

MARKING GUIDELINES

EXAMINATION	NATIONAL SENIOR CERTIFICATE
GRADE	12
DATE	JUNE 2024
SUBJECT	PHYSICAL SCIENCES
PAPER	1
MARK TOTAL	150
DURATION (HOURS)	3
NUMBER OF PAGES	13



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**QUESTION 1**

- | | | |
|------|------|-----|
| 1.1 | D ✓✓ | (2) |
| 1.2 | C ✓✓ | (2) |
| 1.3 | D ✓✓ | (2) |
| 1.4 | D ✓✓ | (2) |
| 1.5 | B ✓✓ | (2) |
| 1.6 | D ✓✓ | (2) |
| 1.7 | D ✓✓ | (2) |
| 1.8 | B ✓✓ | (2) |
| 1.9 | C ✓✓ | (2) |
| 1.10 | B ✓✓ | (2) |

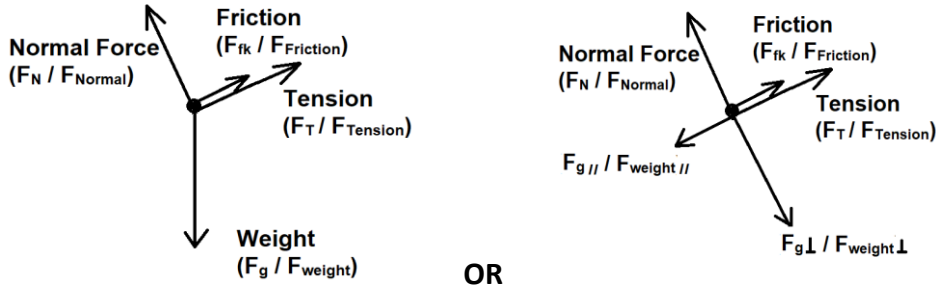
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QUESTION 2

2.1 When a net force acts on an object it causes the object to 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)

2.2



✓ Normal force ✓ Weight **OR** components of weight ✓ Tension
 ✓ Friction (-1 for any extra force) (4)

2.3 $F_{fk} = \mu F_N$
 $F_{fk} = \mu mg \cos \theta$ ✓
 $F_{fk} = (0,1)(2)(9,8) \cos 15^\circ$ ✓
 $F_{fk} = 1,89 \text{ N}$ ✓ (3)



2.4 **2 kg-Block**
 $F_{net} = ma$
 $F_{g||} - F_T - F_{fk} = ma$ ✓
 $mg \sin \theta - F_T - F_{fk} = ma$
 $(2)(9,8) \sin 15^\circ - F_T - 1,89 = (2)a$
 $3,18 - F_T = (2)a$
 $3,18 - 2a = F_T$ ✓

1 kg-Block
 $F_{net} = ma$
 $F_T = ma$
 $F_T = (1)a$ ✓

$F_T \text{ of } 2\text{kg} = F_T \text{ of } 1\text{kg}$ ✓
 $3,18 - 2a = a$
 $3,18 = 3a$
 $a = 1,06 \text{ m} \cdot \text{s}^{-2}$ ✓ (5)

2.5 Decreases. ✓
 When θ increases, Normal force $F_N = F_{g\perp} = mg \cos \theta$ ✓ decreases ✓ (4)
 This results in a decrease in the frictional force $F_{fk} = \mu F_N$ ✓.

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QUESTION 3

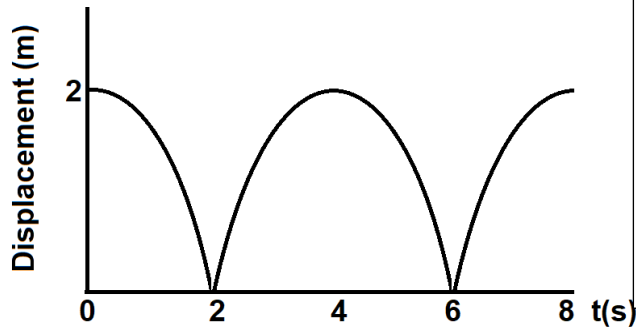
3.1 An object upon which the only force acting is the force of gravity. ✓✓ (2)

3.2

3.2.1 9,8 m.s⁻²✓ (1)

3.2.2 9,8 m.s⁻²✓ (1)

3.3



<p>Shape</p> <ul style="list-style-type: none"> ✓ Displacement 2 m at t=0 s, t=4 s and t=8 s ✓ Displacement 0 m at t=2 s, t=6 s <p>Labels</p> <ul style="list-style-type: none"> ✓ Displacement / x (m) Time / t (s)
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(3)

3.4 $v_f = v_i + a\Delta t$ ✓

$$0 = v_i + (-9,8)(4 - 3) \quad \checkmark$$

$$-v_i = -9,8$$

$$v_i = 9,8 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

OR

$$v_f = v_i + a\Delta t$$

$$v_f = 0 + (-9,8)(2)$$

$$v_f = -19,6 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$v_f = 19,6 + (-9,8)(3 - 2) \quad \checkmark$$

$$v_f = 9,8 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(3)

3.5 Elastic ✓

E_k was conserved. ✓

The ball reached the same height after every bounce. ✓

(3)

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QUESTION 4

4.1 The product of an object's mass and its velocity. ✓✓ (2)

4.2 $p = mv$ ✓

$p = (0,5)(3)$ ✓

$p = 1,5 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ Right ✓ (3)

4.3 The total linear momentum of an isolated system remains constant (is conserved). (2)

4.4 *Sum of momentum before = Sum of momentum after*

$(m_A v_{iA} + m_B v_{iB})_{\text{before}} = (m_A v_{fA} + m_B v_{fB})_{\text{after}}$ } ✓ formula

$(0,5)(3) + (0,25)(0) \checkmark = (0,5)(1,6) + (0,25)v \checkmark$

$1,5 + 0 = (0,8) + 0,25v$

$0,70 = 0,25v$

$v = 2,8 \text{ m} \cdot \text{s}^{-1}$ ✓ (4)

⊕

4.5 $ME_{\text{bottom}} = ME_{\text{top}}$

$\frac{1}{2}mv^2 + mgh = \frac{1}{2}mv^2 + mgh$ } ✓ formula

$\frac{1}{2}(0,25)(2,8)^2 + (0,25)(9,8)(0) \checkmark = \frac{1}{2}(0,25)(0)^2 + (0,25)(9,8)h \checkmark$

$0,98 = 2,45h$

$h = 0,31 \text{ m}$ ✓ (4)

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QUESTION 5

5.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓

OR

The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓ (2)

5.2 $W = \Delta E_k$
 $W = E_{kf} - E_{ki}$
 $W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } ✓ formula
 $W = \frac{1}{2}(100)(0,8)^2_f - \frac{1}{2}(100)(0)^2_i$ ✓
 $W = 32 J$ ✓ (3)

⊕ 5.3 $W = F_{net}\Delta y$
 $W = (T - F_g)\Delta y$ } ✓ formula
 $W = (T - mg)\Delta y$ }
 $32 = [T - (100)(9,8)✓](2,5)$ ✓
 $\frac{32}{2,5} = T - 980$
 $T = 992,8 N$

$F_{app} = T = 992,8 N$ ✓ (4)

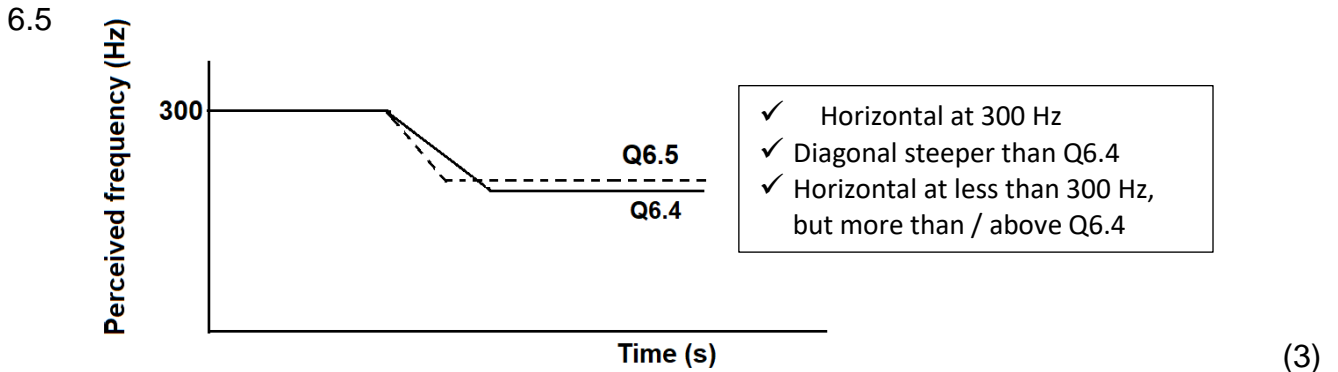
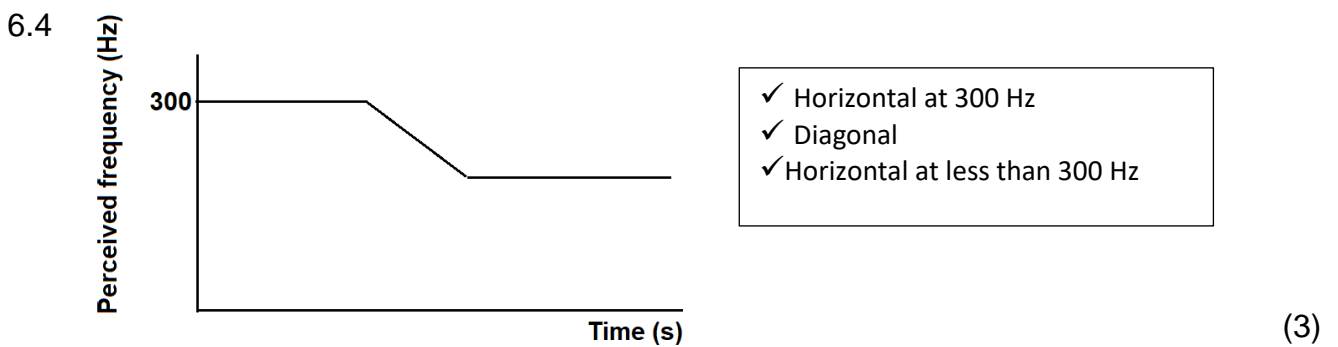
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QUESTION 6

6.1 The change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓ (2)

6.2 300 Hz ✓ (1)

6.3 DECREASES ✓
The wavelength of the sound waves become larger✓ and less waves reach the listener per second (unit time). ✓ (3)



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QUESTION 7

7.1

7.1.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. (2)

7.1.2

$$F_{R \text{ on } S} = \frac{kQ_R Q_S}{r^2} \checkmark$$

$$F_{R \text{ on } S} = \frac{(9 \times 10^9)(5 \times 10^{-12})(X)}{(5 \times 10^{-2})^2} \checkmark$$

$$F_{R \text{ on } S} = 18X \text{ N}$$

$$F_{S \text{ on } T} = \frac{kQ_S Q_T}{r^2}$$

$$F_{S \text{ on } T} = \frac{(9 \times 10^9)X(4 \times 10^{-12})}{(2 \times 10^{-2})^2} \checkmark$$

$$F_{S \text{ on } T} = 90X \text{ N}$$

$$F_{net} = F_{Q \text{ on } R} + F_{P \text{ on } R} \checkmark$$

$$1,728 \times 10^{-10} \checkmark = 18X + 90X \quad (\checkmark \text{ addition - method mark})$$

$$1,728 \times 10^{-10} = X(18 + 90)$$

$$X = 1,6 \times 10^{-12} \text{ C} \checkmark$$



(7)

7.1.3

$$Q_{new} = \frac{Q_R + Q_S}{2} \checkmark$$

$$Q_{new} = \frac{(5 \times 10^{-12}) + (-1,6 \times 10^{-12})}{2} \checkmark$$

$$Q_{new} = 1,7 \times 10^{-12} \text{ pC} \checkmark$$

$$Q_{new} = \frac{Q_R + Q_{-3 \text{ pC}}}{2}$$

$$Q_{new} = \frac{(5) + (-1,6)}{2}$$

$$Q_{new} = 1,7 \text{ pC} \quad (3)$$



7.2

$$7.2.1 \quad E_{at P} = \frac{kQ_Q}{r^2}$$

$$2,7 \times 10^3 \checkmark = \frac{(9 \times 10^9)Q_Q}{(0,1)^2 \checkmark}$$

$$Q_Q = \frac{(2,7 \times 10^3)(0,1)^2}{(9 \times 10^9)}$$

$$Q_Q = 3 \times 10^{-9} C \quad \checkmark$$

$$n_e = \frac{Q}{q_e}$$

$$n_e = \frac{3 \times 10^{-9}}{1,6 \times 10^{-19}} \checkmark \text{ (electron charge)}$$

$$n_e = 1,88 \times 10^{10} \text{ electrons} \quad \checkmark \quad (5)$$

7.2.2 Left \checkmark (1)

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QUESTION 8

8.1 Same. ✓ When S is open both Voltmeters read the potential difference across the terminal/battery. ✓ (2)

8.2 0 V ✓ (1)

8.3
$$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_p} = \frac{1}{16} + \frac{1}{3}$$

$$R_p = 2,53 \Omega \checkmark$$

$$R_{T \text{ ext}} = R_p + R_1$$

$$R_{T \text{ ext}} = 2,53 + 2 \checkmark$$

$$R_{T \text{ ext}} = 4,53 \Omega \checkmark$$

8.4
$$I = \frac{V}{R_T} = \frac{9}{4,53} = 1,99 A \checkmark$$

$$\varepsilon = V + Ir \checkmark$$

$$12 = 9 + (1,99)r \checkmark$$

$$r = 1,51 \Omega \checkmark$$

8.5
$$V_p = IR_p$$

$$V_p = (1,99)(2,53)$$

$$V_p = 5,03 V$$

$$V = IR \checkmark$$

$$5,03 \checkmark = I(3)$$

$$I = 1,68 A \checkmark$$

$$Q = It \checkmark$$

$$Q = (1,68)(3 \times 60)$$

$$Q = 302,4 C \checkmark$$

8.6 INCREASES ✓

The total current decreases since the total resistance increases ✓. The lost volts decreases and therefore the terminal potential difference increases ✓ and from $P = \frac{V^2}{R}$ ✓ the brightness increases. (4)

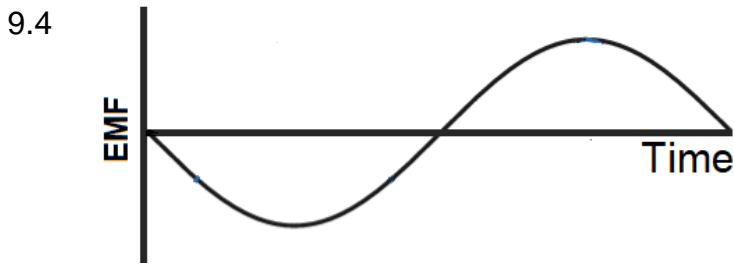
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QUESTION 9

9.1 Mechanical energy ✓ to electrical energy. ✓ (2)

9.2 Sliprings ✓ (1)

9.3 P to Q ✓✓
Fleming's right hand rule ✓ (3)



✓Labels ✓Position of cutting x-axis
✓Position of start & end on y-axis (3)

9.5 Rotate faster ✓ (1)

9.6 $P_{ave} = V_{rms}I_{rms}$ ✓
 $2000 = (240)I_{rms}$ ✓
 $I_{rms} = 8,33 A$ ✓ (3)

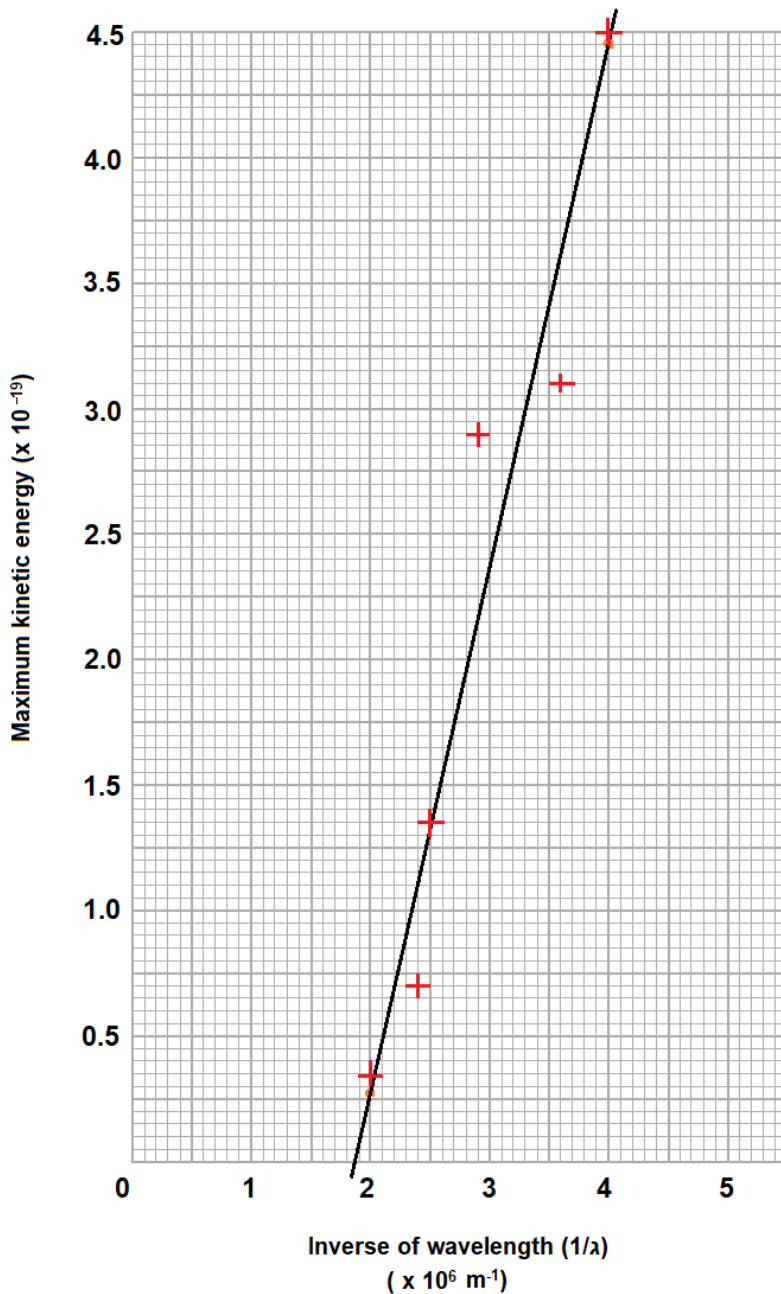
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QUESTION 10

10.1 The process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface. ✓✓ (2)

10.2

Relationship between the maximum kinetic energy and the incerse of wavelength



✓Heading ✓X-axis name and unit ✓Y-axis name and unit
 ✓✓Plot (-1 for every mistake to max of 2) ✓Line of best fit (6)

10.3 $1,85 \times 10^6 \text{ m}$ FROM GRAPH

$$f = \frac{c}{\lambda}$$

$$f = \frac{1}{\lambda}(c) \checkmark$$

$$f = (1,85 \times 10^6 \checkmark)(3 \times 10^8 \checkmark)$$

$$f = 5,85 \times 10^{14} \text{ Hz} \checkmark \quad (4)$$

(Allow: $5,80 \times 10^{14} \text{ Hz} - 5,9 \times 10^{14} \text{ Hz}$)

10.4 STAY THE SAME \checkmark (1)

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GRAND TOTAL: [150]