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Education
KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P1

MEMORANDUM

PREPARATORY EXAMINATION

SEPTEMBER 2017

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

N.B. This memorandum consists of 8 pages including this page.

QUESTION 1

- 1.1 C✓✓
 1.2 C✓✓
 1.3 C✓✓
 1.4 B✓✓
 1.5 B✓✓
 1.6 D✓✓
 1.7 B✓✓
 1.8 C✓✓
 1.9 A✓✓
 1.10 D✓✓

10x 2 = [20]

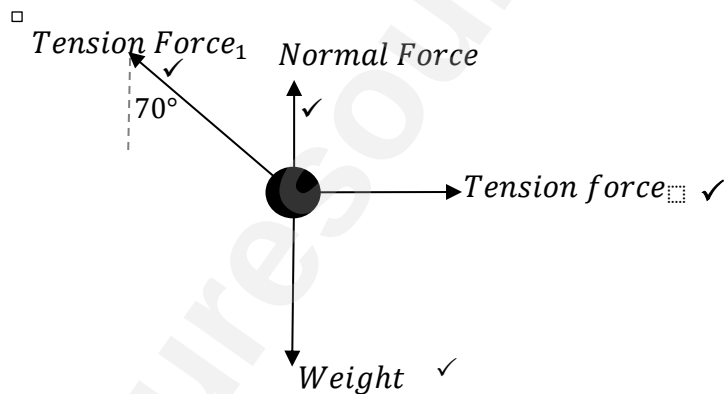
QUESTION 2

- 2.1.1 When a net force acts on an object, the object will accelerate in the direction of the net force with an acceleration that is directly proportional to the net force and inversely proportional to the mass of the object. ✓✓ (2)

OR

Net force is equal to a rate of change in momentum. ✓✓

2.1.2



(4)

$$2.1.3 \quad T_2 - m_2 g = 0$$

$$\vec{T}_2 = m_2 g$$

$$\vec{T}_2 = (5)(9,8) \checkmark$$

$$T_2 = 49 \text{ N} \checkmark$$

(2)

$$2.1.4 \quad \vec{F}_{\text{net}} = 0 \quad (\text{on box mass } 2\text{kg})$$

$$T_{1x} = 49 \text{ N to the left} \checkmark$$

Using trigonometry to work out T_{1y} :

$$\frac{T_{1x}}{T_{1y}} = \tan \alpha$$

$$T_{1y} = \frac{T_{1x}}{\tan \alpha}$$

$$T_{1y} = \frac{49}{\tan 70^\circ}$$

$$T_{1y} = 17,83 \text{ N} \checkmark$$

Working with vertical forces (up as positive):

$$\vec{F}_{\text{net},y} = 0$$

$$T_{1y} + N - F_g = 0$$

$$17,83 + N - (2)(9,8) = 0 \checkmark$$

$$N = 1,77 \text{ N} \checkmark \quad (\text{i.e. the magnitude of the normal force is } 1,77 \text{ N})$$

(4)

$$2.2 \quad W = mg \checkmark$$

$$152,28 = 94g \checkmark$$

$$g = 1,62 \text{ m.s}^{-2} \text{ (downwards)} \checkmark$$

(3)

[15]

QUESTION 3

3.1 An object upon which the only force acting is the force of gravity. $\checkmark \checkmark$

(2)

3.2 **Upward is positive**

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

$$0 = 5 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 0,51 \text{ s} \checkmark$$

Downward is positive

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

$$0 = -5 + (9,8)\Delta t \checkmark$$

$$\Delta t = 0,51 \text{ s} \checkmark$$

(3)

3.3 **Upward is positive**

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

$$= 8 + (-9,8)(0,51) \checkmark$$

$$= 3,00 \text{ m.s}^{-1}, \text{ upwards} \checkmark$$

Downward is positive

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

$$= -8 + (9,8)(0,51) \checkmark$$

$$= 3,00 \text{ m.s}^{-1}, \text{ upwards} \checkmark$$

(3)

3.4 Ball A

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ &= 5 + (-9,8)\Delta t \\ &= 5 - 9,8\Delta t \dots\dots\dots(1) \checkmark \end{aligned}$$

But Ball A is moving downwards

Solving (1) and (2)

$$\begin{aligned} -(5 - 9,8\Delta t) &= (8 - 9,8\Delta t) \checkmark \\ \Delta t &= 0,66 \text{ s} \checkmark \quad (\Delta t = 0,6633 \text{ s}) \end{aligned} \quad (5)$$

Positive marking from Question 3.4

3.5 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $= (5)(0,66) + \frac{1}{2} (-9,8)(0,66)^2$ ✓
 $= 1,17 \text{ m}$ ✓ (using $\Delta t = 0,6633 \text{ s}$, $\Delta y = 1,16 \text{ m}$) (3)

[16]

QUESTION 4

4.1 Principle of Conservation of linear momentum. ✓ The total linear momentum of an isolated system remains constant. ✓✓ (3)

4.2 To the left is positive

Total $p_{\text{before}} = \text{total } p_{\text{after}}$ ✓
 $(340)(2.4) = (340)(0.8) + m_z v_z$ ✓
 $M_z v_z = 544 \text{ kg.m.s}^{-1}$ ✓

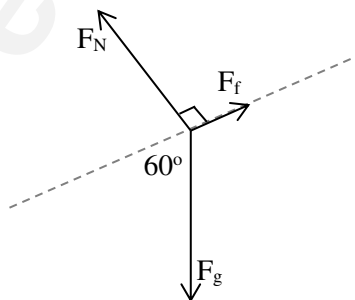
$E_{K\text{before}} = E_{K\text{after}} \checkmark$
 $\frac{1}{2} (340)(2.4)^2 \checkmark = \frac{1}{2} (340)(0.8)^2 + \frac{1}{2} m_z v_z^2$
 $870.4 = \frac{1}{2} (m_z v_z) v_z = \frac{1}{2} (544) v_z \checkmark$
 $v_z = 3.2 \text{ m.s}^{-1} \text{ (to the left)}$
 $m_z = 170 \text{ kg} \checkmark$

$$\begin{aligned} \text{Total } p_{\text{before}} &= \text{total } p_{\text{after}} \checkmark \\ (340)(-2.4) &= (340)(-0.8) + m_z v_z \checkmark \\ m_z v_z &= -544 \text{ kg.m.s}^{-1} \checkmark \end{aligned}$$

$$\begin{aligned} E_{K\text{before}} &= E_{K\text{after}} \checkmark \\ (340)(-2.4)^2 &= \frac{1}{2}(340)(-0.8)^2 + \frac{1}{2} m_z v_z^2 \checkmark \\ 870.4 &= \frac{1}{2} (m_z v_z) v_z = \frac{1}{2} (-544) v_z \checkmark \\ v_z &= 3.2 \text{ m}\cdot\text{s}^{-1} \text{ (to the left)} \\ m_z &= 170 \text{ kg} \checkmark \end{aligned} \quad (8)$$

QUESTION 5

5.1



F_g = gravitational force or weight✓

F_N = Normal force ✓

$$F_f = \text{frictional force} \quad (3)$$

$$5.2 \quad W_{\text{net}} = F_{\text{net}} \Delta x \cos \theta = (F_{\text{q||}} + (-F_{\text{f}})) \Delta x = (343 \text{ N} - 150 \text{ N})(120 \text{ m}) = 23160 \text{ J} \quad (5)$$

- 5.3 The work done by a net force ✓ on an object is equal to the change in the kinetic energy ✓ of the object.

OR

Net work done ✓ on an object is equal to the change in the kinetic energy ✓ of the object. (2)

Mark positively from 5.2

- 5.4 $W_{\text{net}} = \Delta E_k$ ✓ $= \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$

$$23160 \text{ J} = \frac{1}{2} (70) v_f^2 - 0 \text{ J}$$

$$v_f = 25,72 \text{ m.s}^{-1} \text{ ✓}$$

(4)

[14]

QUESTION 6

- 6.1 Doppler Effect. ✓ It is 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. ✓✓

OR

Doppler Effect. ✓ It is the change in the observed frequency of a sound wave when the source of sound is moving relative to the listener. ✓✓ (3)

- 6.2 $56,56 \text{ m.s}^{-1}$ ✓✓ (2)

- 6.3
$$f_L = \frac{v}{v - v_s} f_s \text{ ✓}$$
 (5)

$$298,84 = \frac{340}{340 - 56,56} f_s \text{ ✓}$$

$$f_s = 250 \text{ Hz} \text{ ✓}$$

- 6.4 Determine whether arteries are clogged/narrowed ✓
Determine heartbeat of foetus ✓

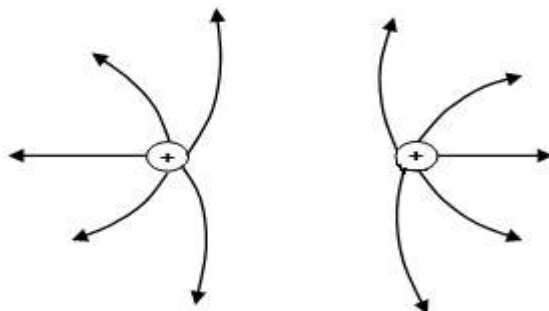
(2)

[11]

QUESTION 7

7.1 Force experienced per unit positive charge placed at a point ✓✓ (2)

7.2



Accept more lines on the 5nC

Checklist Criteria for electric field	Marks
Direction	✓
Shape	✓
Field lines not touching each other or entering the spheres	✓

(3)

$$\begin{aligned}
 7.3 \quad E_3 &= \frac{kQ}{r^2} \checkmark \\
 &= \frac{(9 \times 10^9)(3 \times 10^9)}{(10 \times 10^{-3})^2} \checkmark \\
 &= 270\,000 \text{ N.C}^{-1} \checkmark \text{ (to right)} \\
 E_{\text{net}} &= 270\,000 + (-50\,000) \\
 &= 220\,000 \text{ NC}^{-1} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 E_5 &= \frac{kQ}{r^2} \\
 &= \frac{(9 \times 10^9)(5 \times 10^9)}{(30 \times 10^{-3})^2} \checkmark \\
 &= 50\,000 \text{ N.C}^{-1} \checkmark \text{ (to left)}
 \end{aligned}$$

(6)

Mark positively from 7.3

$$\begin{aligned}
 7.4 \quad F &= qE \checkmark \\
 &= (1,6 \times 10^{-19})(220\,000) \checkmark \\
 &= 3,52 \times 10^{-14} \text{ N} \checkmark \text{ (to the right)} \checkmark
 \end{aligned}$$

(4)

[15]

QUESTION 8

8.1.1 The current through a conductor is directly proportional to the potential difference across the conductor at constant temperature ✓✓ (2)

8.1.2

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{6} \checkmark$$

$$\therefore R_p = 1,5 \, \Omega$$

$$R_T = 1,5 + 3,5 \checkmark$$

$$= 5 \, \Omega \checkmark \quad (3)$$

Mark positively from 8.1.2

8.1.3

$$\text{emf} = I(R_T + r) \checkmark$$

$$12 \checkmark = \frac{2,2(5 + r)}{0,45} \checkmark$$

$$\therefore r = 0,45 \, \Omega \checkmark \quad (4)$$

OR

$$\text{emf} - V_{\text{ext}} = V_{\text{int}} \checkmark$$

$$(12 - 11) \checkmark = (2,2)r \checkmark$$

$$\therefore r = 0,45 \, \Omega \checkmark \quad (4)$$

8.1.4

$$V_2 = IR_1 \checkmark$$

$$= (2,2)(3,5) \checkmark$$

$$= 7,7 \, \text{V} \checkmark$$

OR

$$V_{//} = IR_{//} = 2,2 \times 1,5 \checkmark = 3,30 \, \text{V}$$

$$V_2 = V_T - V_{//} = 11 - 3,3 \checkmark = 7,70 \, \text{V} \checkmark \quad (3)$$

Mark positively from 8.1.4

8.1.5

$$Q = It \checkmark = \frac{2,2 \times (5 \times 60)}{0,45} \checkmark = 660 \, \text{C}$$

$$W = VQ = \frac{7,7 \times 660}{0,45} \checkmark = 5082 \, \text{J} \checkmark$$

OR

$$W = VI\Delta t \checkmark$$

$$= (7,7)(2,2) \checkmark (5 \times 60) \checkmark$$

$$= 5082 \, \text{J} \checkmark \quad (4)$$

OR

$$P = I^2 R \checkmark = (2,2)^2 (3,5) \checkmark = 16,94 \, \text{W}$$

$$W = Pt = (16,94)(5 \times 60) \checkmark = 5082 \, \text{J} \checkmark$$

OR

$$W = I^2 R \Delta t \checkmark$$

$$= (2,2)^2 (3,5) \checkmark (5 \times 60) \checkmark$$

$$= 5082 \, \text{J} \checkmark \quad (4)$$

OR

$$W = \frac{V^2}{R} \Delta t \checkmark$$

$$= \frac{7,7^2}{3,5} \checkmark (5 \times 60) \checkmark$$

$$= 5082 \, \text{J} \checkmark \quad (4)$$

8.2 Decreases✓ (1)

$$\begin{aligned} 8.3 \quad E &= P \times t \\ &= 2 \times 2 \\ &= 4 \text{ kWh} \end{aligned}$$

$$\begin{aligned} C &= \text{tariff} \times E \\ &= 1,25 \times 4 \\ &= R5,00 \end{aligned}$$

(3)
[20]

QUESTION 9

9.1 DC✓ – polarity of emf does not change✓ (2)

9.2 Electromagnetic induction✓ (1)

9.3 Mechanical energy to electrical energy✓ (1)

9.4 Replace split-ring commutator✓ with slip rings✓ (2)

9.5 A✓ (1)

9.6 Friction between moving parts✓
Electrical resistance in wires✓ (2)

9.7 Increase magnetic field strength✓
Increase number of turns on the coil✓ (2)

9.8	$P_{\text{ave}} = I_{\text{rms}}^2 R$	OR	$P = I^2 R$	✓	
	$\frac{1.035 \times 10^6}{I_{\text{rms}}^2} = I_{\text{rms}}^2 (490)$		$\frac{1.035 \times 10^6}{I^2} = I^2 (490)$	✓	
	$I_{\text{rms}} = 45.96 \text{ A}$		$I = 45.96 \text{ A}$	✓	(3)
					[14]

QUESTION 10

10.1	$E = hf$		
	$= 6.63 \times 10^{-34} \times 4.65 \times 10^{14}$		
	$= 3.08 \times 10^{-19} \text{ J}$		
	$E < W_0$ for gold	OR	$f < f_0$ for gold
	$E > W_0$ for caesium✓		$f > f_0$ for caesium
	$\therefore$ choose caesium✓		$\therefore$ choose caesium
			(5)

10.2 There will be a higher current reading on the ammeter. ✓
Each photon ejects one electron, so more electrons per second will be ejected.✓ (2)

10.3.1 $E = W_0 + E_K$ ✓
 $6.6 \times 10^{-34} \times 1.21 \times 10^{15} = 3 \times 10^{-19} + \frac{1}{2} (9.1 \times 10^{-31}) v^2$ ✓
 $\therefore v = 1.05 \times 10^6 \text{ m.s}^{-1}$ ✓ (5)

10.3.2 Remain the same✓ (1)

[13]

GRAND TOTAL: 150