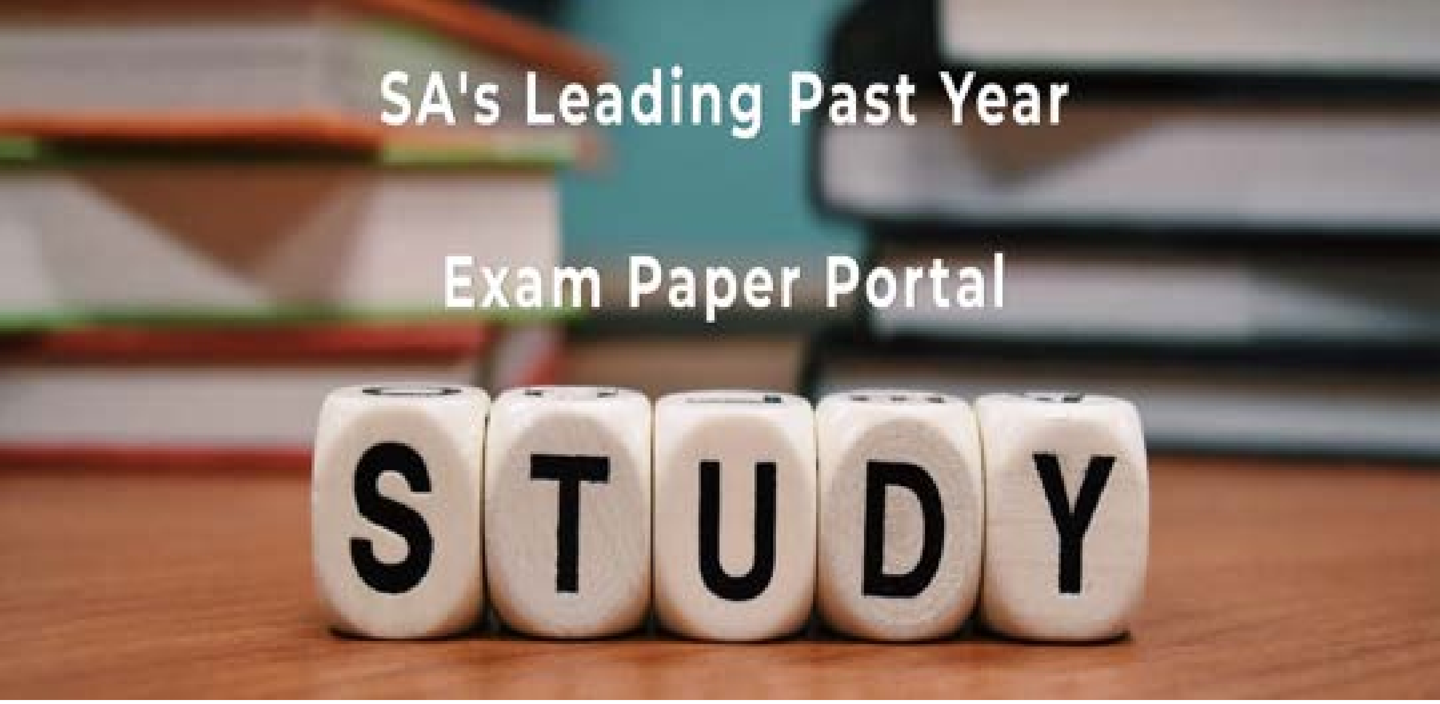

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GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2019

MEMORANDUM

MARKS: 150

This Memorandum consists of 19 pages.

QUESTION 1

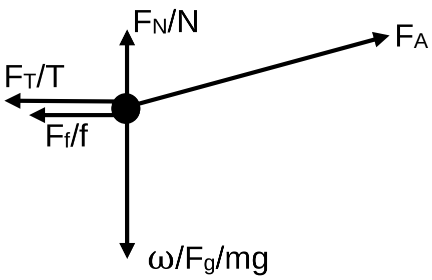
1.1	B✓✓	(2)
1.2	C✓✓	(2)
1.3	D✓✓	(2)
1.4	B✓✓	(2)
1.5	A✓✓	(2)
1.6	C✓✓	(2)
1.7	C✓✓	(2)
1.8	C✓✓	(2)
1.9	D✓✓	(2)
1.10	A✓✓	(2)
		[20]

QUESTION 2

2.1

2.1.1 When a (non-zero) net/resultant force acts on an object, the object will accelerate in the direction of the net force with/at acceleration whose magnitude is directly proportional to the magnitude of the net force✓ and inversely proportional to the mass of the object.✓ (2)

2.1.2



F_N: Normal force ✓

F_A: Applied force ✓

F_T: Tension ✓

F_f: Friction/Frictional force ✓

F_g: Gravitational force/ωeight/$F_{\text{Earth on block}}$ ✓

Notes:
• Mark awarded for label and arrow
• Do not penalise for length of arrows since drawing is not to scale
• Any other additional force(s): -1 mark
• If force(s) do not make contact with body: -1 mark
• -1 mark if all arrows are emitted but correctly labelled

(5)

2.1.3

$$\left.\begin{array}{l} F_{net} = ma \\ (F_{net})_X = m_1 a_X \\ \therefore F_X + (-f_K) + (-T) = m_1 a \\ \therefore F\cos 30° - f_K - T = m_1 a \\ \therefore F\cos 30° - \mu_K (m_1 g - F\sin 30°) - T = m_1 a \end{array}\right\} \text{Any one} \checkmark$$

$\therefore 50\cos 30° - (0,21)\,[(5)(9,8) – (50)(\sin 30°)] \checkmark - T = 5a$

$\therefore 50\cos 30° - 5,04 - T = 5a$

$\therefore 38,26127 - T = 5a \ldots (1) \checkmark$

$(F_{net})_y = m_2 a_y$

$\therefore T + (w_2) = m_2 a$

$\therefore T - m_2 g = m_2 a$

$\therefore T - (0,2)(9,8) = (0,2)a \checkmark$

$\therefore T - (0,2)a + 1,96 \ldots (2) \checkmark$

Subst… (2) into (1) :

$\therefore 38,26127 - [(0,2)a + 1,96] = 5a$

$\therefore 38,26127 - (0,2)a - 1,96 = 5a$

$\therefore 36,30127 = (5,2)a$

$\therefore a = 6,981\ m\cdot s^{-2}$

From (2): $T = (0,2)(6,981) + 1,96$

$\therefore T = 3,3562\ N \checkmark$

(6)

2.2

$$g = \frac{GM_E}{r^2} \checkmark$$

$$= \frac{GM_E}{(R_E + h)^2}$$

$$= \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})}{(6,38 \times 10^6 + 500\ 000)^2} \checkmark$$

$$= 8,43\ m \cdot s^{-2}$$

Reduction in g = 9,8 – 8,43 =1,37✓ ∴%reduction = $\frac{1,37}{9,8}$ x 100 = 13,98% ∴%reduction in ω = 13,98% (for a constant m, ω ∝ g)✓	ω_E = mg = m(9,8) ω_S = (8,43) ∴%ω_S = $\frac{m(8,43}{m(9,8)}$ x 100 = 86,02% ∴%reduction in ω = 100 – 86,02✓ = 13,98% ✓

(4)
[17]

QUESTION 3

3.1

3.1.1 Free fall✓ (1)

3.1.2 The <u>ratio</u> of their weights to their masses is a constant or weight/mass remains the same✓ (1)

3.1.3

<u>Upwards positive</u>:	**<u>Downwards positive</u>:**
ON EARTH: $v_f^2 = v_i^2 + 2a\Delta y$✓ $\therefore (0)^2 = (20)^2 + 2(-9,8)\ \Delta y$✓ $\therefore 0 = 400 - (19,6)\ \Delta y$ $\therefore \Delta y = 20,4082$ m ✓	**ON EARTH:** $v_f^2 = v_i^2 + 2a\Delta y$✓ $\therefore (0)^2 = (-20)^2 + 2(9,8)\ \Delta y$✓ $\therefore 0 = 400 + (19,6)\ \Delta y$ $\therefore \Delta y = -20,4082$ m ✓
<u>On Jupiter:</u> $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore \underline{(0)^2 = v_i^2 + 2(-22,5)\ (20,4082)}$✓ $\therefore 0 = v_i^2 - 918,369$ $\therefore 918,369 = v_i^2$ $\therefore v_i = 30,\ 3046\ m\cdot s^{-1}$ ∴ The speed with which he/she would throw the ball is 30,3046 $m\cdot s^{-1}$✓	**<u>On Jupiter:</u>** $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore \underline{(0)^2 = v_i^2 + 2(22,5)\ (-20,4082)}$✓ $\therefore 0 = v_i^2 - 918,369$ $\therefore 918,369 = v_i^2$ $\therefore v_i = -30,\ 3046\ m\cdot s^{-1}$ ∴ The speed with which he/she would throw the ball is 30,3046 $m\cdot s^{-1}$✓

(5)

3.2

3.2.1 9.8 $m\cdot s^{-2}$ downwards ✓ (1)

3.2.2

<u>Option 1:</u> <u>Downwards as positive:</u>	**<u>Option 2:</u>** **<u>Downwards as positive:</u>**
$\Delta y = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$ Let the distance to **wire1** be xm in time t s Wire1: $x = (0)(t) + \frac{1}{2}(9,8)\ (t)^2$ ✓ $x = 4,9(t)^2 \ldots 1$ Wire2: $(x+1)=(0)(t+0,2)+\frac{1}{2}(9,8)(t+0,2)^2$✓ $x+1 = 4,9(t+0,2)^2$ $\therefore x+1 = 4,9(t^2 + 0,4t + 0,04)$ $\therefore x+1 = 4,9.t^2 + 1,96t + 0,196 \ldots 2$	Consider the motion from wire1 to wire2 Δy=1 m; Δt=0,25 s; a=9,8 $m\cdot s^{-2}$; v_i=? $\Delta y = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$ ✓ $1 = v_i(0,2) + \frac{1}{2}(9,8)(0,2)^2$ ✓ $1 = v_i(0,2) + 0,196$ $0,804 = v_i(0,2)$ $\therefore v_i = 4,02\ m\cdot s^{-1}$ $\therefore v_1 = 4,02\ m\cdot s^{-1}$ ✓ $v_f = v_i + a\Delta t$ ✓ $= \underline{4,02 + (9,8)(0,2)}$ ✓

Subt. 1 Into 2 $\therefore 4{,}9(t)^2 + 1 = 4{,}94{,}9.t^2 + 1{,}96t + 0{,}196$ $\therefore 1 = (1{,}96)t + 0{,}196$ $\therefore 0{,}804 = (1{,}96)t$ $\therefore t = 0{,}4102$ s ✓ $v_f = v_i + a\Delta t$ ✓ wire1: $v_1 = 0 + (9{,}8)(0{,}4102)$ $= 4{,}01996\ m{\cdot}s^{-1}$ ✓ wire1: $v_2 = 0 + (9{,}8)(0{,}4102 + 0{,}2)$ $= 5{,}97996\ m{\cdot}s^{-1}$ ✓	$= 5{,}98\ m{\cdot}s^{-1}$ $\therefore v_2 = 5{,}98\ m{\cdot}s^{-1}$ ✓

(6)
[14]

QUESTION 4

4.1 The total (linear) momentum of an/a isolated/closed system✓is constant/ conserved.✓

OR:

In an/a isolated/closed system, the total (linear) momentum ✓before collision is equal to the total (linear) momentum after collision. ✓

(2)

4.2

4.2.1

Option 1
Take to the right as positive: $\Sigma_{P_i} = \Sigma_{P_f}$ $M_bv_{bi} + m_Bv_{Bi} = M_bv_{bf} + m_Bv_{Bf}$ Any one✓ $\therefore (0{,}0175)(55{,}60) + (8{,}45)(0) = (0{,}0175)(-12{,}60) + (8{,}45)\ v_{Bf}$ ✓ $\therefore 0{,}973 = -0{,}2205 + (8{,}45)\ v_{Bf}$ $\therefore v_{Bf} = 0{,}141243\ m{\cdot}s^{-1}$ $\therefore$ The magnitude of the velocity of the block is $0{,}141243\ m{\cdot}s^{-1}$ ✓
Option 1
Take to the left as positive: $\Sigma_{P_i} = \Sigma_{P_f}$ $M_bv_{bi} + m_Bv_{Bi} = M_bv_{bf} + m_Bv_{Bf}$ Any one✓

$\therefore (0{,}0175)(-55{,}60) + (8{,}45)(0) = (0{,}0175)(12{,}60) + (8{,}45)\, v_{Bf}$ ✓

$\therefore -0{,}973 = 0{,}2205 + (8{,}45)\, v_{Bf}$

$\therefore v_{Bf} = -0{,}141243\ m \cdot s^{-1}$

$\therefore$ The magnitude of the velocity of the block is $0{,}141243\ m \cdot s^{-1}$ ✓

Option 2

Take to the right as positive

$$\left.\begin{array}{r} \Delta P_{block} = -\Delta P_{bullet} \\ m_B(v_{Bf} - v_{Bi}) = -m_b(v_{bf} - v_{bi}) \end{array}\right\} \text{Any one ✓}$$

$\therefore (8{,}45)(v_{Bf} - 0) = -(0{,}0175)(-12{,}60 - 55{,}60)$ ✓

$\therefore (8{,}45)v_{Bf} = 1{,}1935$

$\therefore v_{Bf} = 0{,}141243\ m \cdot s^{-1}$

$\therefore$ The magnitude of the velocity of the block is $0{,}141243\ m \cdot s^{-1}$

Option2

Take to the left as positive

$$\left.\begin{array}{r} \Delta P_{block} = -\Delta P_{bullet} \\ m_B(v_{Bf} - v_{Bi}) = -m_b(v_{bf} - v_{bi}) \end{array}\right\} \text{Any one ✓}$$

$\therefore (8{,}45)(v_{Bf} - 0) = -(0{,}0175)(12{,}60 + 55{,}60)$ ✓

$\therefore (8{,}45)v_{Bf} = -1{,}1935$

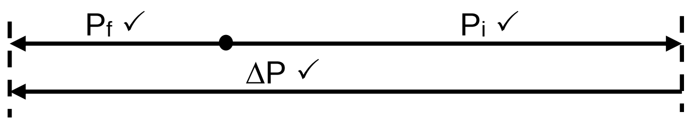
$\therefore v_{Bf} = -0{,}141243\ m \cdot s^{-1}$

$\therefore$ The magnitude of the velocity of the block is $0{,}141243\ m \cdot s^{-1}$ ✓ (3)

4.2.2 **POSITIVE MARKING FROM QUESTION 4.2.1**

Option 1	**Option 2**
$v_f^2 = v_i^2 + 2a\Delta y$ $\therefore (0)^2$ ✓ $= (0{,}141243)^2 + 2(a)\,(1{,}32)$ ✓ $\therefore a = -7{,}55634 \times 10^{-3}\ m \cdot s^{-2}$ $F_{net} = ma$ ✓ $\therefore f = (8{,}45)(-7{,}55634 \times 10^{-3})$ ✓ $= -0{,}06385\ N$ $\therefore$ The magnitude of the frictional force between the block and the table is 0,06385 N ✓	$v_f^2 = v_i^2 + 2a\Delta y$ $\therefore (0)^2$ ✓ $= (0{,}141243)^2 + 2(a)\,(1{,}32)$ ✓ $\therefore a = -7{,}55634 \times 10^{-3}\ m \cdot s^{-2}$ $v_f = v_i + a\Delta t$ $\therefore 0 = 0{,}141243 + (-7{,}55634 \times 10^{-3})\,\Delta t$ $\therefore \Delta t = 18{,}6919858\ s$ ✓ But $F_{net}\Delta t = m(v_f - v_i)$ $\therefore f\,(18{,}6919858) = (8{,}45)(0 - 0{,}141243)$ ✓ $= -0{,}06385\ N$ $\therefore$ The magnitude of the frictional force between the block and the table is 0,06385 N ✓

(5)



(3)
[13]

QUESTION 5

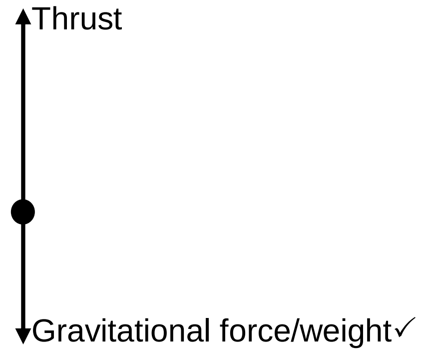
5.1 A force for which work is done in moving an object between two points is independent of the path taken.✓✓

OR:

A force for which the total work done on the particle as it is moved around any closed path is zero ✓✓ (2)

5.2 Non-conservative ✓ (1)

5.3



(2)

Notes:
• Mark awarded for label and arrow
• Do not penalise for length of arrows since drawing is not to scale
• Any other additional force(s): -1 mark
• If force(s) do not make contact with body: -1 mark
• -1 mark if all arrows are emitted but correctly labelled

5.4 The work done on an object by a net force is equal✓ to the change in the object's kinetic energy. ✓

OR:

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

5.5

$$\left.\begin{array}{r} W_{net} = \Delta E_k \\ W_T + W_\omega = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ T.\Delta y.\cos\theta + mg.\Delta y.\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{array}\right\} \text{Any one} \checkmark$$

$(4{,}0 \times 10^6)(500)(\cos 0°) + (150\ 00)(9{,}8)(500)(\cos 180°) \checkmark = \frac{1}{2}(150\ 00)[v_f^2 - (0)^2] \checkmark$ (4)

$20 \times 10^9 + (-7{,}35 \times 10^8) = 75\ 000.\ v_f^2$

$1265000000 = 75\ 000.\ v_f^2$

$\therefore v_f^2 = 16866{,}66667$

$\therefore v_f = 129,\ 8717316\ m \cdot s^{-1}$

$\therefore$ The speed of a rocket at a height of 500 m is 129, 8717316 $m \cdot s^{-1}$ ✓

[11]

QUESTION 6

6.1 The (apparent) <u>change in frequency (or pitch) or wavelength</u> of the sound observed/detected by a listener, because the sound <u>source and the listener have different velocities relative to the medium of the sound propagation</u>.✓✓

OR:

<u>An apparent change in the observed detected frequency (pitch), (wavelength)</u> as a result of the <u>relative motion between a source and an observer (listener)</u>.✓✓

Note: If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.

(2)

6.2

6.2.1

$f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right)f_s$ ✓

$= \left(\frac{340 + 15}{340 - 0}\right)$✓$(18\ 00)$ ✓

$= 18\ 794,\ 11765$ Hz ✓

(4)

6.2.2

$f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right)f_s$

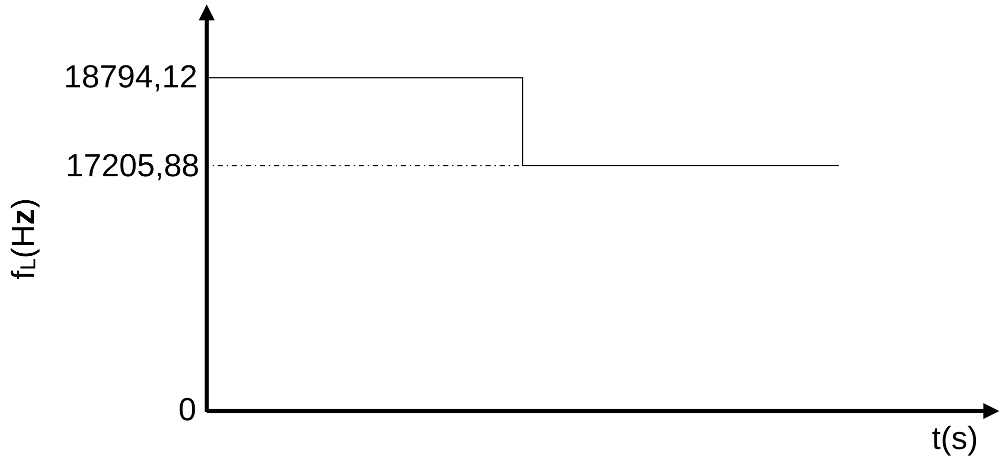
$= \left(\frac{340 - 15}{340 + 0}\right)$✓$(18\ 00)$ ✓

$= 17\ 205{,}88235$ Hz ✓

(3)

6.3 18 000 Hz OR 18 kHz✓ (1)

6.4



Criteria for graph	Mark
First and Second parts of the graph correct (For moving towards and for receding/moving away)	✓
Two frequencies on the vertical axis(**From 6.2.1/6.2.2)**	✓

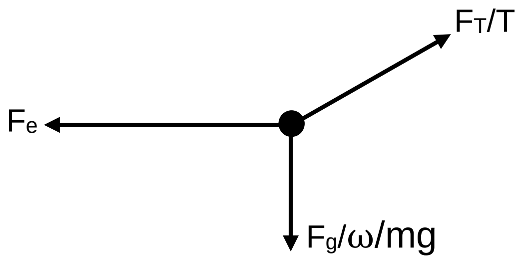
(2)

[12]

QUESTION 7

7.1

7.1.1



F_e: Electrostatic force/Coulombic force/Electric force ✓

F_T: Tension ✓

F_g: Gravitational force/weight/$F_{Earth\ on\ sphere}$ ✓

Notes:
• Mark awarded for label <u>and</u> arrow • Do not penalise for length of arrows since drawing is not to scale • Any other additional force(s): -1 mark • If force(s) do not make contact with body: -1 mark • -1 mark if all arrows are emitted but correctly labelled

(3)

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

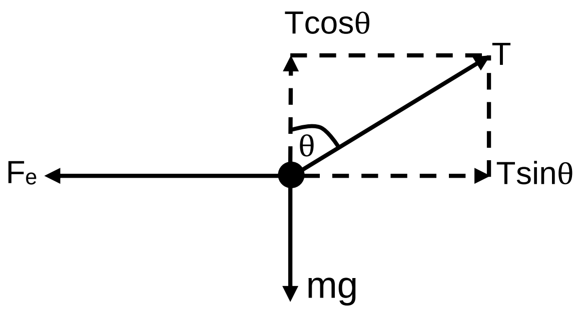
OR:

The magnitudes of the electrostatic force exerted by one charge on another <u>is directly proportional to the magnitudes of the charges</u> and <u>inversely proportional to the square of the distance (r) between their centres.</u> ✓✓

<u>Note:</u> If any of the underlined key words/ phrases in the **correct context** is omitted deduct 1 mark. If masses used $\frac{0}{2}$

(2)

7.1.3



<u>Take to the right and upwards as POSITIVE</u>

$F_{net} = ma$ ✓

$(F_{net})_x = ma_x$

$\therefore T\sin\theta + (-F_e) = ma$

$\therefore T\sin\theta - F_e = 0$

$\therefore T\sin\theta = F_e \ldots (1)$

$(F_{net})_y = ma_y$

$\therefore T\cos\theta + (-mg) = ma$

$\therefore T\cos\theta = mg \ldots (2)$

$(1) \div (2) \quad : \frac{T\sin\theta}{T\cos\theta} = \frac{F_E}{mg}$

$\therefore \tan\theta = \frac{F_E}{mg}$

$\therefore F_e = mg\tan\theta$ ✓

$F_e = \frac{KQ_1Q_2}{r^2}$ ✓

$\therefore \frac{Kq^2}{r^2} = mg\tan\theta$ ✓

From the diagram: $\sin\theta = \frac{a}{L} \quad \therefore a = L\sin\theta$

$= (0,15 \text{ m})\sin\theta$

$\therefore \frac{Kq^2}{(2a)^2} = mg\tan\theta$

$\therefore \frac{(9,0 \times 10^9)q^2 ✓}{[(2)(0,15)(\sin 5,00°)]^2 ✓} = (3,00 \times 10^{-2})(9,8)(\tan 5,00°)$ ✓

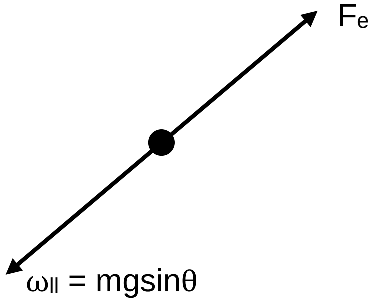
$\therefore q^2 = \frac{1,758464636 \times 10^{-5}}{9,0 \times 10^9} = 1,953849596 \times 10^{-15} \text{ C}^2$

$\therefore q = \sqrt{1,953849596 \times 10^{-15}}$

$= 4,42 \times 10^{-8} \text{ C}$ (7)

7.2.1 The <u>electrostatic force experienced</u> ✓<u>per unit positive charge</u> ✓(placed at that point). (2)

7.2.2



<u>Take uphill as positive</u>

$F_{net}II = ma$ **OR** $F_{net}II = o$
$F_e + (-\omega_{II}) = ma$
$F_e = 0{,}022365$ N
$\therefore F_e - (5{,}40 \times 10^{-3})(9{,}8)(\sin 25{,}0°)$ ✓ $= (5{,}40 \times 10^{-3})(0)$ ✓
$\therefore F_e - 0{,}02236495841 = 0$
$\therefore F_e = 0{,}022365$ N

But $E = \frac{F_e}{|Q|}$ ✓

$= \frac{0{,}022365}{7{,}00}$ ✓

$= 3{,}194994\ N \cdot C^{-1}$ ✓down the incline

(6)
[20]

Question 8

8.1
1.1.1 Current ✓ (1)

1.1.2 Temperature ✓ (1)

1.1.3 Current is directly proportional to the potential difference ✓

OR:

The ratio of potential difference to current is constant ✓ (1)

8.1.4

Gradient = $\frac{\Delta I}{\Delta V}$

$= \frac{0,4-0 \checkmark}{1-0 \checkmark}$ **OR** $\frac{0,8-0,4}{2-1}$ **OR** $\frac{1,6-0,4}{4-1}$

$\therefore \frac{1}{R} = \frac{0,4}{1}$ **OR** $\frac{0,4}{1}$ **OR** $\frac{1,2}{3}$

$\therefore \frac{1}{R} = \frac{I}{V} \therefore \frac{R}{1} = \frac{V}{I} \therefore$ R = $\frac{1}{0,4}$ = 2,50 Ω ✓ (3)

8.2
8.2.1 The battery supplies <u>20 J per coulomb/ 20 J per unit charge</u> ✓✓

OR: <u>The potential difference of the battery in a circuit is 20 V</u> ✓✓

OR: The battery does <u>20 J of work per unit charge/per coulomb</u> ✓✓

OR: <u>Maximum energy supplied by the battery per unit charge is 20 J</u> ✓✓

OR: <u>maximum work done by the battery per unit charge is 20 J</u> ✓✓

OR: The <u>total amount of electric energy supplied by the battery per coulomb/per unit charge is 20 J</u> ✓✓

OR: The total energy transferred by the battery to a unit electric charge is 20 J ✓✓

Note: If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

(2)

8.2.2 0 V/Zero volt✓ (1)

8.2.3

<table>
<tr>
<td>
<u>Option 1:</u>

$V = V_{3\Omega}$
$= IR$ ✓
$= (6)(3)$ ✓
$= 18$ V✓
</td>
<td>
<u>Option 2:</u>

$V_{5\Omega} = V_{3\Omega}$
$(I_{5\Omega})(R_{5\Omega}) = (I_{3\Omega})(R_{5\Omega})$
$I_{5\Omega}(5) = (6)(3)$ ✓
$\therefore\ v = v_{5\Omega}$
$= IR$
$= (3{,}60)(5)$ ✓
$= 18$ V ✓
</td>
</tr>
<tr>
<td colspan="2">
<u>Option 3:</u>

$R_p = \frac{1}{(\frac{1}{R_1} + \frac{1}{R_2})} = \frac{1}{(\frac{1}{3} + \frac{1}{5})} = 1{,}875\ \Omega$

OR:
$R_p = \frac{R_1R_1}{R_1R_2} = \frac{(3)(5)}{(3+5)} = 1{,}875\ \Omega$

OR:
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{3} + \frac{1}{5} = \frac{8}{15}$

$\therefore\ R_p = \frac{15}{8} = 1{,}875\ \Omega$
$V_{5\Omega} = V_{3\Omega}$
$(IR_{5\Omega}) = (IR_{3\Omega})$
$I_{5\Omega}(5) = (6)(3)$
$\therefore\ I_{5\Omega} = 3{,}60$ A
$I_{total} = I_{3\Omega} + I_{5\Omega}$
$= 6 + 3{,}60$
$= 9{,}60$ A
$\therefore\ V = V_{II} = I_{II}R_{II}$ ✓
$= (9{,}60)(1{,}875)$ ✓
$= 18$ V✓
</td>
</tr>
</table>

(3)

8.2.4

Option 1:	**Option 2:**
I_{total} = 9,6 A $R = R_{external}$ = 1,875 Ω **From option 3 of Q8.2.3** ε = I(R + r) ✓ 20 = (9,6)(1,875 + r) ✓ $\frac{25}{12}$ = 1,875 + r ∴ r = 0,2083333 Ω ✓	I_{total} = 9,60 A…**from Q8.2.3 option 3** ∴ ε = I_{total} . R_{total} ✓ 20 = (9,60)(R_{total}) ✓ R_{total} = 2,083333Ω But R_{total} = $R_{external}$ + r 2,083333Ω = 1,875 + r r = 0,2033 Ω ✓
Option 3: V_{lost} = ε – v = 20 – 18 = 2 v but V_{lost} = Ir ✓ ∴ 2 = (9,6)r ✓ ∴ r = 0,20833 Ω ✓	

(3)

8.2.5
- Resistance of a circuit decreases ✓
- current in the circuit increases ✓
- ε = IR + Ir = V+ Ir : Thus Ir (internal voltage) decreases. ✓
  Since ε an r are constant, V will increase.

(3)

Question 9

9.1

9.1.1 Slip rings ✓ (1)

9.1.2

ANY ONE:
• Maintains electrical contact with the slip rings ✓ • Takes current out of/into the coil ✓

(1)

9.1.3 North pole ✓ (1)

9.1.4 To concentrate the magnetic field ✓ (1)

9.1.5 To convert kinetic energy (mechanical energy) into electrical energy ✓ (1)

9.2

9.2.1 T = $\frac{1}{2}$period where period = $\frac{1}{f}$

$= \frac{1}{2}(\frac{1}{f})$

$= \frac{1}{2}(\frac{1}{50})$ ✓

= 0,01 s ✓ (2)

9.2.2

Option 1:	**Option 2**:
$V_{rm5} = \frac{V_{max}}{\sqrt{2}}$ $= \frac{170}{\sqrt{2}}$ ✓ = 120,2082 V $I_{rms} = \frac{V_{rms}}{R}$ ✓ $= \frac{120,2082}{200}$ ✓ = 0,601 A ✓	$I_{max} = \frac{v_{max}}{R}$ ✓ $= \frac{170}{200}$ ✓ =0,85 A $I_{rm5} = \frac{I_{max}}{R}$ ✓ $= \frac{0,85}{\sqrt{2}}$ ✓ = 0,601 A ✓

(4)

9.2.3 The <u>average value of the current over the cycle is zero</u> ✓(and no useful power is delivered). (1)

[12]

QUESTION 10

10.1.1 The process whereby electrons are ejected/emitted/dislodged from a metal surface ✓when light of suitable frequency is incident on that surface. ✓

ACCEPT:
When light of high enough frequency falls on a clean metal surface, ✓ electrons are emitted from the surface by photon-electron interactions within the metal✓

ACCEPT:
The liberation of electrons from a substance✓ exposed to electromagnetic radiation with high enough frequency. ✓ (2)

10.1.2

OPTION 1	OPTION 2
$C = f\lambda$ $3 \times 10^8 = f(400 \times 10^{-9})$ ✓ $\therefore f = 7,5 \times 10^{14}$ Hz But $E = hf$✓ $= (6,63 \times 10^{-34})(7,5 \times 10^{14})$ ✓ $= 4,9725 \times 10^{-19}$ J ✓	$E = hf$ $\therefore E = \frac{hc}{\lambda}$ ✓ $\therefore E = \frac{(6,63 \times 10^{-34})(3 \times 10^8)\ ✓}{(400 \times 10^{-19})\ J\ ✓}$ $\therefore E = 4,9725 \times 10^{-19}$ J ✓

(4)

10.1.3

POSITIVE MARKING FROM QUESTION 10.1.2

$1,5\%\ 600\ W = (\frac{1,5}{100})(600)$

$= 9,00$ W

Number of electrons $= \frac{P}{E}$ ✓

$= \frac{9,00}{4,9725 \times 10^{-19}}$ ✓

$= 1,81 \times 10^{-19}$ e^-/s ✓

(3)

10.2
10.2.1 Emission spectra occur when <u>excited atoms/electrons drop from higher energy levels to lower energy levels.</u> ✓✓ (2)

10.2.2 P ✓ (1)

10.2.3 R ✓ (1)

[13]

TOTAL: [150]

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