

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS
LEFAPHA LA THUTO
ISEBE LEZEMFUNDO

**PROVINSIALE VOORBEREIDINGSEKSAMEN/
PROVINCIAL PREPARATORY EXAMINATION**

GRAAD/GRADE 12

**FISIESE WETENSKAPPE: FISIKA V1/
PHYSICAL SCIENCES: PHYSICS P1**

SEPTEMBER 2022

PUNTE/MARKS: 150

TYD/TIME: 3 uur/hours

**Hierdie vraestel bestaan uit 15 bladsye en 3 gegewensblaaie./
This question paper consists of 15 pages and 3 data sheets.**

INSTRUCTIONS AND INFORMATION

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

QUESTION 1: MULTIPLE CHOICE-QUESTIONS

Various options are provided as possible answers to the following questions. Choose the CORRECT answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10), e.g. 1.11 E.

- 1.1 The resultant of all the forces acting on an object is zero if the body is:
- A Falling freely from rest
 - B Accelerating
 - C Moving in a circular path
 - D Moving at constant velocity
- (2)

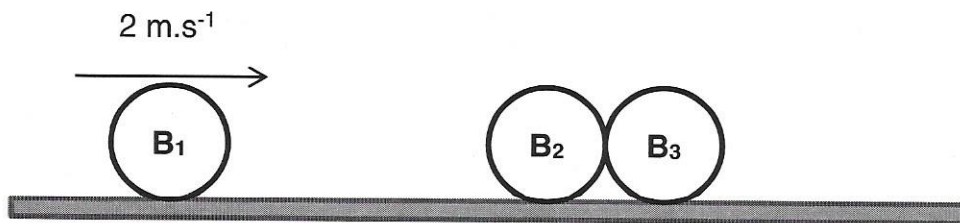
- 1.2 An astronaut of mass m has a weight w on earth. If the force of gravity on the moon is $\frac{1}{6}$ of that of the earth, the astronaut's mass and weight on the moon will respectively be ...

	Mass (m)	Weight (w)
A	$6m$	$6w$
B	m	$\frac{1}{6}w$
C	m	$6w$
D	$\frac{1}{6}m$	$\frac{1}{6}w$

(2)

- 1.3 A hot-air balloon is moving vertically upwards at a constant speed of 4 m.s^{-1} when a sandbag is dropped from the balloon. The sandbag will:
- A Be stationary at first and then fall to the ground
 - B Fall to the ground at a constant speed of 4 m.s^{-1}
 - C Move up at first and then fall to the ground
 - D Immediately fall to the ground with an initial speed of 4 m.s^{-1}
- (2)

- 1.4 A billiard ball **B**₁, moving at 2 m.s^{-1} , collides with two balls **B**₂ and **B**₃ at rest on a horizontal, frictionless table (refer to the diagram below). All three balls are **identical**.

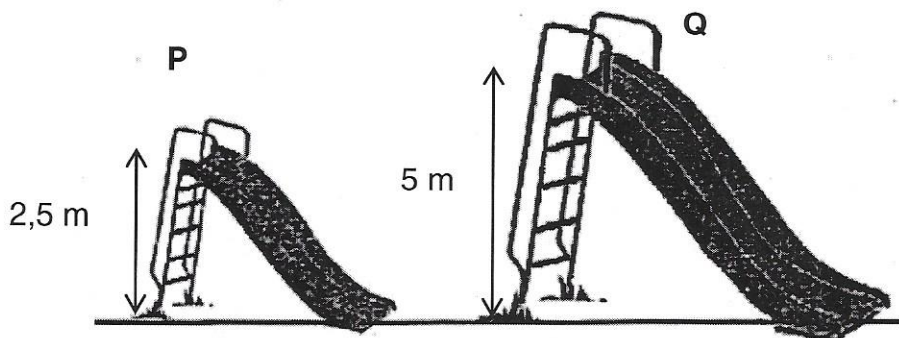


If both the total momentum and the total kinetic energy of the balls are conserved, which **ONE** of the following sets of values correctly gives the velocity, in m.s^{-1} , of the three balls after the collision?

	B ₁	B ₂	B ₃
A	-2	+2	+2
B	0	0	+2
C	0	+1	+1
D	-2	0	+4

(2)

- 1.5 A learner slides down slide **P**, with a vertical height of 2,5 m, reaching the bottom with a speed v . She then slides down slide **Q**, with a vertical height of 5 m, as shown in the diagram below. Ignore friction.



The learner's speed at the bottom of slide **Q** is:

- A v
- B $\sqrt{v}$
- C $\sqrt{2} v$
- D $2v$

(2)

- 1.6 Light from a distant star is observed to have undergone a red shift. The observed light has:

A A lower frequency
 B A shorter wavelength
 C Higher energy
 D Higher speed

(2)

- 1.7 When two small metal spheres **X** and **Y** (shown in the diagram below), carrying identical positive charges, are placed a distance apart, they repel each other with a force **F**.

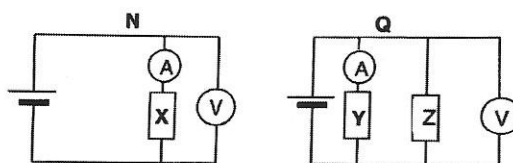


If the distance between spheres **X** and **Y** is halved while all other variables remain unchanged, the new forces which **X** and **Y** experience, respectively are ...

	Force on X	Force on Y
A	F	F
B	$\frac{1}{4}F$	F
C	F	$\frac{1}{4}F$
D	$4F$	$4F$

(2)

- 1.8 In circuits **N** and **Q** shown below all the resistors (**X**, **Y** and **Z**) and cells are identical.

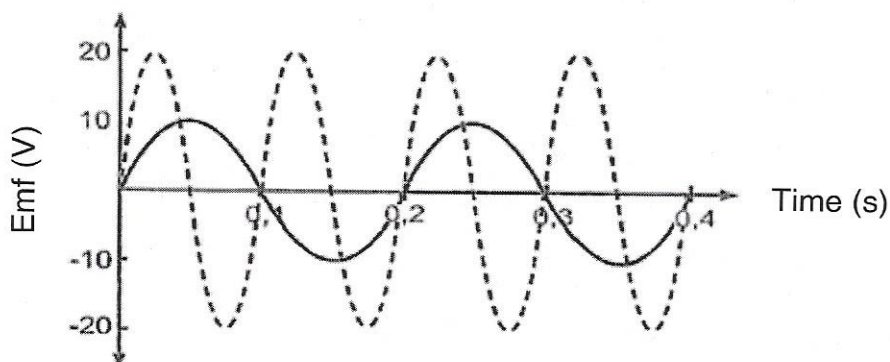


Which ONE of the following gives the correct comparison between the ammeter reading and the voltmeter reading across resistors **X** and **Y** respectively.

	Ammeter Reading	Voltmeter Reading
A	$I_X = I_Y$	$V_X = V_Y$
B	$I_X > I_Y$	$V_X > V_Y$
C	$I_X < I_Y$	$V_X < V_Y$
D	$I_X = I_Y$	$V_X > V_Y$

(2)

- 1.9 In the graph below, the solid curve shows how the emf produced by a simple generator varies with time. The dashed curve is the output from the same generator after a change was made to the generator.

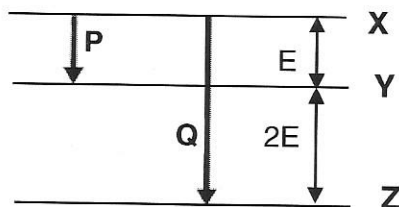


What change was made to the generator to produce the result as shown?

- A The speed of rotation was doubled.
- B A split-ring commutator was added.
- C The number of turns in the coils was quadrupled.
- D The strength of the magnets was halved.

(2)

- 1.10 The diagram below represents 3 energy levels (**X**, **Y** and **Z**) in a certain atom. The energy difference between levels **Y** and **Z** is twice the energy difference between levels **X** and **Y**.



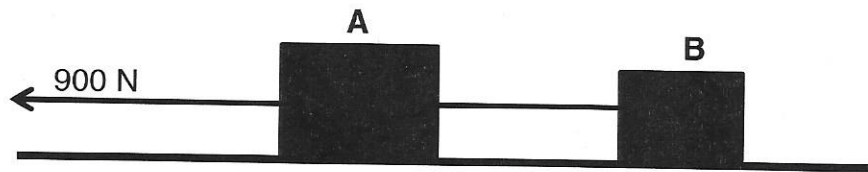
If the wavelength of a photon released as a result of transition **P** from level **X** to **Y**, is λ , what will be the wavelength of the photon released during transition **Q**, from level **X** to **Z** be?

- A 2λ
- B 3λ
- C $\frac{\lambda}{2}$
- D $\frac{\lambda}{3}$

(2)
[20]

QUESTION 2 (Start on a new page)

Two objects are being pulled over a straight rough horizontal surface with a force of 900 N. The mass of object **A** is 130 kg and the mass of object **B** is 95 kg. The two objects are connected to each other by an inelastic rope of negligible mass. See the diagram below.



The two objects move at **CONSTANT VELOCITY**.

- 2.1 State *Newton's third law* in words. (2)
- 2.2 Draw a labelled free-body diagram to indicate all the forces acting on object **B**. (4)
- 2.3 Calculate the magnitude of the kinetic frictional force between object **B** and the rough surface if the coefficient of kinetic friction between object **A** and the rough surface is 0,45. (5)

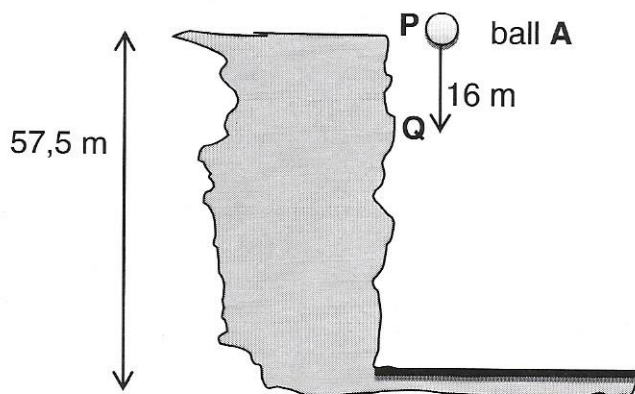
The rope between the two objects suddenly breaks.

- 2.4 Use a relevant law to describe the motion of object **B** after the rope breaks. (3)
- [14]

QUESTION 3 (Start on a new page)

Ball **A**, mass 0,01 kg, is dropped from point **P** from the top of a cliff, 57,5 m above the ground. At the instant that ball **A** passes point **Q**, 16 m below point **P**, a second ball **B**, mass 0,02 kg, is thrown downwards from the same height as point **P**. Both balls reach the ground at the same time.

Ignore the effects of air resistance.



3.1 Is ball **B** in free fall? Choose between YES or NO and explain the answer. (2)

3.2 Calculate the:

3.2.1 Time it takes for ball **A** to reach point **Q**. (3)

3.2.2 Initial speed with which ball **B** is thrown downwards so that both balls reach the ground at the same time. (5)

3.2.3 Speed of ball **B** just before it hits the ground. (3)

Ball **B** is in contact with the ground for 0,02 seconds from where it bounces back with a velocity of 20 m.s^{-1} .

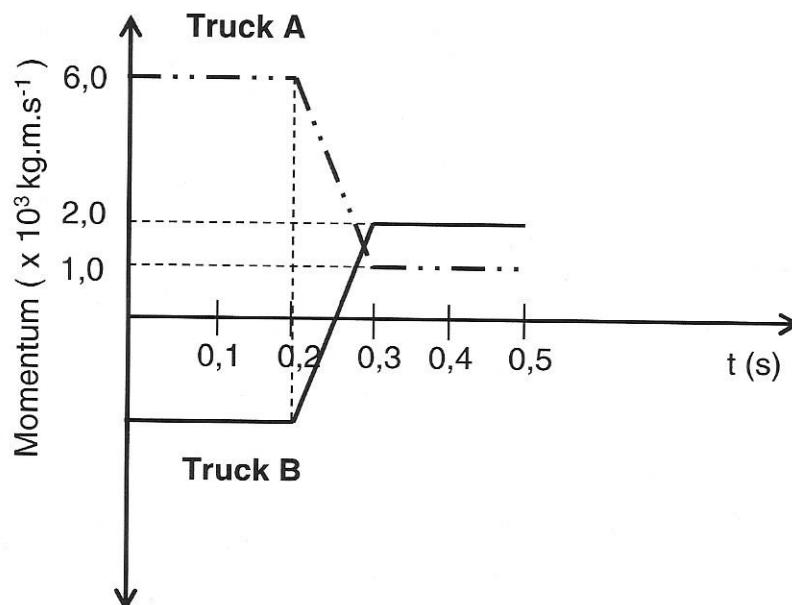
3.3 Calculate the force that the ground exerts on ball **B**. (4)

3.4 Write down the acceleration of ball **B** when it moves vertically upwards. (1)

[18]

QUESTION 4 (Start on a new page)

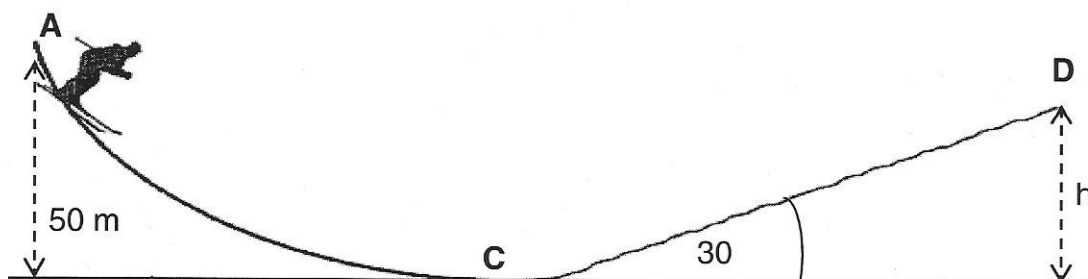
Truck **A**, with mass 2 000 kg, moves eastwards and collides with truck **B** of mass 1 500 kg. The graph below (not drawn to scale) shows how the momentum of each of the trucks varies with time.



- 4.1 Write down the *principle of conservation of linear momentum* in words. (2)
- 4.2 Write down the magnitude of the initial momentum of truck **A**. (1)
- 4.3 Calculate the:
- 4.3.1 Initial speed of truck **A** (3)
- 4.3.2 Velocity of truck **B** before the collision (5)
- [11]

QUESTION 5 (Start on a new page)

A skier, with a total mass of 80 kg, starts from rest from point **A** and skies down a frictionless ski slope as shown in the diagram below. She passes point **C** and continues up a rough slope, coming to rest at point **D**.



- 5.1 State the *work-energy theorem* in words. (2)
- 5.2 Name a conservative force acting on the skier while she moves down the slope from **A** to **C**. (1)
- 5.3 Use energy principles and calculate the speed of the skier at point **C**. (4)

The skier experiences an average *kinetic frictional force* of 160 N while she moves from **C** to **D**.

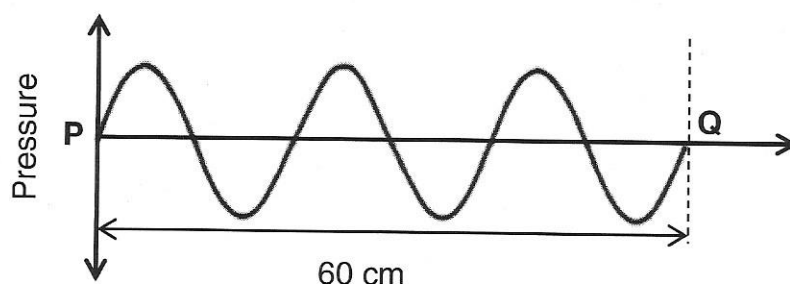
- 5.4 Draw a labelled free-body diagram and indicate ALL the forces acting on the skier while she moves from **C** to **D**. (3)
- 5.5 Use ENERGY PRINCIPLES to calculate the vertical height of point **D** above the ground. (5)
- 5.6 The angle between slope **CD** and the horizontal is increased from 30° to 50°. What effect will this have on the average kinetic frictional force experienced by the skier?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

(1)
[16]

QUESTION 6 (Start on a new page)

The sound waves below are emitted by a bird flying in a straight line at a constant height. Take the speed of sound in air as 340 m.s^{-1} .



6.1 Write down the wavelength of the waves in metres. (2)

6.2 Calculate the frequency of the waves. (3)

A detector, fixed to a pole at the same height at which the bird is flying, measures the frequency of the sound emitted by the bird to be $1\,620 \text{ Hz}$.

6.3 State the *Doppler-effect* in words. (2)

6.4 Calculate the speed at which the bird is flying. (4)

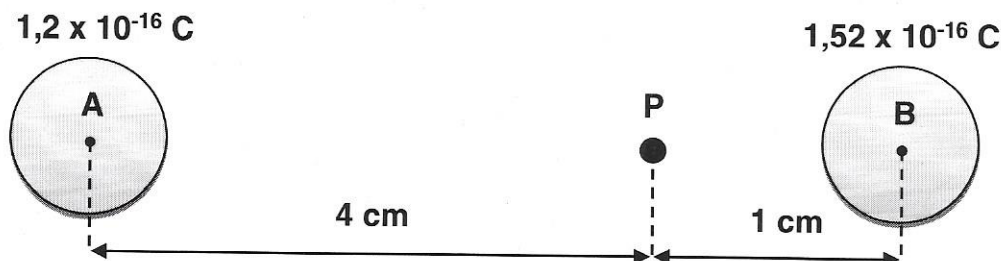
6.5 Is the bird flying towards or away from the detector? (1)
[12]

QUESTION 7 (Start on a new page)

7.1 State *Coulomb's law* in words.

(2)

Point charge **A**, with a charge of $+1,2 \times 10^{-16} \text{ C}$, is placed 5 cm away from another point charge **B**, carrying a charge of $+1,52 \times 10^{-16} \text{ C}$ along a straight line in a vacuum, as shown below. An electron is placed at point **P**, 4 cm to the right of point charge **A**.



7.2 Calculate the:

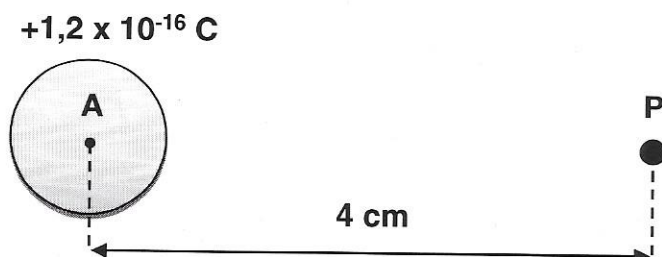
7.2.1 Net electrostatic force experienced by the electron.

(5)

7.2.2 Net electric field at point **P**.

(3)

The electron is released from point **P** and accelerates towards point charge **A**.



7.3 As the electron moves closer to point charge **A**, will the acceleration be INCREASING, DECREASING or REMAIN CONSTANT?

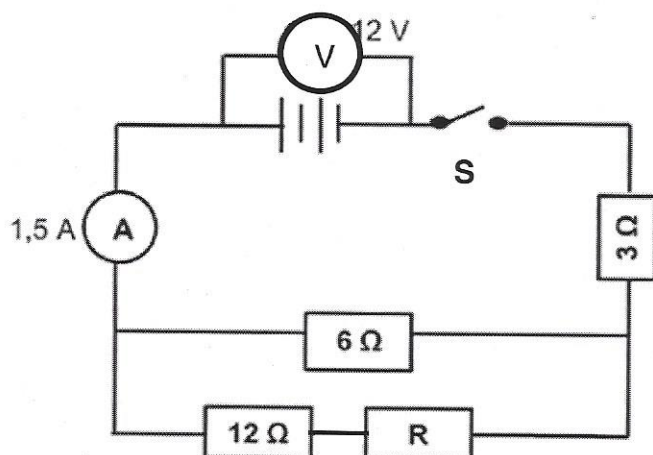
Explain the answer.

(3)
[13]

QUESTION 8 (Start on a new page)

In the diagram below, the battery has an emf of 13,5 V and an internal resistance of 1 ohm. The resistance of resistor **R** is unknown.

When switch **S** is closed the ammeter, **A**, reads 1,5 A. The resistance of the ammeter and the connecting wires are negligible.



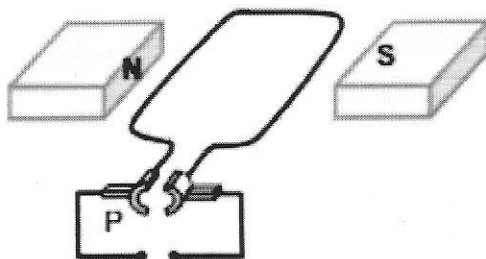
- 8.1 State *Ohm's law* in words. (2)
- 8.2 Write down the reading on the voltmeter (V) while switch **S** is open. (1)
- 8.3 When SWITCH **S** is CLOSED, calculate the:
- 8.3.1 Total parallel resistance (4)
- 8.3.2 Resistance of resistor **R** (4)
- 8.3.3 Power delivered by the 6 Ω resistor (4)
- 8.4 The 3 Ω resistor is now removed from the circuit and replaced with a conducting wire of negligible resistance. How will this affect the voltmeter reading?

Choose from INCREASES, DECREASES or REMAIN THE SAME. Explain the answer.

(4)
[19]

QUESTION 9 (Start on a new page)

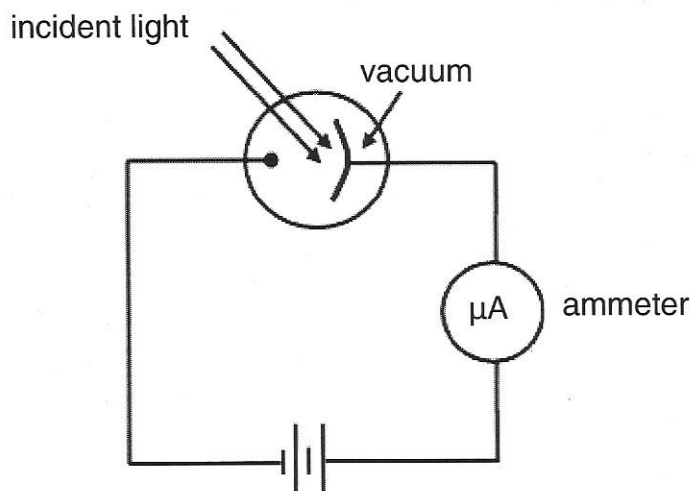
The diagram shows a simple electric motor.



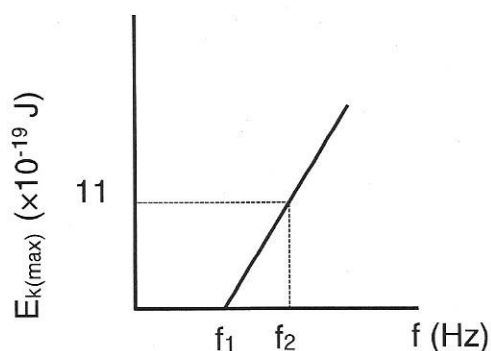
- 9.1 What energy conversion takes place in electric motors? (1)
- 9.2 What type of electric motor (AC or DC) is illustrated in this diagram?
Give a reason for your answer. (2)
- 9.3 Explain the function of the carbon brushes. (1)
- 9.4 To which terminal of the power source (positive or negative) is the brush labelled **P** connected if the coil rotates clockwise? (1)
- 9.5 Name and explain the basic principle on which a motor works. (2)
- 9.6 An electrical appliance with a power rating of 2 000 W is connected to a 230 V_{rms} household mains supply. Calculate:
- 9.6.1 The peak (maximum) voltage (3)
- 9.6.2 The rms current passing through the appliance (3)
- 9.6.3 The resistance of the appliance (3)
- [16]**

QUESTION 10 (Start on a new page)

The diagram below shows a simplified photocell.



The graph below shows the relationship between the maximum kinetic energy of photoelectrons and the frequency of light when light is shone onto the metal surface of the above photocell. The graph cuts the x-axis at $f_1 = 5 \times 10^{14} \text{ Hz}$.



- 10.1 Write down the name of the physical quantity represented by f_1 . (1)
- 10.2 Define the term *work function*. (2)
- 10.3 Calculate the work function of the metal. (3)
- 10.4 Calculate the frequency, f_2 , as shown on the graph. (4)
- 10.5 The intensity of the light is increased while the frequency of the light is kept constant. How will this affect the reading on the ammeter?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

(1)
[11]

GRAND 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 <i>Swaartekragversnelling</i>	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant <i>Universele gravitasiekonstante</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant <i>Coulomb se konstante</i>	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Charge on electron <i>Lading op electron</i>	e ⁻	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m _e	$9,11 \times 10^{-31} \text{ kg}$
Mass of Earth <i>Massa van Aarde</i>	M	$5,98 \times 10^{24} \text{ kg}$
Radius of Earth <i>Radius van Aarde</i>	R _E	$6,38 \times 10^6 \text{ m}$

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

$F_{\text{net}} = ma$	$p = mv$
$f_{s(\text{max})} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$

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 $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{av}} = F \cdot v_{\text{av}} / P_{\text{gem}} = F \cdot v_{\text{gem}}$	

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 $E = h \frac{c}{\lambda}$
$E = W_o + E_{k(\text{max})}$ or/of $E = W_o + K_{(\text{max})}$ where/waar $E = hf$ and/en $W_o = hf_o$ and/en $E_{k(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$ or/of $K_{(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

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

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

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

ALTERNATING CURRENT/WISSELSTROOM

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