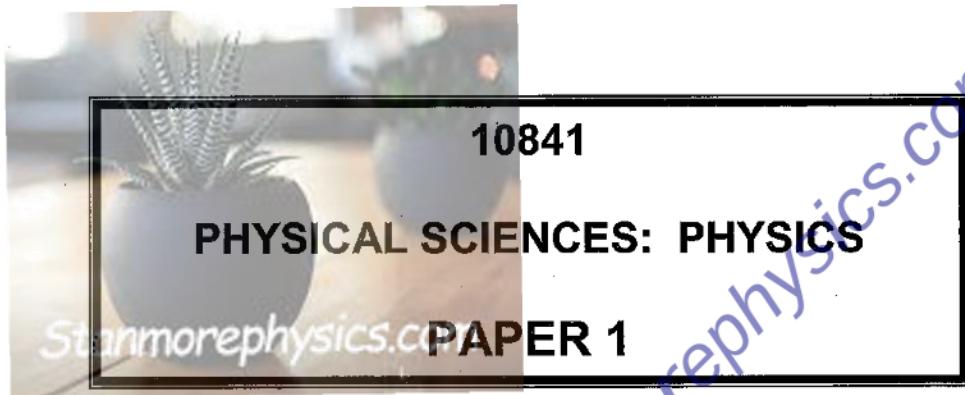




GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2021



TIME: 3 hours

MARKS: 150

14 pages + 3 data sheets

PHYSICAL SCIENCES: Paper 1



10841E

X10



INSTRUCTIONS AND INFORMATION

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

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Inertia is a property of an object whereby the object ...

- A needs a force to accelerate.
- B comes to rest when the force that has set it in motion is removed.
- C has kinetic energy.
- D is not able to move.

(2)

1.2 A box, mass m , rests on the floor of a lift which is accelerating upwards. The lift's acceleration is a and the acceleration due to gravity is g . The net force on the box is equal to:

- A ma
- B $-mg$
- C $ma + (-mg)$
- D $ma - (-mg)$

(2)

1.3 A learner drops an object from the 15th floor of a high building. One second later the learner drops another identical object from the same position. As both objects are in free fall, the distance between them will ...

- A increase.
- B decrease.
- C initially increase, then decrease.
- D remain the same.

(2)

1.4 A trolley with mass m , is moving with a constant horizontal velocity of v , on a frictionless track. A block with mass m , is dropped onto the trolley, from above. The final velocity of the trolley and block will be:

- A 0
- B v
- C $\frac{v}{2}$
- D $\frac{v}{4}$

(2)

- 1.5 An AC electric motor has a power rating of 1,2 kW. In ONE minute, the amount of work done by the motor (in Joule) is:

- A 1 200
 B 2 000
 C 72
 D 72 000

(2)

- 1.6 A car travels at a constant velocity towards a stationary listener. The car's hooter emits a sound of constant frequency as it approaches the listener.

Which ONE of the following statements regarding the frequency and the wavelength of the sound of the hooter, as observed by the listener, is CORRECT?

- A Both the frequency and the wavelength have decreased.
 B Both the frequency and the wavelength have increased.
 C The frequency has decreased while the wavelength has increased.
 D The frequency has increased while the wavelength has decreased.

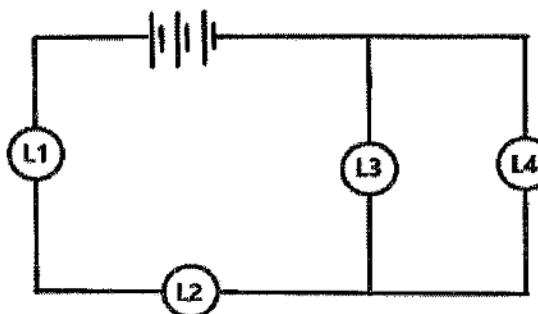
(2)

- 1.7 The number of excess electrons which will cause a charge of $-8\mu\text{C}$ on a sphere, is equal to:

- A 5×10^{-13}
 B 5×10^{13}
 C 5×10^{14}
 D 5×10^{-14}

(2)

- 1.8 Four identical light bulbs are connected as shown in the diagram below.



How does the brightness and potential difference of L4 compare with the brightness and potential difference of L1?

	BRIGHTNESS	POTENTIAL DIFFERENCE
A	LESS	LESS
B	LESS	THE SAME
C	THE SAME	LESS
D	THE SAME	THE SAME

(2)

1.9 Which ONE of the following devices cannot operate with both DC and AC currents?

- A Electric kettle
- B Transformer
- C 240 V Light bulb
- D Electric fan

(2)

1.10 In an experiment on the photoelectric effect, a scientist shines a green light on a metal surface and observes that electrons are ejected from the metal surface. Later the scientist shines a blue light, with the same intensity as the green light, on the same metal surface.

Which ONE of the statements below will be the CORRECT observation as a result of this change?

- A The number of ejected electrons per second will increase.
- B The number of ejected electrons per second will decrease.
- C The maximum kinetic energy of the ejected electrons will increase.
- D The speed of the ejected electrons will decrease.

(2)

[20]

QUESTION 2 (Start on a new page.)

An empty lift is supported by a steel cable. The lift moves upwards at a **constant speed** while an upward force of 2 500 N is applied by the cable. Ignore the mass of the cable and all frictional forces.

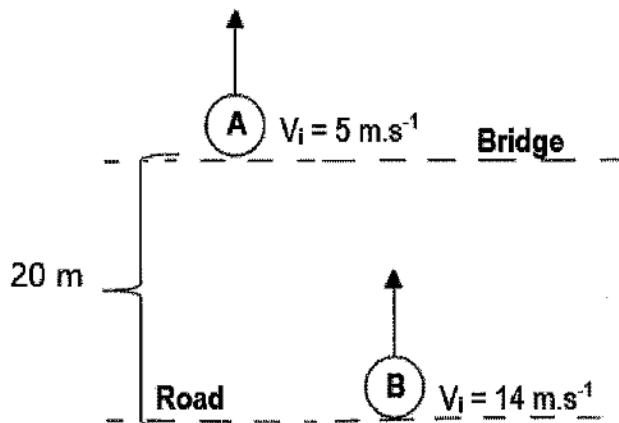
- 2.1 State *Newton's Second Law of motion* in words. (2)
- 2.2 Draw a labelled free-body diagram indicating all the forces acting on the lift while it is travelling upwards at this constant speed. (2)
- 2.3 Write down the magnitude of the acceleration of the lift as it moves upwards. (1)
- 2.4 Calculate the mass of the empty lift. (3)
- 2.5 When the 2 500 N force of the cable is replaced by a force of 3 000 N, the lift accelerates upwards. Calculate the magnitude of this acceleration. (4)
- 2.6 Identify the force that forms a Newton III force pair with the weight of the empty lift. (2)
[14]

QUESTION 3 (Start on a new page.)

A boy standing on a bridge projects a **ball A** vertically upwards with an initial velocity of $5 \text{ m}\cdot\text{s}^{-1}$. The height of the bridge is 20 m. Ignore air resistance.

- 3.1 Give the magnitude and direction of the acceleration of **ball A** as it leaves the boy's hand. (2)
- 3.2 Calculate the total time it will take **ball A** to reach the road. (4)

At the same instant that **ball A** is thrown upwards from the top of the bridge, another **ball B**, is projected up from the road. **Ball B** has an initial velocity of $14 \text{ m}\cdot\text{s}^{-1}$.



- 3.3 Calculate how far apart **ball A** and **ball B** will be after 1,2 s. (6)

Tennis **ball A** hits the road below, stays in contact with the road for 0,2 seconds before it bounces up with a velocity of $14 \text{ m}\cdot\text{s}^{-1}$.

- 3.4 Draw a velocity-time sketch graph for the motion of **ball A** from the time that it is projected up from the bridge until the time it rebounds to a maximum height.

Clearly indicate the following on your graph:

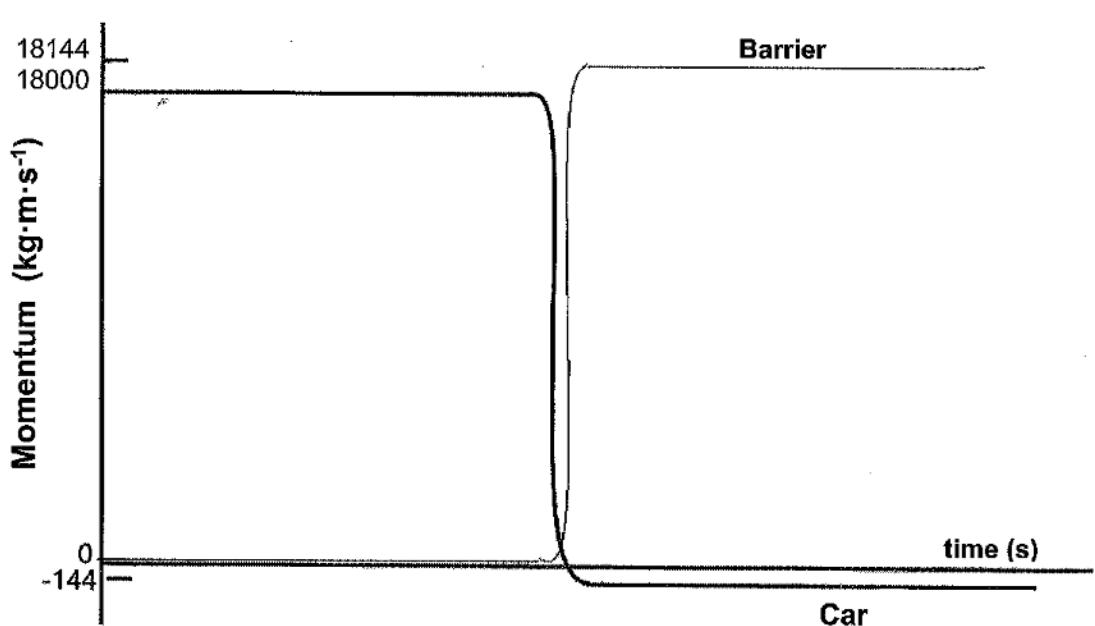
- 3.4.1 The initial velocity of the ball.
- 3.4.2 The time when the ball hits the road and is in contact with the road.
- 3.4.3 The velocity of the ball when it rebounds from the road. (4)

[16]

QUESTION 4 (Start on a new page.)

A car with a mass of 900 kg is moving east and collides with a free-standing barrier that has a mass of 3 200 kg.

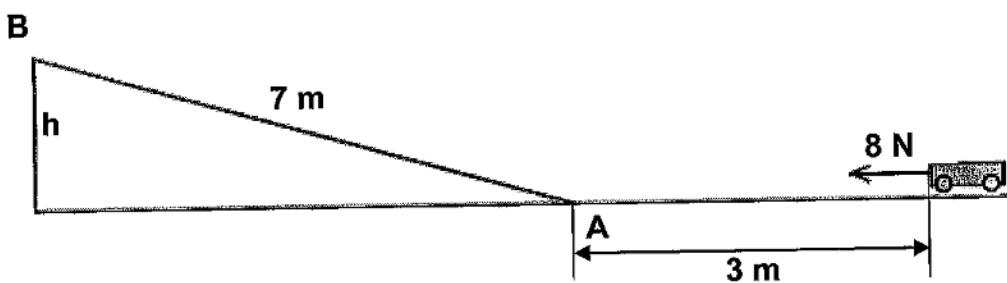
Study the following momentum-time graph of the car and the barrier below and answer the questions that follow.



- 4.1 State the *law of conservation of linear momentum* in words. (2)
- 4.2 Use the information given on the graph and calculate the:
 - 4.2.1 Final speed and direction of the car (4)
 - 4.2.2 Impulse on the car (4)
- 4.3 Is this collision elastic or inelastic?
Use calculations to verify your answer. (5)
[15]

QUESTION 5 (Start on a new page.)

A 2 kg trolley is at rest on a horizontal frictionless surface. A constant horizontal force of 8 N is then applied to the trolley over a distance of 3 m.



At point A, in the diagram above, the force is removed. The trolley moves a distance of 7 m up the incline until it reaches a maximum height at point B. The trolley experiences a constant frictional force of 1,5 N while moving up the incline.

- 5.1 Define a *non-conservative force*. (2)
 - 5.2 Draw a labelled free-body diagram indicating all the forces acting on the trolley as it moves along the horizontal surface. (3)
 - 5.3 State the *work energy theorem* in words. (2)
 - 5.4 Use energy principles to calculate the:
 - 5.4.1 Speed of the trolley when it reaches point A (4)
 - 5.4.2 Height, h , that the trolley reaches at point B (4)
- [15]

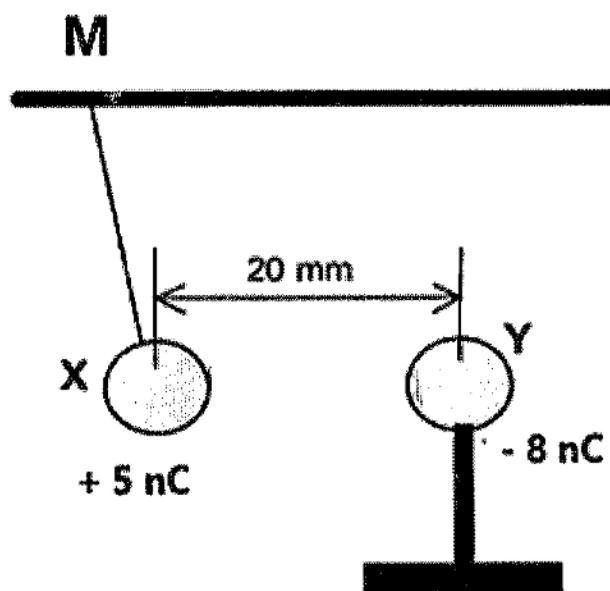
QUESTION 6 (Start on a new page.)

A group of Grade 12 learners stand outside a fire station when a fire engine races past them on a call. The siren of the fire engine emits a sound with a frequency of 250 Hz while moving at a speed of 20 m.s^{-1} past the learners with flashing red lights. The group of learners notice that the sound of the siren changes as the fire engine moves away from them. Take the speed of sound in air as 340 m.s^{-1} .

- 6.1 Name the phenomenon described in the underlined sentence above. (1)
- 6.2 How would each of the following change as the fire engine moves away from the learners? Write only GREATER THAN, LESS THAN or STAYS THE SAME.
- 6.2.1 Frequency observed by the learners (1)
- 6.2.2 The speed of the sound in air (1)
- 6.3 Calculate the apparent frequency of the sound from the siren observed by the learners when the fire engine moves away from the learners at a speed of 20 m.s^{-1} . (4)
- 6.4 Draw a diagram to show the advancing wavefronts that are produced by the sound as the fire engine moves away from the learners. Clearly indicate the learners' position and the direction of the fire engine's velocity in the diagram. (2)
- 6.5 There is a noticeable change in the frequency of the sound, but no noticeable change in the colour of the flashing red light as the fire engine races past the learners. Explain these observations. (3)
- [12]

QUESTION 7 (Start on a new page.)

A metal sphere X, with a charge of +5 nC is suspended by an inelastic thread of negligible mass which is tied to the ceiling at point M. Another metal sphere Y, on an insulated stand, has a charge of -8 nC and is brought closer to sphere X until their centres are 20 mm apart.

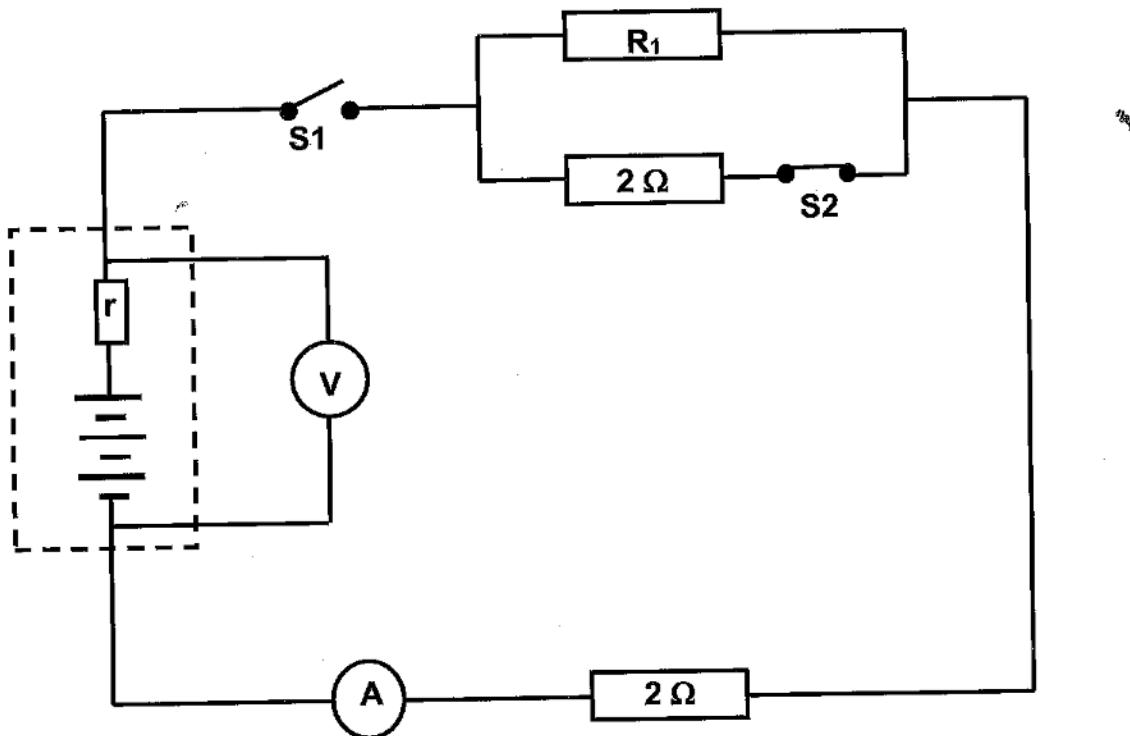


- 7.1 State Coulomb's Law in words. (2)
- 7.2 Calculate the magnitude of the electrostatic force that sphere Y exerts on sphere X. (4)
- 7.3 Draw the resultant electric field pattern produced by spheres X and Y. (3)
- 7.4 Sphere Y is now moved closer and makes contact with sphere X after which sphere X is repelled.
 - ❖ Calculate the new charge on sphere X. (3)

[12]

QUESTION 8 (Start on a new page.)

A battery with an emf of **8 V** and an internal resistance **r**, is connected in a circuit as shown below.

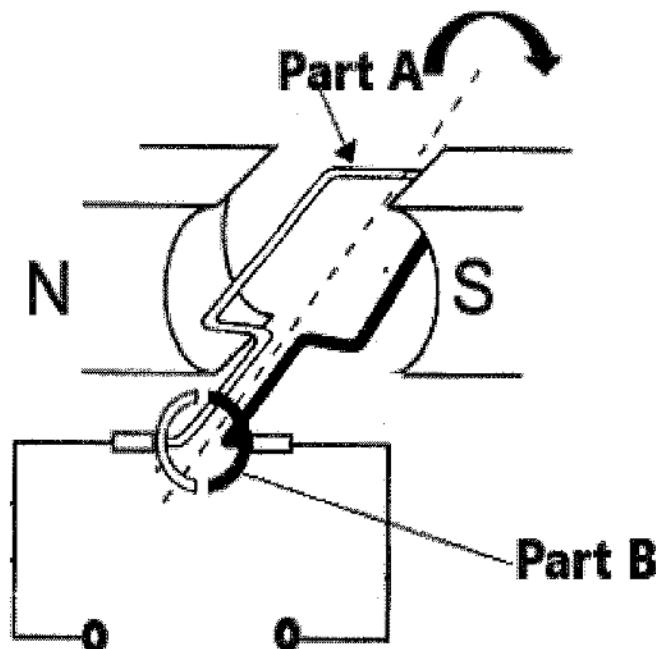


If switch **S₁** is closed, the reading on the voltmeter is **6,86 V** and on the ammeter is **2 A**.

- 8.1 Explain the meaning of an emf of **8 V**. (2)
 - 8.2 Calculate the internal resistance **r**, of the battery. (3)
 - 8.3 Calculate the value of the unknown resistor **R₁**. (5)
 - 8.4 Define the term *power*. (2)
 - 8.5 Switch **S₂** is now opened.
 - 8.5.1 What effect will the power dissipated by **R₁** have? Write down only INCREASE, DECREASE or REMAIN THE SAME. (1)
 - 8.5.2 Explain your answer to QUESTION 8.5.1. (3)
- [16]**

QUESTION 9 (Start on a new page.)

The diagram below shows a simple generator.



- 9.1 Is this an AC or a DC generator? (1)
- 9.2 Give a reason for your answer to QUESTION 9.1. (2)
- 9.3 Write the name of Part A. (1)
- 9.4 Describe the energy conversion that takes place in the generator. (2)
- 9.5 The maximum emf generated is 15 V. Draw a sketch graph of emf-versus-time for ONE and a HALF cycles for this generator. (3)
- 9.6 The specifications of a professional hairdryer are as follows:

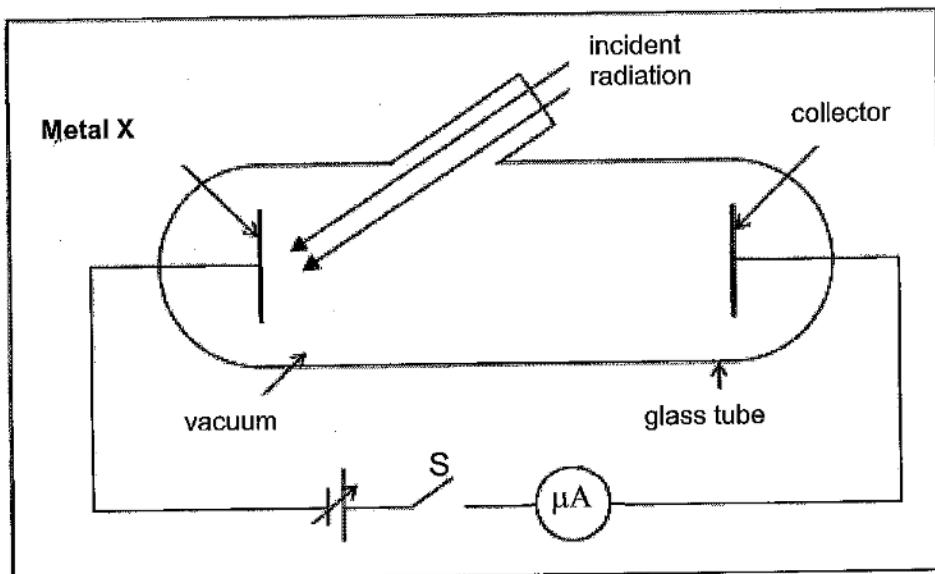
2 100 Watt, AC motor 240 V



- 9.6.1 Define *rms* for an *alternating voltage*. (2)
- 9.6.2 What is the rms voltage for this hairdryer? (2)
- 9.6.3 Calculate the maximum current that might flow through the hairdryer. (4)

QUESTION 10 (Start on a new page.)

The apparatus shown below allows for several variables in the investigation of the photoelectric effect. A learner sets up the apparatus and measures the maximum kinetic energy of photoelectrons emitted from the surface of metal X, using different frequencies of the incident radiation.



Metal	Work function (J)
Sodium	$3,65 \times 10^{-19}$
Magnesium	$5,92 \times 10^{-19}$
Aluminium	$6,53 \times 10^{-19}$
Zinc	$7,15 \times 10^{-19}$

- 10.1 Describe the term *photoelectric effect*. (2)
- 10.2 Light with different wavelengths is shone onto metal X and the kinetic energy is measured.
- 10.2.1 Name the independent, dependent and the controlled variables of this experiment. (3)
- 10.2.2 When ultraviolet light with a wavelength of 280 nm is shone onto metal X, the kinetic energy of the released electron is $5,74 \times 10^{-20}$ J. Identify metal X in the table given above. (5)
- 10.2.3 The maximum kinetic energy of the electrons ejected by this ultraviolet light is greater than the maximum kinetic energy of the electrons ejected by the bright blue light.
Explain why this is so. (3)
[13]

TOTAL: 150**END**

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>Universelle gravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Radius of the earth <i>Radius van die aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$
Mass of the earth <i>Massa van die aarde</i>	M_E	$5,98 \times 10^{24} \text{ kg}$
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 elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$

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

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or/of $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or/of $g = G \frac{M}{r^2}$

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

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

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1 Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

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

ALTERNATING CURRENT/WISSELSTROOM

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



**GAUTENG DEPARTMENT OF EDUCATION/
GAUTENGSE DEPARTEMENT VAN
ONDERWYS**

**PREPARATORY EXAMINATION/
VOORBEREIDENDE EKSAMEN**

2021

**MARKING GUIDELINES/
NASIENRIGLYNE**

10841

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

**PAPER 1/
VRAESTEL 1**

QUESTION/VRAAG 1

- | | | | |
|------|---|----|-----|
| 1.1 | D | ✓✓ | (2) |
| 1.2 | C | ✓✓ | (2) |
| 1.3 | A | ✓✓ | (2) |
| 1.4 | C | ✓✓ | (2) |
| 1.5 | D | ✓✓ | (2) |
| 1.6 | D | ✓✓ | (2) |
| 1.7 | B | ✓✓ | (2) |
| 1.8 | A | ✓✓ | (2) |
| 1.9 | B | ✓✓ | (2) |
| 1.10 | C | ✓✓ | (2) |
- [20]**

QUESTION/VRAAG 2

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp versnel in die rigting van die krag teen 'n versnelling wat direk eweredig is aan die krag ✓ en omgekeerd eweredig is aan die massa van die voorwerp. ✓

OR/OF

The net/resultant force is directly proportional to the rate of change in momentum and the change in momentum is in the direction of the force.✓✓

Die netto/resultante krag is direk eweredig aan die tempo van verandering in momentum en die verandering in momentum is in die rigting van die krag.✓✓

(2)

Marking criteria/Nasienglyne:

If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase.

Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per woord/frase.

2.2

**Marking criteria/Nasienglyne:**

- Mark is awarded for label and arrow./Punt word gegee vir byskrif en pyl.
- Do not penalise for length of arrows./Moenie penaliseer vir pyl lengtes nie.
- Deduct 1 mark for any additional force./Trek 1 punt af vir enige ekstra kragte.
- If all forces are correctly drawn and labelled but no arrows, -1 mark./Indien alle kragte korrek geteken en benoem is maar geen pyle nie, -1 punt.
- If forces are not making contact with the dot, -1 mark./Indien kragte nie kontak maak met die kol nie, -1 punt.

2.3 $0 \text{ m}\cdot\text{s}^{-2}$ ✓ (1)

2.4 $F_g = mg$ ✓
 $2500\checkmark = m(9,8)$
 $m = 255,10 \text{ kg}\checkmark$ (3)

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>2.5 $F_{\text{net}} = ma$ ✓ $T + F_g = ma$ $T - F_g = ma$ $3\ 000 - 2\ 500 \checkmark = 255,10a$ ✓ $500 = 255,10a$ $a = 1,96 \text{ m}\cdot\text{s}^{-2}$ ✓</p>	<ul style="list-style-type: none"> ✓ Formula ($F_{\text{net}} = mx a$)/Formule ✓ substitution/vervanging (3 000-2 500) ✓ substitution/vervanging (255,10) ✓ answer with unit/antwoord met eenheid (4)
<p>2.6 The force of <u>the empty lift on earth.</u> ✓✓ / Die krag van die <u>leë hysbak op die aarde.</u> ✓✓</p>	(2) [14]

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne	
QUESTION/VRAAG 3:		
3.1 9,8 m.s ⁻² downwards/afwaarts ✓✓		(2)
<p>3.2 Up is positive/Opwaarts is positief</p> <p>OPTION/OPSIE 1:</p> $y = v_i t + \frac{1}{2} g t^2 \checkmark$ $-20 \checkmark = +5 t + \frac{1}{2} (-9,8)t^2 \checkmark$ $= -4,9 t^2 + 5t + 20$ $\underline{-b \pm \sqrt{b^2 - 4ac}}$ $2a$ $t = -1,57 \text{ s not applicable/nie van toepassing nie}$ $t = 2,59 \text{ s} \checkmark$ <p>OR/OF</p>	<p>OPTION/OPSIE 1:</p> <ul style="list-style-type: none"> ✓ Formula/formule ✓ Substitution v_i and g with opposite signs./Vervanging van v_i en g met teenoorgestelde tekens. ✓ Substitution: y and g same signs/ Vervanging: y en g dieselfde tekens ✓ Answer/Antwoord 2,59 s 	
<p>OPTION/OPSIE 2:</p> <p>Time up/Tyd opwaarts:</p> $v_f = v_i + at$ $0 = +5 + (-9,8) \times t$ $t = 0,51 \text{ s}$ <p>height above bridge/hoogte bo brug:</p> $y = v_i t + \frac{1}{2} g t^2$ $= (+5 \times 0,51) + \frac{1}{2} \times (-9,8) \times (0,51)^2$ $= 1,2755 \text{ m} \therefore \text{total height/totale hoogte} = 21,276 \text{ m}$ <p>Time down/Tyd afwaarts:</p> $y = v_i t + \frac{1}{2} g t^2$ $-21,276 = 0 + (-9,8) t^2$ $t = 2,0837 \text{ s}$ <p>TOTAL TIME/TOTALE TYD = $2,0837 + 0,51 = 2,59 \text{ s}$</p> <p>OR/OF</p>	<p>OPTION/OPSIE 2:</p> <ul style="list-style-type: none"> ✓ Both Formulae/Beide Formules ($v_f = v_i + at$ and/en $y = v_i t + \frac{1}{2} g t^2$) ✓ Substitution v_i and g with opposite signs/Vervanging v_i en g met teenoorgestelde tekens. ✓ Substitution: y and g same signs/ Vervanging: y en g dieselfde tekens ✓ Answer/Antwoord 2,59 s 	

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>OPTION/OPSIE 3:</p> <p>Time up/Tyd opwaarts:</p> $v_f = v_i + at$ $0 = +5 + (-9,8) \times t$ $t = 0,51 \text{ s}$ <p>FINAL VELOCITY/FINALE SNELHEID:</p> $v_f^2 = v_i^2 + 2ay$ $+ 5^2 + 2 \times (-9,8)(-20)$ $v_f = 20,42 \text{ m.s}^{-1}$ <p>Time down/Tyd afwaarts:</p> $v_f = v_i + at$ $20,42 = 0 + (-9,8) \times t$ $t = 2,08 \text{ s}$ <p>TOTAL TIME/TOTALE TYD = $2,08 + 0,51 = 2,59 \text{ s}$</p> <p>OR/OF</p> <p>OPTION/OPSIE 4:</p> <p>FINAL VELOCITY/FINALE SNELHEID:</p> $v_f^2 = v_i^2 + 2ay$ $= +5^2 + 2 \times (-9,8)(-20)$ $v_f = 20,42 \text{ m.s}^{-1}$	<p>OPTION/OPSIE 3 and/en 4:</p> <ul style="list-style-type: none"> ✓ Both Formulae/Beide Formules $(v_f = v_i + at \text{ and/en } v_f^2 = v_i^2 + 2ay)$ ✓ Substitution v_i and g with opposite signs/Vervanging v_i en g met teenoorgestelde tekens ✓ Substitution: y and g same signs/Vervanging: y en g dieselfde tekens ✓ Answer/Antwoord 2,59 s <p>DOWN IS POSITIVE/AF IS POSITIEF</p> <p>OPTION/OPSIE 1:</p> <p>Down is positive/Af is positief</p> $y = v_i t + \frac{1}{2} a t^2$ $20 = -5t + \frac{1}{2} (9,8)t^2$ $0 = 4,9t^2 - 5t - 20$ $t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= 2,593 \text{ s or } 1,573 \text{ s}$ <p>OPTION/OPSIE 2:</p> <p>Time up/Tyd opwaarts</p> $v_f = v_i + at$ $0 = -5 + (9,8) \times t$ $t = 0,51 \text{ s}$ <p>height above bridge/hoogte bo brug</p> $y = v_i t + \frac{1}{2} a t^2$ $= -5 \times 0,51 + \frac{1}{2} \times 9,8 \times (0,51)^2$ $= -1,2755 \text{ m}$ <p>Therefore total height/Daarom totale hoogte = 21,276 m</p> <p>Time down/Tyd afwaarts</p> $y = v_i t + \frac{1}{2} a t^2$ $21,276 = 0 + 9,8 \times t^2$ $t = 2,0837 \text{ s}$ <p>Total time/Totale tyd</p> $= 2,0837 + 0,51 = 2,59 \text{ s}$

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>TOTAL TIME/TOTALE TYD:</p> $v_f = v_i + at$ $-20,42 = +5 + (-9,8) \times t$ $t = 2,59 \text{ s}$	<p>OPTION/OPSIE 3:</p> <p>Time up/Tyd opwaarts</p> $v_f = v_i + at$ $0 = -5 + (9,8) \times t$ $t = 0,51 \text{ s}$ <p>FINAL VELOCITY/FINALE SNELHEID</p> $v_f^2 = v_i^2 + 2ay$ $= (-5)^2 + 2 \times 9,8 \times 20$ $= 20,42 \text{ m} \cdot \text{s}^{-1}$
	<p>Time down/Tyd afwaarts:</p> $v_f = v_i + at$ $20,42 = 0 + 9,8 \times t$ $t = 2,08 \text{ s}$ <p>Total time/Totale tyd =</p> $2,08 + 0,51 = 2,59 \text{ s}$ <p>OR/OF</p> <p>OPTION/OPSIE 4:</p> $v_f^2 = v_i^2 + 2ay$ $= (-5)^2 + 2 \times 9,8 \times 20$ $= 20,42 \text{ m} \cdot \text{s}^{-1}$ <p>TOTAL TIME/TOTALE TYD</p> $v_f = v_i + at$ $20,42 = -5 + 9,8 \times t$ $T = 2,59 \text{ s}$ (4)

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>3.3 UP IS POSITIVE/Op is positief</p> <p>DISPLACEMENT OF BALL A/ VERPLASING VAN BAL A:</p> $y = v_i t + \frac{1}{2} g t^2 \quad \checkmark$ $= (+5 \times 1,2) + (\frac{1}{2} \times (-9,8) \times (1,2)^2) \quad \checkmark$ $= -1,056 \text{ m}$ $\therefore \text{it is } 1,056 \text{ m below the bridge/}$ $\therefore \text{dit is } 1,056 \text{ m onder die brug}$ <p>DISPLACEMENT OF BALL B/ VERPLASING VAN BAL B:</p> $y = v_i t + \frac{1}{2} g t^2$ $= (+14 \times 1,2) + (\frac{1}{2} \times (-9,8) \times (1,2)^2) \quad \checkmark$ $= 9,74 \text{ m} \quad \checkmark \text{ upwards from ground/}$ $\text{opwaarts vanaf die grond}$ <p>distance apart/afstand apart $= 20 - 1,056 - 9,74 \quad \checkmark$ $= 9,20 \text{ m apart.} \quad \checkmark$</p>	<ul style="list-style-type: none"> ✓ Formula (only once)/formule (slegs een keer) ✓ Substitution v_i and g with opposite signs/Vervanging v_i en g met teenoorgestelde tekens ✓ Substitution: v_i and g same signs (Second equation)/Vervanging: v_i en g dieselfde tekens (tweede vergelyking) ✓ Displacement of B/Verplasing van B = 9,74 m ✓ Subtraction of displacement of A and B/Aftrekking van verplasing van A en B ✓ Answer/Antwoord = 9,20 m <p>DOWN is POSITIVE/AF is POSITIEF</p> <p>DISPLACEMENT OF BALL A/ VERPLASING VAN BAL A:</p> $y = v_i t + \frac{1}{2} g t^2 \quad \checkmark$ $= (-5 \times 1,2) + (\frac{1}{2} \times 9,8) \times (1,2)^2 \quad \checkmark$ $= 1,056 \text{ m}$ $\therefore \text{it is } 1,056 \text{ m below the bridge/}$ $\therefore \text{dit is } 1,056 \text{ m onder die brug}$ <p>DISPLACEMENT OF BALL B/ VERPLASING VAN BAL B:</p> $y = v_i t + \frac{1}{2} g t^2 = (-14 \times 1,2) + (\frac{1}{2} \times 9,8) \times (1,2)^2 \quad \checkmark$ $= -9,74 \text{ m} \quad \checkmark \text{ upwards from ground/}$ $\text{opwaarts vanaf die grond}$ <p>distance apart/afstand van mekaar af $= 20 - 1,056 - 9,74 \quad \checkmark$ $= 9,20 \text{ m apart.} \quad \checkmark$</p>

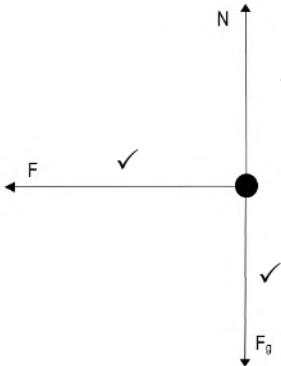
(6)

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>3.4 For up positive/Vir opwaarts positief</p> <p>Velocity vs Time of ball A/ Snelheid teen Tyd van bal A ✓</p> <p>For down positive/Vir afwaarts positief</p> <p>Velocity vs Time of ball A/ Snelheid teen Tyd van bal A ✓</p>	<ul style="list-style-type: none"> ✓ Heading on axis/Asse benoem ✓ The initial velocity of the ball/Die aanvanklik snelheid van die bal ✓ The time when the ball hits the ground and is in contact with the ground/Die tyd wanneer die bal die grond tref en in kontak is met die grond ✓ 18,2 the velocity of the ball when it rebounds from the ground/18,2 die snelheid van die bal wanneer dit weer terugbonds van die grond af
	(4)
	[16]
<p>QUESTION/VRAAG 4</p> <p>4.1 The <u>total linear momentum</u> of a <u>closed/isolated system</u> remains <u>constant</u> (is conserved). ✓✓</p> <p>Die <u>totale lineêre momentum</u> in 'n <u>geslote/geïsolleerde sisteem</u> bly <u>konstant</u> (is behou). ✓✓</p>	<p>If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase./ Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per woord/frase.</p>
	(2)
<p>4.2.1 $p = m \times v_f$ ✓</p> <p>$-144 = 900 \times v_f$ ✓</p> <p>$v_f = 0,160 \text{ m.s}^{-1}$ ✓ West/left/Wes /links✓</p>	<ul style="list-style-type: none"> ✓ Formula/Formule ✓ Substitution/Vervanging ✓ Answer with units/Antwoord met eenhede ✓ Direction – West/left/Rigting – Wes/links
	(4)

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>4.2.2 OPTION/OPSIE 1:</p> $\begin{aligned}\Delta p &= p_f - p_i \checkmark \\ &= -144 - (18\ 000) \checkmark \\ &= -18\ 144 \text{ kg.m.s}^{-1} \\ &= 18\ 144 \text{ N.s} \checkmark \text{West/towards the car/Wes/in die rigting van die motor} \checkmark\end{aligned}$ <p>OR/OF</p> <p>OPTION/OPSIE 2:</p> $\begin{aligned}\Delta p &= p_f - p_i \\ &= 18144 - 0 \\ &= 18\ 144 \text{ kg.m.s}^{-1} \\ &= 18\ 144 \text{ N.s} \text{ West/towards the car/Wes/in die rigting van die motor}\end{aligned}$ <p>OR/OF</p> <p>OPTION/OPSIE 3:</p> $\begin{aligned}\Delta p &= mv_f - mv_i \checkmark \\ &= (900 \times (-0,16)) - (900 \times 20) \checkmark \\ &= -18\ 144 \text{ kg.m.s}^{-1} \\ &= 18\ 144 \text{ N.s} \checkmark \text{West/towards the car/Wes/in die rigting van die motor} \checkmark\end{aligned}$ <p>OR/OF</p> <p>OPTION/OPSIE 4:</p> $\begin{aligned}\Delta p &= mv_f - mv_i \checkmark \\ &= (3\ 200 \times (5,67)) - 0 \checkmark \\ &= -18\ 144 \text{ kg.m.s}^{-1} \\ &= 18\ 144 \text{ N.s} \checkmark \text{West/towards the car/Wes/in die rigting van die motor} \checkmark\end{aligned}$	<ul style="list-style-type: none"> ✓ Formula/Formule ✓ Substitution/Vervanging ✓ Answer must be positive/ Antwoord moet positief wees ✓ The direction of the impulse (West/towards the car)/Die rigting van die impuls (Wes/in die rigting van die motor)

(4)

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>4.3 $\sum E_k_i = E_{k_i} \text{ car} + E_{k_i} \text{ barrier/versperring}$</p> $= \frac{1}{2} m v_i^2 + \frac{1}{2} m v_i^2 \quad \checkmark \text{ any one/ enige een}$ $= \frac{1}{2} \times 900 \times 20^2 + 0 \quad \checkmark$ $= 180\ 000 \text{ J}$ $\sum E_{k_f} = E_{k_f} \text{ car/motor} + E_{k_f} \text{ barrier/versperring}$ $= \frac{1}{2} m v_f^2 + \frac{1}{2} m v_f^2$ $= \frac{1}{2} \times 900 \times 0,16^2 \quad \checkmark + \frac{1}{2} 3200 \times 5,67^2 \quad \checkmark$ $= 11,52 + 51438,24$ $= 51449,76 \text{ J}$ <p>$\therefore \sum E_{k_i} \neq \sum E_{k_f}$ inelastic collision/onelastiese botsing. \checkmark</p>	<ul style="list-style-type: none"> ✓ Formula/Formule ✓ Substitution - initial/Vervanging - aanvanklik ✓✓ Substitution/Vervanging ✓ $\sum E_{k_i} \neq \sum E_{k_f}$ <p>NOTE: Final mark can only be given if rest of the question was answered correctly./ Finale punt kan net toegeken word as die res van die vraag korrek beantwoord is.</p> <p>(5)</p>

ANSWER/ANTWOORD	Marking Guidelines/Nasienriglyne
<p>QUESTION/VRAAG 5:</p> <p>5.1 It is a force for which the work done in moving an object between two points depends on the path taken. ✓✓ <i>'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete of padlengte wat gevolg word.</i> ✓✓</p>	<p>If the words work done is not in the definition, then zero marks./<i>Indien die woorde arbeid verrig nie in die definisie is nie, dan geen punte nie.</i></p> <p style="text-align: right;">(2)</p>
<p>5.2</p> 	<p>✓ N/ F_N ✓ F/ $F_{\text{Applied/toegepas}}$ ✓ F_g/W</p> <p>NOTES</p> <ul style="list-style-type: none"> • Mark is awarded for a label and arrow./<i>Punt toegeken vir byskrif en pyltjies.</i> • Do not penalise for length of arrows./<i>Moenie penaliseer vir lengte van pyle nie.</i> • Any additional force -1/<i>Enige addisionele krag -1</i> • Lines that do not make contact with the body -1/<i>Lyne wat nie kontak maak met kol nie -1</i> • Do not accept force diagram./<i>Moenie kragtediagram aanvaar nie.</i> <p style="text-align: right;">(3)</p>

- 5.3 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓

Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. ✓✓

OR/OF

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

Die arbeid verrig op 'n voorwerp deur 'n resultante/netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. ✓✓

(2)

Marking criteria/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per woord/frase.

- 5.4.1

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

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$(8)(3)\cos 0 \checkmark = \frac{1}{2} (2) v_f^2 - 0 \checkmark$$

$$24 = v_f^2$$

$$v_f = 4,90 \text{ m.s}^{-1} \checkmark$$

- ✓ Formula/Formule (W_{net})
- ✓ Substitution/Vervanging (W_{net})
- ✓ Substitution/Vervanging (ΔE_K)
- ✓ Answer (in m.s^{-1})/Antwoord (in m.s^{-1})

(4)

**Marking
Guidelines/
Nasiennriglyne**

5.4.2 $W_{nc} = \Delta E_P + \Delta E_K \checkmark$

$$W_{friction/wrywing} = \Delta E_P + \Delta E_K$$

$$f\Delta x \cos \theta = (mgh_f - mgh_i) + (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2)$$

$$(1,5)(7)\cos 180^\circ \checkmark = [(2)(9,8)h - 0] + [0 - \frac{1}{2}(2)(4,9)^2] \checkmark$$

$$-10,5 = 19,6h - 24$$

$$13,5 = 19,6h$$

$$h = 0,69 \text{ m.} \checkmark$$

OR/OF

$$W_f = f x \cos \theta$$

$$= 1,5(7)\cos 180^\circ$$

$$= -10,5 \text{ J}$$

- ✓ Formula/
Formule (W_f)
- ✓ Substitution/
Vervanging (W_f)
- ✓ Substitution/
Vervanging
(ΔE_k and/en
 ΔE_p)
- ✓ Answer with
unit/
Antwoord met
eenheid
(0,6892m) (4)

$$\begin{aligned}\Delta E_k &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= 0 - \frac{1}{2}(2)4,90^2 \\ &= -24,01 \text{ J}\end{aligned}$$

$$\begin{aligned}\Delta E_p &= mgh_f - mgh_i \\ &= 2(9,8)h - 0 \\ &= 19,6 h\end{aligned}$$

$$W_f = \Delta E_k + \Delta E_p \checkmark$$

$$-10,5 \checkmark = -24,01 + 19,6 h \checkmark$$

$$h = 0,69 \text{ m.} \checkmark$$

[15]

QUESTION/VRAAG 6

6.1 Doppler effect ✓ /Doppler effek (1)

6.2.1 LESS THAN ✓ /MINDER AS (1)

6.2.2 STAYS THE SAME ✓ /BLY DIESELFDE (1)

Marking Guidelines/Nasienriglyne

6.3
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

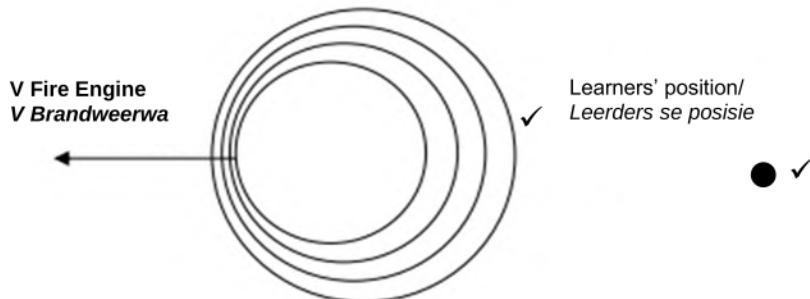
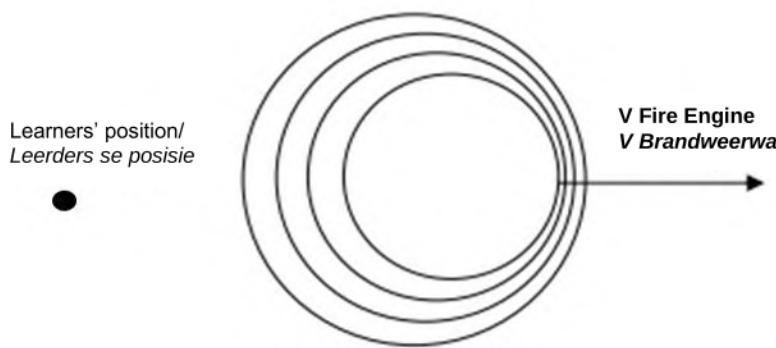
$$= \frac{340-0}{340+20} \checkmark 250 \checkmark$$

$$f_L = 236,11 \text{ Hz} \checkmark$$

- ✓ Doppler Formula/Doppler Formule
- ✓ Substitution (velocities)/
Vervanging (snelhede)
- ✓ Substitution (f_s)/Vervanging (f_s)
- ✓ Answer with units/Antwoord met eenhede

(4)

6.4

**OR/OF**

(2)

Marking guidelines/Nasienriglyne:

Shape correct: Compressed to fire engine movement, rarefaction on the side of the learners' position. Direction of fire engine's velocity ✓
Learners' position on the opposite side of the fire engine's velocity. ✓

Korrekte vorm: Saamgedruk na die die brandweerwa se beweging,
verdunning aan die kant van die leerders se posisie. Rigting van die
brandweerwa se snelheid. ✓

Leerders se posisie aan die teenoorgestelde kant van die brandweerwa se
snelheid. ✓

- 6.5 Speed of sound in air is less than speed of light. ✓ The velocity of the fire engine produces a noticeable Doppler shift in the frequency of the sound but is of no consequence when compared with the speed of light. ✓✓

Spoed van klank in lug is minder as die spoed van lig. ✓ Die snelheid van die brandweerwa produseer 'n waarneembare Doppler verskuiwing in die frekwensie van die klank, maar het geen effek wanneer dit vergelyk word met die spoed van lig nie. ✓✓

OR/OF

Speed of sound in air is comparable with the speed of the fire engine ✓ hence the noticeable difference in frequency ✓ whilst the speed of light is too high compared to the speed of the fire engine. ✓

Spoed van klank in lug is vergelykbaar met die spoed van die brandweerwa ✓ daarom die merkbare verandering in verskillende frekwensies ✓ terwyl die spoed van lig te hoog is in vergelyking met die spoed van die brandweerwa. ✓

(3)

Marking criteria/Nasienriglyne:

- ✓ Comparison between the speed of the ambulance and the speed of sound that are closely related to each other./Vergelyking tussen die spoed van die ambulans en die spoed van klank wat naby aan mekaar verwant is.
- ✓ The speed of light is too high in relation to speed of the ambulance./Die spoed van lig is te hoog in verhouding tot die spoed van die ambulans.
- ✓ Hence the change in frequency of sound will be noticeable./Daarom sal die verandering in frekwensie van klank waarneembaar wees.

[12]

QUESTION/VRAAG 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. ✓

Die grootte van die elektrostatisiese krag uitgeoefen deur een puntlading (Q_1) op 'n ander puntlading (Q_2) is direk eweredig aan die produk van die grootte van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. ✓

(2)

Marking guidelines/Nasienriglyne:

When giving the definition with mass instead of charge, zero out of 2.

Any missing key phrases, one out of 2.

Indien die definisie gegee word met massa in plaas van lading, nul uit 2.

Enige kernwoorde of frases uitgelaat, slegs een uit 2.

Marking Guidelines/ Nasienriglyne

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

$$F = \frac{9 \times 10^9 (5 \times 10^{-9})(8 \times 10^{-9})}{(2 \times 10^{-2})^2} \checkmark$$

$$F = 9 \times 10^{-4} \text{ N} \checkmark$$

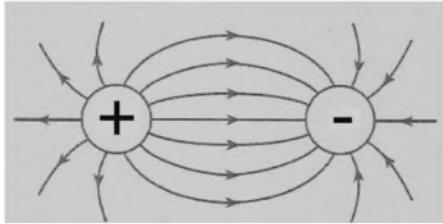
✓ Formula/Formule

✓✓ Substitution (top and bottom)/
Vervanging (bo en onder)

✓ Answer/Antwoord

(4)

7.3



Lines do not cross/ Lyne kruis nie	✓
Correct shape/ Korrekte vorm	✓
Arrow direction indicated correctly/Pyl rigtings korrek aangedui	✓

(3)

7.4 $Q_{\text{new}/\text{nuut}} = \frac{Q_X + Q_Y}{2} \checkmark$

$$= \frac{(+5 \times 10^{-9}) + (-8 \times 10^{-9})}{2} \checkmark$$

$$= -1,5 \times 10^{-9} \text{ C on each/op elk} \checkmark$$

(3)
[12]

QUESTION/VRAAG 8

- 8.1 8 J of energy could be delivered per coulomb of charge travelling in the circuit. ✓✓

8 J energie word gelewer per coulomb lading wat deur die stroombaan beweeg. ✓✓

OR/OF

The battery supplies 8 J of energy per coulomb of charge. ✓✓

Die battery verskaf 8 J energie per coulomb lading. ✓✓

OR/OF

The maximum work done by the battery per unit charge is 8 J. ✓✓

Die maksimum arbeid verrig deur die battery per eenheid lading is 8 J. ✓✓

OR/OF

The total amount of electrical energy supplied by the battery per coulomb/unit of charge is 8 J. ✓✓

Die totale hoeveelheid elektriese energie verskaf deur die battery per coulomb/eenheid lading is 8 J. ✓✓

(2)

Marking criteria/Nasienriglyne:

If any of the underlined key words/phrases in the correct context is omitted, deduct one mark.

Indien enige van die onderstreepte kernwoorde/frases in die korrekte konteks uitgelaat is, word een punt afgetrek.

Marking Guidelines/Nasienriglyne

- 8.2 $\text{emf} = I(R + r)$ ✓ or/of
 $\text{emf} = IR + Ir$
 $= \frac{8 - 6,86}{2}$ ✓
 $= 0,57 \Omega$ ✓

- ✓ Formula/Formule
- ✓ Substitution/Vervanging
- ✓ Answer/Antwoord

$$= 0,57 \Omega$$

(3)

8.3 OPTION/OPSIE 1:

$$V = I \times R$$

$$R_T = \frac{6,86}{2} \checkmark$$

$$= 3,34 \Omega \checkmark$$

$$R_T = R_s + R_p$$

$$\therefore R_p = R_T - R_s$$

$$= 3,34 - 2$$

$$= 1,43 \Omega \checkmark$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{1,43} = \frac{1}{R_1} + \frac{1}{2} \checkmark$$

$$R_1 = \frac{286}{57}$$

$$= 5,02 \Omega \checkmark$$

- ✓ Substitution/Vervanging (A and/en V)
- ✓ Answer/Antwoord (= 3,34 Ω)
- ✓ Finding/Bevinding R_p
- ✓ Formula/Formule R_p
- ✓ Substitution/Vervanging
- ✓ Answer/Antwoord $R_1 = 5,02\Omega$
- Accept/Aanvaar 5,00 Ω

OPTION/OPSIE 2:

$$\epsilon = I (R_T + r)$$

$$8 = 2 (R_T + 0,57) \checkmark$$

$$R_T = \frac{8-1,14}{2} \checkmark$$

$$= 3,34 \Omega \checkmark$$

$$R_T = R_s + R_p$$

$$\therefore R_p = R_T - R_s$$

$$= 3,34 - 2$$

$$= 1,43 \Omega \checkmark$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{1,43} = \frac{1}{R_1} + \frac{1}{2} \checkmark$$

$$R_1 = \frac{286}{57}$$

$$= 5,02 \Omega \checkmark$$

OPTION/OPSIE 3:

At/By 2Ω series resistor, $V_{2\Omega} = IR_{2\Omega} = 2 \times 2 = 4V$

Across parallel network/Oor parallele netwerk, $V_{//} = 6,86 - 4 = 2,86 V$

Current through 2Ω resistor at // network/Lading deur 2Ω resistor by // netwerk

$$I_{2\Omega} = \frac{V}{R} = \frac{2,86}{2} = 1,43A$$

$$\begin{aligned} I_{R_1} &= I_{\text{series}} - I_{2\Omega} \\ &= 2 - 1,43 \\ &= 0,57 A \end{aligned}$$

$$R_1 = \frac{V}{I} = \frac{2,86}{0,57} = 5,02 \Omega$$

(5)

- 8.4 The rate at which work is done/the rate at which the energy is transferred. ✓✓

Die tempo waarteen arbeid verrig word/die tempo waarteen energie oorgedra word. ✓✓

OR/OF

The amount of work done in a certain time. ✓✓

Die hoeveelheid arbeid verrig binne 'n sekere tyd. ✓✓

OR/OF

The energy used in a specific time. ✓✓

Die energie gebruik binne 'n spesifieke tyd. ✓✓

OR/OF

The amount of energy used in one second. ✓✓

Die hoeveelheid energie gebruik binne een sekonde. ✓✓

(2)

- 8.5.1 INCREASE ✓/VERMEERDER

(1)

- 8.5.2 The resistance will increase, ✓ Potential difference across R_1 will increase✓ and V^2 is directly proportional to P ✓ thus the power will increase as

$$P = \frac{V^2}{R}.$$

Die weerstand sal verhoog. ✓ Potensiaalverskil oor R_1 sal verhoog ✓ en V^2 is direk eweredig aan P ✓ daarom sal die drywing verhoog as $P = \frac{V^2}{R}$.

OR/OF

The resistance will increase, ✓ current will decrease ✓ thus the square of the current multiplied by the increase in resistance is directly proportional to the power thus power will increase. $P = I^2 R$ ✓

Die weerstand sal vermeerder, ✓ stroom sal verminder ✓ en dus sal die kwadraat van die stroom vermenigvuldig met die toename in weerstand direk eweredig wees aan die drywing dus sal drywing verhoog. $P = I^2 R$ ✓

(3)

Marking guidelines/Nasiengriglyne:

- ✓ resistance increases/weerstand verhoog
- ✓ potential difference increases/potensiaalverskil verhoog
- ✓ relationship between the potential difference and power/verwantskap tussen die potensiaalverskil en die drywing

[16]

QUESTION/VRAAG 9

9.1 DC/GS (generator/generator) ✓

(1)

Marking criteria/Nasienriglyne:

Generator is optional. (specified in the question)

Generator is opsioneel. (reeds genoem in vraag)

9.2 split ring or commutator ✓✓

splitring of kommutator

(2)

Marking criteria/Nasienriglyne:

Accept "Part B" for ONLY 1 mark

Aanvaar "Deel B" vir SLEGS 1 punt.

9.3 Coil/armature/spoel/anker ✓

(1)

9.4 Mechanical energy to Electrical energy✓✓

Meganiese energie na Elektriese energie ✓✓

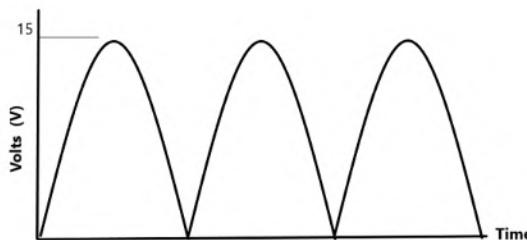
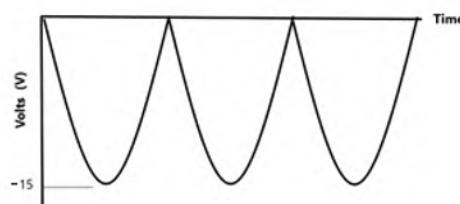
(2)

Marking guidelines/Nasienriglyne:

2 or 0. Not one mark if only one energy given.

2 of 0. Geen punte indien slegs een energie gegee is nie.

9.5

**OR/OF**

- ✓ 15 Volt as max/Volt as maks.
- ✓ 3 loops/hoops/lusse/hoepels
- ✓ All the same height/Almal dieselfde hoogte

(3)

- 9.6.1 The DC potential difference/current which dissipates the same amount of energy as AC. ✓✓

Die GS potensiaalverskil/stroom wat dieselfde hoeveelheid energie versprei as die WS. ✓✓

(2)

- 9.6.2 240 V ✓✓

(2)

Marking Guidelines/Nasienriglyne

- 9.6.3 **OPTION/OPSIE 1:**

$$P_{ave} = V_{rms} I_{rms}$$

$$2100 = 240 \times I_{rms} \checkmark$$

$$I_{rms} = 8,75A$$

$$I_{max} = I_{rms} \times \sqrt{2} \checkmark$$

$$= 8,75 \times \sqrt{2} \checkmark$$

$$= 12,37A \checkmark$$

- ✓ I_{max} formula (No subscripts no marks)/ I_{maks} formule (Geen onderskrifte geen punte)
 $I_{max/maks} = I_{rms/wgk} \times \sqrt{2}$
- ✓ Substitution that leads to finding/
Vervanging wat lei tot berekening van I_{wgk}
- ✓ Substitution into I_{max} formula using the value calculated in the first calculations/*Vervanging in I_{maks} formule en gebruik waarde uit eerste bewerking*.
- ✓ Final answer/*Finale antwoord*

OR/OF

OPTION/OPSIE 2:

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

$$2100 = 240 / R$$

$$R = 27,43 \Omega$$

$$\begin{aligned} I_{rms} &= \frac{V_{rms}}{R} \\ &= \frac{240}{27,43} \end{aligned}$$

$$I_{rms} = 8,75A$$

$$I_{max} = I_{rms} \times \sqrt{2} \checkmark$$

$$= 8,75 \times \sqrt{2}$$

$$= 12,37A \checkmark$$

OR/OF

OPTION/OPSIE 3:

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

$$2\ 100 = 240 / R$$

$$R = 27,43 \Omega$$

$$P_{ave} = I_{rms}^2 R$$

$$2\ 100 = I_{rms}^2 \times 27,43$$

$$I_{rms} = 8,75A$$

$$I_{max} = I_{rms} \times \sqrt{2} \quad \checkmark$$

$$= 8,75 \times \sqrt{2}$$

$$= 12,37A \quad \checkmark$$

(4)

[17]

QUESTION/VRAAG 10

- 10.1 The process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface. $\checkmark \checkmark$

Die proses waarby elektrone vrygestel word vanuit 'n metaal se oppervlakte wanneer lig van 'n geskikte frekwensie inval op die oppervlakte. $\checkmark \checkmark$

OR/OF

When electrons escape the surface of the metal by gaining energy when light of suitable frequency is incident on that surface. $\checkmark \checkmark$

Wanneer elektrone ontsnap uit die oppervlakte van die metaal deur energie by te kry wanneer lig van 'n geskikte frekwensie inval op die oppervlakte. $\checkmark \checkmark$

(2)

Marking criteria/Nasienriglyne:

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

Indien enige van die onderstreepte kernwoorde/frases in die korrekte konteks weggelaat word, trek een punt af.

- 10.2.1 Independent: The frequency/wavelength/colour of the incident light. \checkmark

Dependent: Kinetic energy of the electrons \checkmark

Controlled variable: Type of metal \checkmark

Onafhanklik: Die frekwensie/golflengte/kleur van die invallende lig \checkmark

Afhanklik: Kinetiese energie van die elektrone \checkmark

Gekontroleerde veranderlike: Tipe metaal \checkmark

(3)

10.2.2 $E = h \frac{c}{\lambda} = W_0 + E_k \checkmark$

$$6,63 \times 10^{-34} \times \frac{3 \times 10^8}{280 \times 10^{-9}} \checkmark = W_0 + 5,74 \times 10^{-20} \checkmark$$

Marking Guidelines/Nasienriglyne

$W_0 = 6,53 \times 10^{-19} \text{ J} \checkmark$

\therefore metal X is aluminium.✓/is metaal X aluminium.

OR/OF

$v = f \times \lambda \quad \text{OR/OF } (c = f \times \lambda)$

$$3 \times 10^8 = f \times 280 \times 10^{-9}$$

$$f = 1,07 \times 10^{15} \text{ Hz}$$

$E = hf = W_0 + E_k \checkmark$

$$6,63 \times 10^{-34} \times 1,07 \times 10^{15} \checkmark = W_0 + 5,74 \times 10^{-20} \checkmark$$

$W_0 = 6,52 \times 10^{-19} \text{ J} \checkmark$

\therefore metal X is aluminium./is metaal X aluminium. ✓

(5)

- ✓ Energy formula/Energie formule
- ✓ Substituting c and λ correctly/Vervang c en λ korrek
- ✓ Substituting E_k and Planck's constant correctly/Vervang E_k en Planck se konstante korrek
- ✓ Answer and units for W₀/Antwoord en eenheid vir W₀
- ✓ Metal is aluminium/Metaal is aluminium.

- 10.2.3 Photon energy increases as the frequency of the light increases.✓
 Intensity only increases the number of electrons not their average kinetic energy.✓
 Thus the ultraviolet light will release electrons with a much higher kinetic energy.✓

*Die foton se energie verhoog soos die frekwensie van die lig verhoog. ✓
 Intensiteit verhoog slegs die aantal elektrone en nie die gemiddelde kinetiese energie nie. ✓*

Dus sal die ultraviolet lig die elektrone vrylaat met 'n baie hoër kinetiese energie. ✓

(3)
 [13]

TOTAL/TOTAAL: 150