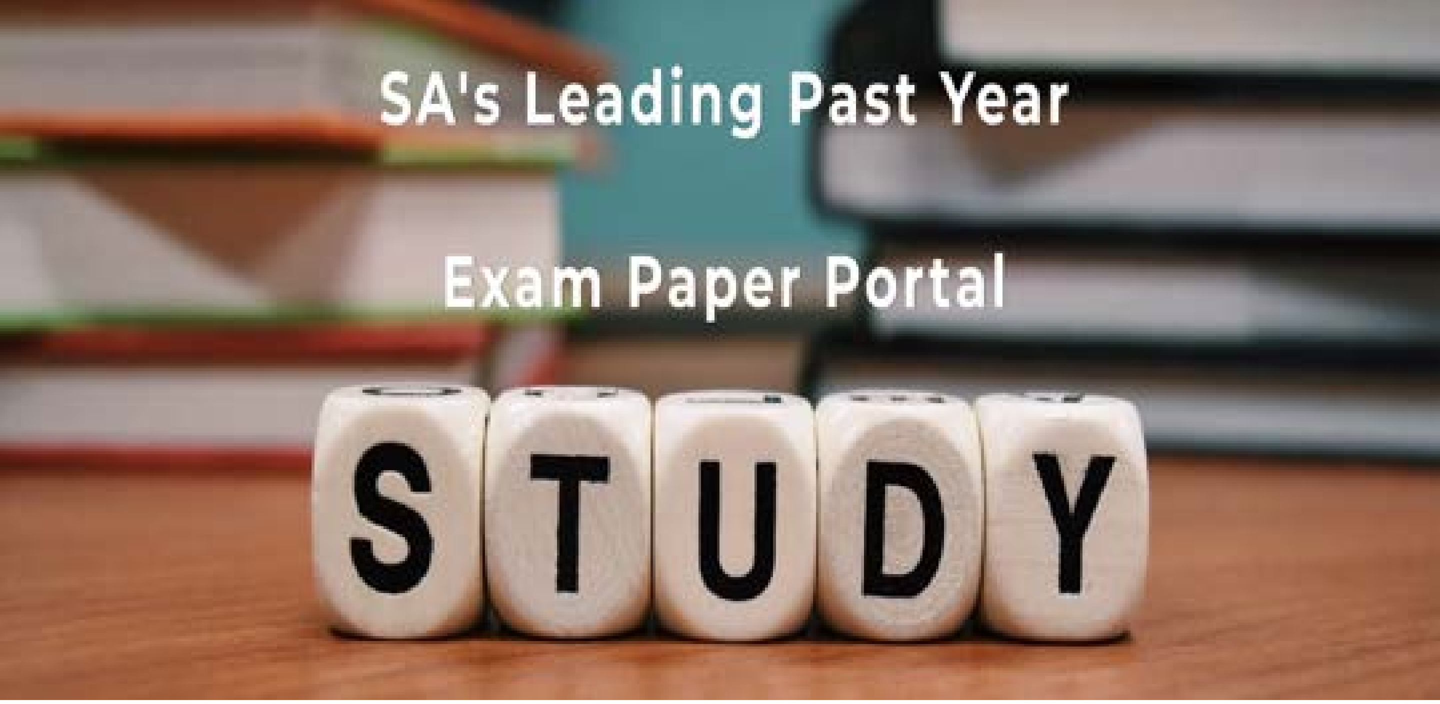
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GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATIONS

SEPTEMBER 2020

MARKING GUIDELINE

Time: 3 Hours

Marks: 150

This marking guideline has 17 pages.

SECTION A

QUESTION 1

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

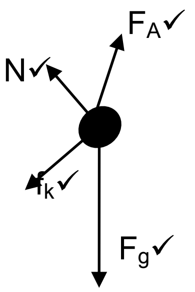
2 x 10 = **[20]**

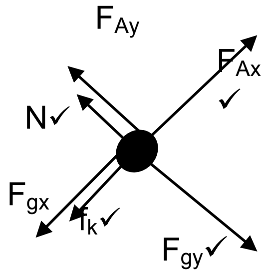
SECTION B

QUESTION 2

2.1 Normal force is the force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface. ✓✓ (2)

2.2





	Accept the following symbols
N✓	F_N/Normal/Normal force
fk✓	Kinetic friction force/f/F_f/f_r
F_A✓	F/$F_{applied}$
F_g✓	W/78,4 N

Notes

- Mark is awarded for label and arrow.
- Do not penalise for length of arrows.
- Deduct 1 mark for any additional force.
- If force(s) do not make contact with body/dot : *Max:3/4*
- If arrows missing but labels are there: *Max:3/4*

(4)

2.3 **Considering the forces parallel to the plane::**

$F_{net} = ma$

$F_{net} = 0$ ✓

$F_{Ax} - f_k - F_{gx} = 0$

$F_A\cos\theta = f_k + F_{gx}$

$51\cos\theta = 1 + 8(9,8)\sin 30^o$ ✓

$\theta = 37,98^o$ ✓ (3)

2.4 **POSITIVE MARKING FROM 2.3**

Consider the forces perpendicular to the plane:

$F_{net} = ma$
$F_{net} = 0$
$F_{Ay} + N - F_{gy} = 0$
$F_A \sin\theta + N = F_{gy}$ ✓

51sin 37,98° + N = 8 x 9,8cos(30°)✓

∴ N = 36,51 N✓ (3)

2.5 Increases ✓ (1)

[13]

QUESTION 3

3.1

3.1.1

UPWARDS IS POSITIVE	**UPWARDS IS NEGATIVE**
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
$0 = 12 - 9{,}8\Delta t$✓	$0 = -12 + 9{,}8\Delta t$✓
$\Delta t = 1.2245s$✓	$\Delta t = 1.2245s$✓

(3)

3.1.2 **OPTION 1**

UPWARDS IS POSITIVE	**UPWARDS NEGATIVE**
$v_f^2 = v_i^2 + 2a\Delta y$✓	$v_f^2 = v_i^2 + 2a\Delta y$✓
$0 = 12^2 + 2(-9{,}8)\Delta y$✓	$0 = (-12)^2 + 2(9{,}8)\Delta y$✓
Δy = 7,35 m	Δy = – 7,35m
∴Max height = 50+✓7,35 = 57,35m✓	∴Maximum height = 50 +✓7,35 = 57,35m✓

OPTION 2

POSITIVE MARKING FROM 3.1.1

UPWARDS IS POSITIVE	**UPWARDS IS NEGATIVE**
$\Delta y = (\frac{v_i+v_f}{2})\Delta t$✓	$\Delta y = (\frac{v_i+v_f}{2})\Delta t$✓
$[\Delta y = \left(\frac{12+0}{2}\right)1{,}2245]$ ✓	$[\Delta y = \left(\frac{-12+0}{2}\right)1{,}2245]$✓
Δy = 7,35 m	Δy = –7,35 m
∴Max height = 50+✓7,35 = 57,35m✓	∴Max height = 50+✓7,35 = 57,35m✓

OPTION 3

POSITIVE MARKING FROM 3.1.1

UPWARDS IS POSITIVE

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓

$\Delta y = \underline{(12)(1,23) + \frac{1}{2}(-9,8)(1,23)^2}$✓

$\Delta y = 7,35$ m

∴Maximum height = 50+✓7,35
= 57,35m✓

UPWARDS IS NEGATIVE

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓

$\Delta y = \underline{(-12)(1,23) + \frac{1}{2}(9,8)(1,23)^2}$✓

$\Delta y = -7,35$ m

∴Maximum height = 50+✓7,35
= 57,35m✓

OPTION 4

$(K + U)_1 = (K + U)_2$✓

$(\frac{1}{2}mv^2 + mgh)_1 = (\frac{1}{2}mv^2 + mgh)_2$

$\underline{\frac{1}{2}m(12)^2 + m(9,8)(50)}$ ✓ = $\underline{\frac{1}{2}m(0)^2 + m(9,8)h}$ ✓

h = 57,35 m✓ (4)

3.1.3 **OPTION 1**

UPWARDS POSITIVE

$v_f = v_i + a\Delta t$✓

$v_f = \underline{12 + (-9,8)(4)}$ ✓

$v_f = -27,20\ m\bullet s^{-1}$

∴ velocity of the ball is $\underline{27,20\ m\bullet s^{-1}\ \text{downwards}}$✓

UPWARDS NEGATIVE

$v_f = v_i + a\Delta t$✓

$v_f = \underline{-12 + (9,8)(4)}$ ✓

$v_f = 27,20\ m\bullet s^{-1}$

∴ velocity of the ball is $\underline{27,20\ m\bullet s^{-1}\ \text{downwards}}$✓

OPTION 2

UPWARDS POSITIVE

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$\Delta y = (12)(4) + \frac{1}{2}(-9,8)(4)^2$

$\Delta y = -30,40$ m

$\Delta y = (\frac{v_i+v_f}{2})\Delta t$ ✓

$-30,40 = (\frac{12+v_f}{2})(4)$ ✓

v_f =–27,20 m•s^{-1}
∴ velocity of the ball is <u>27,20 m•s^{-1} downwards</u>✓

UPWARDS NEGATIVE

Δy= v_iΔt + ½aΔt^2

Δy= (–12)(4) + ½(9,8)(4)^2

Δy = 30,40 m

$\Delta y = (\frac{v_i+v_f}{2})\Delta t$ ✓

$30,40 = (\frac{-12+v_f}{2})(4)$ ✓

v_f =27,20 m•s^{-1}
∴ velocity of the ball is <u>27,20 m•s^{-1} downwards</u>✓

OPTION 3

UPWARDS POSITIVE

Δy= v_iΔt + ½aΔt^2

Δy= (12)(4) + ½(–9,8)(4)^2

Δy = –30,40 m

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
v_f^2 = <u>(12)^2 + 2(–9,8)(–30.40)</u> ✓
v_f =27,20 m•s^{-1}
∴ velocity of the ball is <u>27,20 m•s^{-1} downwards</u>✓

UPWARDS NEGATIVE

Δy= v_iΔt + ½aΔt^2

Δy= (–12)(4) + ½(9,8)(4)^2

Δy = 30,40 m

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
v_f^2 = <u>(–12)^2 + 2(9,8)(30.40)</u> ✓
v_f =27,20 m•s^{-1}
∴ velocity of the ball is <u>27,20 m•s^{-1} downwards</u>✓ (3)

3.1.4 **OPTION 1**

UPWARDS POSITIVE

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$\Delta y = \underline{(12)(4) + \frac{1}{2}(-9,8)(4)^2}$ ✓

$\Delta y = -30,40$ m

> If candidate calculated 30.40 m in Q 3.1.3. above award 2 marks here.

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m ✓

UPWARDS NEGATIVE

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$\Delta y = \underline{(-12)(4) + \frac{1}{2}(9,8)(4)^2}$ ✓

$\Delta y = 30,40$ m

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m ✓

OPTION 2

POSITIVE MARKING FROM 3.1.3

UPWARDS POSITIVE

$$\Delta y = \left(\frac{v_i+v_f}{2}\right)\Delta t \checkmark$$

$$\Delta y = \left(\frac{12+(-27,20)}{2}\right)(4) \checkmark$$

$\Delta y = -30,40$ m

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m ✓

UPWARDS NEGATIVE

$$\Delta y = \left(\frac{v_i+v_f}{2}\right)\Delta t \checkmark$$

$$\Delta y = \left(\frac{-12+27,20}{2}\right)(4) \checkmark$$

$\Delta y = 30,40$ m

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m ✓

OPTION 3

POSITIVE MARKING FROM 3.1.3

UPWARDS POSITIVE

$v_f^2 = v_i^2 + 2a\Delta y$✓

$(–27,20)^2 = (12)^2 + 2(–9,8)\ \Delta y$ ✓

$\Delta y = –30,40$

∴Position above the ground $= \underline{50 -}$ ✓$30,40$

$= 19,60$ m✓

UPWARDS NEGATIVE

$v_f^2 = v_i^2 + 2a\Delta y$✓

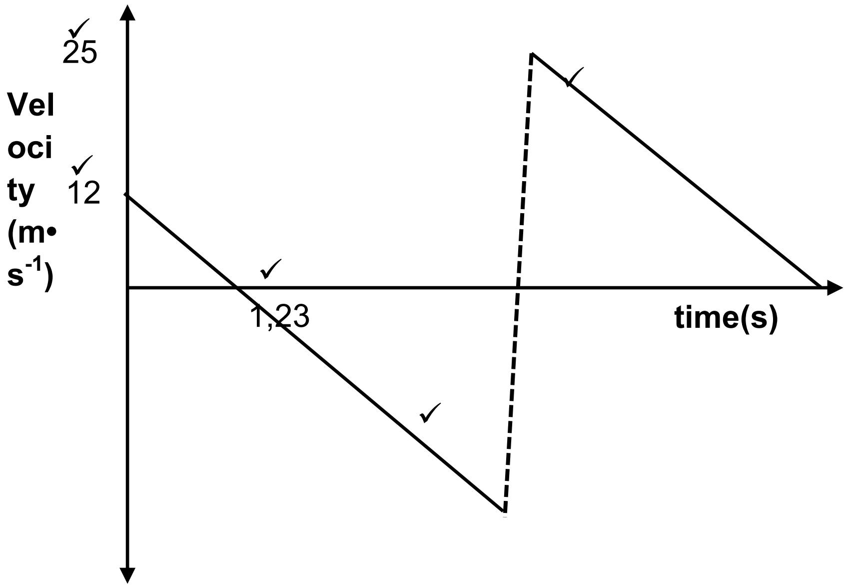
$(27,20)^2 = (–12)^2 + 2(9,8)\ \Delta y$ ✓

$\Delta y = 30,40$

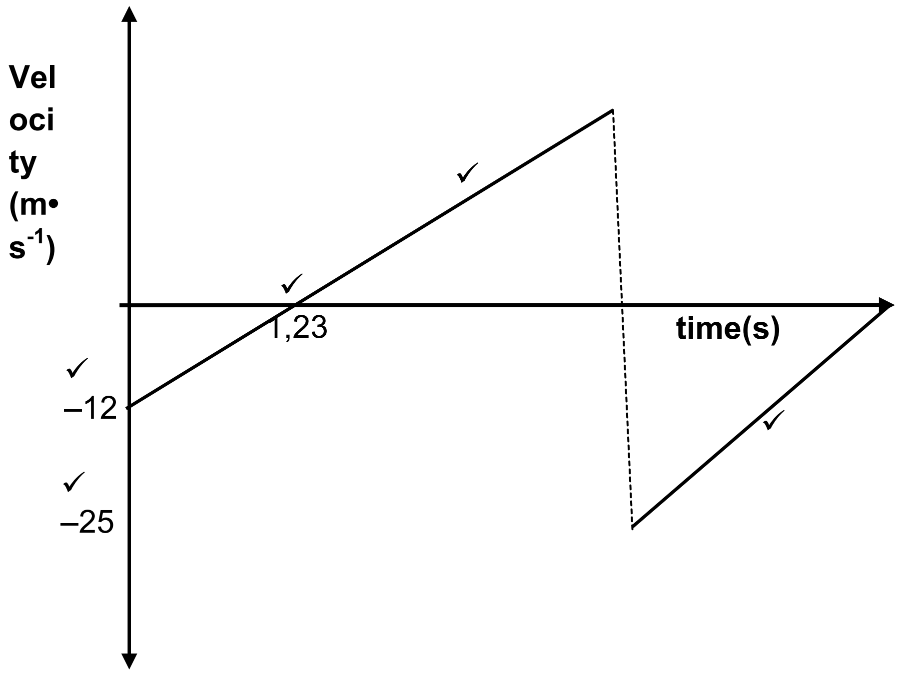
∴Position above the ground $= \underline{50 -}$ ✓$30,40$

$= 19,60$ m✓ (4)

3.2



OR



CRITERIA FOR MARKING OF GRAPH	
Correct shape (the three lines must have same gradient)	✓
Indication of initial velocity (12 m.s^{-1})	✓
Indication of velocity of bounce (25 m.s^{-1})	✓
1.23s	✓
First line longer below x-axis than above	✓
If 25 m.s^{-1} line beyond x-axis then -1	
Do not penalise if dotted lines are solid	

(5)

[19]

QUESTION 4

4.1 The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.✓✓ (2)

4.2

4.2.1 $(K + U)_1 = (K + U)_2$
$(\frac{1}{2}mv^2 + mgh)_1 = (\frac{1}{2}mv^2 + mgh)_2$ ✓
$(\frac{1}{2}(1,005)v^2 + 0) = 0 + (1,005)(9,8)(0,5)$ ✓
$v_1 = 3,13 \text{ m•s}^{-1}$
∴The velocity of the block – bullet system immediately after collision is $3,13 \text{ m•s}^{-1}$✓ (3)

4.2.2 **POSITVE MARKING FROM 4.2.1**
$\Sigma p_i = \Sigma p_f$
$m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$ ✓
$(0,005)v_{1i} + (1)(0)$ ✓ = $(0,005+ 1)(3,13)$ ✓
$v_{1i} = 629,13 \text{ m•s}^{-1}$ ✓ (4)

4.3 Less than✓ (1)

[10]

QUESTION 5

5.1.1 Total mechanical energy of an isolated system remains constant✓✓ (2)

5.1.2 No,✓ (1)

5.1.3 **OPTION 1**
$(K + U)_P = (K + U)_Q – W_f$
OR
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$(\frac{1}{2}mv^2 + mgh)_P = (\frac{1}{2}mv^2 + mgh)_Q – W_f$

$[\frac{1}{2}(1200)(0,8)^2 + (1200)(9,8)(1,8)]_P$✓ = $[\frac{1}{2}(1200)(4)^2 + 0$ ✓$– W_f]_Q$
$W_f = –11952 \text{ J}$

$W_f = F_f \Delta x \cos 180$ ✓
$–11952 = –F_f\, 2,2$
$F_f = 5432,73 \text{ N}$✓

OPTION 2

$W_{net} = \Delta K$
$W_f + W_g = ½mv_f^2 - ½mv_i^2$
$W_f + mgh = ½m(v_f^2 - v_i^2)$
$W_f + mgh = ½mv_f^2 - ½mv_i^2$ ✓

W_f + <u>1200(9,8) (2,2) cos324,90°</u> ✓= <u>½(1200)(4)² - ½(1200)(0,8)²</u> ✓
(accept 35.1°)
$W_f = –11952$ J

$W_f = F_f \Delta x \cos 180$ ✓
$–11952 = –F_f 2,2$
$F_f = 5432,73$ N✓ (5)

5.2

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

OR

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

Note: -1 mark for each key word/phrase omitted in the correct context.

(2)

5.2.2 $W_{net} = \Delta K$
$W_f + W_g + W_N = ½mv_f^2 – ½mv_i^2$ ✓
✓
<u>8000cos180°Δx</u> + 0 + 0 = <u>½(1000)(0)</u> – <u>½(1000)(35²)</u> ✓
$\Delta x = 76,56$ m✓ (4)

5.2.3 $W_{net} = \Delta K$

$W_f + W_g + W_N = ½mv_f^2 – ½mv_i^2$

<u>8000cos180°(30) + 0 + 0</u>✓ = ½(1000)v_f^2 – ½(1000)(35²) ✓
$v_f = 27,29$ m•s⁻¹✓ (3)

5.2.4 INCREASE✓
On a rainy day the road surface would have less frictional force needed for the braking. ✓ (2)

[19]

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 Towards✓ (1)

6.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$(f_s + 50)✓ = (\frac{340+0✓}{340-20✓})f_s$ OR $f_L✓(\frac{340+0✓}{340-20✓})(f_L - 50)$

f_s = 800 Hz (range: 800 – 833.33 Hz)

$v = f_s\lambda$✓
340 = 800λ✓
λ = 0,425 m✓ (range: 0,425 – 0,408) (7)

6.4 Greater than. ✓
The reflected waves are moving toward the ambulance. ✓ (2)

6.5
- blood flow meter ✓
- echocardiograms. ✓
- ultrasound technology
- monitor pregnancies
- examine soft tissue injuries. (any two) (2)

[15]

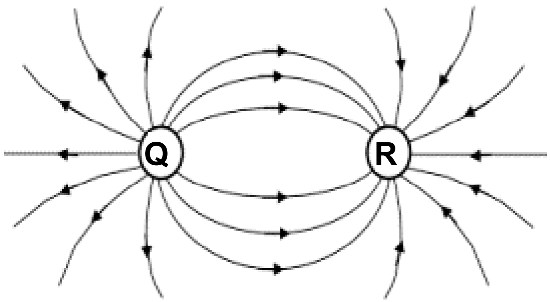
QUESTION 7

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

(2)

> **Note:** -1 mark for each key word/phrase omitted in the correct context.

7.1.2

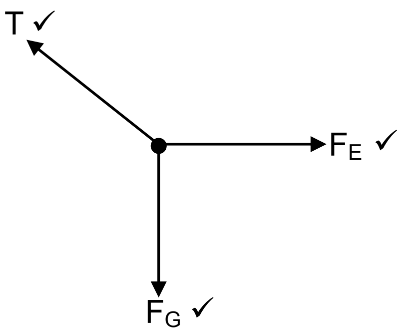


Accept:
Density around R maybe greater than Q

Marking Criteria	
Correct Shape	✓
Field lines do not cross	✓
Direction of field lines correct	✓

(3)

7.1.3



(3)

7.1.4 **CONSIDERING THE HORIZONTAL FORCES:**

$F_{net} = 0$

$T\sin\theta = F_e$ ✓

$$T\sin\theta = \{9 \times 10^9 \left[\frac{(0{,}6 \times 10^{-6})(0{,}9 \times 10^{-6})}{0{,}150^2} ✓\right]\} ✓$$

$T\sin\theta = 0{,}216$ ………………………………… (1)

CONSIDERING THE VERTICAL FORCES:

$F_{net} = 0$

$T\cos\theta = mg$✓

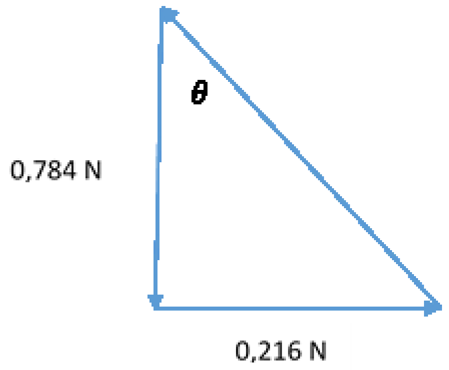
$T\cos\theta = 8 \times 10^{-2}\ (9{,}8)$ ✓ ……………………… (2)

(1) ÷ (2)

tan θ = 0,26/(8 x 10^{-2} (9,8))

θ = 15,40°✓

OPTION 2



F = $\{9 \times 10^9 \left[\frac{(0{,}6 \times 10^{-6})(0{,}9 \times 10^{-6})✓}{0{,}150^2 ✓}\right]\}$
= 0.216N

F_g = mg✓
= 8 x 10^{-2} x 9,8✓
= 0,784 N

tan θ = F/F_g
= 0,216/0,784✓
θ = 15,40°✓

(6)

7.1.5 **POSITIVE MARKING FROM 7.2**
Tcos θ= 8 x 10^{-2} (9,8)
Tcos 15,40°✓= 8 x 10^{-2} (9,8) ✓
T = 0,81 N✓ (3)

7.2.1 *Electric field* is a region of space in which an electric charge experiences a force. ✓✓ (2)
(accept : force experienced per unit positive charged when placed at that point)

7.2.2 $E_1 = k\frac{q_1}{d^2}$ ✓

$E_{net} = [k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}]$✓ OR (E_1 = E_2)

✓
$2E_1 = k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}$

$$2\,k\frac{q_1}{d^2} = k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}$$

$$2\,k\frac{q_1}{d^2} = k\frac{q_1}{d^2} + k\frac{q_2}{4d^2}$$

$$k\frac{q_1}{d^2} = k\frac{q_2}{4d^2}$$

$4q_1 = q_2$
$4 \times 0,5 \times 10^{-6} = q_2$
$q_2 = 2 \times 10^{-6}$ C✓ (4)

[21]

QUESTION 8

8.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature ✓✓

NOTE
If constant temperature is omitted -1 mark (2)

8.2

8.2.1 Total Resistance = $R_{series} + R_{parallel}$

Total Resistance = 4 +✓ $\left(\frac{1}{12} + \frac{1}{18}\right)^{-1}$✓

Total Resistance = 11,20

I = $\frac{V}{R}$✓

I = $\frac{12}{11,2}$✓

I = 1,07A✓ (5)

8.2.2 **POSITIVE MARKING FROM 8.2.1**

$V_{4\Omega} = IR$
$V_{4\Omega} = 1{,}07 \times 4$✓
$V_{4\Omega} = 4{,}28$ V
$V_{//} = 12 - V_{4\Omega}$
$V_{//} = 12 - 4{,}28$
$V_{//} = 7{,}72$ V
$I_{10\Omega} = \frac{V}{R}$
$I_{10\Omega} = \frac{7{,}72}{18}$✓
$I_{10\Omega} = 0{,}43$ A

$P = I^2R$✓ $P = (0{,}43)^2(10)$ ✓ $P = 1{,}85$ W✓	$V_{10\Omega} = IR$ $V_{10\Omega} = 0{,}43 \times 10$ $V_{10\Omega} = 4{,}3$ V $P = \frac{V^2}{R}$✓ $P = \frac{4{,}3^2}{10}$✓ $P = 1{,}85$ W✓	$P = VI$✓ $P = 4{,}3 \times 0{,}43$✓ $P = 1{,}85$ W✓

(5)

8.2.3 **POSITIVE MARKING FROM 8.2.1**

$W = V.I\Delta t$✓ $= 12 \times 1.07 \times 30$✓ $= 385{,}20$ J✓	$W = I^2Rt$✓ $= 1{,}07^2 \times 11{,}2 \times 30$✓ $= 384{,}69$ J✓	$W = \frac{V^2}{R}t$ $= \frac{12^2}{11.2} \times 30$ $= 385{,}71$J

(3)

8.3 Decreases✓
If the 12 Ohm resistor stops working, the total resistance would increase✓. Resistance is inversely proportional to the current✓. (3)

[18]

QUESTION 9

9.1 AC (generator) ✓ (1)

9.2 Slip rings✓ (1)

9.3 The AC potential difference/voltage which dissipates the same amount of energy as DC. ✓✓

OR

(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy as AC. ✓✓ (2)

9.4

$$V_{RMS} = \frac{V_{Max}}{\sqrt{2}} \checkmark$$

$$V_{RMS} = \frac{1}{\sqrt{2}} \checkmark$$

V_{RMS} = 0,71 V✓ (3)

9.5 0,04 s.✓ (1)

9.6 Positive marking from Q 9.4

$$\left.\begin{array}{l} P_{Ave} = V_{RMS} I_{RMS} \\ P_{Ave} = V_{RMS}(\frac{I_{Max}}{\sqrt{2}}) \end{array}\right\} \checkmark$$

$$P_{Ave} = 0{,}71(\frac{2}{\sqrt{2}}) \checkmark$$

P_{Ave} = 1,00 W✓ (3)

9.7 Any two:

(i) easier to generate and transmit from place to place ✓
(ii) easier to convert from a.c. to d.c. than the reverse ✓
(iii) voltage can be easily changed by stepping it up or down
(iv) high frequency used in a.c. make it more suitable for electric motors (2)

[13]

TOTAL: 150