmark = \frac{6,7 \times 10^{-11} M}{590000^2} \checkmark$$

$$M = 3,9 \times 10^{22} \text{ kg} \checkmark$$

6.1.3 $\text{planet X} = 150 \times 7,5 = 1125 \text{ N} \checkmark$
 $\text{Earth} = 150 \times 9,8 = 1470 \text{ N} \checkmark$
 $\text{Percentage Change} = 30,67\% \checkmark$ (3)

6.2

6.2.1  (2)

6.2.2
$$F = \frac{kq_1q_2}{r^2}$$
 (3)

$$F = \frac{9 \times 10^9 \times (30 \times 10^{-9})(40 \times 10^{-9}) \checkmark}{(48 \times 10^{-3})^2 \checkmark}$$

$$F = 4,69 \times 10^{-3} \text{ N} \checkmark$$

6.2.3

$$\begin{aligned} T \cos 35^\circ &= F \sin 35^\circ \\ T &= 2,75 \times 10^{-4} \text{ N} \checkmark \\ 2,75 \times 10^{-4} \sin 35^\circ &= 9,8 \text{ m} \checkmark \\ m &= 1,61 \times 10^{-5} \text{ kg} \checkmark \end{aligned} \quad (3)$$

6.2.4

$$\begin{aligned} E &= E_y + E_x \checkmark \\ &= \frac{(9 \times 10^9)(40 \times 10^{-9})}{0,024^2} \checkmark + \frac{(9 \times 10^9)(30 \times 10^{-9})}{0,024^2} \checkmark \\ E_{\text{net}} &= 156\,250 \text{ N/C} \checkmark \end{aligned} \quad (4)$$

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QUESTION 7 ELECTRIC CIRCUITS

7.1

7.1.1 a material's opposition to the flow of electric current. ✓✓ (2)

7.1.2

$$\begin{aligned} R &= \frac{V}{I} \checkmark \\ I &= \frac{5}{6} \checkmark = 0,83 \text{ A} \checkmark \end{aligned} \quad (3)$$

7.1.3

$$\begin{aligned} \text{emf} &= IR + Ir \checkmark \\ 6 &= (0,83 \times 6) + 0,83r \checkmark \\ r &= 1,23 \, \Omega \checkmark \end{aligned} \quad (3)$$

7.2

7.2.1 the work done per unit positive charge. ✓✓ (2)

7.2.2 $V_{lost} = 6 - 4,5 = 1,5 \text{ V} \checkmark$ (3)

$$V_{lost} = Ir$$

$$I = \frac{1,5}{1,23} \checkmark = 1,22 \text{ A} \checkmark$$

7.2.3 Calculate the resistance of X when the voltmeter reads 4,5 V. (5)

$$\text{for } 6\Omega \text{ resistor: } I = \frac{4,5}{6} \checkmark = 0,75 \text{ A} \checkmark$$

$$R = \frac{V}{I} = \frac{4,5}{1,22 - 0,75} \checkmark \checkmark = 9,57 \Omega \checkmark$$

7.2.4

(a) Increase $\checkmark$ (1)

(b) $V_{ext} = emf - Ir \checkmark$
 When switch S is opened, Resistance will increase. $\checkmark$ Current decrease. (3)
 V_{lost} will also decrease, hence the increase in V_1 (V_{ext}) $\checkmark$.

7.3

7.3.1 Current through a conductor is directly proportional to the potential difference across the conductor at constant temperature. $\checkmark \checkmark$ (2)

7.3.2 **DECREASES** $\checkmark$ (1)

7.3.3 $\text{cost} = \text{power} \times \text{time} \times \text{rate} \checkmark$ (3)
 $0,38 = 0,01 \times t \times 1,25 \checkmark$

$$\text{time} = 30,4 \text{ hours} \checkmark$$

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QUESTION 8 ELECTRODYNAMICS

8.1

8.1.1 Electrical ✓ to mechanical ✓ (2)

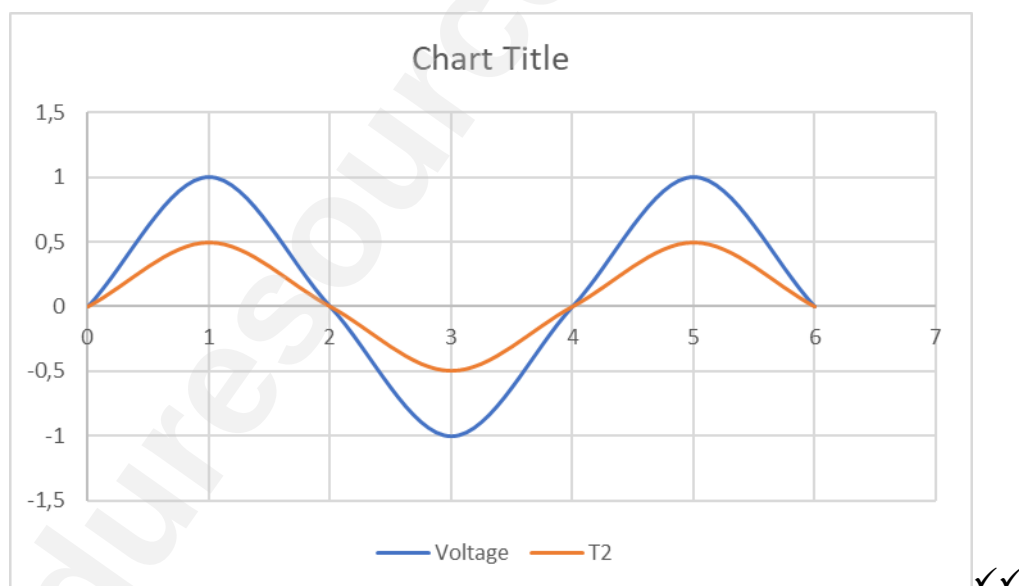
8.1.2 Split ring ✓: completes the circuit/allows for rotation of the armature. ✓ (2)

8.1.3 anti-clockwise ✓ ✓ (2)

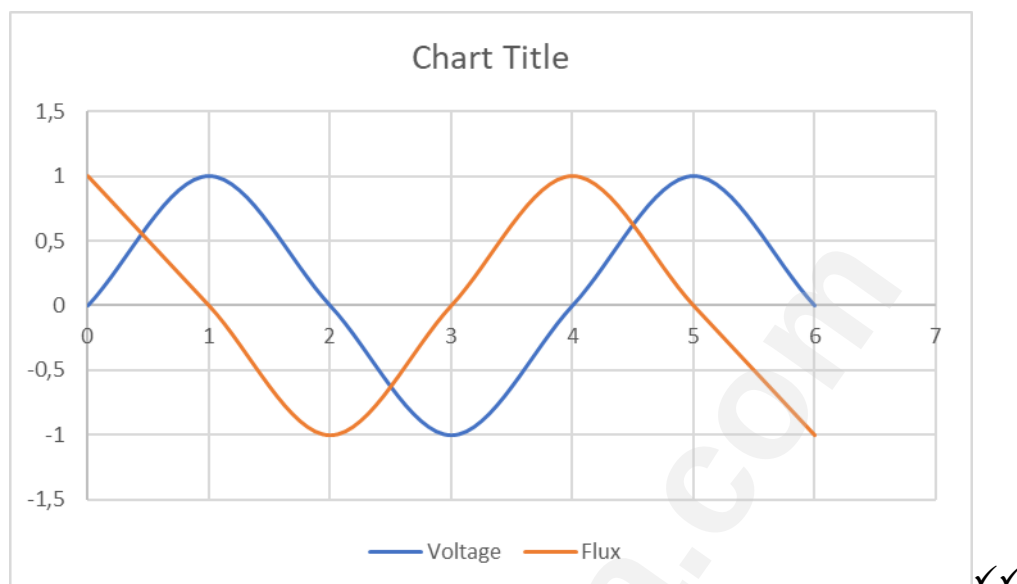
8.2

8.2.1 the emf induced is directly proportional to the rate of change of magnetic flux (flux linkage) ✓ ✓ (2)

8.2.2 (2)



8.2.3 (3)



8.3

8.3.1 Step-down transformer✓

(1)

8.3.2

$$\frac{N_s}{N_p} = \frac{V_s}{V_p}✓$$

(3)

$$N_s = \frac{400 \times 240}{15000} ✓ = 6,4 = 7 \text{ turns} ✓$$

8.3.3

$$V_p I_p = V_s I_s ✓$$

$$I_p = \frac{240 \times 2,5}{15000} ✓ = 0,04 \text{ A} ✓$$

(3)

8.3.4 Direct current results in a steady magnetic field (does not result in a changing magnetic field) so no voltage is induced at the secondary coil✓✓

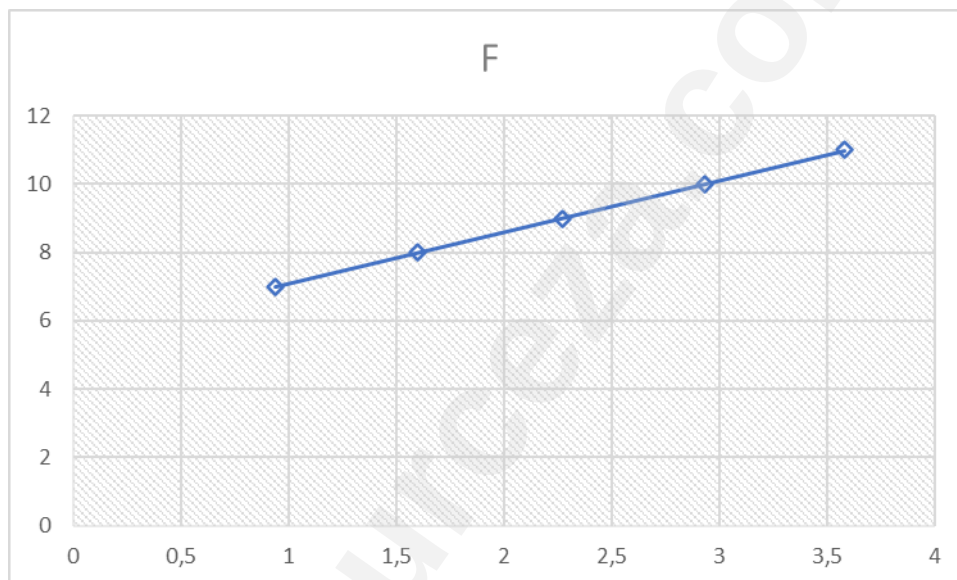
(2)

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QUESTION 9 PHOTONS AND ELECTRONS

9.1

- 9.1.1 *x-axis labelled and units of measurement given. ✓*
y-axis labelled and units of measurement given. ✓
All points plotted. ✓
Line of best fit plotted with a y-intercept around $5,6 \times 10^{14}$ Hz (2) ✓✓ (5)



- 9.1.2 All points must be from the line of best fit. ✓ (3)
 $m = 6,36 \times 10^{-34}$ ✓✓
- 9.1.3 The Plank's constant ✓ (1)
- 9.1.4 *the minimum frequency of incident radiation at which electrons will be emitted from a particular metal. ✓✓* (2)
- 9.1.5 $5,6 \times 10^{14}$ Hz ✓ (1)

9.2

9.2.1 EMISSION ✓ (1)

9.2.2 $E = \frac{hc}{\lambda}$ ✓ (3)

$$\lambda = \frac{(6,6 \times 10^{-34})(3 \times 10^8)}{(-0,5 + 3)(1,6 \times 10^{-19})} = 4,95 \times 10^{-7} \text{ m} \checkmark$$

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TOTAL: 200 MARKS