GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

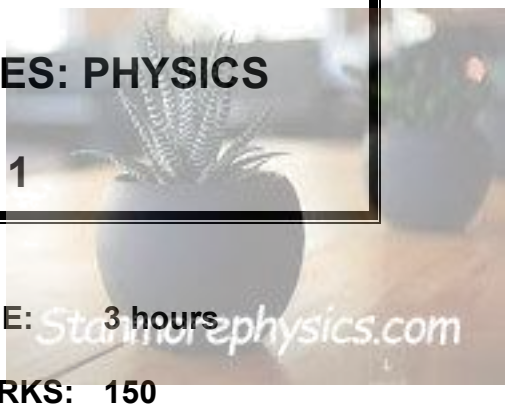
PREPARATORY EXAMINATION

2022

10841

PHYSICAL SCIENCES: PHYSICS

PAPER 1



TIME: 3 hours

MARKS: 150

17 pages + 3 data sheets and an answer sheet

PHYSICAL SCIENCES: Paper 1

10841E

X05

INSTRUCTIONS AND INFORMATION

1. This question paper consists of TEN 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. Write neatly and legibly.
7. Start EACH question on a NEW page in the ANSWER BOOK.
8. Leave ONE line between two sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a minimum of TWO decimal places, where needed.
11. Give brief motivations, discussions, et cetera, where required.

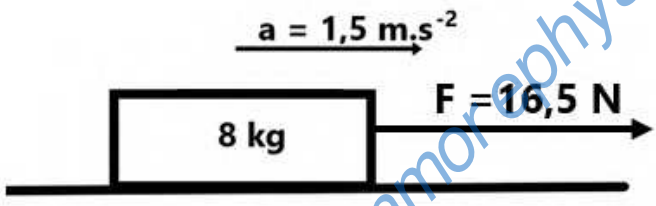
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 Which of the following best illustrates balanced forces?

A A person lifting a heavy object from the ground
B A big rock free-falling to the ground
C A light stationary object
D A force of a box on the earth and a force of the earth on the box (2)

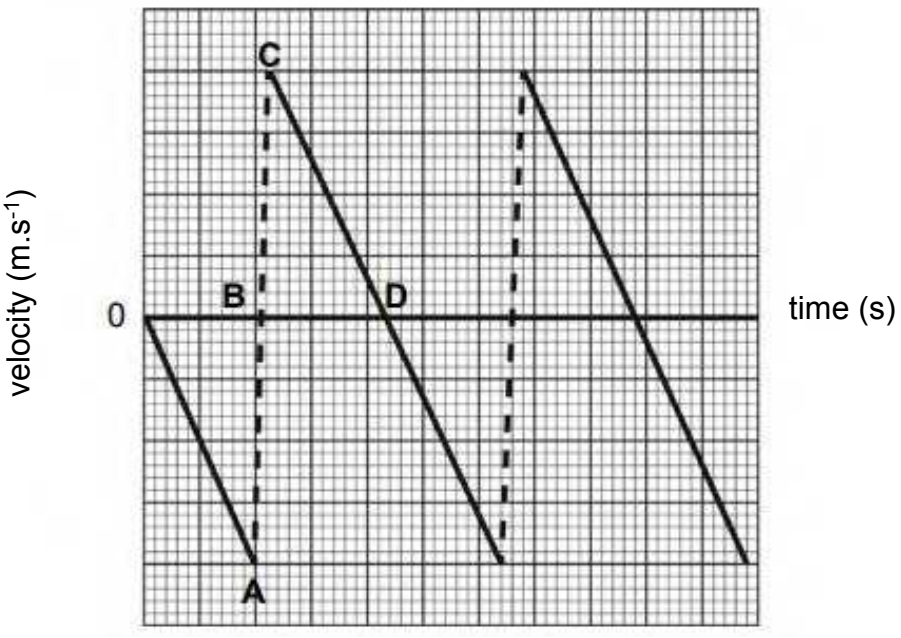
1.2 An 8 kg box is placed on a rough surface as shown below.



If a force of 16,5 N is applied to the box, it accelerates at 1,5 $m \cdot s^{-2}$ to the right. The frictional force between the 8 kg box and the surface is ...

A 0 N.
B 4,5 N.
C 10,3 N.
D 29,4 N. (2)

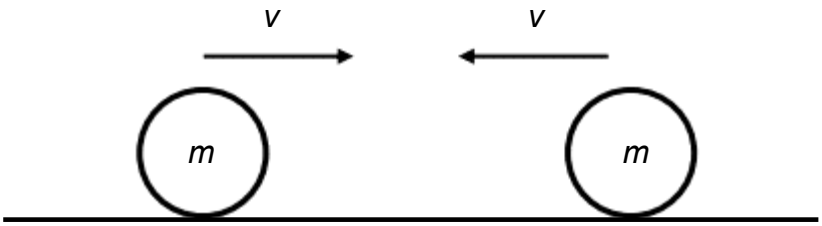
1.3 A ball is dropped from a certain height above the ground and bounces a few times as it hits the ground. The velocity-time graph below describes the motion of the ball from the time it is dropped. Ignore all the effects of air friction.



In relation to the velocity-time graph for the bouncing ball shown above, which statement below is correct?

A Down is taken as the positive direction and the ball is at the highest position of its bounce at point C.
B Down is taken as the positive direction and the ball is at the highest position of its bounce at point D.
C Down is taken as the negative direction and the ball is at the highest position of its bounce at C.
D Down is taken as the negative direction and the ball is at the highest position of its bounce at D. (2)

1.4 Two identical solid spheres, each with a mass ***m*** and travelling at a speed ***v***, move towards each other in an isolated system. The spheres have a head-on **elastic collision**.



Which statement is correct for the collision as described above?

A The spheres stick together on impact.
B The total kinetic energy after impact is mv^2.
C The total kinetic energy before impact is zero.
D The total momentum before impact is 2mv. (2)

1.5 The mechanical energy of a moving object will remain constant if …

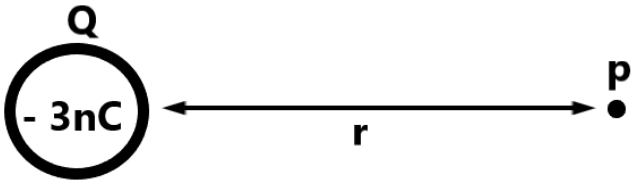
A there are frictional forces present.
B there is only gravitational force acting on it.
C only the kinetic energy remains constant.
D only the gravitational potential energy remains constant. (2)

1.6 A train is moving at a constant velocity of 10 $m \cdot s^{-1}$ while sounding its whistle which has a frequency of 500 Hz.

Take the speed of sound in air as 340 $m \cdot s^{-1}$. What frequency will be heard by a man sitting in the train?

A 500 Hz
B More than 500 Hz
C Less than 500 Hz
D No sound will be heard. (2)

1.7 The diagram below shows a point ***p*** at a distance ***r*** from a charged sphere ***Q***.



The electric field strength at point ***p*** is …

A directly proportional to ***r*** and to the right.
B directly proportional to the square of ***r*** and to the left.
C inversely proportional to the square of ***r*** and to the right.
D inversely proportional to the square of ***r*** and to the left. (2)

1.8 Which of the following statements about an AC generator is TRUE?

A The minimum potential difference produced is not zero volts.
B The emf produced decreases as the number of windings in the armature increases.
C The maximum value of the AC can be increased by increasing the period of rotation.
D The maximum value of the AC produced can be increased by increasing the speed of rotation of the coil. (2)

1.9 A battery with internal resistance is connected to a fixed resistor **R**.
A voltmeter is connected across the battery as in diagram **A**. The battery is replaced by one with the same emf but with a larger internal resistance **(r),** as shown in diagram **B.**

In diagram **B**: How would the voltmeter reading and the current through the fixed resistor change, compared to diagram **A,** when switch **S** is closed?

Diagram A

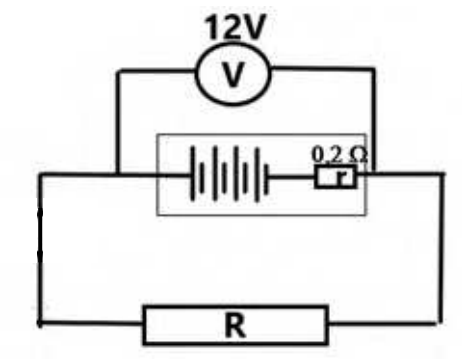
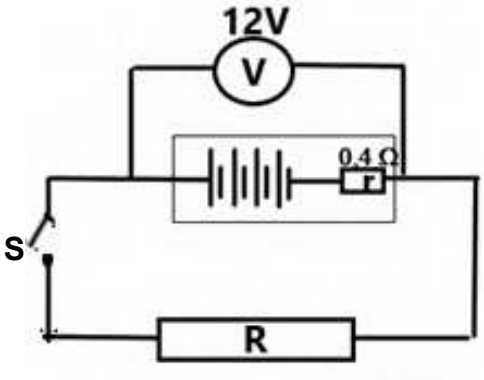


Diagram B

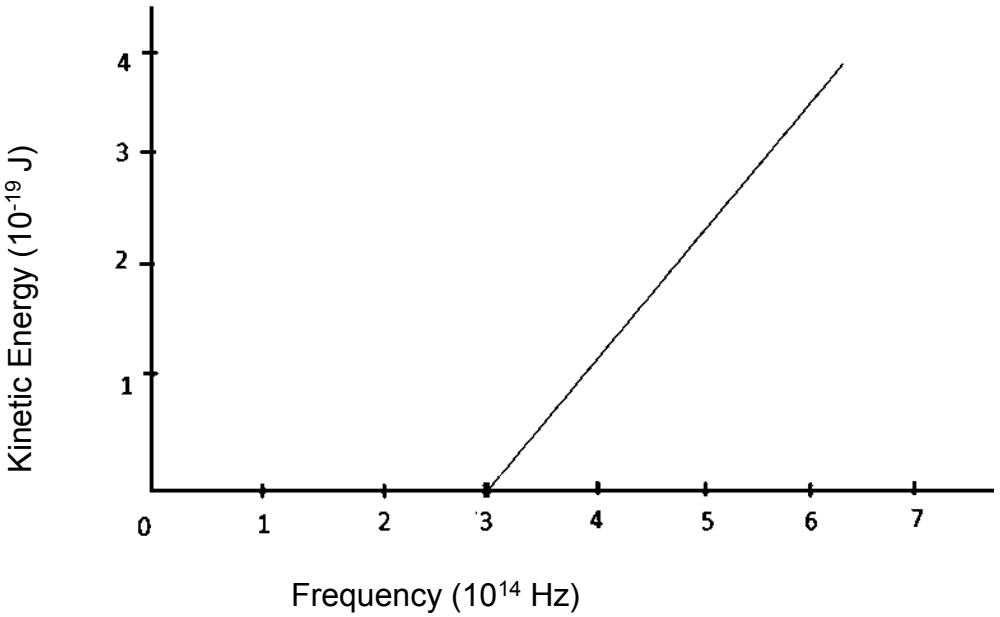


	Voltmeter reading	**Current through resistor**
A	Decreases	Decreases
B	Decreases	Stays the same
C	Stays the same	Decreases
D	Stays the same	Stays the same

(2)

1.10 The graph below shows the kinetic energy versus frequency for a photocell that has a sodium metal cathode.

The work function of sodium is 4,41 x 10^{-19} J.



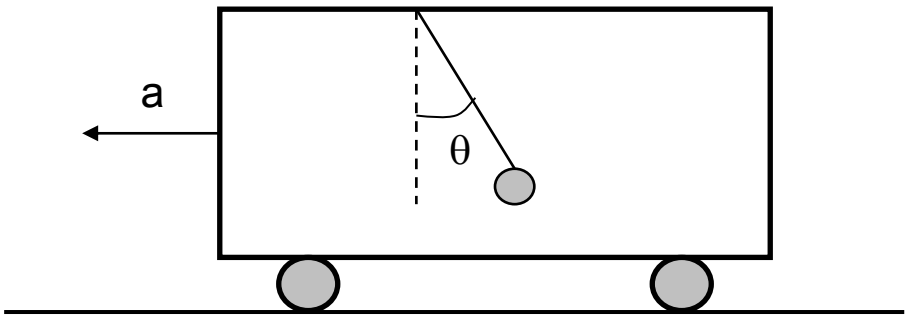
The threshold frequency of sodium is ...

A 4,41 x 10^{14} Hz.
B 3 x 10^{14} Hz.
C 3 x 10^{14} J.
D 4,41 x 10^{-19} J. (2)

[20]

QUESTION 2 (Start on a new page.)

A group of learners design a device that consists of a light ball on a string hanging from the roof of a cargo truck. This device is used to determine the acceleration of the truck. When the truck is stationary or moving at a constant speed, the ball will hang straight down, but when it is undergoing a constant acceleration, the ball hangs down at an angle θ, as shown in the diagram below.



2.1 Draw a free body diagram of all the forces acting on the ball. (2)

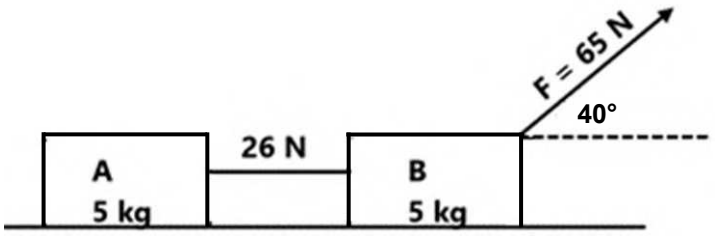
2.2 In this case the mass of the ball is 50 g and the angle θ is 18°.

Calculate the:

2.2.1 Horizontal force on the ball (4)

2.2.2 Magnitude of the acceleration of the truck (3)

2.3 **A** and **B** below are two identical blocks, each with a mass of 5 kg, joined together by a light inextensible string. The blocks are being pulled with a force of 65 N at an angle of 40° to the horizontal. The two blocks accelerate to the right at an acceleration of 2,17 $m \cdot s^{-2}$ and the tension in the rope is 26 N.



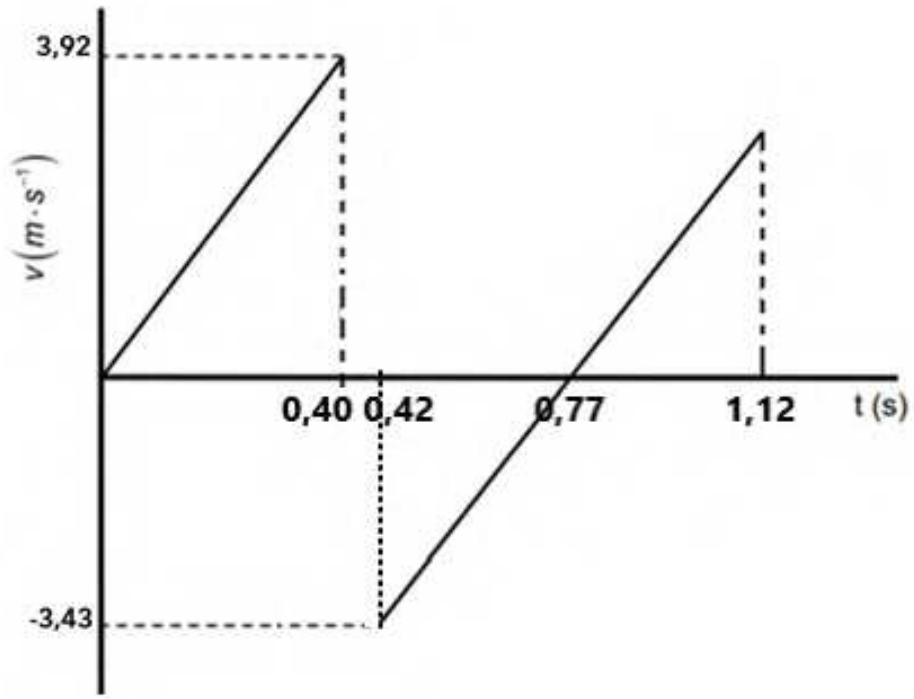
2.3.1 Calculate the friction on each block. (5)

2.3.2 Explain why the frictional forces on the two blocks differ. (3)

[17]

QUESTION 3 (Start on a new page.)

A 50 g ball is dropped from a certain height. The velocity-time graph below represents the motion of the ball as it bounces vertically on a concrete floor. The time of contact during the bounce is 0,02 s. Ignore all effects of air friction.



3.1 Define a *projectile*. (2)

3.2 Write down the magnitude of the velocity with which the ball leaves the ground after bouncing. (1)

3.3 Draw a labelled free-body diagram showing all the forces acting on the ball at 0,77 s. (2)

3.4 Use the information given on the graph and calculate the:

3.4.1 Acceleration of the ball (3)

3.4.2 Height from which the ball was dropped (4)

3.5 On a set of axes, draw a position-time graph for the motion of the ball from 0 s to 1,12 s. Use the ground as zero reference. Indicate the height from which the ball was dropped and all the relevant times on the t-axis on your graph. (4)

3.6 Give ONE term for the rate of change of momentum. (2)

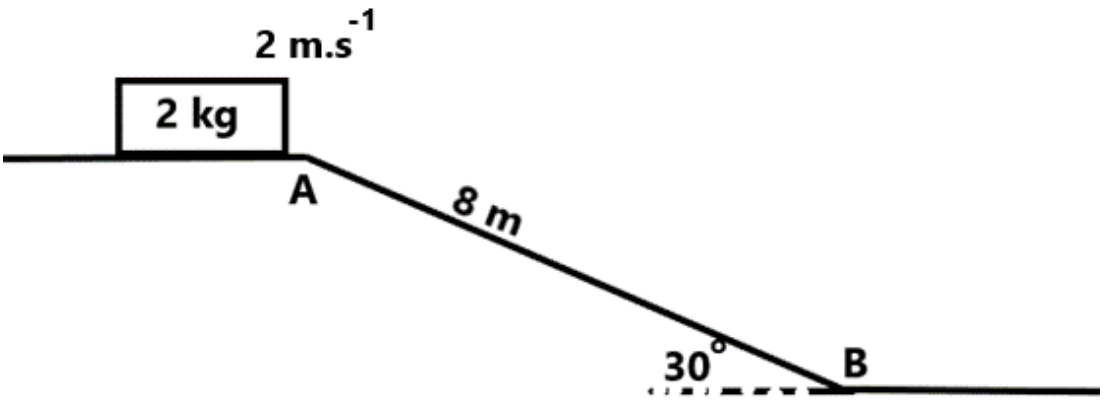
3.7 Calculate the magnitude of the force exerted by the floor on the ball for the time of contact. (3)

3.8 If a softer ball is used and the time of contact with the floor is increased while the change in momentum remains constant, how will it influence the force on the ball? Write only INCREASES, DECREASES or REMAINS THE SAME.

Explain the answer. (3)
[24]

QUESTION 4 (Start on a new page.)

A wooden box slides down a rough 8 m long inclined plane **AB**. The initial velocity of the box at **A** is 2 m·s^{-1} as shown in the diagram below.



4.1 Define a *conservative force*. (2)

4.2 Name the conservative force in the diagram above. (1)

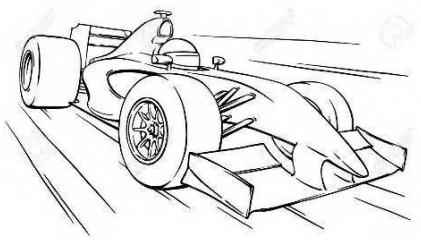
4.3 State the work-energy theorem in words. (2)

4.4 The velocity of the block at point **B** is 6,92 m·s^{-1}. Use ENERGY PRINCIPLES ONLY to calculate the frictional force that the block experiences as it moves from point **A** to point **B**. (4)

4.5 The coefficient of friction for the last horizontal stretch after point **B** is 0,35. Calculate the distance the block will travel before coming to a complete stop without using equations of motion. (4)
[13]

QUESTION 5 (Start on a new page.)

Grade 12 learners conduct an investigation to verify the speed of a race car using the Doppler effect. A race car driving around a racecourse at constant speed emits a single frequency of 200 Hz. A learner standing on the final straight records the sound using a cell phone, as the car approaches him and after passing him.



5.1 For this investigation, write down the following:

5.1.1 A dependent variable (2)

5.1.2 One controlled variable (2)

5.1.3 A suitable investigative question for this experiment (2)

5.2 When playing back the sound recorded on the cell phone in the presence of an oscilloscope, a difference in frequency of 67,15 Hz was registered. Use the information above to calculate the speed of the race car. Take the speed of sound in air as 340 $m \cdot s^{-1}$. (5)

5.3 The spectrum of light from most stars contains lines corresponding to helium gas.

Diagram **A** shows the helium spectrum as observed in a laboratory.

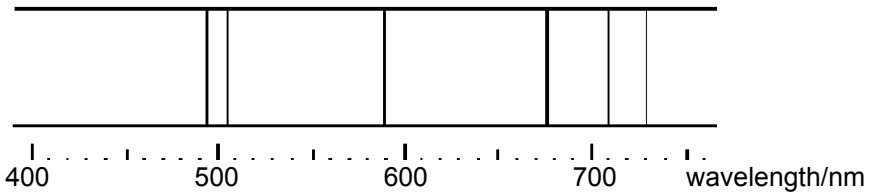
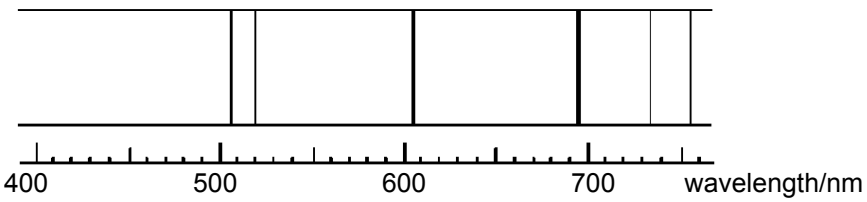


Diagram **B** shows the helium spectrum of light from a distant star.

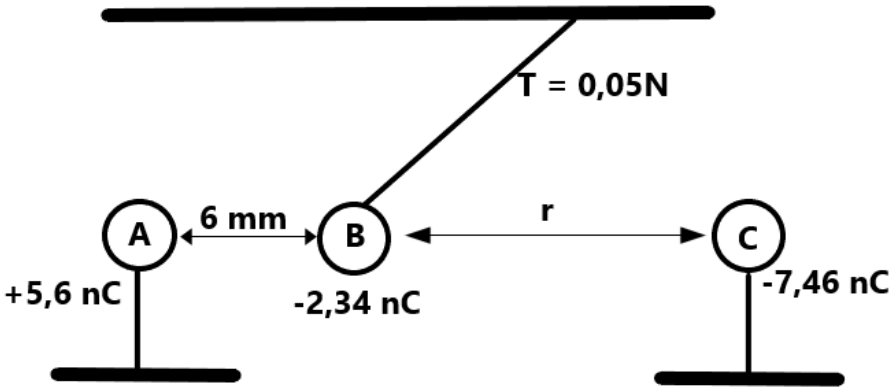


5.3.1 Is the distant star moving AWAY FROM or TOWARDS the earth? Explain the answer. (3)

[14]

QUESTION 6 (Start on a new page.)

A small polystyrene sphere, **B**, hangs from the ceiling and is attached by a string of negligible mass. Two other spheres, **A** and **C** are suspended on insulated stands. The charges on each sphere are **A** = +5,6 nC, **B** = - 2,34 nC and **C** = -7,46 nC. The mass of sphere **B** is 5,085 x 10^{-3} kg. Assume that the surfaces of all the three spheres are conducting.



6.1 Define *electrical field strength at a point*. (2)

6.2 Sketch the electric field pattern around spheres **B** and **C** if **A** was removed. (3)

6.3 Charge **B** experiences a net force of 0,004078 N due to charges **A** and **C**. Find the distance, **r**, between charges **B** and **C**. (5)

6.4 Charges **A** and **B** are allowed to touch and then moved back to the original distance between them.

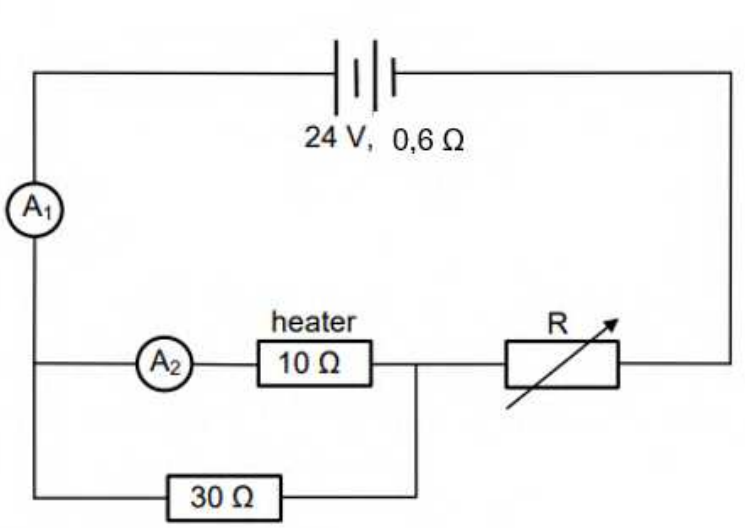
6.4.1 Calculate the new charge on each sphere. (2)

6.4.2 Explain the change, if any, to the field pattern between **B** and **C**. (3)

[15]

QUESTION 7 (Start on a new page.)

In the circuit below, the battery has an emf of 24 V and an internal resistance of 0,6 Ω. The heater has a resistance of 10 Ω and the fixed resistor has a resistance of 30 Ω. The variable resistor, **R**, can change between 0 Ω and 15 Ω.



7.1 The variable resistor, **R**, is set at a resistance of 3,5 Ω.

Calculate:

7.1.1 The total resistance of the circuit (including the battery) (5)

7.1.2 The current measured by ammeter A_2 (3)

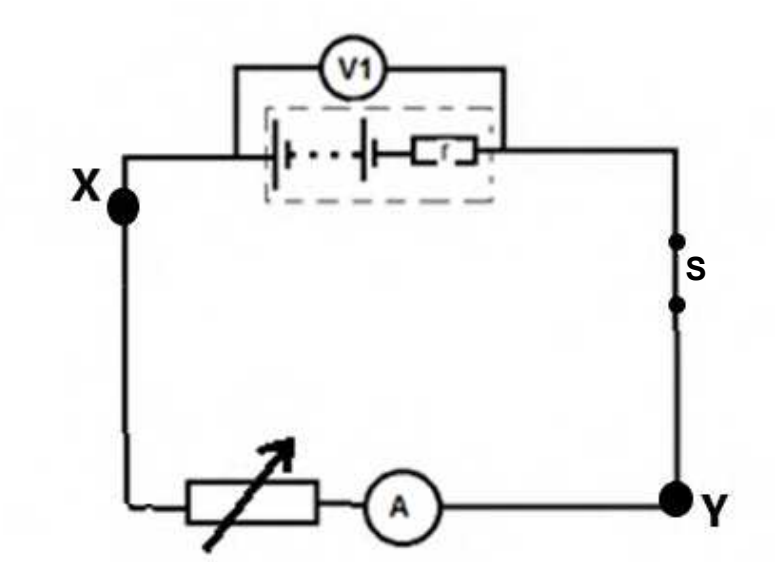
7.2 The variable resistor is now adjusted to have an even higher resistance value.

How will this affect the power dissipated by the heater? Write only INCREASES, DECREASES or REMAINS THE SAME. Explain the answer by making use of a suitable equation. (3)

[11]

QUESTION 8 (Start on a new page.)

Learners perform an experiment to determine the internal resistance, **r**, of a battery. They use a variable resistor as the external resistance as shown in the diagram below.



Switch **S** is closed. Readings from the voltmeter and ammeter are recorded after each change of the resistor.

Experiment no.	Current (mA)	Potential difference (V)
1	0,00	1,5
2	131	1,30
3	229	1,15
4	327	1,00
5	652	0,50

8.1 Use the information in the table above to plot a graph of potential difference versus current. Use the graph paper supplied at the end of the question paper. (4)

8.2 Use the graph to determine the following:

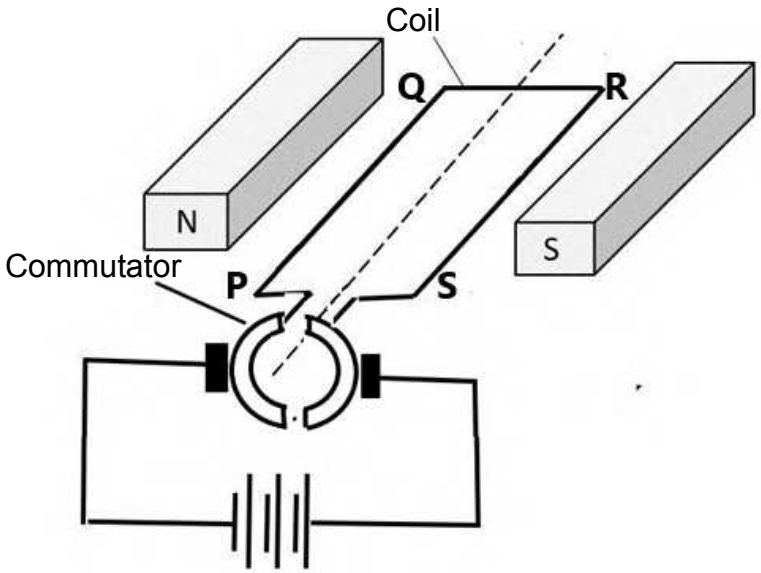
8.2.1 The emf of the battery (1)

8.2.2 The internal resistance of the battery
Use an equation to justify the method used. (3)

8.3 A conducting wire of negligible resistance is connected between the points **X** and **Y**. How does this affect the temperature of the battery? Write down only INCREASES, DECREASES or REMAINS THE SAME.
Explain the answer. (3)
[11]

QUESTION 9 (Start on a new page.)

The diagram below shows a simple model of a DC motor.



9.1 Describe the energy change that occurs in a DC motor. (2)

9.2 Explain the term *DC*. (2)

9.3 In which direction will the conventional current in the coil flow?
Write only FROM **P to Q** or FROM **Q to P**. (1)

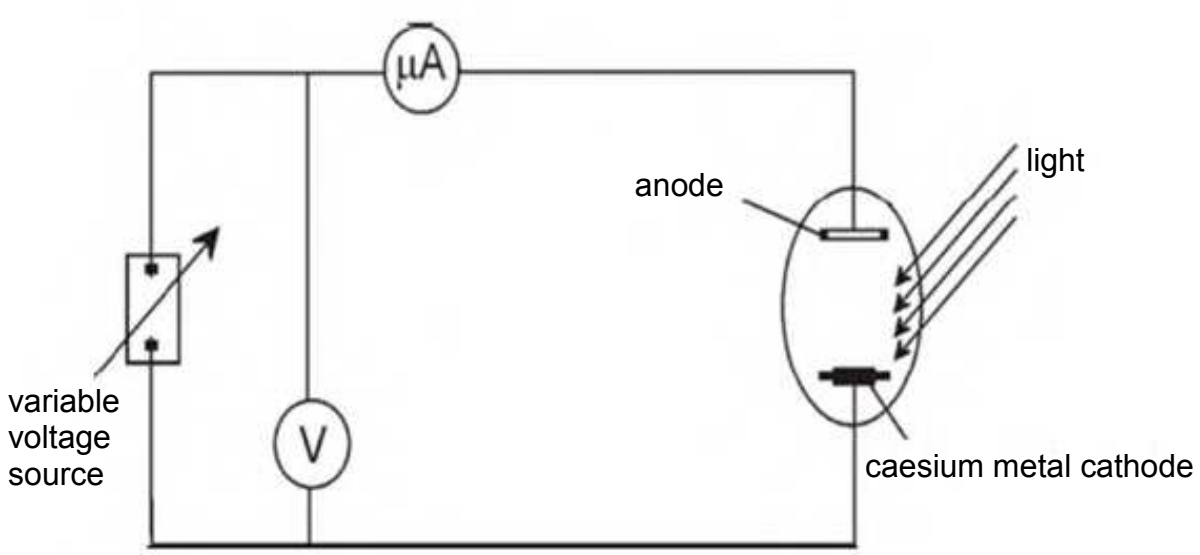
9.4 Explain the change that needs to be made for this motor to be an AC motor. (2)

9.5 A heater labelled 2 000 W, 220 V and 50 Hz is connected to an AC circuit.
Calculate the maximum current that flows through the heater. (5)
[12]

QUESTION 10 (Start on a new page.)

A photoelectric cell is connected in a circuit. The lowest frequency of light that will emit electrons from its caesium surface is $5,1 \times 10^{14}$ Hz.

Violet light of wavelength 400 nm is incident on the caesium surface.



10.1 Define *threshold frequency*. (2)

10.2 Calculate:

10.2.1 The work function of caesium (3)

10.2.2 The amount of energy carried by the incident photons of violet light (3)

10.2.3 The maximum kinetic energy of the photoelectrons emitted from the caesium surface when violet light shines on it (4)

10.3 Give ONE application, other than a photovoltaic cell, which makes use of the particle nature of light. (1)

[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 *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Mass of the Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} J·s
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} 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*

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

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)*
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
W = Vq W = VIΔt W= $I^2R\Delta t$ W= $\frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R P = $\frac{V^2}{R}$

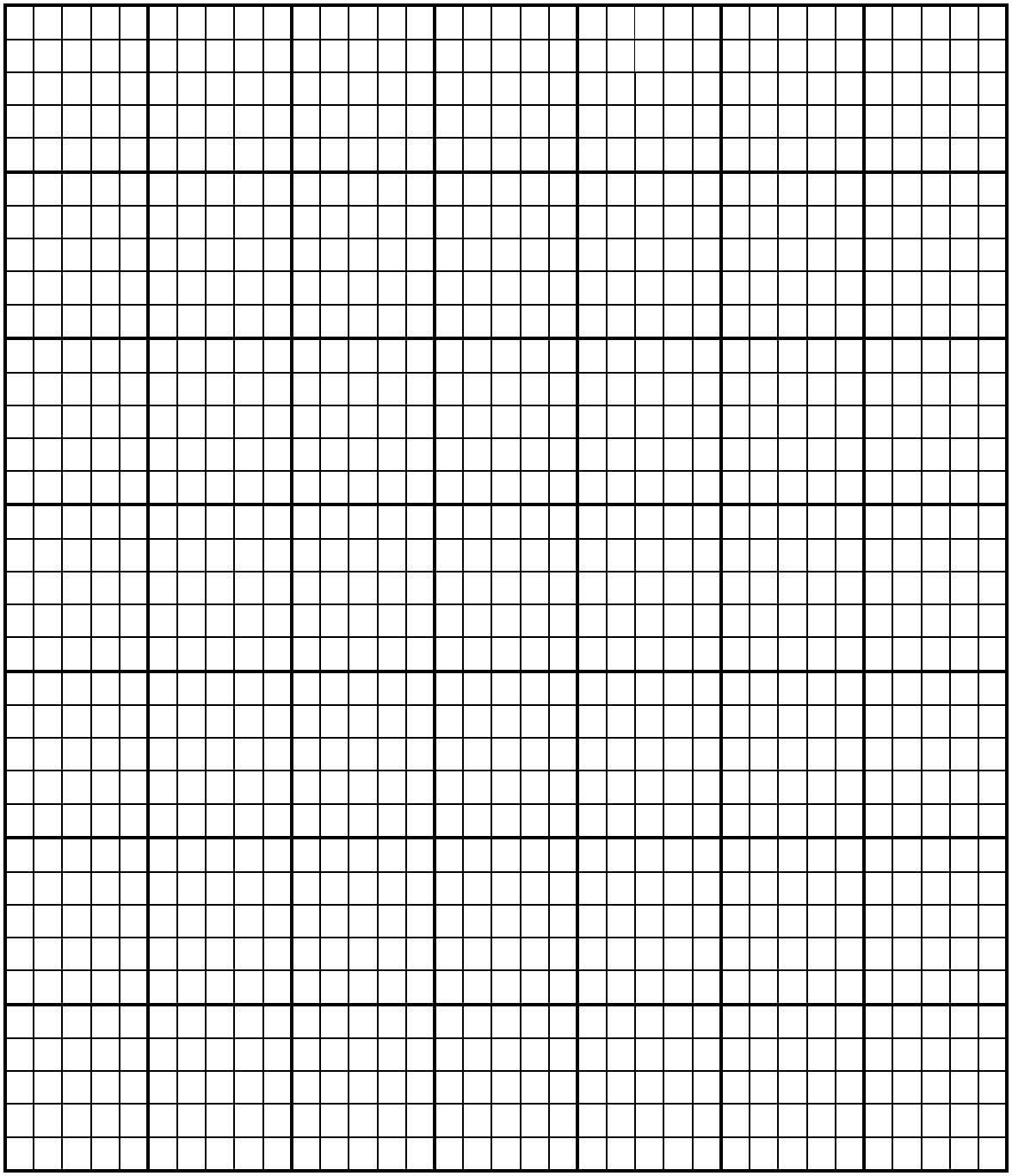
ALTERNATING CURRENT/*WISSELSTROOM*

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

ANSWER SHEET

QUESTION 8.1

NAME OF LEARNER: _____



GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION/
VOORBEREIDENDE EKSAMEN

2022

MARKING GUIDELINES/
NASIENRIGLYNE

10841

PHYSICAL SCIENCES: PHYSICS/
FISIESE WETENSKAPPE: FISIKA

PAPER/*VRAESTEL* 1

20 pages/*bladsye*

QUESTION/*VRAAG* 1

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 A ✓✓ (2)

1.7 D ✓✓ (2)

1.8 D ✓✓ (2)

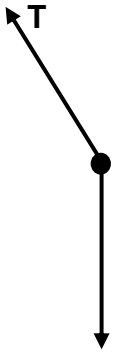
1.9 A ✓✓ (2)

1.10 Accept any answer. All answers correct. If learner gives no answer, allocate two marks as well. ✓✓ (2)

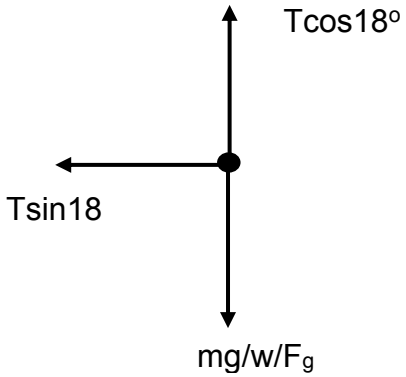
(10 x 2) **[20]**

QUESTION/*VRAAG* 2

2.1

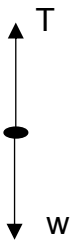


OR/*OF*



If learner does free body diagram vertically up and down, also accept the answer. Question did not stipulate in which position the ball was.

Indien leerder vryliggaamdiagram op en af teken, aanvaar. Vraag het nie posisie van bal aangedui nie.



Marking Guidelines:	***Nasienriglyne:***
✓ for each force with label Arrow with line	✓*vir elke krag met 'n byskrif*

(2)

2.2 2.2.1 **OPTION/*OPSIE* 1**

$F_g = mg$ ✓
$= 0,05 \times 9,8$ ✓
$= 0,49$ N

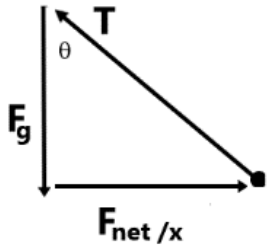
$\tan \theta = \frac{F_x}{F_g}$
$\tan 18° = F_x \div 0,49$ ✓
$F_x = 0,159$ N ✓

Marking Guidelines:/
Nasienriglyne:
- ✓ Formula
- ✓ $F_g = 0,49$ N (substitution)
- ✓ Trig calculation/*trigonometrie bewerking*
- ✓ Answer: $F_y = 0,159$ N
  Antwoord: $F_y = 0,159$ N

OPTION/*OPSIE* 2

$T\cos 18° = mg$ ✓
$T \cos 18° = 0,05 \times 9,8$ ✓
$T = 0,5152$N

$F_x = T \sin 18°$
$= 0,5152 \times \sin 18°$✓
$= 0,1592$N ✓



(4)

2.2.2 $F_{net} = ma$ ✓
$0,159 = 0,05 \times a$ ✓
$a = 3,1842$ m.s^{-2} ✓

If carried over 0,16 instead of 0,159
Final answer 3,2 m.s^{-2}
Learner gets full marks if calculation is correct.

Marking Guideline:
Positive marking from 2.2.1
- ✓ $F_{net} = ma$
- ✓ Substitution
- ✓ Final answer

Nasienriglyne:
Positiewe nasien vanaf 2.2.1
- ✓ *$F_{net} = ma$*
- ✓ *Invervanging*
- ✓ *Finale antwoord*

(3)

2.3 2.3.1 $F_{netA} = ma$ ✓$= +T - f_{kA}$
$5 \times 2,17 = +26 - f_{kA}$ ✓
$f_{kA} = 15,15$ N ✓
$F_{netB} = ma = +F_x - T - f_{kB}$
$5 \times 2,17 = +(65 \times \cos 40°) - 26 - f_{kB}$ ✓
$f_{kB} = 12,94$ N ✓
✓ Formula
✓ Whole substitution
✓ Answer
✓ Whole substitution
✓ Answer

(5)

2.3.2 $f_k = \mu_k \text{N}$

μ_k is a constant for a specific surface. ✓ The surfaces can differ.
Force (Block B) at an angle will decrease the normal force. ✓
Normal force is directly proportional to the kinetic frictional force, thus if the normal force decreases then the frictional force will decrease. ✓

$f_k = \mu_k \text{N}$

μ_k is 'n konstante vir 'n spesifieke oppervlakte. ✓Die oppervlaktes kan verskil. Krag (Blok B) teen 'n hoek sal die normaalkrag verminder. ✓ Normaalkrag is direk eweredig aan die kinetiese wrywingskrag, dus indien die normaalkrag verminder dan sal die wrywingskrag verminder. ✓ (3)

[17]

QUESTION/*VRAAG* 3

3.1 An object which has been given an initial velocity and then it moves under the influence of the gravitational force only ✓✓
'n Voorwerp wat 'n aanvanklike snelheid gegee is en dan beweeg dit onder slegs die invloed van die gravitasiekrag

OR

Moving body where the only force acting on the object is the force of gravity
Bewegende liggaam waar die enigste krag wat op die voorwerp inwerk, gravitasiekrag is

Marking criteria/*Nasienriglyne*
If any of the underlined words/phrases in the correct context is omitted deduct 1 mark./ *Indien enige van die onderstreepte woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

(2)

3.2 3,43 m.s^{-1}. ✓ penalise if there is no unit / *penaliseer indien geen eenheid* (1)

3.3

NOTE: ACCEPTED LABELS/ *AANVAARDE BYSKRIFTE*		MARK/ *PUNT*
w	F_g/F_w/weight/0,49N/gravitational force	✓✓

Notes:/*Notas:*

- Mark awarded for label and arrow./*Ken punt toe vir byskrif en pyl.*
- Do not penalise for length of arrows, drawing is not to scale./*Moenie penaliseer vir lengte van pyle, nie op skaal geteken nie.*
- Any other additional force(s) Max. ½ /*Enige ander addisionele kragte Max. ½*
- If force(s) do not make contact with body. Max. ½ /*Indien krag nie kontak maak met kol nie Maks ½*
- If no arrows indicated and all forces correctly drawn deduct 1 mark./*Indien geen pyle nie maar alle kragte korrek getrek is, trek een punt af*

(2)

3.4 3.4.1 **OPTION/*OPSIE* 1**

Gradient/*Gradiënt* = acceleration/*versnelling* = $\frac{\Delta y}{\Delta x}$

$= \frac{3,92 - 0}{0,4}$ ✓✓

$= 9,8\ m.s^{-2}$ ✓

OPTION/*OPSIE* 2

Gradient/*Gradiënt* = acceleration/*versnelling* = $\frac{\Delta y}{\Delta x}$

$= \frac{3,43 - 0}{0,77 - 0,42}$ ✓✓

$= 9,8\ m.s^{-2}$ ✓

OPTION/*OPSIE* 3

$v_f = v_i + a\Delta t$

$3,92 ✓ = 0 + a(0,40)$ ✓

$a = 9,8\ m.s^{-2}$ ✓

any equation of motion can be used

(3)

Option 4

If learner uses the values for the collision during the 0,02 seconds when the ball is in contact with the ground.

$v_f = v_i + a\Delta t$

$-3,43$ ✓ $= +3,92 + a(0,02)$ ✓

$a = -367,5\ m.s^{-2}$

Answer will be $367,5\ m.s^{-2}$ ✓

Give learner the credit if following this path and doing the correct science and calculations. (3)

3.4.2 **OPTION/*OPSIE* 1**

Height/*Hoogte* = area under the graph/ *area onder die grafiek*
= ½ bh ✓
= ½ x 0,4 x 3,92✓✓
= 0,784 m ✓
Do not penalise if formula is not given

OPTION/*OPSIE* 2

$y = v_i t + ½ gt^2$ ✓
= 0✓ + ½ (9,8)(0,4)^2✓
= 0,784 m ✓

OPTION/*OPSIE* 3

Downwards as positive/*Afwaarts as positief*

$v_f^2 = v_i^2 + 2ay$ ✓
3,92^2 ✓ = 0 + 2 x (9,8)y ✓
y = 0,784 m (downwards/*afwaarts*) ✓

(4)

OPTION/*OPSIE* 4

Downwards as negative/*Afwaarts as negatief*

$v_f^2 = v_i^2 + 2a\Delta y$✓

(-3,92)^2 ✓= (0)^2 + 2(-9,8) Δy✓

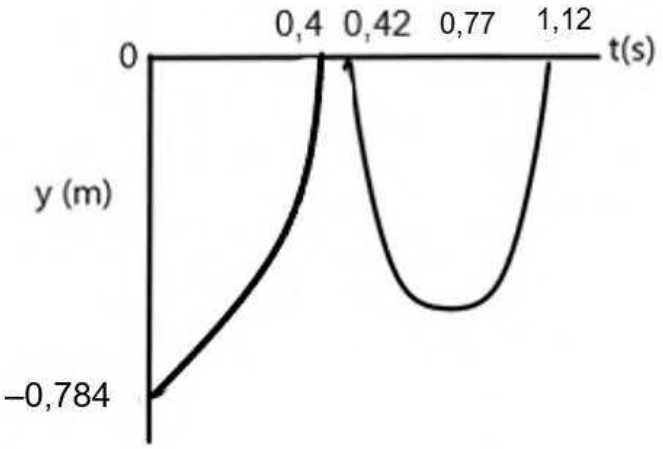
∴ Δy = -0,784 m
∴ Δy = 0,784 m downwards/*afwaarts*
The height from which the ball was dropped = 0,784 m.✓
Die hoogte waarvan dan die bal laat val is = 0,784 m.

OPTION/*OPSIE* 5

$y = \left(\frac{v_f + v_i}{2}\right) t$✓
= $\left(\frac{3,92 + 0}{2}\right)$ ✓0,4✓

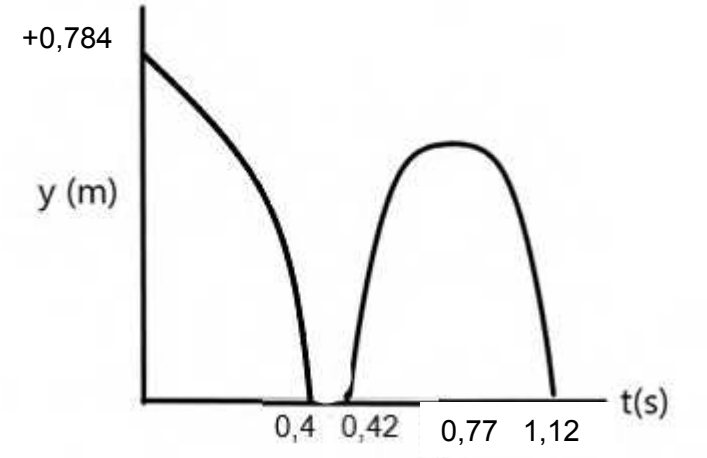
= 0,784 m✓

3.5 **(Downwards taken as positive)/*(afwaarts geneem as positief)***
positive marking on the height / positiewe nasien vir die hoogte



OR/*OF*

(Downward taken as negative)/*(Afwaarts geneem as negatief)*
positive marking on the height / positiewe nasien vir die hoogte



Marking Criteria/*Nasienriglyne*	**Mark/*Punt***
Graph starting from the maximum height (0,784 m) *Grafiek begin vanaf maksimum hoogte (0,784 m)*	✓
Time taken to reach the ground indicated *Tyd geneem om grond te bereik aangedui*	✓
Correct shape of the graph/*Korrekte vorm van grafiek*	✓
Ground taken as zero/*Grond geneem as nulverwysing*	✓

(4)

3.6 Net force/resultant force. ✓✓
Netto krag/resultante krag (2)

3.7 $F_{net} = Fg + Ffloor$ ✓

$-18{,}375$ = 0,49 + F_{floor} ✓

F_{net} = 18,865 N ✓
Rounding-off will have to be 18,87 N./*Afronding sal 18,87 N moet wees.*
Minus must not be in the final answer. (3)

3.8 DECREASES ✓
$F_{net}\,\Delta t = \Delta p$ formula refers to proportionality – allocate marks.
If the change in momentum remains constant,
the net force is inversely proportional to the time of contact.✓
Thus, if the time increases the net force will decrease. ✓

AFNEEM ✓
$F_{net}\,\Delta t = \Delta p$
Indien die verandering in momentum konstant bly,
is die netto krag omgekeerd eweredig aan die kontaktyd. ✓
Dus, indien die tyd vermeerder sal die netto krag verminder. ✓ (3)
[24]

QUESTION/*VRAAG* 4

4.1 A force for which the work done in moving an object between two points is independent of the path taken. ✓✓
'n Krag waarvoor die arbeid verrig om die voorwerp te beweeg tussen twee punte onafhanklik is van die pad wat geneem word.

Marking criteria/*Nasienriglyne*

If any of the underlined words/phrases in the correct context is omitted, deduct 1 mark. If the word work is omitted, zero marks.
Indien enige van die onderstreepte woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af. Indien die woord arbeid weggelaat is, geen punte.

(2)

4.2 Force of gravity **OR** Gravitational force ✓/
*Gravitasiekrag **OF** swaartekrag* (1)

4.3 The net work done on an object by a net force is equal to the change in the object's kinetic energy.✓✓
Die netto arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/*OF*

The work done on an object by a net force is equal to the change in the object's kinetic energy. ✓✓/
Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.

Marking criteria/*Nasienriglyne*
If any of the underlined words/phrases in the correct context is omitted, deduct 1 mark.
Indien enige van die onderstreepte woorde/frases in die korrekte konteks uitegelaat is, trek een punt af.

(2)

4.4 **OPTION/*OPSIE* 1**
Change substitution. K together.
Formula Left right answer

Wnc = ΔK + ΔU ✓
$f_k \,.\, \Delta x.\, cos180°$ = (½ mv^2- ½ mv^2) + (mgh - mgh)
$f_k \; x \; (-8)$✓ = ½(2)6,92^2 - ½(2) 2^2 + 0 – 2(9,8)(8)sin 30 ° ✓
$f_k \; x \; (-8)$ = -34,5136
f_k = 4,3142 N
f_k = 4,31 N ✓

(4)

OPTION/*OPSIE* 2

$h = 8\sin 30 = 4m$
$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$\Delta E_k = \Delta E_{kf} - \Delta E_{ki}$
= ½ (2) $6{,}92^2$ – ½ (2) 2^2 ✓ this mark goes for both substitutions
= 43,886 J
$\Delta E_p = \Delta E_{pf} - \Delta E_{pi}$
= 2(9,8)0 - 2(9,8)4
= -78,4 J
$W_{nc} = \Delta E_k + \Delta E_p$
= 43,886 – 78,4
= -34,514 J
$f\Delta x\cos 180$✓ $= -34{,}514$
f = 4,31 N ✓

OPTION/*OPSIE* 3

$W_{net} = F_{net}\cos\theta = \Delta Ek$ ✓ either or
F_{net} (8)cos 0° = ½ mv_f^2 - ½ m v_i^2
8F = ½ (2)$6{,}92^2$ - ½ (2) 2^2 ✓
F_{net} = 5,486 N
F_{net} = + $Fg_{//}$ - f
5,486 = (2)(9,8)sin 30° - f ✓
f = 4,31 N ✓

4.5 **OPTION/*OPSIE* 1**

$W_{net} = f_k.x.cos\theta = \Delta E_k$ ✓
(0,35(2)9,8)cos180° ✓= 0 - ½ (2)($6{,}92^2$) ✓
- 6,86 *x* = - 47,8864
x = 6,981 m ✓

OPTION/*OPSIE* 2

$f\Delta x\cos\theta = \Delta E_k$✓
$\mu_K\, x\, cos\theta = E_{kf} - E_i$
0,35(2)(9,8) $\Delta x\cos 180°$ ✓ = ½ (2)0^2 - ½ (2)($6{,}92^2$)✓
$x = 6{,}98\,m$ ✓

(4)
[13]

QUESTION/*VRAAG 5*

5.1 5.1.1 Change in frequency observed or frequency received/The speed of the race car ✓✓
Frequency of listener as observed by the phone.
Verandering in frekwensie waargeneem of frekwensie ontvang/Die spoed van die renmotor
Frekwensie van luisteraar soos waargeneem deur die foon. (2)

5.1.2 Speed of sound in air ✓✓/stationary listener/siren set at 200 Hz
Spoed van klank in lug/ stilstaande luisteraar/sirene gestel op 200 Hz (2)

5.1.3 What is the relationship between the change in the frequency that will be heard relative to the speed of the vehicle? ✓✓
Wat is die verwantskap tussen die verandering in die frekwensie wat gehoor sal word relatief tot die spoed van die voertuig?

OR/*OF*

How can the speed of the race car be determined using the change in the frequency and the relative motion between the observer and the source? ✓✓
Hoe kan die spoed van die renmotor bepaal word deur gebruik te maak van die verandering in die frekwensie en die relatiewe beweging tussen die waarnemer en die bron?

Marking criteria/*Nasienriglyne*
Refer to **change in frequency** and **relative motion/Doppler effect.**
*Verwys na **verandering in frekwensie** en **relatiewe beweging/Doppler effek.***
In context with Doppler and scenario given.
Starting with **Is/Do/Does/Will/Can** one mark if answer to question is yes or no.
*Begin sin met **Sal/Is/Kan** een punt indien antwoord vir vraag ja of nee is.*

(2)

5.2 **OPTION/*OPSIE* 1**

$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓

TOWARDS/*NA*:

$f_L = \frac{340}{340 - v_s}$ ✓ $x\ 200$ ✓ Either or

AWAY/*WEG*:

$f_L = \frac{340}{340 + v_s}\ x\ 200$

$\Delta f = f_f - f_i$

-67,15 ✓ = $\frac{340}{340+v_s}\ x\ 200 - \frac{340}{340-v_s}\ x\ 200$

-67,15 = $200\ \frac{340}{340+v_s} - \frac{340}{340-v_s}$

v = 57,02 m.s^{-1}. ✓

Marking guidelines/ *Nasienriglyne:*
- ✓ Formula/*Formule*
- ✓ Substitution towards/ *Invervanging na*
- ✓ Substitution away/ *Invervanging weg*
- ✓ Substitution change in/*Invervanging vir verandering*
- ✓ Answer/*Antwoord*

Range for answers. (55-57) (5)

OPTION/*OPSIE* 2

$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓ $\Delta f = f_f - f_i$ $\Delta f = \frac{v \pm v_L}{v \pm v_S} f_S - \frac{v \pm v_L}{v \pm v_S} f_S$ (-)67,15 ✓ = $\frac{340}{340+v_s} x\ 200$ ✓ - $\frac{340}{340-340} x200$ ✓ v = 57,02 m.s^{-1}. ✓
Ignore negative in front of the 67,15 during marking.

OPTION 3

If learners add or subtract the 67,15 Hz from 200 Hz. They will only do one sum.

Give mark allocation as follows:

✓ formula

✓ ✓ ✓ substitution

✓ answer

$f_L = \frac{v \pm v_L}{v \pm v_S} x f_S$ ✓

TOWARDS/*NA*:

$267{,}15$ ✓ $= \frac{340}{340-v_s}$ ✓$x\ 200$✓

v_s = 85,46 m.s^{-1}✓

OR if sum done as AWAY/*WEG*:

$$132{,}85 = \frac{340}{340 + v_s} x\ 200$$

v_s = 171,86 m.s^{-1}

5.3 **AWAY** ✓

The spectrum of the distant star moved towards the <u>longer wavelengths</u>/ lower frequencies, ✓thus stretching out the waves proving that it is moving away. ✓

WEG ✓

Die spektrum van die verafgeleë ster beweeg na die <u>langer golflengtes</u>/laer frekwensies, dus die uitrekking van die golwe bewys dat dit besig is om weg te beweeg. (3)

[14]

QUESTION/*VRAAG* 6

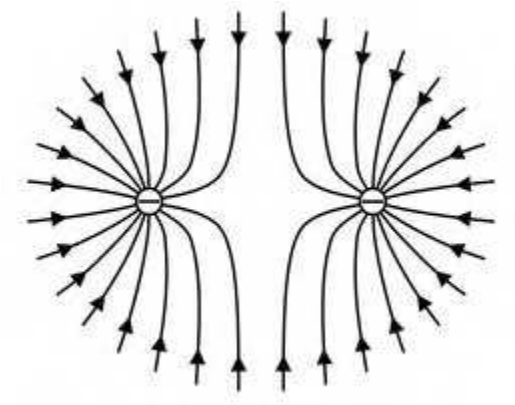
6.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt in die elektrostatiese krag ondervind per eenheid positiewe lading geplaas by daardie punt.

2 marks or zero.

(2)

6.2



Marking criteria/*Nasienriglyne*
- ✓ Shape/form/ all lines need to be curved / *Vorm / alle lyne moet 'n kurwe hê.*
- ✓ Direction of arrows towards sphere/*Rigting van pyle na die sfere*
- ✓ All other field rules applied. / *Alle ander veldreëls toegepas.*

Do not penalise if different amounts of lines around the charges.
Ignore if different number of lines are drawn around each charge. / *Ignoreer indien die verskillende aantal lyne getrek is rondom elke lading.*

(3)

6.3 **OPTION/*OPSIE 1***

$F_{net\ on/op\ B} = F_{A\ on/op\ B} + F_{C\ on/op\ B}$

$F_{net\ on/op\ B} = \frac{kQ_A\ Q_B}{r^2} + \frac{kQ_C\ Q_B}{r^2}$ ✓

0,004078 ✓ $= \frac{9\ x\ 10^9\ x\ 5{,}6\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{0{,}006^2}$ ✓ $+ \frac{9\ x\ 10^9\ x\ 7{,}46\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{r^2}$ ✓

r = 0,01399 m (accept/*aanvaar* 0,014 m) ✓

(5)

OPTION/*OPSIE* 2

$F_{A\ on/op\ B} = \frac{kQ_A\ Q_B}{r^2}$ ✓

$= \frac{9\ x\ 10^9\ x\ 5{,}6\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{0{,}006^2}$ ✓

= 0,003276 N

$F_{C\ on/op\ B} = \frac{kQ_C\ Q_B}{r^2}$

$= \frac{9\ x\ 10^9\ x\ 7{,}46\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{r^2}$ ✓

$F_{C\ on/op\ B} = \frac{1{,}57\ x\ 10^{-7}}{r^2}$

$F_{net\ on/op\ B} = F_{A\ on/op\ B} + F_{C\ on/op\ B}$

0,004078 ✓= 0,003272 + $\frac{1{,}57\ x\ 10^{-7}}{r^2}$

r = 0,01399 m (accept/*aanvaar* 0,014 m) ✓

accept 0,01 m rounding off

6.4 6.4.1 $Q_{new/nuwe} = \frac{Q_A + Q_B}{2}$

$= \frac{+5{,}6 + (-2{,}34)}{2}$ ✓

= 1,63 nC

= 1,63 x 10^{-9} C ✓ accept either or (2)

6.4.2 B is positively charged ✓and C negative. Attractive pattern. ✓
The electric field pattern has changed. It is now originating from B and ending at C✓. This is because B is now positively charged whilst C remains negatively charged.

B is positief gelaai ✓en C is negatief gelaai. Aantrekkende patroon. ✓
Die elektriese veldpatroon het verander. Dit begin nou vanaf B en eindig by C ✓. Dit is omdat B nou positief gelaai is terwyl C negatief gelaai bly.

(3)

[15]

QUESTION/*VRAAG* 7

7.1 7.1.1 **OPTION/*OPSIE* 1**

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

$\frac{1}{R_p} = \frac{1}{30} + \frac{1}{10}$ ✓

$R_1 = \frac{15}{2}$

= 7,5 Ω

$R_T = R_s + R_p + r$

= 7,5✓ + 0,6 + 3,5 ✓ or (4,1)

= 11,6 Ω✓

Marking guidelines:/ *Nasienriglyne:*
- ✓ Formula R_T/*Formule* R_T
- ✓ Substitution/ *Invervanging*
- ✓ Formula R_T/ *Formule* R_T
- ✓ Substitution/ *Invervanging*
- ✓ Answer/*Antwoord*

OPTION/*OPSIE 2*

$R_T = R_s + R_p + r$ ✓

= 3,5 ✓ + $\frac{10\ x\ 30}{10+30}$ ✓ + 0,6 ✓

= 11,6 Ω✓

(5)

7.1.2 **OPTION/*OPSIE* 1**

$V_P = I \times R_P$
$= 2{,}07 \times 7{,}5$ ✓
$= 15{,}53$ V
$I_2 = \frac{V_P}{R}$
$= \frac{15{,}53}{10}$ ✓
$= 1{,}55$ A ✓

Marking guidelines:/ *Nasienriglyne:*

- ✓ ✓Substitution/ *Invervanging*
- ✓ Answer/ *Antwoord*

OPTION/*OPSIE* 2

RATIO 1 : 3 ✓
∴ ¾ : ¼
∴ 2,07 x ¾ ✓ = 1,55 A ✓

OPTION/*OPSIE* 3

$V_{//} = 24 - V_r - V_{ex}$
$= 24 - (2{,}06897 \times 0{,}6) - (2{,}06897 \times 3{,}5)$ ✓
$= 15{,}517$ V
$I_{A2} = \frac{V_{//}}{R_{\text{heater}/verwarmer}}$
$= \frac{15{,}517}{10}$ ✓
$= 1{,}55$ A ✓

(3)

7.2 DECREASES ✓
Increasing R increases the total resistance of the circuit, hence reduces the overall circuit current, ✓ This will reduce the reading on A_2 and from $P = I^2R$, heat dissipated reduces. ✓ (relationship between current and power)

VERLAAG ✓
Toename van R lei tot toename in totale weerstand van die stroom, daarom verminder die totale stroom van die stroombaan. Dit sal die lesing op A_2 verminder en vanaf $P=I^2r$, word hitte gelewer verminder.

OR/*OF*

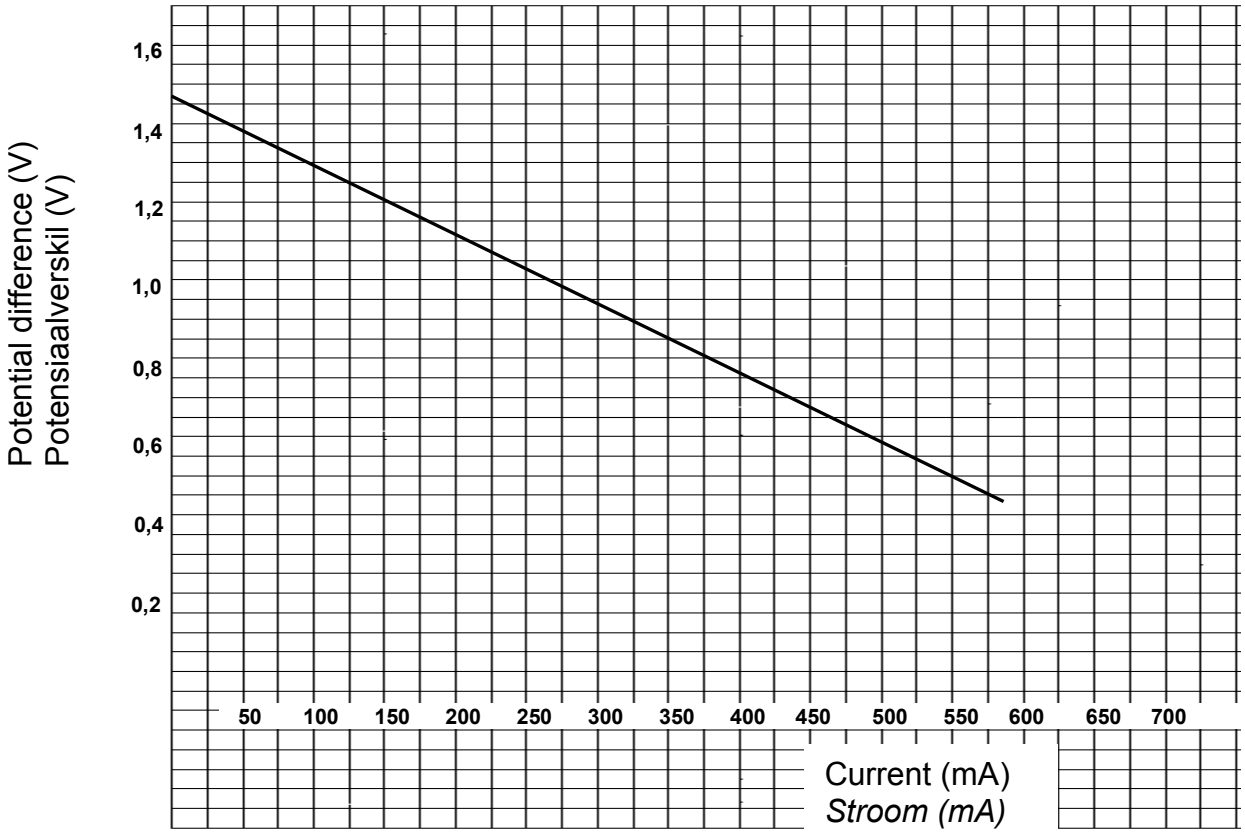
I decreases or V decreases ✓*I I verminder of V verminder*

$P = I^2 R$ or $P = \frac{V^2}{R}$ ✓

∴ Less heat dissipated. ✓/*Minder hitte word versprei.* (3)
[11]

QUESTION/*VRAAG* 8

8.1



Marking Guidelines/*Nasienriglyne*:
✓ Calibration on both axes/*Intervalle op beide asse*
✓ 5 points plotted correctly/*5 punte korrek geplot*
✓ Close fit line through most of the points/*Beste paslyn deur die meeste punte*
✓ Negative gradient/*Negatiewe gradient*
Do not penalise for A in place of mA

(4)

8.2 8.2.1 1,5 V ✓ (1)

8.2.2 gradient $= \frac{\Delta y}{\Delta x} = \frac{0,5-1,5\checkmark}{652\ x\ 10^{-3}-0\checkmark}$ if learners swop final and initial do not penalise

= - 1,53 Ω

r = 1,53 Ω ✓ (can use any of the values from the table.)/*(enige waardes vanuit die tabel kan gebruik word)*

must have a positive as the answer (3)

8.3 INCREASES ✓

As the resistance decreases the current will increase. ✓

Resistance is inversely proportional to the current.

As the current increases, the temperature of the battery will increase due to an increase in total resistance since internal resistance stays the same.

✓(relationship between current and energy) $W = I^2R\Delta t$

VERHOOG ✓

Soos die weerstand verminder sal die stroom verhoog. ✓

Weerstand is omgekeerd eweredig aan die stroom.

Soos die stroom verhoog, verhoog die temperatuur van die battery as gevolg van die groter totale weerstand en die interne weerstand bly konstant. ✓

$W = I^2R\Delta t$ (3)

[11]

QUESTION/*VRAAG* 9

9.1 Electrical energy to mechanical energy/ ✓✓ 2 or zero
Elektriese energie na meganiese energie (2)

9.2 Direct current: The current keeps flowing in one direction only. ✓✓
Gelykstroom: Die stroom hou aan om slegs in een rigting te beweeg.

OR/*OF*

The current carrying charges move in only one direction. ✓✓
Die stroom wat ladings dra, beweeg net in een rigting.

Marking criteria/*Nasienriglyne:*

If any of the underlined words/phrases in the correct context is omitted, deduct 1 mark.
Indien enige van die onderstreepte woorde/frases in die korrekte konteks uitgelaat word, trek een punt af.

(2)

9.3 FROM Q to P ✓/*VANAF Q tot P* (1)

9.4 Replace the commutator (split ring) ✓ with slip rings. ✓/
Vervang die kommutator (splitring) met 'n sleepring. (2)
✓

9.5 $P_{ave} = V_{rme} I_{rms}$ ✓
2000 = 220 I_{rms} ✓
I_{rms} = 9,09 A

I_{max} = $I_{rms}\sqrt{2}$ ✓
= 9,09 x $\sqrt{2}$ ✓
= 12,86 A ✓

If combined formulae – give the credit. (5)
[12]

QUESTION/*VRAAG* 10

10.1 The minimum frequency of light needed to emit electrons from a certain metal surface ✓✓
Die minimum frekwensie van lig benodig om elektrone vry te stel vanuit 'n sekere metaal se oppervlakte

OR/*OF*

A certain minimum frequency of incident radiation which will cause photoelectrons to be emitted from the surface of a metal✓✓
'n Sekere minimum frekwensie van invallende strale wat sal veroorsaak dat foto-elektrone uit die oppervlak van 'n metaal vrygestel word

Marking criteria/*Nasienriglyne:*
If any of the underlined words/phrases in the correct context is omitted, deduct 1 mark.
If learner explains **minimum energy** then **zero marks** are allocated. It has to be **frequency**.
Indien enige van die onderstreepte woorde/frases in die korrekte konteks uitgelaat word, trek 1 punt af.
*Indien leerder **minimum energie** verduidelik, dan **geen punte** toegeken nie. Dit moet **frekwensie** wees.*

(2)

10.2 10.2.1 $W_0 = hf_0$ ✓
= 6,63 x 10^{-34} 5,1 x 10^{14} ✓
= 3,38 x 10^{-19} J ✓

Marking guidelines/
***Nasienriglyne*:**
✓ Formula/*Formule*
✓ Substitution/*Vervanging*
✓ Answer/*Antwoord*

(3)

10.2.2 **OPTION/*OPSIE* 1**

$E = h\frac{c}{\lambda}$ ✓
$= \frac{6{,}63 \times 10^{-34} \times 3 \times 10^{8}}{400 \times 10^{-9}}$ ✓✓
= 4,97 x 10^{-19} J ✓

Marking guidelines/
***Nasienriglyne*:**
✓ Formula/*Formule*
✓ ✓Substitution/*Vervanging*
✓ Answer/*Antwoord*

(4)

OPTION 2: *OPSIE 2*

$f = \frac{c}{\lambda}$
$= \frac{3 \times 10^{8}}{400 \times 10^{-9}}$ ✓

$= 7{,}50 \times 10^{14}$ Hz
$E = hf$ ✓
$= 6{,}63 \times 10^{-34} \times 7{,}5 \times 10^{14}$ ✓

$= 4{,}97 \times 10^{-19}$ J ✓

(3)

10.2.3 **Positive marking from Question 10.2.1 and 10.2.2**
Positiewe nasien vanaf Vraag 10.2.1 en 10.2.2

$E = h\frac{c}{\lambda} = W_0 + Ek_{max/maks}$ ✓
$4{,}97 \times 10^{-19}$ ✓ $= 3{,}38 \times 10^{-19} + Ek_{max/maks}$ ✓

$Ek_{max/maks} = 1{,}59 \times 10^{-19}$ J ✓

Marking guidelines/*Nasienriglyne*:
- ✓ Formula/*Formule*
- ✓ ✓Substitution/*Vervanging*
- ✓ Answer/*Antwoord*

Notes/*Notas*:
- If max. is omitted from Ek formula, marks are lost for the formula. The rest can however be marked./
- *Indien maks. uitgelaat word van formule met Ek, word punte verbeur vir die formule. Die res kan wel steeds punte kry.*

(4)

10.3 Not marked. Mark moved to 10.2.2

[13]

TOTAL/*TOTAAL*: 150