



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

MARKING GUIDELINE

PREPARATORY EXAMINATION

SEPTEMBER 2022

MARKS: 150

This marking guideline consists of 15 pages.

QUESTION 1

1.1 A✓✓ (2)

1.2 C✓✓ (2)

1.3 B✓✓ (2)

1.4 D✓✓ (2)

1.5 C✓✓ (2)

1.6 A✓✓ (2)

1.7 D✓✓ (2)

1.8 B✓✓ (2)

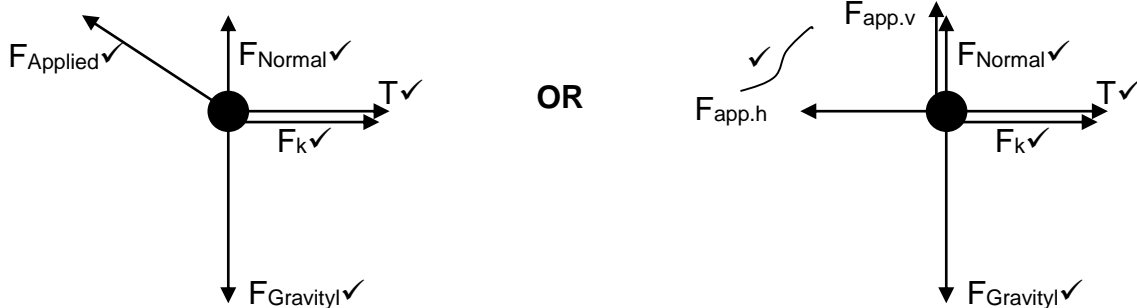
1.9 D✓✓ (2)

1.10 B✓✓ (2)

[20]

QUESTION 2

2.1



OR

Accept the following symbols	
F_{Normal}	N; Normal
F_{Applied}	45,0N/F/ F_A / F_{app}
T	F_{TENSION} /Tensional force
F_k	f_s / f /friction/ F_r
W	F_g / mg /98N

If components of F_{app} and F_{app} shown then minus one mark.

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:4/5*
- If arrows missing but labels are there: *Max:4/5*

(5)

2.2 Normal 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)

NOTE:

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

2.3 $F_{\text{net}} = ma$ ✓
 $F_v + N - F_g = 0$
 $45\sin 30^\circ + N - 10(9,8)$ ✓ = 0 ✓
 $N = 75,50 \text{ N}$ ✓

(4)

2.4 **POSITIVE MARKING FROM QUESTION 2.3****OPTION 1**

CONSIDER 10 kg BLOCK
TAKING LEFT TO BE POSITIVE

$$F_{\text{net}} = ma \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \checkmark$$

$$F_H - T - F_{\text{fk}} = ma$$

$$45\cos 30^\circ \checkmark - T - \underline{0,125(75,50)} \checkmark = 10(2,5) \checkmark$$

$$T = 4,53 \text{ N}$$

CONSIDER BLOCK m

$$F_{\text{net}} = ma$$

$$T - F_{\text{fk}} = m(2,5)$$

$$\underline{4,53 - 1} \checkmark = m(2,5)$$

$$m = 1,41 \text{ kg} \checkmark$$

OPTION 2

CONSIDER 10 kg BLOCK
TAKING LEFT TO BE NEGATIVE

$$F_{\text{net}} = ma \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \checkmark$$

$$-F_H + T + F_{\text{fk}} = ma$$

$$-45\cos 30^\circ \checkmark + T + \underline{0,125(75,50)} \checkmark = -10(2,5) \checkmark$$

$$T = -4,53 \text{ N}$$

CONSIDER BLOCK m

$$F_{\text{net}} = ma$$

$$T - F_{\text{fk}} = m(2,5)$$

$$\underline{-4,53 + 1} \checkmark = m(-2,5)$$

$$m = 1,41 \text{ kg} \checkmark$$

OPTION 3

If masses added then max 3/6

- $F_{\text{net}} = ma \checkmark$
- $45\cos 30^\circ \checkmark$
- $1,41 \text{ kg} \checkmark$

(6)

[17]

QUESTION 3

3.1 $9,8 \text{ m}\cdot\text{s}^{-2}$ ✓ downwards ✓ (2)

(downward positive)	(upwards positive)
$v_f = v_i + a\Delta t$ ✓ $0 = (-20) + 9,8\Delta t$ ✓ $\Delta t = 2,04 \text{ s}$ ✓	$v_f = v_i + a\Delta t$ ✓ $0 = 20 + (-9,8)\Delta t$ ✓ $\Delta t = 2,04 \text{ s}$ ✓

3.2.2 **OPTION 1**

(downward positive)	(upwards positive)
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = (-20)^2 + 2 \times (9,8)(-8)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = (20)^2 + 2 \times (-9,8)(8)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓

OPTION 2

Considering motion from maximum height

(downward positive)	(upwards positive)
$v_f^2 = v_i^2 + 2a\Delta y$ $0 = 20^2 + 2(9,8)\Delta y$ $\Delta y = 20,41 \text{ m}$	$v_f^2 = v_i^2 + 2a\Delta y$ $0 = 20^2 + 2(-9,8)\Delta y$ $\Delta y = 20,41 \text{ m}$

On its way down $\Delta y = 20,41 - 8 = 12,41 \text{ m}$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0 + 2(9,8)(12,41)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0 + 2(-9,8)(-12,41)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓
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OPTION 3

Considering motion from ground to the roof

(downward positive)	(upwards positive)
$\Delta y = v_i \Delta t + \frac{1}{2} a\Delta t^2$ $8 = 20 \Delta t + \frac{1}{2} (-9,8)\Delta t^2$ $\Delta t = 0,45 \text{ s}$ $v_f = v_i + a\Delta t$ ✓ $v_f = (-20) + 9,8(0,45)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓	$\Delta y = v_i \Delta t + \frac{1}{2} a\Delta t^2$ $-8 = -20 \Delta t + \frac{1}{2} (9,8)\Delta t^2$ $\Delta t = 0,45 \text{ s}$ $v_f = v_i + a\Delta t$ ✓ $v_f = (-20) + 9,8(0,45)$ ✓ $v_f = 15,60 \text{ m}\cdot\text{s}^{-1}$ ✓

3.2.3 **OPTION 1**

(downward positive)	(upwards positive)
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-8 \checkmark = \underline{-20 \Delta t + \frac{1}{2} (9,8) (\Delta t)^2} \checkmark$ $\Delta t = 3,63\text{s}$ or $\Delta t = 0,45\text{s}$ $\Delta t = 3,63\text{s} \checkmark$	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $8 \checkmark = \underline{20 \Delta t + \frac{1}{2} (-9,8) (\Delta t)^2} \checkmark$ $\Delta t = 3,63\text{s}$ or $\Delta t = 0,45\text{s}$ $\Delta t = 3,63\text{s} \checkmark$

OPTION 2:**POSITIVE MARKING FROM QUESTION 3.2.2**

(downward positive)	(upwards positive)
Time taken to reach maximum height from the ground. $v_f = v_i + a \Delta t \checkmark$ $0 = \underline{(-20) + 9,8 \Delta t} \checkmark$ $\Delta t = 2,04 \text{ s}$	Time taken to reach maximum height from the ground. $v_f = v_i + a \Delta t \checkmark$ $0 = \underline{20 + (-9,8) \Delta t} \checkmark$ $\Delta t = 2,04 \text{ s}$
From the maximum height to the top of the building $v_f = v_i + a \Delta t$ $\underline{15,60 = 0 + 9,8 \Delta t} \checkmark$ $\Delta t = 1,59 \text{ s}$	From the maximum height to the top of the building $v_f = v_i + a \Delta t$ $\underline{-15,60 = 0 - 9,8 \Delta t} \checkmark$ $\Delta t = 1,59 \text{ s}$
The total time from the ground to the top of the building: $\Delta t_{\text{total}} = 2,04 + 1,59 = 3,63 \text{ s} \checkmark$	The total time from the ground to the top of the building: $\Delta t_{\text{total}} = 2,04 + 1,59 = 3,63 \text{ s} \checkmark$

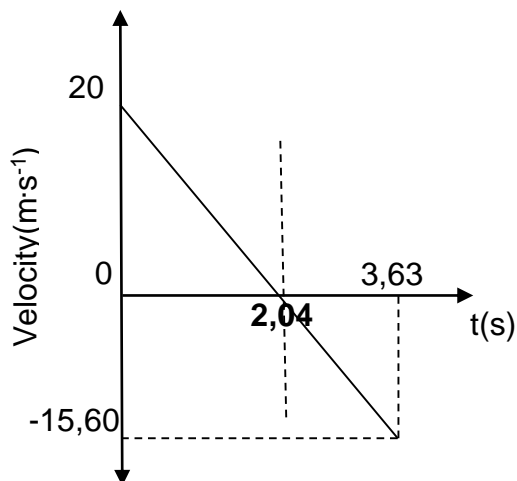
OPTION 3:**POSITIVE MARKING FROM QUESTION 3.2.2**

(downward positive)	(upwards positive)
$v_f = v_i + a \Delta t \checkmark$ $\underline{15,60 \checkmark = -20 + 9,8 \Delta t} \checkmark$ $\Delta t = 3,63 \text{ s} \checkmark$	$v_f = v_i + a \Delta t \checkmark$ $\underline{-15,60 \checkmark = 20 + (-9,8) \Delta t} \checkmark$ $\Delta t = 3,63 \text{ s} \checkmark$

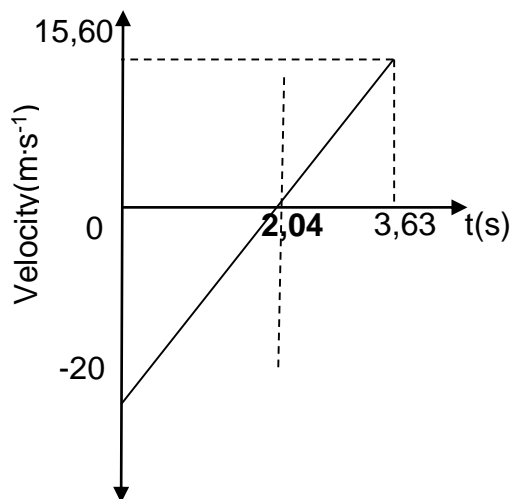
(4)

3.3 POSITIVE MARKING FROM QUESTION 3.2.1 AND 3.2.2

(upwards positive)



(downward positive)



Criteria for marking the graph	Marks
Correct shape (straight line) having a positive and negative velocities with line longer before 2,04 s than after 2,04 s	✓
Graph starts at $v = 20 \text{ m}\cdot\text{s}^{-1}/-20 \text{ m}\cdot\text{s}^{-1}$ and $t = 0 \text{ s}$	✓
Graph cuts t-axis at 2,04 s at $v = 0 \text{ m}\cdot\text{s}^{-1}$	✓
Graph shows the $v = -15,60 \text{ m}\cdot\text{s}^{-1}/15,60 \text{ m}\cdot\text{s}^{-1}$ at $t = 3,63 \text{ s}$	✓

(4)

[16]

QUESTION 4

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

4.2 **OPTION 1****Taking right to be positive**

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{iA} + m_B v_{iB} &= m_A v_{fA} + m_B v_{fB} \quad \checkmark \\ \underline{60(0,60) + 85(0)} \quad \checkmark &= \underline{60(-0,20) + 85} \\ \underline{v_{fB}} \quad \checkmark & \\ v_{fB} &= 0,57 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \text{ to the right} \quad \checkmark \end{aligned}$$

OPTION 2**Taking left to be positive**

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{iA} + m_B v_{iB} &= m_A v_{fA} + m_B v_{fB} \quad \checkmark \\ \underline{60(-0,60) + 85(0)} \quad \checkmark &= \underline{60(0,20) + 85} \\ \underline{v_{fB}} \quad \checkmark & \\ v_{fB} &= -0,57 \text{ m}\cdot\text{s}^{-1} \\ v_{fB} &= 0,57 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \text{ to the right} \quad \checkmark \end{aligned} \quad (5)$$

4.3 **POSITIVE MARKING FROM QUESTION 4.2**

$$\begin{aligned} \Sigma K_i &= \frac{1}{2} m_A v_{iA}^2 + \frac{1}{2} m_B v_{iB}^2 \quad \checkmark \\ &= \frac{1}{2} (60)(0,6)^2 + 0 \quad \checkmark \\ &= 10,80 \text{ J} \end{aligned}$$

$$\begin{aligned} \Sigma K_f &= \frac{1}{2} m_A v_{fA}^2 + \frac{1}{2} m_B v_{fB}^2 \\ &= \frac{1}{2} (60)(0,2)^2 + \frac{1}{2} (85)(0,57)^2 \quad \checkmark \\ &= 15,01 \text{ J} \end{aligned}$$

$\Sigma K_f \neq \Sigma K_i \quad \checkmark$ OR Total E_k before \neq Total E_k after
 \therefore Collision is Inelastic \checkmark

NOTE:

If learners starts with $\Sigma K_f = \Sigma K_i$, then minus one mark.

(5)

[12]

QUESTION 5

- 5.1 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. ✓✓ (2)

5.2 $E_{MA} = E_{MB}$ } ✓
 $(K + U)_X = (K + U)_Y$
 $(\frac{1}{2}mv^2 + mgh)_X = (\frac{1}{2}mv^2 + mgh)_Y$
 $(0,5)(2)(0) + (2)(9,8)(5) \checkmark = 0,5(2)v^2 + 0 \checkmark$
 $v = 9,90 \text{ m}\cdot\text{s}^{-1} \checkmark$ (4)

- 5.3 The net 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 net force is equal to the change in the object's kinetic energy. ✓✓ (2)

NOTE:

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

5.4 **OPTION 1**

$$W_{\text{net}} = \Delta K \checkmark$$

$$mg \sin 30^\circ \left(\frac{5}{\sin 30^\circ} \right) \checkmark = \frac{1}{2}(2)v^2 - 0 \checkmark$$

$$v = 9,90 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2

$$W_{\text{net}} = \Delta K \checkmark$$

$$mg \cos 30^\circ \left(\frac{5}{\sin 30^\circ} \right) \checkmark = \frac{1}{2}(2)v^2 - 0 \checkmark$$

$$v = 9,90 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 3

$$W_{\text{nc}} = \Delta E_p + \Delta E_k \checkmark$$

$$0 \checkmark = 2 \times 9,8 (0 - 5) + \frac{1}{2}(2)v^2 - 0 \checkmark$$

$$v = 9,90 \text{ m}\cdot\text{s}^{-1} \checkmark$$

- 5.5 Equal ✓
 Work done by the conservative force does not depend on the path taken. ✓✓
 OR: gravitational force is the only force doing work on the block. It is a conservative force ✓✓ (3)

[15]

QUESTION 6

6.1 Doppler effect as the (apparent) 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 $v = f\lambda$ ✓
 $340 = f(0,80)$ ✓
 $f = 425 \text{ Hz}$ ✓ (3)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

$$\frac{340}{(340 - v_s)} \cdot 400 \quad \checkmark$$

$$v_s = 20 \text{ m}\cdot\text{s}^{-1}$$

$$\therefore v_s = 72 \text{ km}\cdot\text{h}^{-1}$$

The car was not exceeding the speed limit. ✓

NOTE:

Statement must be marked in relation to answer.

(5)

6.4 Less than ✓ (1)

6.5 Blood flow meter ✓
 Detecting foetal heartbeat ✓ (2)

[13]

QUESTION 7

- 7.1 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)

NOTE:

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

7.2
$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$1984 = \frac{kQ^2}{x^2} \checkmark \text{-----}(1)$$

$$124 = \frac{kQ^2}{(x+0,8)^2} \checkmark \text{-----}(2)$$

$x = 0,27 \text{ m} \checkmark$ (4)

7.3 **POSITIVE MARKING FROM QUESTION 7.2****OPTION 1**

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$1984 = \frac{9 \times 10^9 Q^2}{0,27^2} \checkmark$$

$$Q = 1,27 \times 10^{-4} \text{ C} \checkmark$$

OPTION 2

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$124 = \frac{9 \times 10^9 Q^2}{(0,27 + 0,8)^2} \checkmark$$

$Q = 1,26 \times 10^{-4} \text{ C} \checkmark$ (3)

- 7.4.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)

NOTE:

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

POSITIVE MARKING FROM QUESTION 7.3

7.4.2 $E = \frac{kQ}{r^2}$ ✓

$$E_{1P} = \frac{(9 \times 10^9)(1,26 \times 10^{-4})}{(0,4)^2} = 7087500 \text{ N}\cdot\text{C}^{-1} \text{ to the right}$$

$$E_{2P} = \frac{(9 \times 10^9)(1,26 \times 10^{-4})}{(0,67)^2} = 2526175,095 \text{ N}\cdot\text{C}^{-1} \text{ to the right}$$

$$E_{\text{net}} = E_{1P} + E_{2P}$$

$$= 7087500 + 2526175,095$$

$$= \underline{9,61 \times 10^6 \text{ N}\cdot\text{C}^{-1} \text{ to the right}}$$
 ✓

NOTE: The mark is for the addition

(5)

7.4.3 **OPTION 1:****POSITIVE MARKING FROM QUESTION 7.4.2**

$$E = \frac{F}{q}$$
 ✓

$$9616375,10 = \frac{F}{1,6 \times 10^{-19}}$$
 ✓

$$F = \underline{1,54 \times 10^{-12} \text{ N to the right}}$$
 ✓

OPTION 2:**POSITIVE MARKING FROM QUESTION 7.3**

$$F = \frac{kQ_1Q_2}{r^2}$$

$$F_{q1} = \frac{kQ_1q}{r^2}$$

$$F_{q1} = \frac{k(1,26 \times 10^{-4})(1,6 \times 10^{-19})}{(0,4)^2}$$
 ✓

$$= 1,134 \times 10^{-12} \text{ N to the right}$$

$$F_{q2} = \frac{k(1,26 \times 10^{-4})(1,6 \times 10^{-19})}{(0,67)^2}$$
 ✓

$$= 4,04 \times 10^{-13} \text{ N to the right}$$

$$F_{\text{net}} = F_{q1} + F_{q2} = 1,134 \times 10^{-12} + 4,04 \times 10^{-13}$$

$$= \underline{1,54 \times 10^{-12} \text{ N to the right}}$$
 ✓

(3)

[19]

QUESTION 8

- 8.1.1 *Emf* is the maximum energy provided by a battery per unit charge passing through it. ✓✓ (2)

NOTE:

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

8.1.2	EXPERIMENT 2	EXPERIMENT 1
	$\mathcal{E} = I (R + r) \checkmark$ $\mathcal{E} = 20,58 + 1,78r \checkmark$ -----(1) $r = 0,50 \Omega$ $\mathcal{E} = 20,58 + 1,78(0,5) \quad \text{OR}$ $\mathcal{E} = 21,47 \text{ V} \checkmark$	$\mathcal{E} = I (R + r)$ $\mathcal{E} = 18,40 + 6,13r \checkmark$ -----(2) $\mathcal{E} = 18,40 + 6,13(0,5) \checkmark$

(5)

8.1.3 **POSITIVE MARKING FROM QUESTION 8.1.2**

OPTION 1	OPTION 2
EXPERIMENT 2 $\mathcal{E} = I (R + r) \checkmark$ $21,47 = 1,78(R+0,5) \checkmark$ $R = 11,56 \Omega$ $R_s = R_1 + R_2 + \dots$ $11,56 = R_1 + R_2 \checkmark$ $R = 5,78 \Omega \checkmark$ OPTION 3 $V = IR_{\text{ext}} \checkmark$ $20,58 = 1,78 \cdot 2R \checkmark$ $R = 5,78 \Omega \checkmark$	EXPERIMENT 1 $\mathcal{E} = I (R + r) \checkmark$ $21,47 = 6,13(R+0,5) \checkmark$ $R = 3 \Omega$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ $\frac{1}{2,99} = \frac{1}{R} + \frac{1}{R} \checkmark$ $R = 6 \Omega \checkmark$ OPTION 4 $V = IR_{\text{ext}} \checkmark$ $18,40 = 6,13 R/2 \checkmark$ $R = 6 \Omega \checkmark$

(3)

- 8.1.4 Decrease ✓
 If R_1 is removed in circuit X, the total resistance will increase ✓. For a constant emf ✓, from $P = V^2/R$ ✓, power will decrease. (4)

8.2 **OPTION 1**

$$\begin{aligned} \text{KWh} &= \frac{P\Delta t}{1000} \\ &= \frac{I^2 R\Delta t}{1000} \\ &= \frac{(4,4^2)(50)(6)}{1000} \checkmark \\ &= 5,808 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Cost of electricity} &= 1,69 \times 5,808 \checkmark \\ &= \text{R}9,82 \checkmark \end{aligned}$$

OPTION 2

$$\begin{aligned} V &= IR \\ &= 4,4 \times 50 \\ &= 220 \text{ V} \end{aligned}$$

$$\begin{aligned} \text{KWh} &= \frac{P\Delta t}{1000} \\ &= \frac{\left(\frac{V^2}{R}\right)\Delta t}{1000} \\ &= \frac{\left(\frac{220^2}{50}\right)6}{1000} \checkmark \\ &= 5,808 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Cost of electricity} &= 1,69 \times 5,808 \checkmark \\ &= \text{R}9,82 \checkmark \end{aligned}$$

OPTION 3

$$\begin{aligned} \text{KWh} &= \frac{P\Delta t}{1000} \\ &= \frac{VI\Delta t}{1000} \\ &= \frac{(220)(4,4)(6)}{1000} \checkmark \\ &= 5,808 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Cost of electricity} &= 1,69 \times 5,808 \checkmark \\ &= \text{R}9,82 \checkmark \end{aligned}$$

(3)

[17]

QUESTION 9

9.1.1 Split rings (commutator)✓ (1)

9.1.2 Anticlockwise✓✓ (2)

9.1.3 Electrical to mechanical✓✓ (2)

9.2.1 ANY TWO
The DC power supply can be replaced by a load / resistor. ✓
The split rings (commutator) is replaced by the slip rings. ✓
The coil should be rotated. (2)

9.2.2 $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
 $V_{\text{rms}} = \frac{311,13}{\sqrt{2}}$ ✓
 $V_{\text{rms}} = 220 \text{ V}$ ✓ (3)
[10]

QUESTION 10

10.1 Work function is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓ (2)

10.2 $E = \frac{hc}{\lambda}$ ✓ OR $c = \lambda f$ $E = hf$
 $E = \frac{(6,63 \times 10^{-34})(3,00 \times 10^8)}{400 \times 10^{-9}}$ ✓ $3 \times 10^8 = 400 \times 10^{-9}$ ✓ $= 6,6 \times 10^{-34} \cdot 7,5 \times 10^{14}$
 $E = 4,97 \times 10^{-19} \text{ J}$ ✓ $f = 7,5 \times 10^{14} \text{ Hz}$ $= 4,97 \times 10^{-19} \text{ J}$ ✓ (3)

10.3 **POSITIVE MARKING FROM QUESTION 10.2**

$$E = W_0 + \frac{1}{2} m v_{\text{max}}^2 \quad \checkmark$$

$$4,97 \times 10^{-19} \checkmark = 2,46 \times 10^{-19} \checkmark + \frac{1}{2} (9,11 \times 10^{-31}) v_{\text{max}}^2$$

$$V_{(\text{max})} = 742322,57 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (4)$$

10.4 No✓
The work function of platinum is higher than the energy of the photon✓ (2)
[11]

TOTAL: 150