GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2025

10841

PHYSICAL SCIENCES: PHYSICS

(PAPER 1)

PHYSICAL SCIENCES: Paper 1

10841E

TIME: 3 hours

MARKS: 150

16 pages + 3 data sheets

X05

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. You are advised to use the attached DATA SHEETS.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Start EACH question on a NEW page in the ANSWER BOOK.
8. Leave ONE line between two subquestions, e.g. 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.
11. Give brief motivations, discussions, etc. where required.
12. 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 A mass hangs from a single vertical string attached to a ceiling.

Which of the following forces is the Newton's third law pair for the weight of the mass?

A The force from the ceiling acting on the mass
B The tension in the string acting on the mass
C The gravitational force exerted by the mass on the Earth
D The gravitational force exerted by the Earth on the mass (2)

1.2 A block is at rest on a rough surface. The surface is at an angle θ to the horizontal. The block remains at rest as the angle θ is slowly increased.

Which of the following best describes how the magnitudes of the static frictional force of the rough surface on the block and the normal force change as θ is slowly increased?

	STATIC FRICTION FORCE	NORMAL FORCE
A	No change	No change
B	Increase	Increase
C	Decrease	Decrease
D	Increase	Decrease

(2)

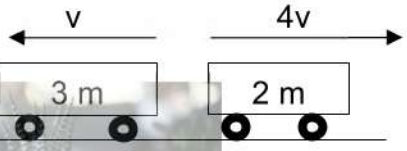
1.3 Ball A is thrown vertically upwards with speed v from the top of a building. At the same time, ball B is thrown vertically downwards with the same speed v. Both balls reach the ground at the same instant. Ignore the effects of air friction.

Which of the following statements is TRUE about the speed at which the balls hit the ground?

A The speed of ball A is greater than the speed of ball B.
B The speed of ball B is greater than the speed of ball A.
C The speed of ball B is equal to the speed of ball A.
D The speed of the balls will depend on their masses. (2)

1.4 Two trolleys of masses 3 m and 2 m are connected to each other and are moving at an unknown velocity.

A small explosion between them causes the trolleys to move apart in opposite directions. The trolley of mass 3 m moves at velocity v, and the trolley of mass 2 m, moves at a velocity of 4v.

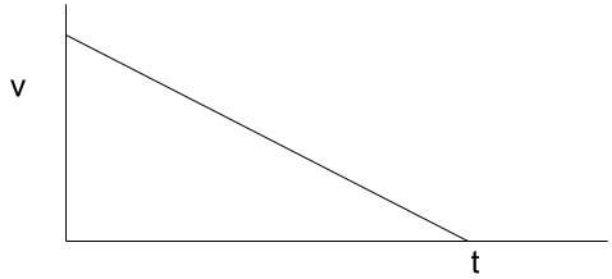


Which of the following statements is CORRECT?

	TOTAL p BEFORE	TOTAL KINETIC ENERGY AFTER
A	11 mv	17,5 mv^2
B	5 mv	17,5 mv^2
C	11 mv	14,5 mv^2
D	5 mv	14,5 mv^2

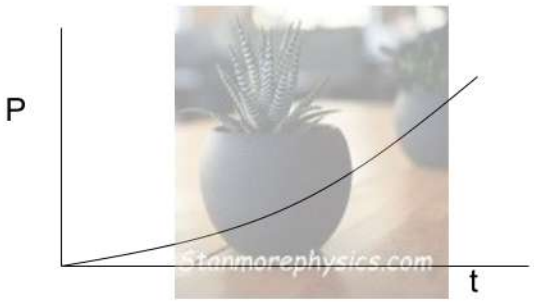
(2)

1.5 A car is moving in a straight line. The velocity of the car decreases with time t, as shown in the graph below.

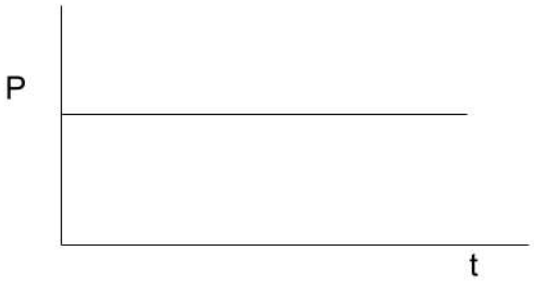


Which of the following graphs best represents the power of the braking system over this period of time, t?

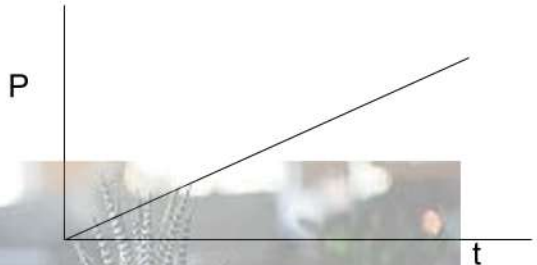
A



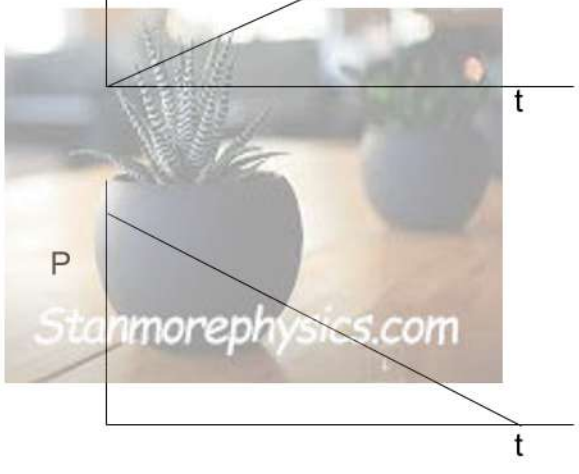
B



C



D



(2)

1.6 A car moves at a constant velocity towards a learner who is standing on the side of the road. The driver hoots as the car moves TOWARDS the learner.

Which of the following statements is CORRECT?

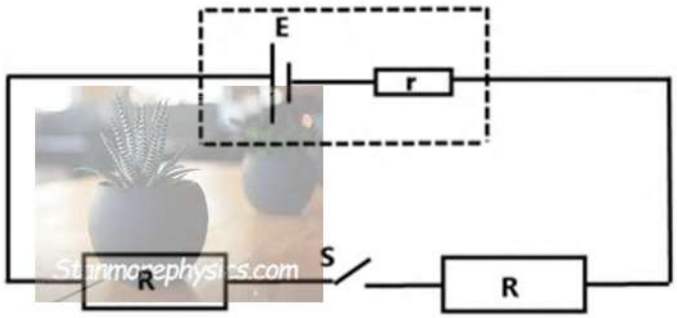
A The speed of the sound heard by the learner is higher than the speed of the sound emitted by the hooter.
B The wavelength of the sound heard by the learner is higher than the wavelength of the sound emitted by the hooter.
C The frequency of the sound heard by the learner is higher than the frequency of the sound emitted by the hooter.
D Both the wavelength and the frequency of the sound heard by the learner are lower than the wavelength and frequency of the sound emitted by the hooter. (2)

1.7 Two small spheres, each with a net charge of − Q, exert a force of magnitude **F** on each other.

One of the charges is now replaced by another with a charge of – 4Q. In the process, the distance between the objects is doubled. The force that one charge now exerts on the other charge is:

A F
B 2F
C 4F
D $\frac{1}{2}$F (2)

1.8 A battery, with an emf **E** and internal resistance **r**, is connected to a switch **S** and two identical resistors, as shown in the sketch below. Each resistor has a resistance **R**.



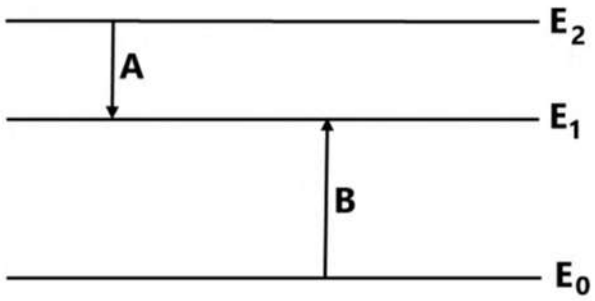
Which of the following statements is CORRECT when switch **S** is closed?

A The voltmeter reading is **E** when an ideal voltmeter is connected across the two resistors.
B The voltmeter reading is less than **E** when an ideal voltmeter is connected across the battery.
C The voltmeter reading is ½ **E** when an ideal voltmeter is connected across the two resistors.
D The voltmeter reading is **E** when an ideal voltmeter is connected across the battery. (2)

1.9 Which of the energy conversions below takes place when an AC generator is in operation?

A Potential to electrical
B Mechanical to electrical
C Electrical to mechanical
D Heat to mechanical (2)

1.10 The energy diagram for an element is shown below.



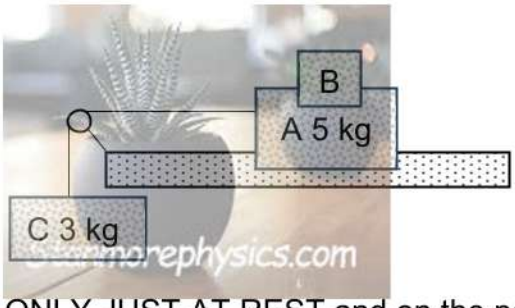
The electron transmission, **A,** from E_2 to E_1 corresponds to a green line in the element's spectrum.
The transition **B**, from E_0 to E_1, corresponds to the …

A emission of green light.
B absorption of green light.
C emission of red light.
D absorption of red light. (2)

[20]

QUESTION 2 (Start on a new page.)

Block **A** has a mass of 5 kg and block **C** has a mass of 3 kg. Block **A** is placed on a rough table with a coefficient of static friction of 0,2. Block **A** and block **C** are connected via a light, inextensible rope over a frictionless pulley and block **B** is placed on top of block **A** as shown in the diagram below.



The system is ONLY JUST AT REST and on the point of sliding.

2.1 Define the term *normal force*. (2)

2.2 Determine the tension in the string while the system is at rest. (3)

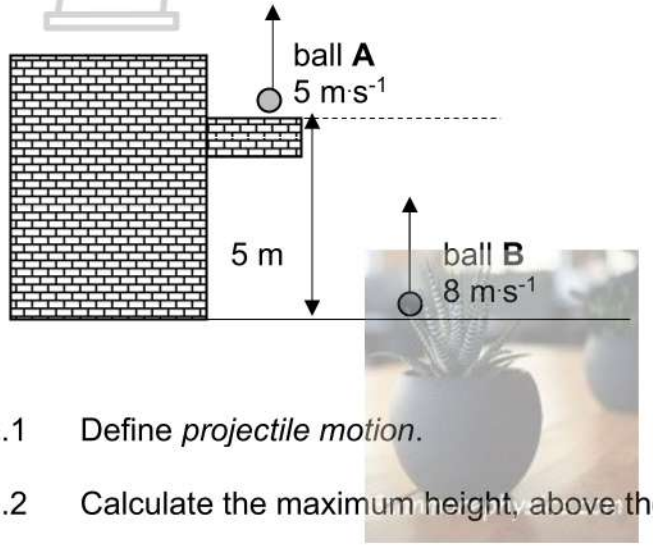
2.3 Draw a labelled free-body diagram, showing all the forces acting on block **A.** (5)

2.4 Calculate the minimum weight of block **B** needed to prevent block **A** from sliding. (5)

[15]

QUESTION 3 (Start on a new page.)

A learner stands on a balcony 5 m above the street and throws ball **A** vertically upwards at a velocity of 5 $m \cdot s^{-1}$. At the same time, another learner throws ball **B** vertically upwards from the street at an initial velocity of 8 $m \cdot s^{-1}$. Ignore all effects of air friction.



3.1 Define *projectile motion*. (2)

3.2 Calculate the maximum height, above the ground, reached by ball **A**. (3)

3.3 Calculate the time at which the two balls will move at the same speed. (5)

3.4 Ball **A** reached maximum height after 0,51 s. Calculate the velocity at which ball **B** was moving when ball **A** reached its maximum height. (2)

3.5 Sketch a velocity-time graph for the motion of the two balls until they reach the same speed.

Clearly indicate the following values on your graph:

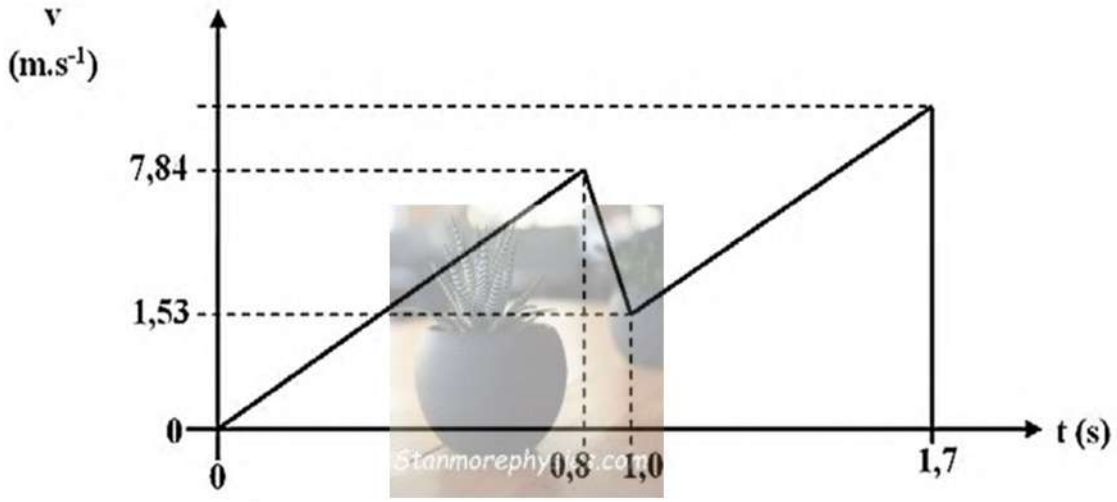
- Initial velocities of both balls
- Time at which ball **A** reaches maximum height
- Time at which the balls reach the same speed (4)

[16]

QUESTION 4 (Start on a new page.)

A learner is tests the strength of a piece of glass by dropping a steel ball of mass 5 kg from a height of 3 m onto the glass.

The velocity-time graph below represents the motion of the steel ball from the moment the learner drops the ball until it reaches the ground.



4.1 Define the term *momentum*. (2)

4.2 Calculate the net force exerted by the glass on the steel ball. (4)

4.3 Is this an ELASTIC or INELASTIC collision? Refer to the data in the graph and the relevant principles to explain the answer. (4)

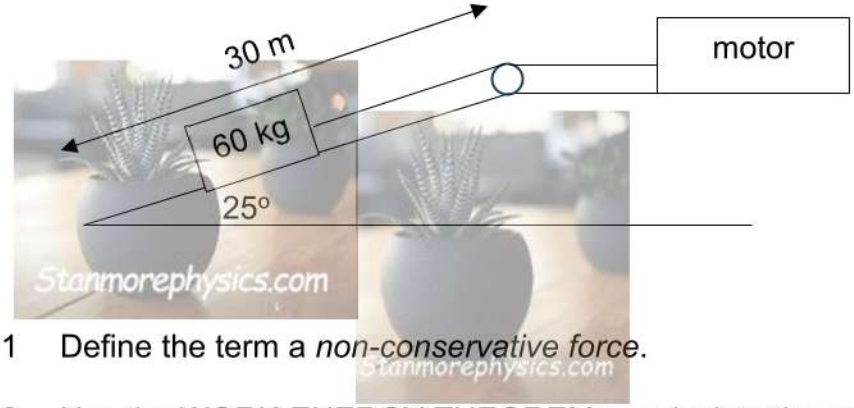
4.4 The glass does not break when the learner drops a soft rubber ball of similar mass from the same height onto the glass.

Use Physics principles to explain this phenomenon. (3)
[13]

QUESTION 5 (Start on a new page.)

A motor is used to pull a crate of mass 60 kg up a 30 m rough slope. The motor is connected to the crate with an inextensible rope of negligible mass running over a frictionless pulley. The slope is at an angle of 25° to the horizontal.

The crate starts from rest and reaches a speed of 7,5 $m \cdot s^{-1}$ at the top of the slope. The crate experiences a constant frictional force of 16,2 N.



5.1 Define the term a *non-conservative force*. (2)

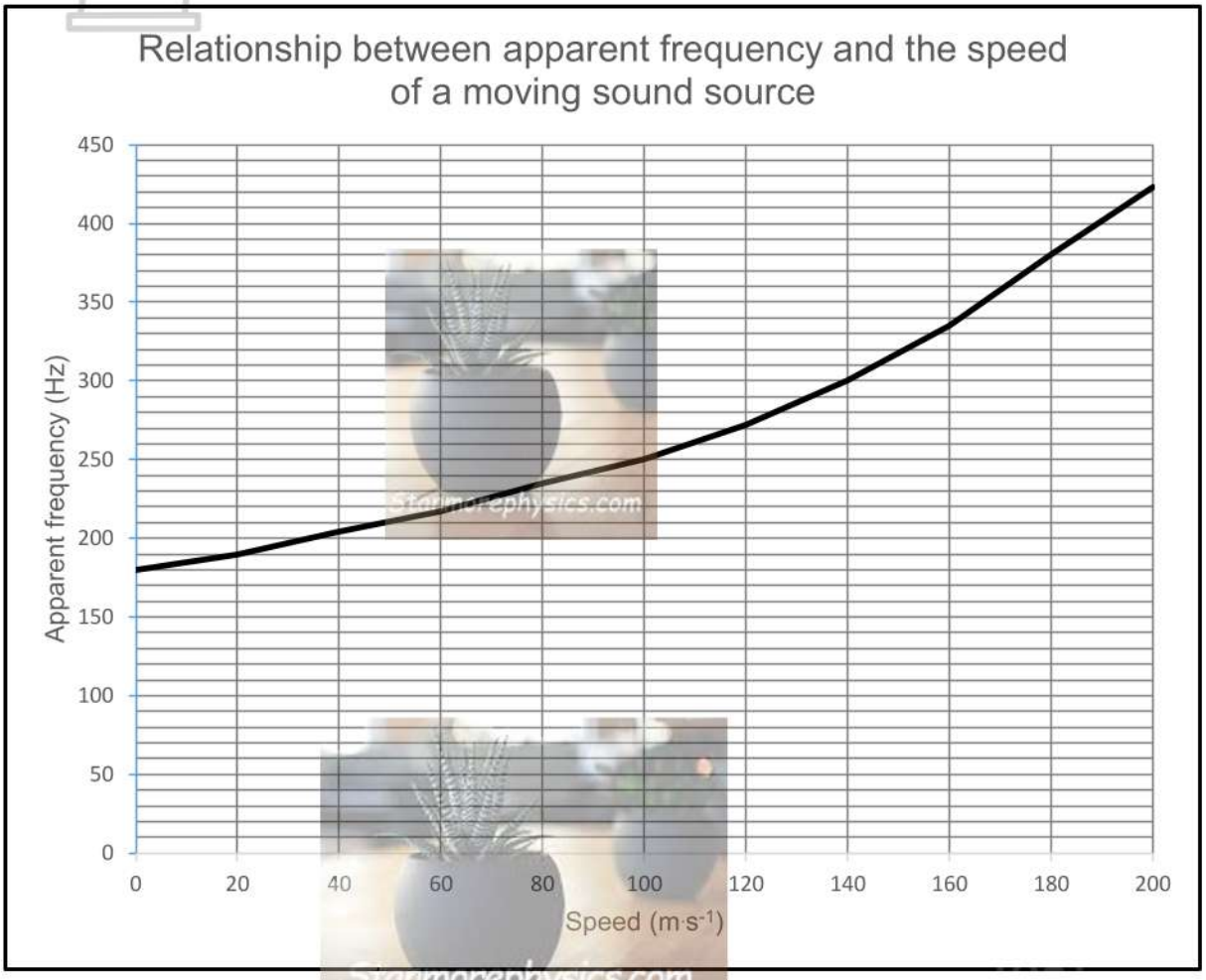
5.2 Use the WORK-ENERGY THEOREM to calculate the average power that the motor must provide to pull the crate up in 2 minutes. (7)

5.3 Will the work done by the motor INCREASE, DECREASE or REMAIN THE SAME if the crate is lowered down the same slope at the same initial and final velocities?

Explain the answer. (3)
[12]

QUESTION 6 (Start on a new page.)

A group of learners conducted an experiment to determine how the speed of a sound source moving towards a stationary observer affects the apparent frequency of the sound heard by the observer. The results of the experiment are shown in the graph below.



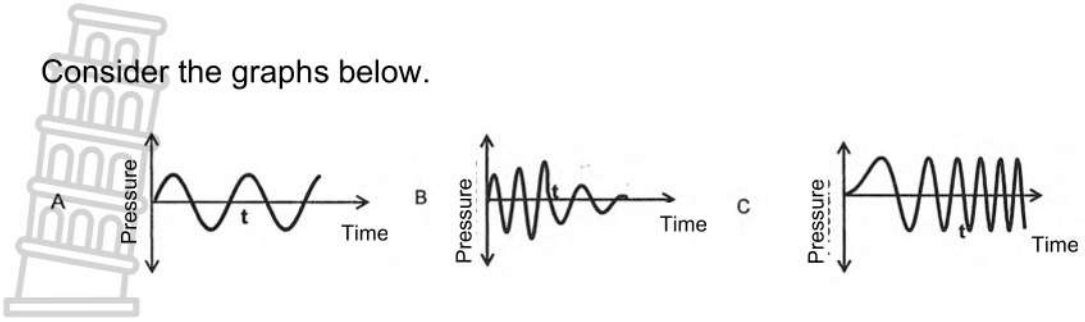
6.1 State the Doppler effect in words. (2)

6.2 Write down an investigative question for this experiment. (2)

6.3 Use the graph to determine the true frequency of the source. (2)

6.4 Use the results of the experiment conducted at a source speed of 100 $m \cdot s^{-1}$ to calculate the speed of sound in air on the day that the experiment was conducted. (4)

6.5 Consider the graphs below.



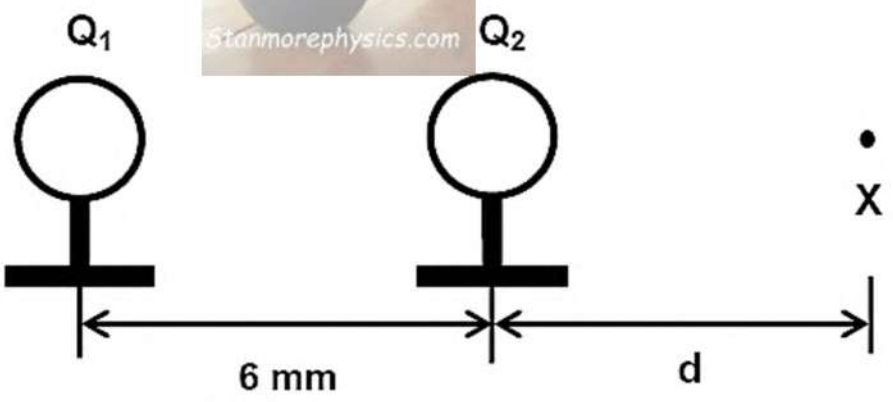
Which of the graphs best represents the wave as the source approaches the listener?

Explain the answer. (3)

[13]

QUESTION 7 (Start on a new page.)

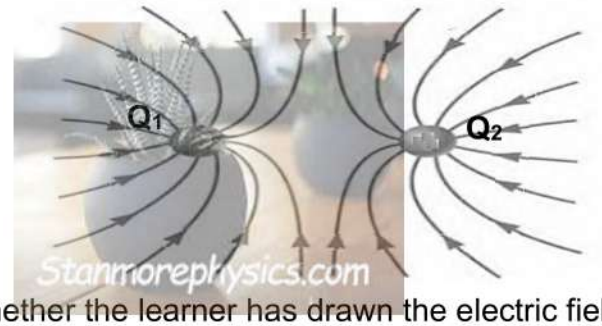
Two identical charges Q_1 and Q_2 are placed on insulated stands 6 mm apart, as shown in the diagram below.



The magnitude of the electrostatic force that Q_1 exerts on Q_2 is 3×10^{-3} N.
Point **X** is a distance **d** to the right of Q_2.

7.1 State Coulomb's law in words. (2)

7.2 A learner has drawn the following electric field pattern between charges Q_1 and Q_2.



State whether the learner has drawn the electric field pattern for TWO POSITIVE CHARGES or TWO NEGATIVE CHARGES.

Provide TWO reasons for the answer. (3)

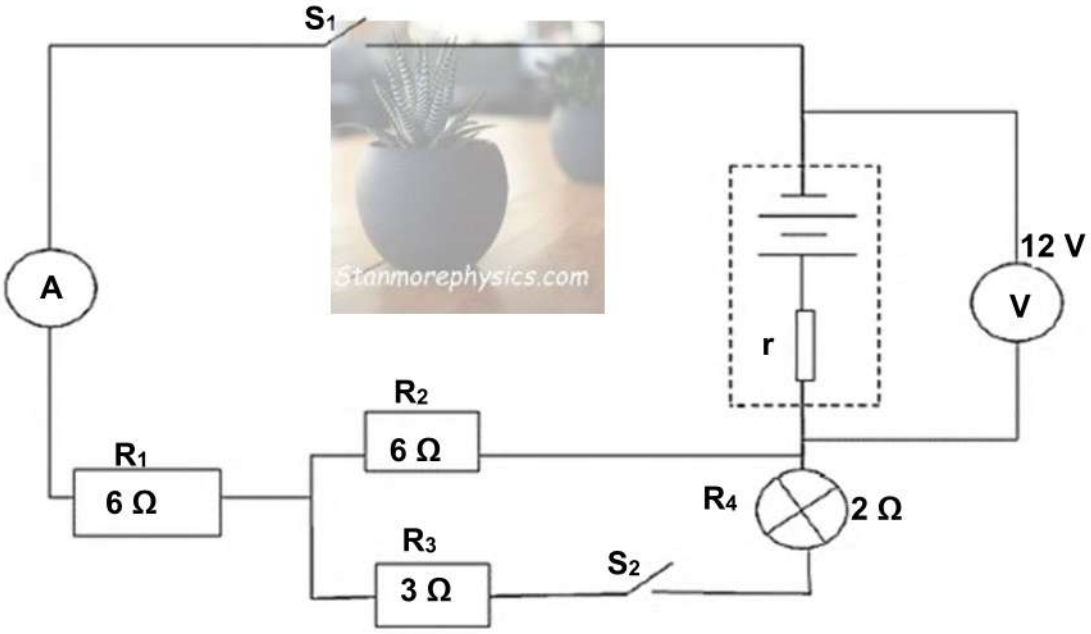
7.3 Calculate the magnitude of the charge on Q_1. (4)

7.4 The electric field strength due to Q_1 ONLY is 3,33 x 10^5 N.C^{-1} to the left.

Calculate the magnitude of the of distance **d**. (Refer to the first diagram.) (5)
[14]

QUESTION 8 (Start on a new page.)

In the circuit below, the battery has an emf of 12 V and internal resistance **r**. The three resistors and the light bulb are connected as shown in the diagram. The resistance of the bulb is 2 Ω. Initially, both switches S_1 and S_2 are open. The connecting wires and the ammeter have negligible resistance.



8.1 Define the term *emf*. (2)

8.2 With only switch S_1 closed, the reading on the voltmeter drops to 10,8 V.

Calculate the:

8.2.1 Reading on the ammeter A (4)

8.2.2 Internal resistance, **r**, of the battery (3)

8.3 With both switches, S_1 and S_2, now closed, the ammeter reading is 1,5 A.

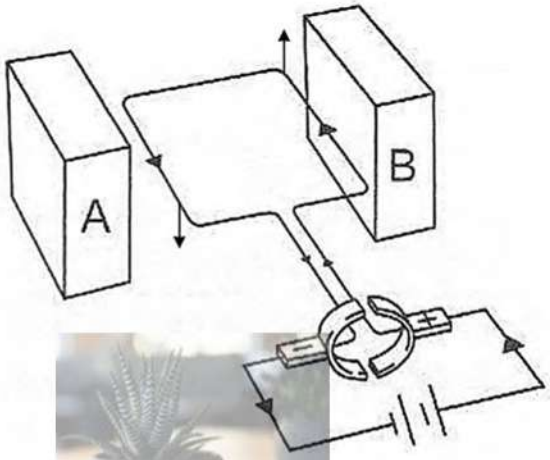
8.3.1 Calculate the power dissipated by the bulb. (7)

8.3.2 What effect will the closing of both switches have on the internal volts (lost volts)?

Write only INCREASE, DECREASE or REMAIN THE SAME.
Explain the answer. (3)
[19]

QUESTION 9 (Start on a new page.)

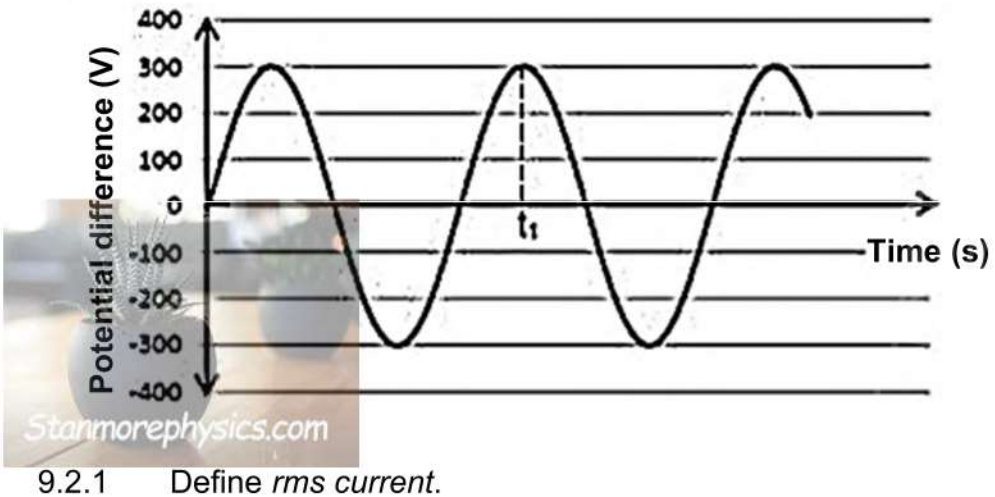
9.1 The simplified sketch below represents the structure of the motor of a cordless drill.



9.1.1 Name the electrical component in the above motor that ensures that the coil rotates in one direction only. (2)

9.1.2 Identify the polarity of magnets **A** and **B** if the current flows in the coil as indicated on the sketch and the coil rotates in an ANTICLOCKWISE direction. (2)

9.2 The maximum current output of another drill, operating on ALTERNATING current, is 10,6 A. A graph of potential difference output of the drill against time is shown below.



9.2.1 Define *rms current*. (2)

9.2.2 Calculate the rms current that the drill draws when operating. (3)

9.2.3 Hence, calculate the average power generated by the drill. (3)

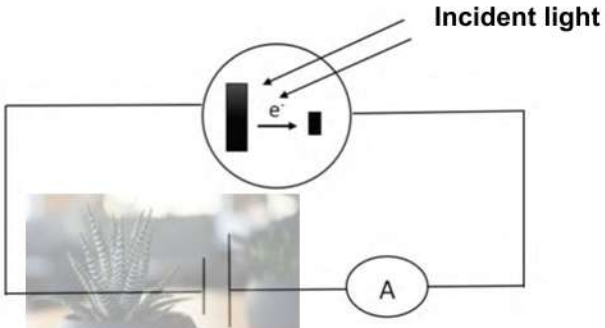
9.2.4 Is the power generated by the drill at t_1 a MAXIMUM or MINIMUM? (1)

9.2.5 Provide TWO reasons why alternating current is preferred over direct current over long distance transmission. (2)

[15]

QUESTION 10 (Start on a new page.)

Learners demonstrated the photo-electric effect by irradiating green and then blue light on a photocell as shown below.



10.1 A reading is registered on the ammeter when green light is used in the photocell above.

Provide a reason for this observation. (2)

10.2 The green light is now replaced with blue light of the same intensity and irradiated onto the photocell.

What influence will this have on the following:

10.2.1 The kinetic energy of the photoelectrons? Choose from INCREASES, DECREASES or STAYS THE SAME. (1)

10.2.2 The reading on the ammeter? Choose from INCREASES, DECREASES or STAYS THE SAME.

Provide an explanation to the answer. (4)

10.3 The wavelength of the blue light used in the demonstration is $4,5 \times 10^{-7}$ m.

Calculate the cut-off frequency (threshold frequency) of the metal used in the photocell if the average speed of the emitted photoelectrons is $4,62 \times 10^{5}$ m·s^{-1}. (6)

[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 electron*	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*** $E_P = mgh$
$K = \frac{1}{2}mv^2$ c **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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **or/*of*** $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ **or/*of*** $= \frac{hc}{\lambda}$
$E = W_o + E_{k(max)}$ 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) **or/*of*** emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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

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PHYSICAL SCIENCES: PHYSICS
FISIESE WETENSKAPPE: FISIKA

(PAPER/*VRAESTEL* 1)

16 pages/*bladsye*

QUESTION/*VRAAG* 1

1.1 C ✓✓ (2)

1.2 D ✓✓ (2)

1.3 Accept any answer ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 B ✓✓ (2)

1.10 Accept any answer ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1 The force or the component of a force which a surface exerts on an object with which it is in contact and which is perpendicular to the surface. ✓✓

Die krag of komponent van 'n krag wat 'n oppervlak op 'n voorwerp waarmee dit in kontak is, uitoefen en wat loodreg op die oppervlak is.

Marking criteria/*Nasienkriteria:*

If any of the underlined key words/phrases in the correct context is omitted, deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.* (2)

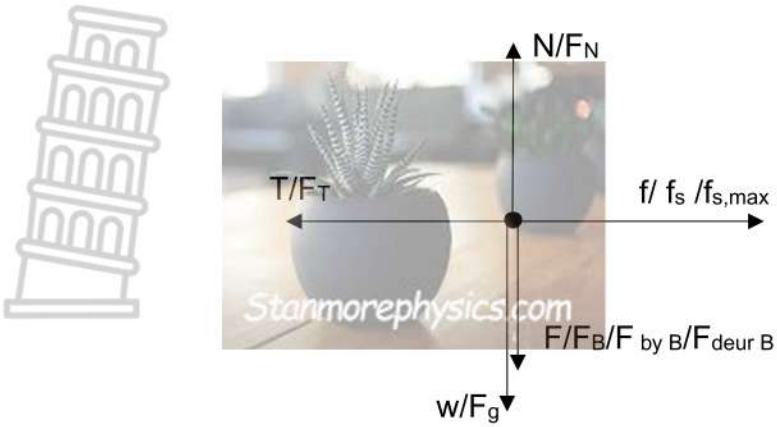
2.2 In horizontal direction/*In horisontale rigting*:

$F_{net} = 0$ (N)
$T - w = 0$
$T = mg$
✓ Any one/*Enige een*

$= (3)(9,8)$ ✓

$= 29,4$ N ✓ (3)

2.3



Accepted labels/Aanvaarde benoemings	
w	F_g/F_w/weight/gravitational force/*gewig/gravitasiekrag*
N	N/ F_N / Normal Force/*Normaalkrag*
f	f_s / Friction/*Wrywing*
T	F_T /Tension/*Spanning*
F	T/ F_B/$F_{by\ B}$/ Force applied by B/ w_B / $F_{deur\ B}$/*Krag toegepas deur B*

Marking criteria/*Nasienkriteria:*

1 mark is allocated for each correct label and arrow./*1 punt word toegeken vir elke korrekte benoeming en pyl.*

Do not penalise for length of arrows./*Moenie penaliseer vir lengte van pyle nie.*

Any additional force(s)/*Enige ekstra krag(te)*: max/maks 4/5

If everything is correct but no arrows/*Indien alles korrek is maar geen pyle*: max/maks 4/5

(5)

2.4 **POSITIVE MARKING FROM QUESTION 2.2.**
POSITIEWE NASIEN VANAF VRAAG 2.2.

OPTION 1/*OPSIE 1*:	OPTION 2/ *OPSIE 2*:
$f_{s,max/maks} = \mu_s N$✓ 29,4 = 0,2N✓ N = 147 N Vertical direction/ *Vertikale rigting:* $F_{net} = 0$ ✓ $N - w - F_B = 0$ $\frac{147 - (5)(9,8)}{}$ ✓$= F_B$ F_B = 98 N ✓	$F_{net} = 0$ ✓ $T - f_s^{max} = 0$ $T - \mu_s N$✓ $= 0$ ✓ $\frac{29,4 - (0,2)(5+m_B)(9,8)}{}$ ✓$= 0$ m_B = 10 kg $F_g = mg = (10)(9,8)$ = 98 N ✓

OPTION 3:

$f_{s,max/maks} = \mu_s N$ ✓
$29,4 = (0,2)N$ ✓
$N = 147$ N

$N - F_g = 0$ ✓
$147 - 9,8(5 + m_B)$ ✓$= 0$

$m_B = 10$ kg

$F_g = mg = (10)(9,8)$
$= 98$ N ✓

Marking guidelines/*Nasienriglyne*:
- ✓ Formula for friction/*Formule vir wrywing*
- ✓ Substitution from Q 2.2 and μ_s/ *Invervanging vanaf Vr 2.2 en* μ_s
- ✓ Substitution of N/*Invervanging van N*
- ✓ Substitution of w_A/*Invervanging van* w_A
- ✓ Answer/*Antwoord* 98 N

(5)

[15]

QUESTION/*VRAAG* 3

3.1 The motion of an object under the influence of gravitational force only. ✓✓ (2 or 0)

Die beweging van 'n voorwerp slegs onder die invloed van gravitasiekrag. (2 of 0)

Marking criteria/*Nasienkriteria*
Do not accept gravity.
Do not accept if projectile is defined (when starting with the object in your sentence).
Moet nie gravitasie aanvaar nie.
Moet nie aanvaar indien projektiel gedefinieer word nie (m.a.w. begin die sin met die voorwerp)

(2)

3.2

Option 1/*Opsie 1*

Up as positive/*Op as positief*:
$v_f^2 = v_i^2 + 2a\Delta y$✓
$0^2 = (5)^2 + (2)(-9,8)\Delta y$✓
$\Delta y = 1,28$ m
Maximum height = 1,28 + 5 ✓ = 6,28 m ✓ (above the ground)
Maksimum hoogte = 1,28 + 5 = 6,28 m (bokant die grond)

Down as positive/*Af as positief*:
$v_f^2 = v_i^2 + 2a\Delta y$✓
$0^2 = (-5)^2 + (2)(9,8)\Delta y$✓
$\Delta y = -1,28$ m
Maximum height = 1,28 + 5 ✓ = 6,28 m ✓ (above the ground)
Maksimum hoogte = 1,28 + 5 = 6,28 m (bokant die grond)

(4)

Option 2/*Opsie 2*	**Down as positive/*Af as positief***
Up as positive/*Op as positief*	
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0 = 5 + (-9,8)\,\Delta t$	$0 = -5 + 9,8\Delta t$
$\Delta t = 0,51$ s	$\Delta t = 0,51$ s
$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$ ✓
$= 5(0,51) + \frac{1}{2}(-9,8)(0,51)$ ✓	$= (-5)(0,516) + \frac{1}{2}(9,8)(0,51)$ ✓
$= 1,28$ m	$= -1,28$ m
Maximum height/*Maksimum hoogte* =	Maximum height/*Maksimum hoogte* =
1,28 + 5 ✓ = 6,28 m✓	1,28 + 5 ✓ = 6,28 m✓

Marking criteria/*Nasienkriteria*:
- ✓ Formula/*Formule*
- ✓ Substitution/*Invervanging*
  (v and g opposite signs./*v en g teenoorgestelde tekens*)
- ✓ Adding 5 m to answer./*Voeg 5 m by antwoord.*
- ✓ Final correct answer / *finale korrekte antwoord*

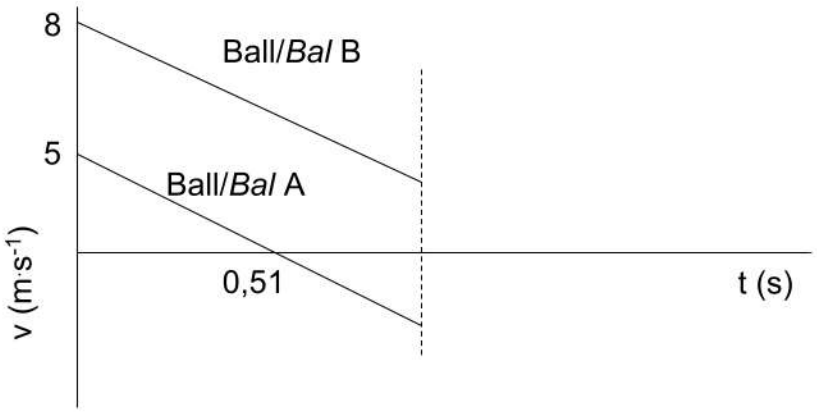
(4)

3.3 Do not mark this question
Marks have been redistributed

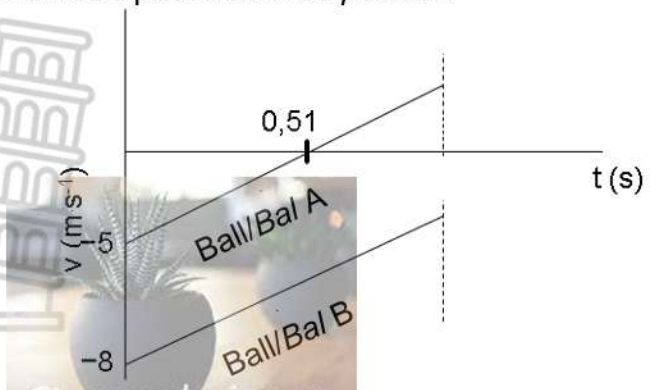
Moet nie hierdie vraag merk nie
Punte is herverdeel

3.4
$v_f = v_i + a\Delta t$ ✓
$v_f = 8 + (-9,8)(0,51)$ ✓
$v_f = 3,0\ m{\cdot}s^{-1}$ ✓ up/*op* ✓ (4)

3.5 Up as positive:/*Op as positief:*



Down as positive:/*Af as positief*:



Marking criteria/*Nasienkriteria*:

- ✓ Lines are parallel/*Lyne is parallel*
- ✓ Ball A intercepts at 0,51 s/*Bal A sny die x-as by 0,51 s*
- ✓✓ Each initial velocity/*Elke aanvanklike snelheid*
- ✓ Graphs for balls A and B are in different quadrants at end/*Grafieke vir balle A en B is in verskillende kwadrante aan die einde*
- ✓ Both graphs end at the same time./*Albei grafieke eindig op dieselfde tyd*.

If graphs are not labelled as A or B, deduct one mark /*Indien grafieke nie benoem is met A of B nie, trek een punt af*

(6)

[16]

QUESTION/*VRAAG* 4

4.1 The product of an object's mass and its velocity. ✓✓ (2 or zero)
Die produk van 'n voorwerp se massa en sy snelheid (2 of nul) (2)

4.2

OPTION 1/ *OPSIE 1*

Down is positive/Af is positief

$F_{net}\Delta t = \Delta p$✓

$F_{net}(0,2)$ ✓$= (5)(1,53 - 7,84)$ ✓

$F_{net} = -157,75$ N

$F_{net} = 157,75$ N ✓ (upwards/*opwaarts*)

OPTION 2/ *OPSIE 2*

Gradient = $\frac{1,53-7,84}{1,0-0,8}$ ✓

a = - 31,55 m·s^{-2}

$F_{net} = ma$ ✓

$= (5)(-31,55)$ ✓

$= - 157, 75$

$F_{net} = 157, 75$ N ✓ (upwards/*opwaarts*)

Marking guideline/*Nasienriglyn*:
- ✓ Formula/*Formule*
- ✓ ✓ Substitution/*Invervanging*
- ✓ Answer/*Antwoord*

(4)

4.3 Inelastic ✓
- The velocity/speed before is greater than the velocity/speed after the collision ✓ ✓
- Total kinetic energy is not conserved ✓

OR/*OF*

If calculation is given:

Total E_k before = ½ mv^2

= ½ (5)(7,84)^2✓

= 153,664 J

Total E_k after = ½ mv^2

= ½ (5)(1)^2 ✓

= 2,5 J

Total E_k before is not equal to total E_k after ✓

Onelasties
- *Die snelheid/spoed van die bal voor die botsing is groter as die snelheid/spoed van die bal na die botsing*
- *Totale kinetiese energie bly nie behoue nie.*

(4)

4.4
- The two balls will undergo the same Δp to stop. ✓
- The rubber ball will take longer to stop as it is soft. F is inversely proportional to Δt if Δp is constant. ✓
- The force needed to stop the rubber ball is small enough for the glass not to break. ✓

(3)

- *Die twee balle ondergaan dieselfde Δp om te stop.*
- *Die rubberbal sal langer neem om te stop aangesien dit sag is. F is omgekeerd eweredig aan Δt indien Δp konstant is.*
- *Die krag wat nodig is om die rubberbal te stop, is klein genoeg dat die glas nie breek nie.*

[13]

QUESTION/*VRAAG* 5

5.1 A force for which the work done in moving an object between two points depends on the path taken.
'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word. (2)

Marking criteria/*Nasienkriteria*:
Deduct 1 mark for each of the underlined phrases in the correct context that are omitted. If the word **work done** is left out, then zero. If conservative force is defined, then zero.
*Trek 1 punt af vir elk van die onderstreepte frases in die korrekte konteks wat uitgelaat is. Indien die woord **arbeid verrig** uitgelaat is dan geen punte. Indien die konserwatiewe krag gedefinieer word, dan geen punte.*

5.2

ANSWER FOR ENGLISH PAPER:

$W_{net} = \Delta K$ ✓

$W_{motor} + W_w + W_f = ½ m(v_f^2 - v_i^2)$

$W_{motor} + (60)(9,8)(30)\cos 115^o$✓$ + (16,2)(30)\cos 180^o$✓$ = ½(60)(7,5^2 - 0^2)$ ✓

$W_{motor} = 9628,486J$

$P = \frac{W}{\Delta t}$ ✓

$= \frac{9628,486}{120}$ ✓

= 80,24 W ✓ (80,2374 Watt)

(If W_{nc} is used, then deduct only one mark for formula.) (7)

ANTWOORD VIR AFRIKAANSE VRAESTEL:

$W_{net} = \Delta K$✓

$W_{motor} + W_w + W_f = ½ m(v_f^2 - v_i^2)$

$W_{motor} + (60)(9,8)(30)\cos 115^o$✓$ + (16,2)(30)\cos 180^o$✓$ = ½(60)(7,5^2 - 0^2)$✓

$W_{motor} = 9628,486J$

$W_{motor} = F\Delta x\cos\theta$✓

$9628,486 = F(30)\cos 0^o$ ✓

$F = 320,95$ N✓

(Indien W_{nc} gebruik word, trek slegs een punt af vir formule.) (7)

5.3 DECREASES ✓

- ΔK stays the same✓
- Work done by the motor is in the same direction as work done by the gravitational force ✓

VERLAAG

- *ΔK bly dieselfde*
- *Arbeid verrig deur die motor is in dieselfde rigting as die arbeid verri deur die gravitasiekrag.* (3)

[12]

QUESTION/*VRAAG* 6

6.1 The change in frequency (or pitch) of the sound detected by a listener, because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

OR

An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer (listener).

Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.

OF

'n (Skynbare) verandering in waargenome frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer (luisteraar).

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

(2)

6.2 What is the relationship between the speed at which a source moves and the apparent frequency detected by the observer if the speed of sound in air is constant?
Wat is die verwantskap tussen die spoed waarteen 'n bron beweeg en die skynbare frekwensie waargeneem deur die waarnemer indien die spoed van klank in lug konstant is?

Marking criteria/*Nasienkriteria:*
Relationship must be stated between dependent and independent variables.
If question has yes/no answer: max ½
Verwantskap moet gestel word tussen afhanklike en onafhanklike veranderlikes.
Indien vraag 'n ja/nee antwoord het: maks ½
Indien vraagteken uitgelaat is: maks ½ (2)

6.3 180 (Hz) ✓✓ (2)

6.4 **POSITIVE MARKING FROM QUESTION 6.3.**
POSITIEWE NASIEN VANAF VRAAG 6.3.

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

$250 ✓ = \frac{v}{v - 100} 180$ ✓

v = 357,143 m·s^{-1} ✓

Marking guideline/*Nasienriglyn*:
✓ Complete doppler formula/*Volledige Doppler-formule*
✓ Substitution left/*Invervanging links*
✓ Substitution right with correct signs./*Invervanging regs met korrekte tekens.*
✓ Answer/*Antwoord* (4)

6.5 Graph A and/or C ✓
- As the source approaches the number of wavefronts approaching the learner per second will increase ✓
- leading to a higher frequency. ✓

OR
- As it gets closer the waves are more compressed as the frequency increases/wavelength decreases
- and the time decreases.

Grafiek A en/of C
- *Soos die bron nader kom, neem die aantal golffronte per sekonde wat na die leerling beweeg toe,*
- *wat lei tot 'n hoër frekwensie.*

OF
- *Soos dit nader kom, is die golwe meer saamgepers omdat die frekwensie toeneem/golflengte afneem*
- *en die tyd afneem.* (3)

[13]

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 (magnitude of the) ✓ charges and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

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

7.2 2 negative charges ✓
- Direction of field pattern is towards the spheres ✓✓

OR
- direction in which a positive test charge will move if placed in the field.

2 negatiewe ladings
- *Rigting van die veldpatroon is na die sfere toe*

OF
- *Rigting waarin 'n positiewe toetslading sal beweeg indien dit in die veld geplaas word.* (3)

7.3 $F = \frac{kQ_1Q_2}{r^2}$ ✓

✓$3 \times 10^{-3} = \frac{(9\times10^9)Q_1Q_2}{(6\times10^{-3})^2}$ ✓

Q = $3{,}46 \times 10^{-9}C$ ✓ ACCEPT/*AANVAAR* Q = $-3{,}46 \times 10^{-9}C$

Marking criteria/*Nasienkriteria*:
- ✓ Formula/*Formule*
- ✓ Substitution left/*Invervanging links*
- ✓ Substitution right/*Invervanging regs*
- ✓ Answer/*Antwoord* (4)

7.4 **POSITIVE MARKING FROM QUESTION 7.3.**
POSITIEWE NASIEN VANAF VRAAG 7.3.

$E = \frac{kQ}{r^2}$ ✓

✓ $3{,}33 \times 10^5 = \frac{(9\times10^9)(3{,}46\times10^{-9})}{(r)^2}$ ✓

$r = 9{,}67 \times 10^{-3}\text{m}$

d = $9{,}67 \times 10^{-3} - 6 \times 10^{-3}$ ✓ (for subtraction/*vir aftrek*)

$= 3{,}67 \times 10^{-3} m$ ✓

OR/*OF*

$E = \frac{kQ}{r^2}$ ✓

✓ $3{,}33 \times 10^5 = \frac{(9\times10^9)(3{,}46\times10^{-9})\checkmark}{(0{,}006 + d)^2\checkmark}$

d = $3{,}67 \times 10^{-3} m$ ✓

Marking criteria/*Nasienkriteria*:
- ✓ Formula/*Formule*
- ✓ Substitution left/*Invervanging links*
- ✓ Substitution right/*Invervanging regs*
- ✓ Subtracting/Adding 6 mm/ *Aftrek/Optel van 6 mm*
- ✓ Answer/*Antwoord*

If – Q is substituted./*Indien – Q invervang word.*
Max/*Maks* 3/5 (5)

[14]

QUESTION/*VRAAG* 8

8.1 The maximum energy provided by a battery per unit charge passing through it. ✓✓ (2 or 0)
Die maksimum energie wat 'n battery lewer per eenheidslading wat daardeur vloei. (2 of 0) (2)

8.2.1 $R_{ext} = R_1 + R_2 = 6 + 6 = 12\ \Omega$

$V = IR$ ✓

$10{,}8$ ✓$= I(12)$ ✓

$I = 0{,}9\ A$ ✓

Marking criteria/*Nasienkriteria*:
- ✓ Formula/*Formule*
- ✓ Substitution left/*Invervanging links*
- ✓ Substitution right *Invervanging regs*
- ✓ Answer/*Antwoord* (4)

8.2.2 **POSITIVE MARKING FROM QUESTION 8.1.1.**
POSITIEWE NASIEN VAN VRAAG 8.1.1.

Option/*Opsie* 1

$\varepsilon = I(R + r)$ ✓

$12 = 0{,}9\ (12 + r)$ ✓

$r = 1{,}33\ \Omega$ ✓

Option/*Opsie* 2

$V = Ir$ ✓

$(12 - 10{,}8) = 0{,}9\ r$

$1{,}2 = 0{,}9\ r$ ✓

$r = 1{,}33\ \Omega$ ✓

Marking Criteria/*Nasienkriteria*:
- ✓ Formula/*Formule*
- ✓ Substitution/*Invervanging*
- ✓ Answer/*Antwoord*

(3)

8.3.1

Option/*Opsie* 1

$R_p = \frac{R_2 \times R_{3+4}}{R_2 + R_{3+4}}$ ✓

$= \frac{6 \times 5}{6+5}$ ✓

$= 2{,}73\ \Omega$ ✓

$V_p = IR = 1{,}5\ (2{,}73) = 4{,}1\ V$

$V_p = V_3 + V_{bulb}$

$4{,}1 = IR_3 + IR_{bulb}$

$4{,}1 = I(R_3 + R_{bulb})$

$4{,}1 = I(3 + 2)$ ✓

$I = 0{,}82\ A$ ✓ ✓

$P = I^2R = (0{,}82)^2(2) = 1{,}34\ W$ ✓

Option/*Opsie* 2

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_{2+3}}$ ✓

$\frac{1}{R_P} = \frac{1}{6} + \frac{1}{3+2}$ ✓

$R_P = 2{,}73\ \Omega$ ✓

$V_P = IR_P = 1{,}5(2{,}73) = 4{,}1\ V$

$V_p = V_3 + V_{bulb}$

$4{,}1 = IR_3 + IR_{bulb}$

$4{,}1 = I(R_3 + R_{bulb})$

$4{,}1 = I(3 + 2)$ ✓

$I = 0{,}82\ A$ ✓ ✓

$P = I^2R = (0{,}82)^2(2) = 1{,}34\ W$ ✓

Marking citeria/Nasienkriteria:
- ✓ formula for Rp/*formule vir Rp*
- ✓ substitution for Rp/*invervanging vir Rp*
- ✓ substitution for Ohms law/*invervanging vir Ohm se wet*
- ✓ substitution for calculating current/*invervanging vir berekening van stroom*
- ✓ formula for power/*formule vir drywing*
- ✓ substitution for power/*invervanging vir drywing*
- ✓ answer for power/*antwoord vir drywing*

Option/*Opsie* 3 – using ratios/*gebruik verhoudings*

Resistance/*weerstand* 6 : 5
Current/*stroom* 5 : 6 ✓

∴ current through the bulb/*stroom deur gloeilamp* $= \frac{6}{11}\ x\ 1{,}5 = 0{,}518\ A$ ✓✓

✓ ✓ ✓

$P = I^2R = (0{,}82)^2 \times 2 = 1{,}34\ W$ ✓

(7)

8.3.2 INCREASES ✓
Internal resistance AND emf remains the same ✓
Total resistance decreases AND Total current increases ✓

VERHOOG
Interne weerstand EN emk bly dieselfde
Totale weerstand verlaag EN Totale stroom neem toe

(3)
[19]

QUESTION/*VRAAG* 9

9.1.1 (split-ring) Commutator ✓✓
(Splitring) Kommutator (2)

9.1.2 A – South/*Suid* ✓
B – North/*Noord* ✓ (2)

9.2.1 The rms current is the alternating current that dissipates/produces the same amount of energy as the equivalent direct current (DC). ✓✓ (2 or zero)

If potential difference is explained – zero.

Die wgk-stroom is die wisselstroom wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente gelykstroom (GS). (2 of nul)

Indien potensiaalverskil verduidelik word dan nul. (2)

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

$= \frac{10,6}{\sqrt{2}}$ ✓

$= 7,495\ A$ (7,50A) ✓ (3)

9.2.3

Positive marking for option 1 from 9.2.2/*Positiewe nasien vir opsie 1 vanaf 9.2.2*	
OPTION 1/*OPSIE 1* $P_{ave} = V_{rms}I_{rms}$ ✓ $= \left(\frac{V_{max}}{\sqrt{2}}\right)(7,495)$ $= (\frac{300}{\sqrt{2}})(7,495)$ ✓ $= 1\,589,93\ W$ ✓ (Accept range/*Aanvaar gebied*: 1 589,93 – 1 590,99 W)	OPTION 2/*OPSIE 2* $P_{max} = V_{max}I_{max}$ ✓ = (300)(10,6) = 3180 W $P_{ave} = \frac{3180}{2}$ ✓ = 1590 W ✓ (Accept range/*Aanvaar gebied*:1589,93 -1590,99 W)

(3)

OPTION 3/*OPSIE 3*

$R = \frac{V}{I}$

$= \frac{300}{10,6}$

=28,302 Ω

$P = I^2_{rms}R$✓ OR $P = \frac{V^2_{rms}}{R}$ ✓

= (7,95)²(28,302)✓ $= \frac{(\frac{300}{\sqrt{2}})^2}{28,302}$✓

= 1591,98 W✓ =1589,99 W✓

(Accept range/*Aanvaar gebied*: 1589,93 -1591,99 W)

9.2.4 Maximum ✓/*Maksimum* (1)

9.2.5 AC can be transported over long distances as it can be transformed (Step up/ down) to minimise power loss. ✓
It is easier to generate AC current.
OR
Higher voltage means lower current $P\alpha I^2$.

WS kan oor groot afstande vervoer word aangesien dit met 'n transformator verhoog of verlaag kan word om energie verlies te verminder.
Dit is makliker om WS-krag op te wek.
OF
Hoër potensiaalverskil beteken laer stroom aangesien $P\alpha I^2$. (2)
[15]

QUESTION/*VRAAG* 10

10.1 The frequency of the green light is higher than the threshold/ "cut-off" frequency of the metal in the photocell. (accept $f > f_0$) ✓✓

OR

The energy of the photons of green light is greater than the work function of the metal in the photocell. (accept $E > W_0$)

OR

Accept: The photo-electric effect takes place

OR

Accept: Light of a suitable frequency is used.

Die frekwensie van die groen lig is hoër as die drumpel-/'afsny-' frekwensie van die metaal in die fotosel. (aanvaar $f > f_0$)

OF

Die energie van die fotone van groen lig is groter as die werkfunksie van die metaal in die fotosel. (aanvaar $E > W_0$)

OF

Aanvaar: die foto-elektriese effek vind plaas.

OF

Aanvaar: Lig van 'n geskikte frewkensie word gebruik

(2)

10.2.1 Increase/*Verhoog* ✓ (1)

10.2.2 Stays the same ✓

- Blue light has photons of higher energy. ✓
- Higher kinetic energy of the electrons. ✓
- Only the intensity of light has an influence on the number of electrons emitted per unit time. ✓

Bly dieselfde

- *Blou lig het fotone met 'n hoër energie*
- *Hoër kinetiese energie van die elektrone.*
- *Slegs die intensiteit van lig het 'n invloed op die aantal elektrone wat per eenheid tyd vrygestel word.* (4)

10.3 $E = W_0 + E_{k(max)}$ ✓

$\frac{hc}{\lambda} = hf_0 + {}^1/_2 mv_{max}^2$ ✓ ✓ } Any one/*Enige een*

$\frac{6,63 \times 10^{-34} \times 3 \times 10^8}{4,5 \times 10^{-7}} = 6,63 \times 10^{-34} f_0 + {}^1/_2 (9,11 \times 10^{-31})(4,62 \times 10^5)^2$ ✓ ✓

$f_0 = 5,20 \times 10^{14} Hz$ ✓ (6)

[13]

TOTAL/*TOTAAL:* **150**