LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL
SENIOR CERTIFICATE

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)
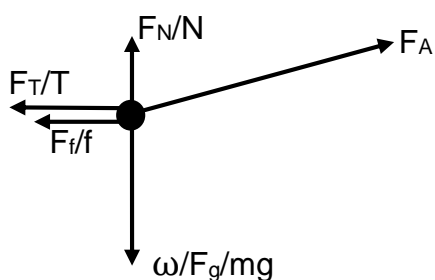
1.9   D✓✓ (2)

1.10   A✓✓ (2)

[20]

QUESTION 2

2.1
2.1.1 When a (non-zero) net/resultant force acts on an object, <u>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</u>✓ and <u>inversely proportional to the mass of the object</u>.✓   (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/$F_{Earth\ on\ block}$ ✓

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

          (5)

2.1.3

F_{net} = ma
$(F_{net})_X$ = m_1a_X
∴ F_X + (-f_K) + (-T) = m_1a
∴ Fcos30° - f_K -T = m_1a
∴ Fcos30° - $μ_K$ (m_1g - Fsin30°) -T = m_1a Any one ✓
∴ 50cos30° - (0,21) [(5)(9,8) – (50)(sin30°)] ✓ -T = 5a
∴ 50cos30° - 5,04 -T = 5a
∴ 38,26127 - T = 5a… ① ✓

$(F_{net})_y$ = m_2a_y
∴ T + (w_2) = m_2a
∴ T - m_2g = m_2a
∴ T - (0,2)(9,8) = (0,2)a ✓
∴ T - (0,2)a + 1,96… ② ✓

Subst… ② into ① :

∴ 38,26127 - [(0,2)a + 1,96] = 5a
∴ 38,26127 - (0,2)a - 1,96 = 5a
∴ 36,30127 = (5,2)a
∴ a = 6,981 m·s^{-2}

From ② : T = (0,2)(6,981) + 1,96
        ∴ T = 3,3562 N ✓

(6)

2.2

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

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

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

$$= 8,43 \text{ m·s}^{-2}$$

Reduction in g = 9,8 − 8,43 = 1,37 $\checkmark$ $\therefore$%reduction = $\frac{1,37}{9,8}$ x 100 = 13,98% $\therefore$%reduction in ω = 13,98% (for a constant m, $\omega \propto g$) $\checkmark$	$\omega_E = mg$ = m(9,8) $\omega_S = (8,43)$ $\therefore$%$\omega_S = \frac{m(8,43)}{m(9,8)}$ x 100 = 86,02% $\therefore$%reduction in ω = 100 − 86,02 $\checkmark$ = 13,98% $\checkmark$

(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

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

(5)

3.2

3.2.1   9.8 m·s^{-2} downwards ✓   (1)

3.2.2

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

	= 5,98 m·s^{-1}
	∴ v$_2$ = 5,98 m·s^{-1} ✓
Subt. ① Into ② ∴ 4,9(t)^2 + 1 = 4,94,9.t^2 + 1,96t +0,196 ∴ 1 = (1,96)t + 0,196 ∴ 0,804 = (1,96)t ∴ t = 0,4102 s ✓ v$_f$ = v$_i$ + aΔt ✓ wire1: v$_1$ = 0 + (9,8)(0,4102) = 4,01996 m·s^{-1} ✓ wire1: v$_2$ = 0 + (9,8)(0,4102 + 0,2) = 5,97996 m·s^{-1} ✓	

(6)

[14]

QUESTION 4

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

        OR:

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

(2)

4.2

4.2.1

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

∴ (0,0175)(-55,60) + (8,45)(0) = (0,0175)(12,60) + (8,45) v_{Bf} ✓
∴ -0,973 = 0,2205 + (8,45) v_{Bf}
∴ v_{Bf} = -0,141243 m·s⁻¹
∴ The magnitude of the velocity of the block is 0,141243 m·s⁻¹ ✓

Option 2

Take to the right as positive

ΔP$_{block}$ = -ΔP$_{bullet}$ ⎫
m$_B$(v$_{Bf}$ - v$_{Bi}$) = -m$_b$(v$_{bf}$ – v$_{bi}$) ⎭ — Any one ✓
∴ (8,45)(v$_{Bf}$ -0) = -(0,0175)(-12,60 – 55,60) ✓
∴ (8,45)v$_{Bf}$ = 1,1935
∴v$_{Bf}$ = 0,141243 m·s⁻¹
∴ The magnitude of the velocity of the block is 0,141243 m·s⁻¹

| **Option2** |
| **Take to the left as positive** |

ΔP$_{block}$ = -ΔP$_{bullet}$ ⎫
m$_B$(v$_{Bf}$ - v$_{Bi}$) = -m$_b$(v$_{bf}$ – v$_{bi}$) ⎭ — Any one ✓
∴ (8,45)(v$_{Bf}$ -0) = -(0,0175)(12,60 + 55,60) ✓
∴ (8,45)v$_{Bf}$ = -1,1935
∴v$_{Bf}$ = -0,141243 m·s⁻¹
∴ The magnitude of the velocity of the block is 0,141243 m·s⁻¹ ✓

(3)

4.2.2

POSITIVE MARKING FROM QUESTION 4.2.1

Option 1	**Option 2**
$v_f^2 = v_i^2 + 2a\Delta y$ ∴ (0)² ✓ = (0,141243)² + 2(a) (1,32) ✓ ∴ a = -7,55634 x 10⁻³ m·s⁻² F$_{net}$ = ma ✓ ∴ f = (8,45)(-7,55634 x 10⁻³) ✓ = -0,06385 N ∴ The magnitude of the frictional force between the block and the table is 0,06385 N ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ∴ (0)² ✓ = (0,141243)² + 2(a) (1,32) ✓ ∴ a = -7,55634 x 10⁻³ m·s⁻² v$_f$ = v$_i$ + aΔt ∴ 0 = 0,141243 + (-7,55634 x 10⁻³) Δt ∴ Δt = 18,6919858 s ✓ But F$_{net}$Δt = m(v$_f$ - v$_i$) ∴ f (18,6919858) = (8,45)(0-0,141243)✓ = -0,06385 N ∴ The magnitude of the frictional force between the block and the table is 0,06385 N ✓

(5)
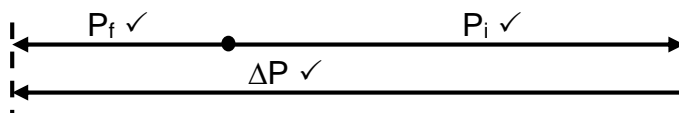
(3)
[13]

QUESTION 5

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

OR:

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

5.2   Non-conservative ✓   (1)

5.3

↑Thrust

●

↓Gravitational force/weight✓   (2)

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

OR:

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

5.5

$$W_{net} = \Delta E_k$$
$$W_T + W\omega = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$
$$T.\Delta y.\cos\theta + mg.\Delta y.\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

Any one ✓

$(4,0 \times 10^6)(500)(\cos0°) + (150\ 00)(9,8)(500)(\cos180°)$ ✓ $= \frac{1}{2}(150\ 00)[v_f^2 - (0)^2]$ ✓   (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·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
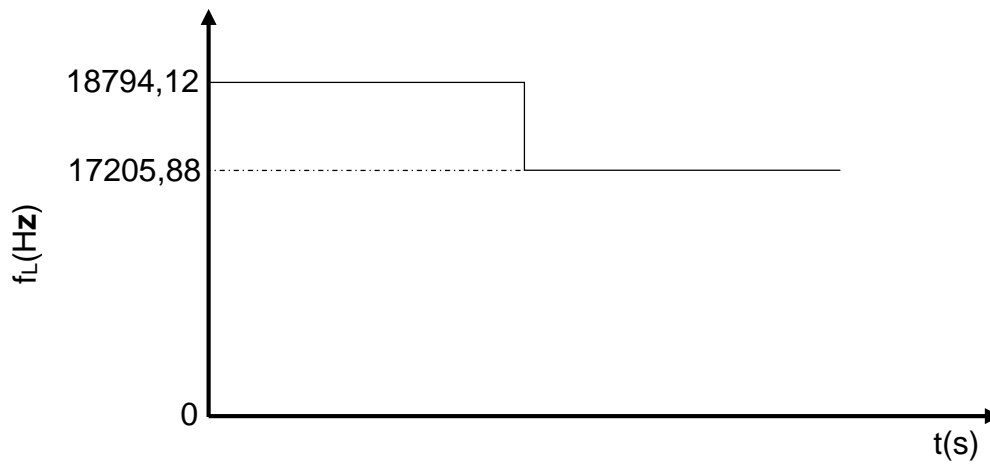
Criteria for graph	Mark
First and Second parts of the graph correct (For moving towards and for receding/moving away)	✓
Two frequencies on the vertical axis(**From 6.2.1/6.2.2)**	✓

(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 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
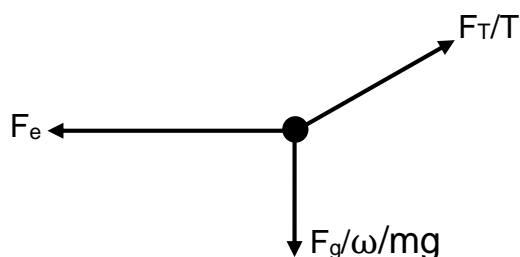
(3)

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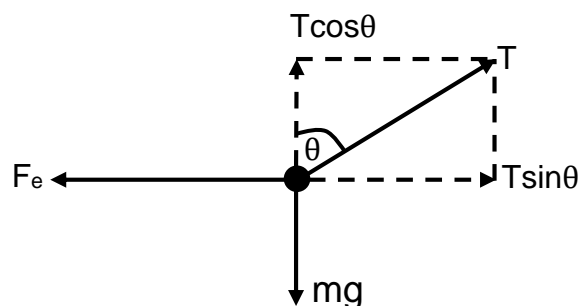
OR:

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

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

(2)

7.1.3

Take to the right and upwards as POSITIVE

$$F_{net} = ma \checkmark$$
$$(F_{net})_x = ma_x$$
$$\therefore T\sin\theta + (-F_e) = ma$$
$$\therefore T\sin\theta - F_e = 0$$
$$\therefore T\sin\theta = F_e \dots \textcircled{1}$$

$$(F_{net})_y = ma_y$$
$$\therefore T\cos\theta + (-mg) = ma$$
$$\therefore T\cos\theta = mg \dots \textcircled{2}$$

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

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

$$F_e = \frac{KQ_1Q_2}{r^2} \checkmark$$
$$\therefore \frac{Kq^2}{r^2} = mg\tan\theta \checkmark$$

From the diagram: $\sin\theta = \frac{a}{L}$ $\therefore a = L\sin\theta$
$$= (0,15 \text{ m})\sin\theta$$

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

$$\therefore \frac{(9,0 \times 10^9)q^2 \checkmark}{[(2)(0,15)(\sin5,00°)]^2 \checkmark} = (3,00 \times 10^{-2})(9,8)(\tan5,00°) \checkmark$$

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

$$\therefore q = \sqrt{1,953849596 \times 10^{-15}}$$
$$= 4,42 \times 10^{-8} \text{ C}$$

(7)

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

7.2.2

$$\omega_{\parallel} = mg\sin\theta$$

F_e
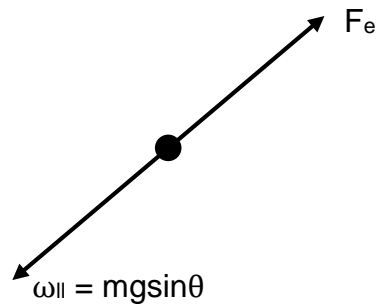
<u>Take uphill as positive</u>

$F_{net}\parallel = ma$ **OR** $F_{net}\parallel = o$

$F_e + (- \omega_{\parallel}) = ma$

$\quad\quad F_e = 0,022365 \text{ N}$

$\therefore F_e - (5,40 \times 10^{-3})(9,8)(\sin25,0°)$ ✓ $= (5,40 \times 10^{-3})(0)$ ✓

$\therefore F_e - 0,02236495841 = 0$

$\therefore F_e = 0,022365 \text{ N}$

But $E = \dfrac{F_e}{|Q|}$ ✓

$\quad\quad = \dfrac{0,022365}{7,00}$ ✓

$\quad\quad = 3,194994 \text{ N·C}^{-1}$ ✓ 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 $= \dfrac{\Delta I}{\Delta V}$
>
> $= \dfrac{0,4-0 \,\checkmark}{1-0 \,\checkmark}$ **OR** $\dfrac{0,8-0,4}{2-1}$ **OR** $\dfrac{1,6-0,4}{4-1}$
>
> $\therefore \dfrac{1}{R} = \dfrac{0,4}{1}$ **OR** $\dfrac{0,4}{1}$ **OR** $\dfrac{1,2}{3}$
>
> $\therefore \dfrac{1}{R} = \dfrac{I}{V} \quad \therefore \dfrac{R}{1} = \dfrac{V}{I} \quad \therefore R = \dfrac{1}{0,4} = 2,50 \ \Omega \ \checkmark$

(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

Option 1:

$V = V_{3\Omega}$
$ = IR$ ✓
$ = (6)(3)$ ✓
$ = 18\ V$ ✓

Option 2:

$V_{5\Omega} = V_{3\Omega}$
$(I_{5\Omega})(R_{5\Omega}) = (I_{3\Omega})(R_{5\Omega})$
$I_{5\Omega}(5) = (6)(3)$ ✓
$\therefore V = V_{5\Omega}$
$ = IR$
$ = (3,60)(5)$ ✓
$ = 18\ V$ ✓

Option 3:

$R_P = \dfrac{1}{\left(\dfrac{1}{R_1} + \dfrac{1}{R_2}\right)} = \dfrac{1}{\left(\dfrac{1}{3} + \dfrac{1}{5}\right)} = 1,875\ \Omega$

OR:
$R_P = \dfrac{R_1 R_1}{R_1 R_2} = \dfrac{(3)(5)}{(3+5)} = 1,875\ \Omega$

OR:
$\dfrac{1}{R_P} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{3} + \dfrac{1}{5} = \dfrac{8}{15}$

$\therefore R_P = \dfrac{15}{8} = 1,875\ \Omega$
$V_{5\Omega} = V_{3\Omega}$
$(IR_{5\Omega}) = (IR_{3\Omega})$
$I_{5\Omega}(5) = (6)(3)$
$\therefore I_{5\Omega} = 3,60\ A$
$I_{total} = I_{3\Omega} + I_{5\Omega}$
$\phantom{I_{total}} = 6 + 3,60$
$\phantom{I_{total}} = 9,60\ A$
$\therefore V = V_{\parallel} = I_{\parallel}R_{\parallel}$ ✓
$ = (9,60)(1,875)$ ✓
$ = 18\ V$ ✓

(3)

8.2.4

Option 1:	**Option 2:**
I_{total} = 9,6 A $\quad$ **From option 3 of** $\quad$ R = $R_{external}$ $\quad$ **Q8.2.3** $\quad\quad$ = 1,875 Ω $\quad$ 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} ✓ $\quad$ 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 $T = \dfrac{1}{2}\text{period where period} = \dfrac{1}{f}$

$= \dfrac{1}{2}\left(\dfrac{1}{f}\right)$

$= \dfrac{1}{2}\left(\dfrac{1}{50}\right)$ ✓

$= 0,01 \text{ s}$ ✓   (2)

9.2.2
Option 1:	**Option 2**:
$V_{rm5} = \dfrac{V_{max}}{\sqrt{2}}$	$I_{max} = \dfrac{v_{max}}{R}$ ✓
$= \dfrac{170}{\sqrt{2}}$ ✓	$= \dfrac{170}{200}$ ✓
$= 120,2082 \text{ V}$	$= 0,85 \text{ A}$
$I_{rms} = \dfrac{V_{rms}}{R}$ ✓	$I_{rm5} = \dfrac{I_{max}}{R}$ ✓
$= \dfrac{120,2082}{200}$ ✓	$= \dfrac{0,85}{\sqrt{2}}$ ✓
$= 0,601 \text{ A}$ ✓	$= 0,601 \text{ A}$ ✓

(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 $E = hf$ ✓ $\quad\quad = (6,63 \times 10^{-34})(7,5 \times 10^{14})$ ✓ $\quad\quad = 4,9725 \times 10^{-19}$ J ✓	$E = hf$ $\therefore E = \dfrac{hc}{\lambda}$ ✓ $\therefore E = \dfrac{(6,63 \times 10^{-34})(3 \times 10^8)\;✓}{(400 \times 10^{-19})\,J\;✓}$ $\therefore E = 4,9725 \times 10^{-19}$ J ✓

(4)

10.1.3

POSITIVE MARKING FROM QUESTION 10.1.2

$$1,5\% \; 600 \text{ W} = \left(\frac{1,5}{100}\right)(600)$$

$$= 9,00 \text{ W}$$

Number of electrons $= \dfrac{P}{E}$ ✓

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

$\quad\quad\quad\quad = 1,81 \times 10^{-19} \text{ e}^-/\text{s}$ ✓

(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]