KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions et cetera where required.
10. You are advised to use the attached DATA SHEETS.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

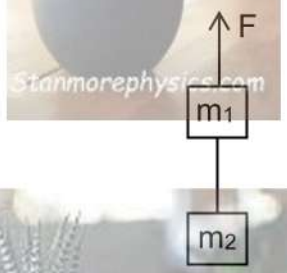
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 A.

1.1 A physics learner stands on a scale in a lift that is moving upwards at CONSTANT VELOCITY.

The reading on a scale, compared to the reading when the lift was stationary, would be…

A zero.
B greater.
C smaller.
D the same. (2)

1.2 Two blocks of masses m_1 and m_2, are connected to each other by a light inextensible string. The blocks are accelerated upwards by a force F.



The tension in the string between the blocks will be…

A equal to F.
B equal to m_2g.
C less than m_2g.
D greater than m_2g. (2)

1.3 A ball is dropped from a height *h* and hits the ground with a speed *v*. The speed of the ball at the moment when it reaches half its initial height is…

A v

B $\frac{v}{\sqrt{2}}$

C $\frac{v}{2}$

D $\frac{v}{4}$ (2)

1.4 A trolley with a mass *m* has momentum *p*. The kinetic energy of the trolley will be…

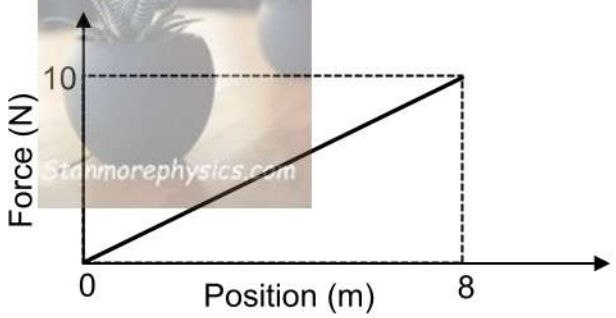
A pm

B $\frac{p}{m}$

C $\frac{p^2m}{2}$

D $\frac{p^2}{2m}$ (2)

1.5 An object is moved from rest in a straight line across a flat surface by a changing horizontal force. The changing force is plotted against the position of the object to produce the graph below.



The work done on the object by the applied force from x = 0 m to x = 8 m is…

A 40 J
B 80 J
C 0,8 J
D 1,25 J (2)

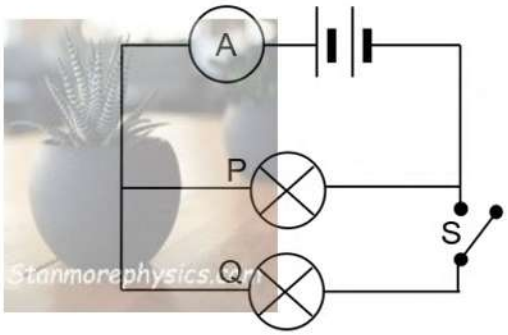
1.6 The reason why the observed pitch of sound wave of an ambulance decreases as the ambulance moves away from a stationary observer, is because the

A amplitude of the sound wave increases.
B amplitude of the sound wave decreases.
C wavelength of the sound wave increases.
D wavelength of the sound wave decreases. (2)

1.7 Point charges with magnitudes q, 2q, 3q and 4q are placed in different electric fields. The force on each point charge is measured and the results are recorded in the table shown below. Which point charge experiences the greatest electric field strength?

	Magnitude of point charge experiencing a force	**Force (N)**
A	4q	60
B	q	20
C	2q	25
D	3q	33

1.8 Two identical light bulbs, P and Q, are connected as shown in the circuit diagram below. The internal resistance of the battery can be ignored.

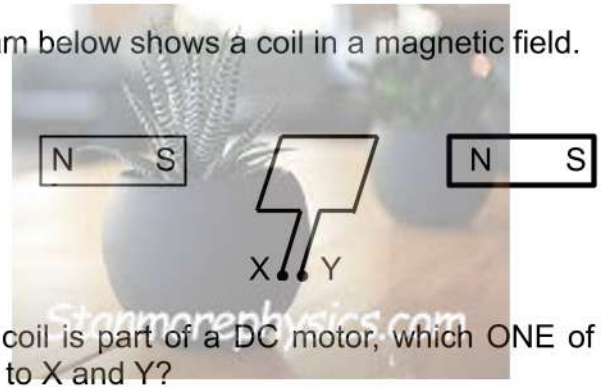


When switch S is closed, which combination best represents the effect on the ammeter reading and the brightness of bulb P?

	Reading on ammeter	**Brightness of bulb P**
A	Increases	Stays the same
B	Stays the same	Increases
C	Stays the same	Stays the same
D	Increases	Increases

(2)

1.9 The diagram below shows a coil in a magnetic field.



When the coil is part of a DC motor, which ONE of the following must be connected to X and Y?

A Split ring (commutator)
B Slip rings
C AC supply
D Soft iron core (2)

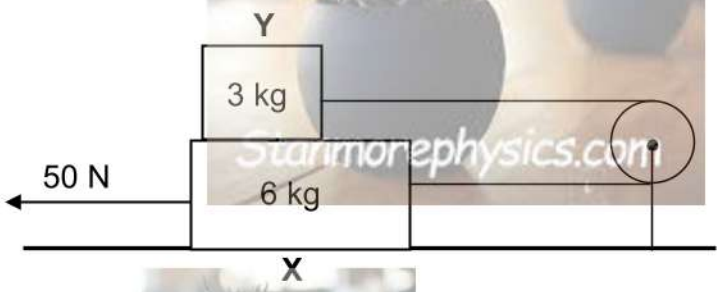
1.10 High-energy light is shone onto a metal plate. Electrons are emitted from the metal plate. Which combination will be true when the wavelength of the light is decreased?

	Kinetic energy of the emitted electrons	**Number of emitted electrons**
A	Decreases	Decreases
B	Increases	Decreases
C	Increases	Stays the same
D	Decreases	Stays the same

(2)
[20]

QUESTION 2 (Start on a new page)

A block **X** of mass 6 kg, at rest on a rough horizontal surface, is connected to another block **Y** of mass 3 kg by means of a light inextensible string which passes over a frictionless pulley. A force of 50 N is applied horizontally to block **X**, as shown in the diagram below.



The coefficient of kinetic friction between the horizontal surface and block **X** is 0,3 and there is no friction between the surfaces of blocks **X** and **Y**.

2.1 Draw a labelled free-body diagram showing all the HORIZONTAL forces acting on block **X**. (3)

2.2 State Newton's Second Law in words. (2)

2.3 Calculate the magnitude of the:

2.3.1 Frictional force acting on block **X** (3)

2.3.2 Acceleration of each block (6)

2.4 A man on the surface of planet **M** weighs HALF his weight compared to his weight on the surface of the Earth. The mass of planet **M** is TWICE that of the Earth.

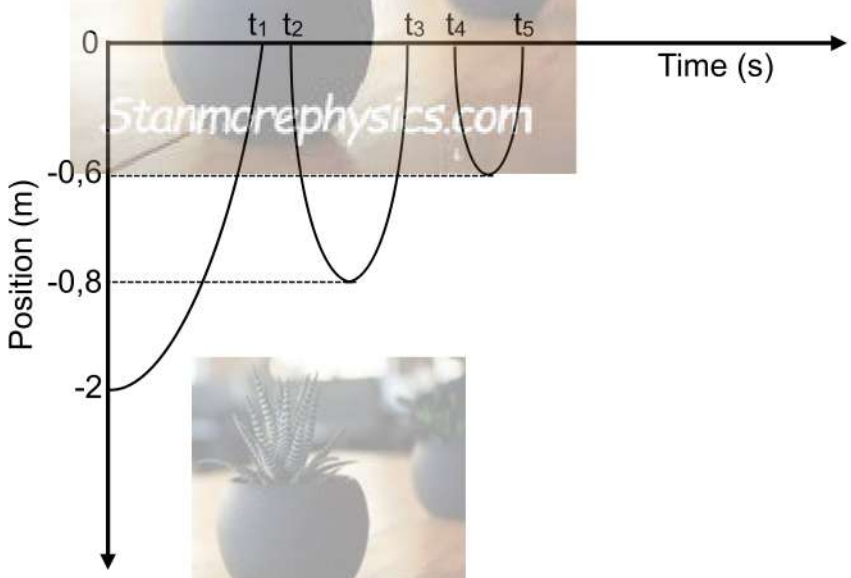
2.4.1 State Newton's Law of Universal Gravitation in words. (2)

2.4.2 Calculate the radius of planet **M** in terms of the radius of the Earth. (4)

[20]

QUESTION 3 (Start on a new page)

A ball of mass 500 g is projected vertically downwards towards the ground from a height of 2 m at a velocity of 1,5 $m.s^{-1}$ The position-time graph for the motion of the ball is shown below.



Ignore the effects of air friction.

3.1 Write down the maximum vertical height reached by the ball after the second bounce. (1)

3.2 Calculate the:

3.2.1 Speed with which the ball hits the ground for the first time (3)

3.2.2 Time t_1 indicated on the graph (3)

3.2.3 Velocity with which the ball rebounds from the ground during the first bounce. (4)

The ball is in contact with the ground for 0,2 s during the first bounce.

3.3 Calculate the force exerted by the ground on the ball during the first bounce. (4)

3.4 Draw a velocity-time graph for the motion of the ball from the time that it is projected to the time when it rebounds to a height of 0,8 m.

Clearly show the following on your graph:

- Time t_1 indicated on the graph
- Velocity of the ball when it hits the ground for the first time
- Velocity of the ball when it rebounds from the ground during the first bounce (4)

[19]

QUESTION 4 (Start on a new page)

A boy, of mass 60 kg on ice skates, is stationary on a frictionless surface. He throws an object, of mass 4 kg, at 3 m·s^{-1} horizontally in the westerly direction as shown in the diagram below.

At the instant the object leaves the boy's hand, the boy starts moving.

Ignore the effects of friction.

4.1 In which direction does the boy move? Write down only EAST or WEST. (1)

4.2 Name and state the law which explains the direction in which the boy experiences a force when he throws the object. (3)

4.3 Calculate the speed of the boy immediately after the object leaves his hand. (4)

4.4 How will the answer to QUESTION 4.3 be affected if:

4.4.1 The boy throws the object at a higher velocity in the same direction
Choose from: INCREASES, DECREASES or REMAINS THE SAME. (1)

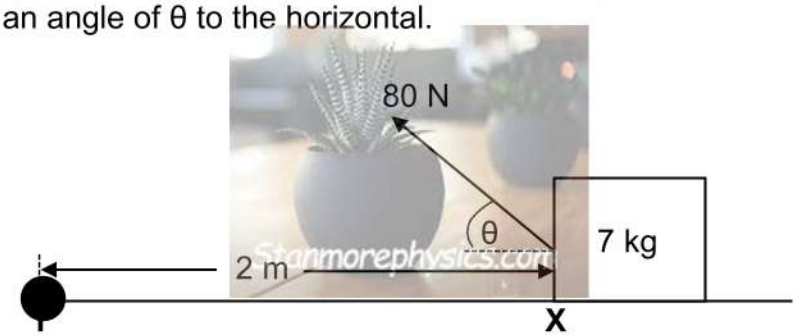
4.4.2 The boy throws the object of double the mass at the same velocity.
Choose from: INCREASES, DECREASES or REMAINS THE SAME. (1)

4.4.3 Explain the answer to QUESTION 4.4.2 (2)

[12]

QUESTION 5 (Start on a new page)

A box of mass 7 kg, which is initially at rest, is acted upon by a constant force of 80 N that is applied at an angle of θ to the horizontal.



The box experiences a constant frictional force of 8 N as it moves from rest at point **X** along a horizontal surface to point **Y** and passes point **Y** with a speed of 1,5 $m \cdot s^{-1}$

5.1 Draw a labelled free-body diagram showing ALL the forces acting on the box as it moves. (4)

5.2 Define the term *work done by a force*. (2)

5.3 Calculate the size of angle θ, by using ENERGY PRINCIPLES only. (4)

5.4 The angle between the applied force of 80 N and the horizontal is now decreased. What effect will this have on the work done by the same applied force when the box is moved from point **X** to point **Y**?
Write only INCREASES, DECREASES or REMAINS THE SAME. (2)
[12]

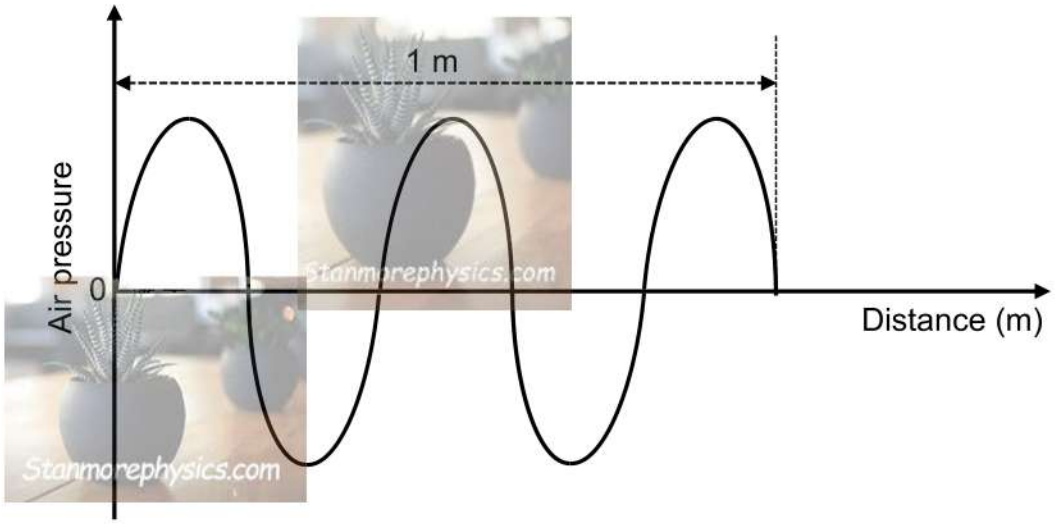
QUESTION 6 (Start on a new page)

A bat flies away from a stationary bat watcher at a constant velocity. The bat constantly emits sound waves at a frequency of 875 Hz. The bat watcher hears a change in pitch as the bat moves away from her.

6.1 Write down the property of sound that is related to pitch. (1)

6.2 Give a reason why the bat watcher observes a change in pitch as the bat moves away from her. (2)

Shown below is the air pressure versus distance graph, which represents the sound waves detected by the bat watcher as the bat moves away from her with a constant velocity. The speed of sound in air is 340 $m \cdot s^{-1}$.



6.3 Use the graph to write down the wavelength of the detected waves. (1)

6.4 Determine the:

6.4.1 Frequency of the sound waves detected by the bat watcher (3)

6.4.2 Velocity at which the bat flies (5)

[12]

QUESTION 7 (Start on a new page)

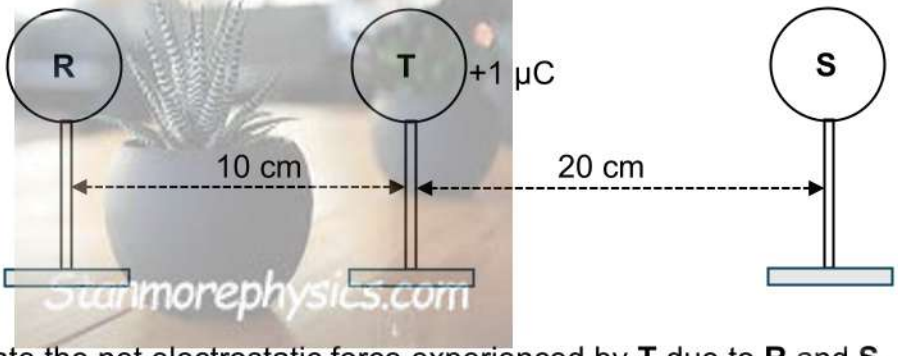
The diagram below shows two identical metal spheres, **R** and **S**, each placed on an insulated stand. The spheres **R** and **S** carry charges of +9 μC and -5 μC, respectively

The spheres **R** and **S** are brought into contact for a while and then placed 30 cm apart.

7.1 Calculate the charge on each sphere immediately after separation. (2)

7.2 Draw the resultant electric field pattern due to spheres **R** and **S** after separation. (3)

After **R** and **S** have been in contact and separated, a third sphere **T** of charge +1 μC, is now placed between them as shown in the diagram below.



7.3 Calculate the net electrostatic force experienced by **T** due to **R** and **S**. (5)

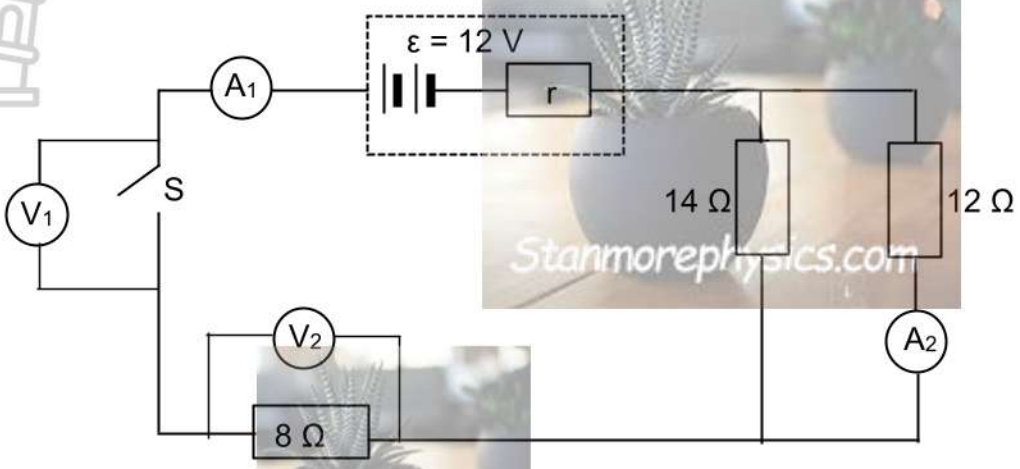
7.4 Define the *electric field at a point*. (2)

7.5 Calculate the net electric field at the location of **T** due to **R** and **S**. (3)

[15]

QUESTION 8 (Start on a new page)

The circuit diagram below shows a battery with an emf of 12V and an unknown internal resistance, r. The resistance of the ammeters and connecting wires can be ignored. The resistance of the voltmeters is very high.



8.1 Write down the reading on voltmeter V_1 when switch S is open. (1)

8.2 The switch S is now CLOSED. The reading on voltmeter V_2 is 6 V.

Determine the:

8.2.1 Reading on ammeter A_1 (3)

8.2.2 Effective resistance of the parallel resistors (3)

8.2.3 Internal resistance, r, of the battery (4)

8.2.4 Reading on ammeter A_2 (4)

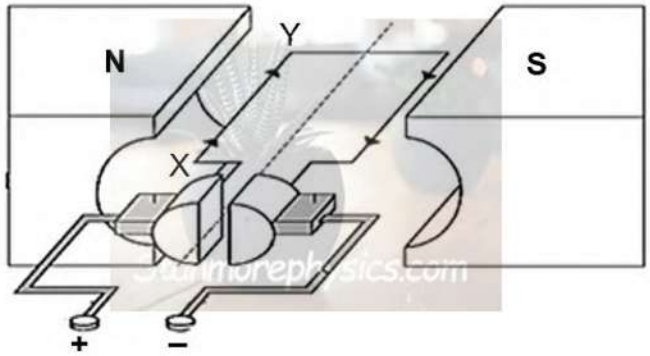
8.3 The cost of electricity is R2,65 per kWh. A 3 500 W electrical oven is used for 50 minutes.

Calculate the cost of using the oven for 50 minutes. (4)

[19]

QUESTION 9 (Start on a new page)

A simplified representation of a DC motor is shown in the diagram below. The current in the coil is in the direction X to Y.



9.1 Name the component that ensures that the coil rotates continuously in ONE DIRECTION. (1)

9.2 In which direction will the coil rotate?
Write down only CLOCKWISE or ANTI-CLOCKWISE. (2)

9.3 Write down the energy conversion which takes place while the motor is working. (1)

9.4 An AC generator, producing a maximum voltage of 311,12 V, is connected to an electric heater of resistance 30 Ω.

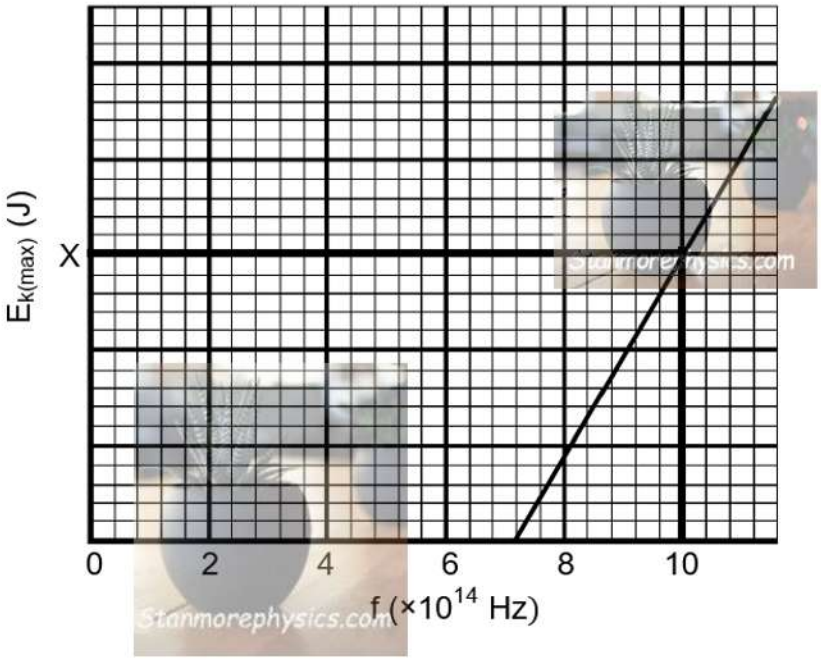
Calculate the:

9.4.1 Root mean square (rms) value of the voltage (3)

9.4.2 Root mean square (rms) value of the current in the heater (4)
[11]

QUESTION 10 (Start on a new page)

The graph below represents the maximum kinetic energy of an electron, $E_{k(max)}$, ejected from the surface of a metal as the frequency (f) of light shone on it is increased.



10.1 Define *threshold frequency*. (2)

10.2 Write down the threshold frequency of the metal. (2)

10.3 Determine the value of X as indicated on the graph. (4)

10.4 The intensity of the incident light is increased without changing the frequency.

How will this affect the maximum kinetic energy of the emitted electrons?
Choose from INCREASES, DECREASES or REMAINS THE SAME.

Give a reason for the answer. (2)

[10]

TOTAL: [150]

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12

VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ J·s
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op electron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Mass of Earth *Massa van Aarde*	M	$5,98 \times 10^{24}$ kg
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^6$ m

TABLE 2: FORMULAE / TABEL 2: FORMULES

MOTION / BEWEGING

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/of $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE / KRAG

$F_{net} = ma$	$p = mv$
$f_s^{(max)} = \mu_s N$	$f_k = \mu_k N$
$w = mg$	$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gem} = Fv_{gem}$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_0 + E_{k(max)}$ or/*of* $E = W_0 + K_{max}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$	

ELECTRICITY AND MAGNETISM/*ELEKTRISITEIT EN MAGNETISME*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ or $n = \frac{Q}{q_e}$	

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$
	$P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$

FINAL

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

MARKING GUIDELINES

SEPTEMBER 2025

MARKS: 150

These marking guidelines consist of 9 pages.

QUESTION 1

1.1 D✓✓ (2)

1.2 D✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 C✓✓ (2)

1.7 B✓✓ (2)

1.8 A✓✓ (2)

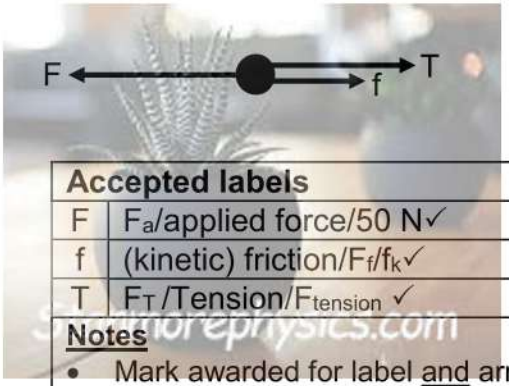
1.9 A✓✓ (2)

1.10 C✓✓ (2)

[20]

QUESTION 2

2.1



Accept force diagram:

Accepted labels	
F	F_a/applied force/50 N✓
f	(kinetic) friction/F_f/f_k✓
T	F_T/Tension/$F_{tension}$ ✓

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): Max ⅔
- If everything correct, but no arrows: Max ⅔

(3)

2.2 When a net force is applied on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the force✓ and inversely proportional to the mass of the object.✓ (2)

Accept Newton's second law in terms of momentum

2.3.1 $f_k = \mu_k N$✓

$= 0,3[(6)(9,8) + (3)(9,8)]$✓

= 26,46 N✓ (3)

2.3.2

POSITIVE MARKING FROM Q 2.3.1
LEFT AS NEGATIVE

Block X
$F_{net} = ma$ ✓
$-F + T + f = ma$
$-50 + T + 26,46$ ✓ $= -6a$✓ .....(1)

Block Y
$F_{net} = ma$
$T = 3a$✓ .....(2)

Solving equation (1) and (2):
$-50 + 3a + 26,46 = -6a$✓
$a = 2,62\ m{\cdot}s^{-2}$ ✓ (6)

POSITIVE MARKING FROM Q 2.3.1
LEFT AS POSITIVE

Block X
$F_{net} = ma$ ✓
$F - T - f = ma$
$50 - T - 26,46$ ✓ $= 6a$✓ .....(1)

Block Y
$F_{net} = ma$
$T = -3a$ ✓ ..... (2)

Solving equation (1) and (2):
$+50 - 3a - 26,46 = +6a$✓
$a = 2,62\ m{\cdot}s^{-2}$ ✓

2.4.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres.✓ (2)

If charges are mentioned $\frac{0}{2}$

2.4.2

OPTION 1	**OPTION 2**
$F_{planet\ M} = ½F_{Earth}$ ✓	$g_{planet\ M} = ½g_{Earth}$ ✓
$\frac{G(2M_E)(m)}{x^2}$ ✓ $= \frac{\frac{1}{2}G(M_E)(m)}{R^2}$ ✓	$\frac{G(2M_E)}{x^2}$ ✓ $= \frac{\frac{1}{2}G(M_E)}{R^2}$ ✓
$x = 2R$✓	$x = 2R$✓

(4)
[20]

QUESTION 3

3.1 0,6 m✓ (1)

3.2.1

DOWNWARD AS POSITIVE	DOWNWARD AS NEGATIVE
$v_f^2 = v_i^2 + 2a\Delta y$✓ $= \underline{(1,5)^2 + 2(9,8)(2)}$ ✓ $v_f = 6,44\ m{\cdot}s^{-1}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ $= \underline{(-1,5)^2 + 2(-9,8)(-2)}$ ✓ $v_f = 6,44\ m{\cdot}s^{-1}$ ✓

(3)

3.2.2

OPTION 1 **POSITIVE MARKING FROM Q 3.2.1** **DOWNWARD AS POSITIVE** $v_f = v_i + a\Delta t$ ✓ $\underline{6,44 = 1,5 + (9,8)\Delta t}$ ✓ $\Delta t = 0,50$ s✓	**OPTION 1** **POSITIVE MARKING FROM Q 3.2.1** **DOWNARD AS NEGATIVE** $v_f = v_i + a\Delta t$ ✓ $\underline{-6,44 = -1,5 + (-9,8)\Delta t}$ ✓ $\Delta t = 0,50$ s✓
OPTION 2 **POSITIVE MARKING FROM Q 3.2.1** **DOWNWARD AS POSITIVE** $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $[2 = \left(\frac{1,5 + 6,44}{2}\right)]$✓$\Delta t$ $\Delta t = 0,50$	**OPTION 2** **POSITIVE MARKING FROM Q 3.2.1** **DOWNWARD AS NEGATIVE** $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $[-2 = \left(\frac{-1,5 + (-6,44)}{2}\right)]$ ✓ Δt $\Delta t = 0,50$ s ✓
OPTION 3 **DOWNWARD AS POSITIVE** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $[2 = 1,5\ \Delta t\ + \frac{1}{2}(9,8)]$✓$\Delta t^2$ $\Delta t = 0,50$ s ✓	**OPTION 3** **DOWNWARD AS NEGATIVE** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $[-2 = -1,5\ \Delta t\ + \frac{1}{-2}(-9,8)]$✓$\Delta t^2$ $\Delta t = 0,50$ s ✓

(3)

3.2.3

OPTION 1 DOWNWARD AS POSITIVE	OPTION 1 DOWNWARD AS NEGATIVE
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0^2✓ $= v_i^2 + 2(9,8)(-0,8)$ ✓ $v_i = \underline{3,96\ m{\cdot}s^{-1}, \text{upwards}}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0^2✓ $= v_i^2 + 2(-9,8)(0,8)$ ✓ $v_i = \underline{3,96\ m{\cdot}s^{-1}, \text{upwards}}$ ✓

(4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.1 & QUESTION 3.2.3**

$F_{net}\ \Delta t = m(v_f - v_i)$ ✓

$F_{net}(0,2)$ ✓ $= 0,5(3,96 - (-6,44))$ ✓

$F_{net} = \underline{26\ N, \text{upwards}}$ ✓ (4)

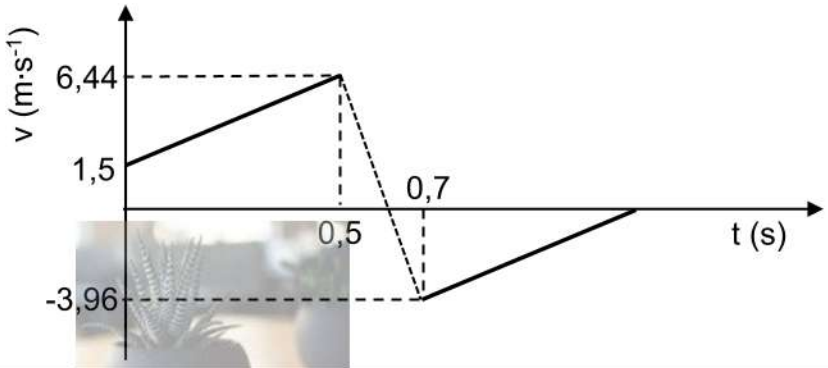
3.4

POSITIVE MARKING FROM QUESTION 3.1 TO QUESTION 3.3

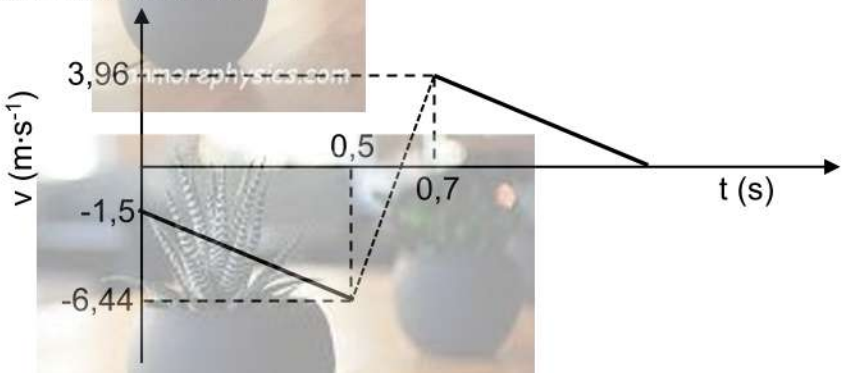
Criteria

- First part of starts at v = 1,5 m·s^{-1} and ends at 6,44 m·s^{-1} ✓
- Second part starts at v = 3,96 m·s^{-1} until v= 0 m·s^{-1} ✓
- Shape (parallel lines) ✓
- Both axes labelled ✓

DOWNWARD AS POSITIVE



DOWNWARD AS NEGATIVE



(4)
[19]

QUESTION 4

4.1 East✓ (1)

4.2 Newton's Third Law (of Motion) ✓
(Mark independently)
When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓ ✓ (3)

4.3

OPTION 1 **TO THE LEFT AS POSITIVE**	**OPTION 1** **TO THE LEFT AS NEGATIVE**
$\sum p_i = \sum p_f$ $m_t v_{it} = m_1 v_{f1} + m_2 v_{f2}$ } ✓Any one 0✓ $= \underline{60 v_{f1}} + (4)(3)$ ✓ $v_f = -0,20$ $\therefore\ v_f = 0,20\ m\cdot s^{-1}$ ✓	$\sum p_i = \sum p_f$ $m_t v_{it} = m_1 v_{f1} + m_2 v_{f2}$ } ✓Any one 0✓ $= \underline{60 v_{f1}} + (4)(-3)$ ✓ $v_f = 0,20\ m\cdot s^{-1}$ ✓
OPTION 2 $\Delta p_{boy} = -\Delta p_{object}$ $m_b(v_{bf} - v_{bi}) = -m_o(v_{of} - v_{oi})$ } ✓ Any one $60(v_{bf} - 0)$✓ $= -4(3-0)$✓ $v_{bf} = -0,20$ $\therefore\ v_{bf} = 0,20\ m\cdot s^{-1}$ ✓	

(4)

4.4.1 Increases ✓ (1)

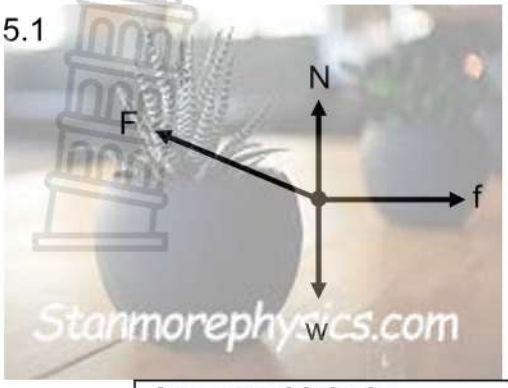
4.4.2 Increases ✓ (1)

4.4.3 Δp_{object} increases✓, which causes Δp_{boy} to increase✓ (2)

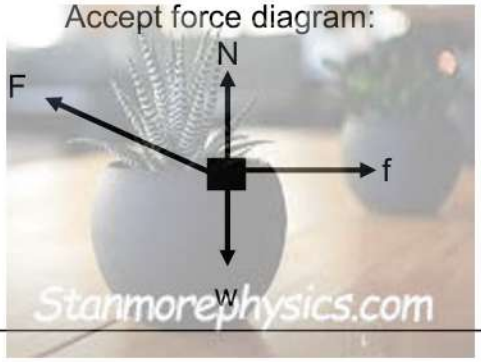
[12]

QUESTION 5

5.1



Accept force diagram:



Accepted labels	
w	F_g/ F_w/ weight/588 N/gravitational force✓
F	F_a/applied force✓
f	(kinetic) friction/F_f/f_k✓
N	F_N /Normal/F_{normal} ✓

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): Max $^3/_4$
- If everything correct, but no arrows: Max/*Maks* $^3/_4$

(4)

5.2 Work done on an object by a constant force F is F Δx cos θ , where F is the magnitude of the force, Δx the magnitude of the displacement and θ the angle between the force and the displacement. ✓✓

OR

The work done on an object is the product of the force and the displacement of the object in the direction of the displacement. ✓✓

(2)

5.3

OPTION 1

$W_{net} = \Delta K$
$W_F + W_f = ½m(v_f^2 - v_i^2)$ } ✓ Any one
$(80)(2)\cos\Theta + (8)(2)\cos180^\circ$ ✓$= [½(7)(1,5^2 - 0^2)]$ ✓
$\Theta = 81,42^\circ$✓

OPTION 2

$W_{nc} = \Delta K + \Delta U$
$W_F + W_f = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$ } ✓ Any one
$(80)(2)\cos\Theta + (8)(2)\cos180^\circ$ ✓$= [½(7)(1,5^2 - 0^2) + 0]$ ✓
$\Theta = 81,42^\circ$✓

(4)

5.4 Increases✓✓ (2)

[12]

QUESTION 6

6.1 Frequency✓ (1)

6.2 The sound source (bat) and the listener (bird watcher) have different velocities relative to the medium of sound propagation. ✓✓ (2)

6.3 0,4 m✓ (1)

6.4.1 $v = f \times \lambda$✓

$340 = f \times 0{,}4$✓

$f = 850$ Hz✓ (3)

6.4.2 **POSITIVE MARKING FROM QUESTION 6.4.1**

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

$f_L = \frac{v}{v - v_s} \cdot f_s$ ✓ Any one

850✓ $= \frac{340}{340 + v_s}$ ✓(875) ✓

$v_s = 10\ m \cdot s^{-1}$ (away from the batwatcher) ✓ (5)

[12]

QUESTION 7

7.1 $Q = \frac{Q_1 + Q_2}{2}$

$= \frac{(9\times10^{-6}) + (-5\times10^{-6})}{2}$ ✓

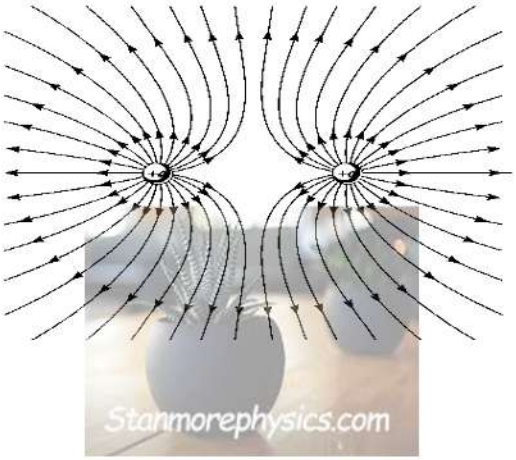
$= 2\times10^{-6}$ C ✓

Accept $Q = \frac{(9\mu C) + (-5\mu C)}{2}$ ✓

$= 2\mu C$ ✓ (2)

7.2

Criteria for sketch	Marks
Correct direction of field lines	✓
Shape of electric field	✓
Field lines not crossing each other / Field lines start from sphere / No field lines inside the spheres	✓



(3)

7.3

$F_{RT} = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^{9})(2\times10^{-6})(1\times10^{-6})}{(0,1)^2}$ ✓

= 1,8 N to the right

$F_{ST} = \frac{(9\times10^{9})(2\times10^{-6})(1\times10^{-6})}{(0,2)^2}$ ✓

= 0,45 N to the left

F_{net} = 1,8 + (-0,45) ✓

= 1,35 N to the right ✓ (5)

7.4 Electrostatic force experienced per unit positive charge placed (at that point).✓✓ (2)

7.5 **POSITIVE MARKING FROM QUESTION 7.3**

OPTION 1

$E = \frac{F}{q}$ ✓

$= \frac{1,35}{1\times10^{-6}}$ ✓

= $1,35\times10^{6}$ N·C^{-1} to the right ✓ (3)

OPTION 2

$E = \frac{kQ}{r^2}$

$E_1 = \frac{(9,0 \times 10^{9})(2 \times 10^{-6})}{(0,1)^2}$

= 1,80 x 10^{6} N·C^{-1} to the right ✓

$E_2 = \frac{(9,0 \times 10^{9})(2 \times 10^{-6})}{(0,2)^2}$

= *4,50 x 10^{5}* N·C^{-1} to the left ✓

E_{net} = 1,80 x 10^{6} N – *4,50 x 10^{5}*

= $1,35\times10^{6}$ N·C^{-1} to the right ✓ (3)

[15]

QUESTION 8

8.1 12 V✓ (1)

8.2.1 $I = \frac{V}{R}$ ✓
$= \frac{6}{8}$ ✓
$= 0,75A$ ✓ (3)

8.2.2

OPTION 1	OPTION 2
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $= \frac{1}{14} + \frac{1}{12}$ ✓ $R_p = 6,46\ \Omega$ ✓	$R_p = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓ $= \frac{14 \times 12}{14 + 12}$ ✓ $= 6,45\ \Omega$ ✓

(3)

8.2.3 **POSITIVE MARKING FROM QUESTION 8.1 & 8.2.2**
$\varepsilon = I(R+r)$ ✓
12 ✓ $= \underline{0,75(6,46 + 18 + r)}$ ✓
$r = 1,54\ \Omega$✓ (4)

8.2.4

OPTION 1 POSITIVE MARKING FROM QUESTION 8.2.1 & 8.2.2	OPTION 2 POSITIVE MARKING FROM QUESTION 8.2.1
$V_{//} = IR$ $= (0.75)(6,46)$ ✓ $= 4,845$ V $I_{12\Omega} = \frac{V}{R}$ ✓ $= \frac{4,845}{12}$ ✓ $= 0,404$ A✓	$V_{lost} = Ir$ $= (0,75)(1,54)$ $= 1,155$ V $V_{12\Omega} = \underline{12 - 1,155 - 6}$✓ $= 4,845$ V $I_{12\Omega} = \frac{V}{R}$ ✓ $I_{12\Omega} = \frac{4,845}{12}$ ✓ $= 0,404$ A ✓

(4)

8.3 $\text{Cost} = P \times \Delta t \times \text{tariff}$
$= 3,5$ ✓ $\times \frac{50}{60}$ ✓ $\times\ 2,65$ ✓
$= R7,73$ ✓ (4)
[19]

QUESTION 9

9.1 Split ring (commutator) ✓ **Accept: Commutator** (1)

9.2 Anticlockwise ✓✓ (2)

9.3 Electrical to mechanical✓ (1)

9.4.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$✓

$= \frac{311}{\sqrt{2}}$ ✓

$= 220\ V$ ✓ (3)

9.4.2

POSITIVE MARKING FROM QUESTION 9.4.1

$P_{ave} = \frac{V_{rms}^2}{R}$

$= \frac{220^2}{30}$ ✓

$= 1\ 613,33\ W$

OPTION 1	**OPTION 2**
$P_{ave} = I_{rms}V_{rms}$ ✓	$P_{ave} = I^2_{rms}R$ ✓
$1\ 613,33 = I_{rms}(220)$ ✓	$1\ 613,33 = I^2_{rms}(30)$ ✓
$I_{rms} = 7,33\ A$ ✓	$I_{rms} = 7,33\ A$ ✓

OPTION 3

$R = \frac{V_{rms}}{I_{rms}}$ ✓

$30 = \frac{220}{I_{rms}}$ ✓

$I_{rms} = 7,33\ A$ ✓ (4)

[11]

QUESTION 10

10.1 Minimum frequency of light needed to emit electrons from a certain metal surface. ✓✓ (2)

10.2 $7,2\times 10^{14}$ Hz✓✓ (2)

10.3 **OPTION 1**
POSITIVE MARKING FROM QUESTION 10.2
$E_{k(max)} = hf - hf_o$ ✓
$X = (6,63\times 10^{-34})(1\times 10^{15})$ ✓ $- (6,63\times 10^{-34})(7,2\times 10^{14})$ ✓
$= 1,86\times 10^{-19}$ J ✓ (4)

OPTION 2
Gradient $= \frac{E_{k(max)2} - E_{k(max)1}}{f_2 - f_1}$ ✓✓
✓
$6,63 \times 10^{-34} = \frac{X - 0}{10 \times 10^{14} - 7,2 \times 10^{14}}$
$x = 1,86\times 10^{-19}$ J ✓ (4)

10.4 Remains the same✓
Intensity does not affect kinetic energy of the photons✓
OR
Only frequency affects $E_{k(max)}$
OR
The frequency remains the same. (2)

[10]

TOTAL: 150