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.**

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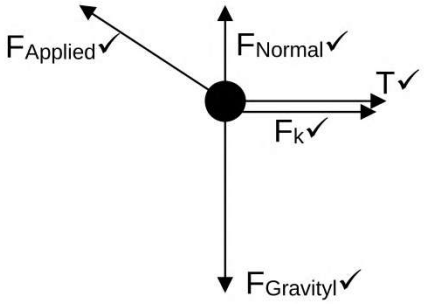
## QUESTION 1

| | | |
|---|---|---|
| 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]** |

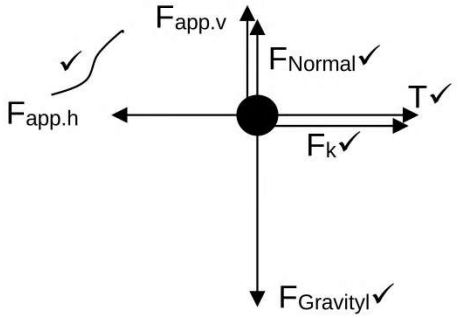
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## QUESTION 2

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 $F_{net} = ma$ ✓
$F_v + N – F_g = 0$
$45\sin30^o + N – 10(9,8)$ ✓ = 0✓
N = 75,50 N✓

(4)

2.4 **POSITIVE MARKING FROM QUESTION 2.3**

**OPTION 1**

CONSIDER 10 kg BLOCK
TAKING LEFT TO BE POSITIVE

$F_{net} = ma$ } ✓
$F_H - T - F_{fk} = ma$
$45\cos 30^o$✓ $- T -$ $0{,}125(75{,}50)$ ✓ $= 10(2{,}5)$✓

$T = 4{,}53$ N

CONSIDER BLOCK m

$F_{net} = ma$
$T - F_{fk} = m(2{,}5)$
$4{,}53 - 1$✓ $= m(2{,}5)$
$m = 1{,}41$ kg✓

**OPTION 2**

CONSIDER 10 kg BLOCK
TAKING LEFT TO BE NEGATIVE

$F_{net} = ma$ } ✓
$-F_H + T + F_{fk} = ma$
$-45\cos 30^o$✓ $+ T +$ $0{,}125(75{,}50)$ ✓ $= -10(2{,}5)$✓
$T = -4{,}53$ N

CONSIDER BLOCK m

$F_{net} = ma$
$T - F_{fk} = m(2{,}5)$
$-4{,}53+1$✓ $= m(-2{,}5)$
$m = 1{,}41$ kg✓

**OPTION 3**

**If masses added then max 3/6**

- $F_{net} = ma$ ✓
- $45\cos 30^o$ ✓
- 1,41 kg ✓ (6)

**[17]**

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## QUESTION 3

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

3.2.1

| **(downward positive)** | **(upwards positive)** |
|---|---|
| $v_f = v_i + a\Delta t$ ✓<br>$0 = (-20) + 9,8\Delta t$ ✓<br>$\Delta t = 2,04$ s ✓ | $v_f = v_i + a\Delta t$ ✓<br>$0 = 20 + (-9,8)\Delta t$ ✓<br>$\Delta t = 2,04$ s ✓ |

(3)

3.2.2 **OPTION 1**

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

**OPTION *2***

Considering motion from maximum height

| **(downward positive)** | **(upwards positive)** |
|---|---|
| $v_f^2 = v_i^2 + 2a\Delta y$<br>$0 = 20^2 + 2(9,8)\ \Delta y$<br>$\Delta y = 20,41$ m | $v_f^2 = v_i^2 + 2a\Delta y$<br>$0 = 20^2 + 2(-9,8)\ \Delta y$<br>$\Delta y = 20,41$ m |

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

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

**OPTION 3**

Considering motion from ground to the roof

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

(3)

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3.2.3 **OPTION 1**

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

**OPTION *2*:**

**POSITIVE MARKING FROM QUESTION 3.2.2**

**(downward positive)** **(upwards positive)**

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

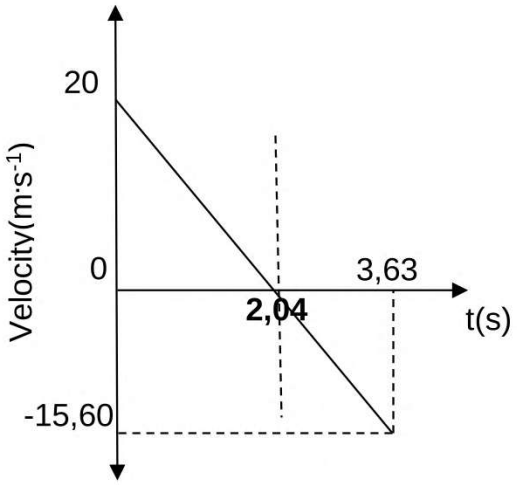
**OPTION 3:**

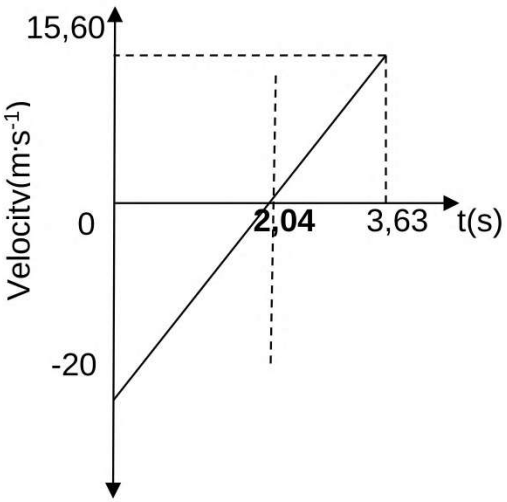
**POSITIVE MARKING FROM QUESTION 3.2.2**

| **(downward positive)** | **(upwards positive)** | |
|---|---|---|
| $v_f = v_i + a\Delta t$ ✓<br>$\underline{15,60}$✓ = $\underline{-20 + 9,8\Delta t}$ ✓<br>$\Delta t$ = 3,63 s ✓ | $v_f = v_i + a\Delta t$ ✓<br>$\underline{-15,60}$✓ = $\underline{20 + (-9,8)\Delta t}$ ✓<br>$\Delta t$ = 3,63 s ✓ | (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 m·s$^{-1}$/-20 m·s$^{-1}$ and t = 0 s | ✓ |
| Graph cuts t-axis at 2,04 s at v = 0 m·s-1 | ✓ |
| Graph shows the v = -15,60m·s$^{-1}$/15,60 m·s$^{-1}$at t = 3,63 s | ✓ |

(4)

**[16]**

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## QUESTION 4

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

4.2

| **OPTION 1** | **OPTION 2** |
|---|---|
| **Taking right to be positive** | **Taking left to be positive** |
| $\Sigma p_i = \Sigma p_f$<br>$m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$ ✓<br>$\underline{60\ (0,60)+85\ (0)}$ ✓ $= \underline{60(-0,20)+85\ v_{fB}}$ ✓<br>$v_{fB} = 0,57\ m{\cdot}s^{-1}$ ✓ to the right ✓ | $\Sigma p_i = \Sigma p_f$<br>$m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$ ✓<br>$\underline{60\ (-0,60) + 85\ (0)}$ ✓ $= \underline{60\ (0,20) + 85\ v_{fB}}$ ✓<br>$v_{fB} = -0,57\ m{\cdot}s^{-1}$<br>$v_{fB} = 0,57\ m{\cdot}s^{-1}$ ✓ to the right ✓ |

(5)

4.3 **POSITIVE MARKING FROM QUESTION 4.2**

| | |
|---|---|
| $\Sigma K_i = \frac{1}{2} m_A v_{iA}^2 + \frac{1}{2} m_B v_{iB}^2$ ✓<br>$= \frac{1}{2}(60)(0,6)^2 + 0$ ✓<br>$= 10,80\ J$ | $\Sigma K_f = \frac{1}{2} m_A v_{fA}^2 + \frac{1}{2} m_B v_{fB}^2$<br>$= \frac{1}{2}(60)(0,2)^2 + \frac{1}{2}(85)(0,57)^2$ ✓<br>$= 15,01\ J$ |

$\Sigma K_f \neq \Sigma K_i$ ✓ OR Total Ek before ≠ Total Ek after
∴ Collision is Inelastic ✓

**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 $E_{MA} = E_{MB}$ ✓

$(K + U)_X = (K+U)_Y$

$(½ mv^2 + mgh)_X = (½mv^2 + mgh)_Y$

$\underline{(0,5)(2)(0) + (2)(9,8)(5)}$ ✓ $= \underline{0,5(2)v^2 + 0}$✓

$v = 9,90\ m\cdot s^{-1}$✓ (4)

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

OR

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

**NOTE:**

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

5.4

**<u>OPTION 1</u>**

$W_{net} = \Delta K$✓

$mgsin30^o(\frac{5}{sin30^o})$ ✓$= \underline{½(2)v^2 - 0}$✓

$v = 9,90\ m\cdot s^{-1}$✓

**<u>OPTION 2</u>**

$W_{net} = \Delta K$✓

$mgcos300^o(\frac{5}{sin30^o})$ ✓$= \underline{½(2)v^2 - 0}$✓

$v = 9,90\ m\cdot s^{-1}$✓

**<u>OPTION 3</u>**

$W_{nc} = \Delta Ep + \Delta Ek$ ✓

0✓ $= \underline{2 \times 9,8\ (0 - 5) + ½(2)v^2 - 0}$ ✓

$v = 9,90\ m\cdot s^{-1}$✓ (4)

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]**

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## 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 $v = f\lambda$ ✓

$340 = f(0,80)$ ✓

$f = 425$ Hz ✓ (3)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

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

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

$v_S = 20$ m·s$^{-1}$

$\therefore v_S = 72$ km·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]**

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## 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 $F = \frac{kQ_1Q_2}{r^2}$ ✓

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

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

$x = 0,27$ m✓ (4)

7.3 **POSITIVE MARKING FROM QUESTION 7.2**

**OPTION 1**

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$1984 = \frac{9x10^9Q^2}{0,27^2}$ ✓

$Q = 1,27 \times 10^{-4}$ C✓

**OPTION 2**

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$124 = \frac{9x10^9Q^2}{(0,27+0,8)^2}$ ✓

$Q = 1,26 \times 10^{-4}$ C✓ (3)

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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 $E = \frac{kQ}{r^2}$ ✓

$E_{1P} = \frac{(9x10^9)(1,26x10^{-4})}{(0,4)^2}$ ✓ $= 7087500\ N{\cdot}C^{-1}$ to the right

$E_{2P} = \frac{(9x10^9)(1,26x10^{-4})}{(0,67)^2}$ ✓ $= 2526175,095\ N{\cdot}C^{-1}$ to the right

$E_{net} = E_{1P} + E_{2P}$
$= 7087500 +$ ✓2526175,095 **NOTE:** The mark is for the addition
$= 9,61x10^6\ N{\cdot}C^{-1}$ to the right ✓ (5)

7.4.3 **OPTION 1:**

**POSITIVE MARKING FROM QUESTION 7.4.2**

$E = \frac{F}{q}$ ✓

$9616375,10 = \frac{F}{1,6x10^{-19}}$ ✓

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

**OPTION 2:**

**POSITIVE MARKING FROM QUESTION 7.3**

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

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

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

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

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

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

$F_{net} = F_{q1} + F_{q2} = 1,134 \times 10^{-12} + 4,04 \times 10^{-13}$
$= 1,54 \times 10^{-12}$ N to the right ✓ (3)

**[19]**

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## 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** |
|---|---|---|
| $\varepsilon = I(R + r)$ ✓ | | $\varepsilon = I(R + r)$ |
| $\varepsilon = 20,58 + 1,78r$ ✓----------(1) | | $\varepsilon = 18,40 + 6,13r$✓ ---------(2) |
| $r = 0,50\ \Omega$ | | |
| $\varepsilon = 20,58 + 1,78(0,5)$ | OR | $\varepsilon = 18,40 + 6,13(0,5)$ ✓ |
| $\varepsilon = 21,47$ V✓ | | |

(5)

8.1.3 **POSITIVE MARKING FROM QUESTION 8.1.2**

| **OPTION 1** | **OPTION 2** |
|---|---|
| EXPERIMENT 2 | EXPERIMENT 1 |
| $\varepsilon = I(R + r)$ ✓ | $\varepsilon = I(R + r)$ ✓ |
| $21,47 = 1,78(R+0,5)$ ✓ | $21,47 = 6,13(R+0,5)$ ✓ |
| $R = 11,56\ \Omega$ | $R = 3\ \Omega$ |
| $R_s = R_1 + R_2 + \ldots$ | $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ |
| $11,56 = R_1 + R_2$ ✓ | $\frac{1}{2,99} = \frac{1}{R} + \frac{1}{R}$ ✓ |
| $R = 5,78\ \Omega$✓ | $R = 6\ \Omega$✓ |
| **OPTION 3** | **OPTION 4** |
| V = IRext✓ | V = IRext✓ |
| 20,58 = 1,78.2R✓ | 18,40 = 6,13 R/2✓ |
| R = 5,78 Ω✓ | R = 6 Ω✓ |

(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)

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8.2 **OPTION 1**

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

Cost of electricity = 1,69 x 5,808 ✓
= R9,82✓

**OPTION 2**

V = IR
=4,4 x 50
=220 V

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

Cost of electricity = 1,69 x 5,808 ✓
= R9,82✓

**OPTION 3**

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

Cost of electricity = 1,69 x 5,808 ✓
= R9,82✓ (3)

**[17]**

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## 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 replaced by a load / resistor. ✓
The split rings (commutator) is replaced by the slip rings. ✓
The coil should be rotated. (2)

9.2.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$V_{rms} = \frac{311,13}{\sqrt{2}}$ ✓

Vrms = 220 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** $c = \lambda f$ $E = hf$

$E = \frac{(6,63x10^{-34})(3,00x10^{8})}{400x10^{-9}}$ ✓ $3 \times 10^{8} = 400 \times 10^{-9}$✓ $= 6,6 \times 10^{-34} . 7,5 \times 10^{14}$

$E = 4,97 \times 10^{-19}$ J✓ $f = 7,5 \times 10^{14} Hz$ $= 4,97 \times 10^{-19}$ J ✓ (3)

10.3 **POSITIVE MARKING FROM QUESTION 10.2**

$E = W_O + \frac{1}{2}mv_{max}^2$ ✓

$4,97 \times 10^{-19}$ ✓$= 2,46 \times 10^{-19}$ ✓$+ \frac{1}{2}(9,11x10^{-31})v_{max}^2$

$v_{(max)} = 742322,57\ m \cdot s^{-1}$✓ (4)

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

**TOTAL: 150**

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