education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES P1

SEPTEMBER 2026

PHYSICAL SCIENCES P1

12841B

MARKS: 150

TIME: 3 HOURS

X05

This paper consists of 15 pages and 3 information sheets.

N4

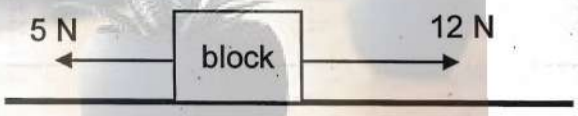
INSTRUCTIONS AND INFORMATION

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

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 number (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 Two forces, 5 N and 12 N, act simultaneously on a block as shown in the diagram below.



What is the magnitude and direction of the third force which will keep the block in equilibrium?

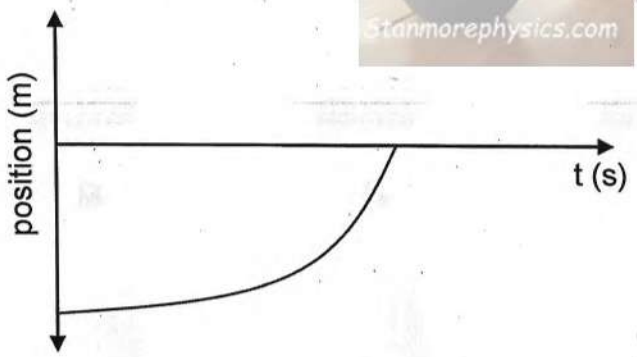
A 7 N to the left

B 7 N to the right

C 17 N to the left

D 17 N to the right (2)

1.2 A position-time graph of an object dropped from the top of a building is given below. Ignore the effects of air resistance.



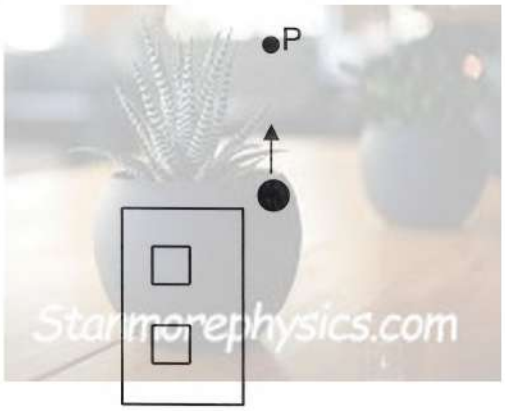
Which ONE best describes the magnitude of velocity and the direction of an object?

	Velocity ($m \cdot s^{-1}$)	Acceleration ($m \cdot s^{-2}$)
A	Decreasing	–
B	Decreasing	+
C	Increasing	–
D	Increasing	+

(2)

1.3 A ball is projected vertically upward from the top of a building with initial speed v. On its way upward, it reaches speed $\frac{v}{2}$ at point P.

Ignore the effect of air resistance.



Which ONE of the following statements is correct?

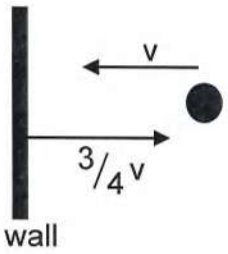
A The time taken to travel from P to the maximum height is equal to the time taken to travel from the maximum height back to P.

B The displacement of the ball from P to the maximum height is half the displacement from the launch point to P.

C The acceleration of the ball at P is less than 9,8 $m \cdot s^{-2}$ because the particle is moving upward.

D The time taken to travel from P to the maximum height is half the total time of projection. (2)

1.4 A ball of mass m, travelling to the left, hits a wall with a velocity v and bounces back with a velocity $^3/_4 v$ to the right.



The magnitude of the change in momentum of the ball will be ...

A $^1/_4 mv$

B $^3/_4 mv$

C $^5/_4 mv$

D $^7/_4 mv$ (2)

1.5 An object moves in a straight line on a rough horizontal surface. If the net work done on the object is zero, then ...

A the object has zero kinetic energy.

B the object moves at constant speed.

C the object moves at constant acceleration.

D there is no frictional force acting on the object. (2)

1.6 A sound source moves in a straight line past a stationary observer. At the instant the source passes the observer, the observed frequency ...

A becomes zero.

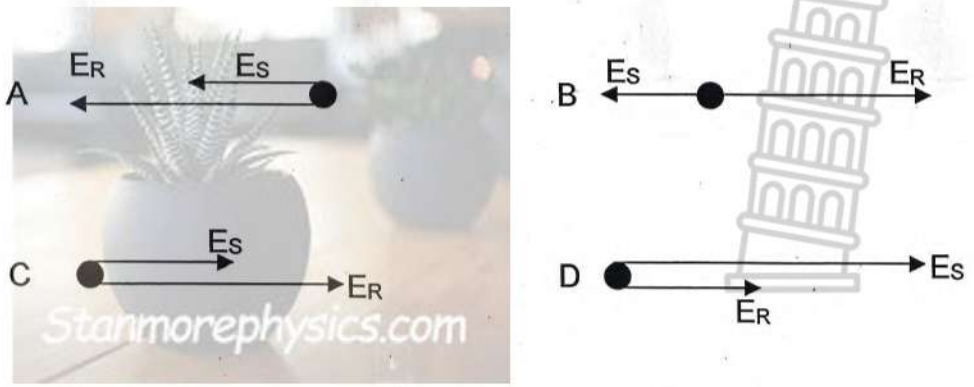
B remains at maximum.

C becomes equal to the speed of sound.

D changes abruptly from higher than emitted to lower than emitted. (2)

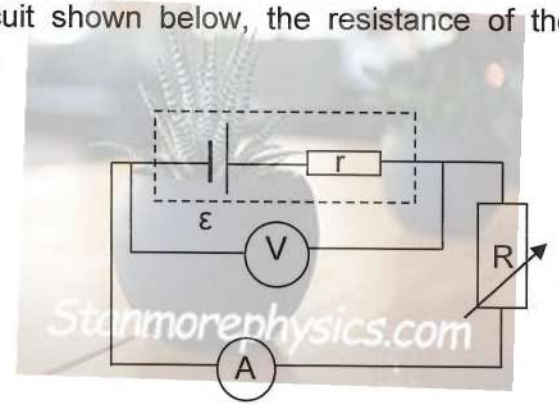
1.7 R and S are two NEGATIVE point charges of equal magnitude. P is a point to the left of R. Point P and charges R and S are on the same horizontal line.

Which ONE of the following vector diagrams, drawn to scale, of the electric fields E_R due to R, and E_S due to S at point P, is CORRECT?



(2)

1.8 In the circuit shown below, the resistance of the variable resistor is increased.



How would this increase affect the readings on the voltmeter and ammeter?

	VOLTMETER READING	AMMETER READING
A	Unchanged	Unchanged
B	Decreases	Increases
C	Decreases	Unchanged
D	Increases	Decreases

(2)

1.9 In an AC generator the current to the external circuit is delivered through the …

A coils.

B battery.

C slip rings.

D (split ring) commutator.

(2)

1.10 Two monochromatic light beams, P and Q, of the same intensity shine on the same metal surface. The magnitude of the frequencies is as follows:

P: $f = f_0$
Q: $f = 2f_0$

Which ONE of the following statements is correct if photo electrons are emitted?

A Light beam P will emit electrons, while light beam Q will not.

B Light beam P will emit more electrons than light beam Q.

C Light beam Q will emit electrons with greater maximum kinetic energy than light beam P.

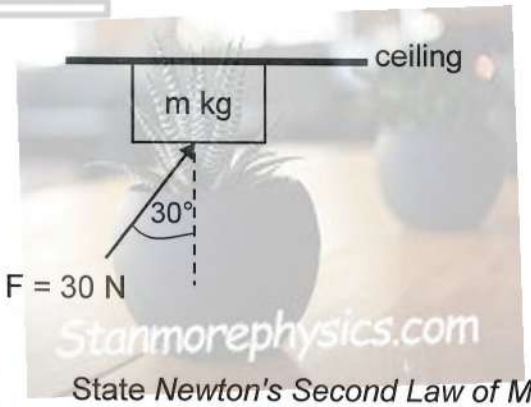
D Both light beams will emit the electrons with the same maximum kinetic energy.

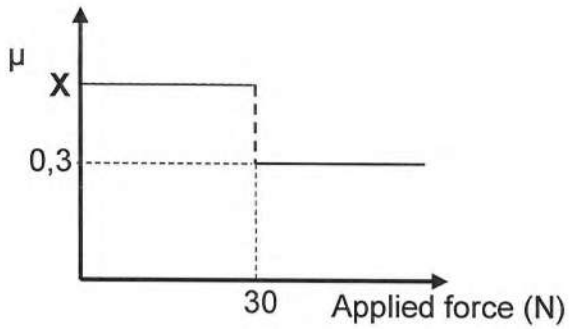
(2)
[20]

QUESTION 2 (Start on a new page.)

A block with mass m is pressed upward against a rough ceiling by a constant force F of 30 N applied at an angle of 30° with the vertical as shown below.

When the block starts to move, its acceleration is 10 $m \cdot s^{-2}$ to the right. The graph of the coefficient of friction and the applied force is given below.





2.1 State *Newton's Second Law of Motion* in words. (2)

2.2 Draw a labelled free-body diagram and identify ALL the forces acting on the block. (4)

2.3 Calculate the:

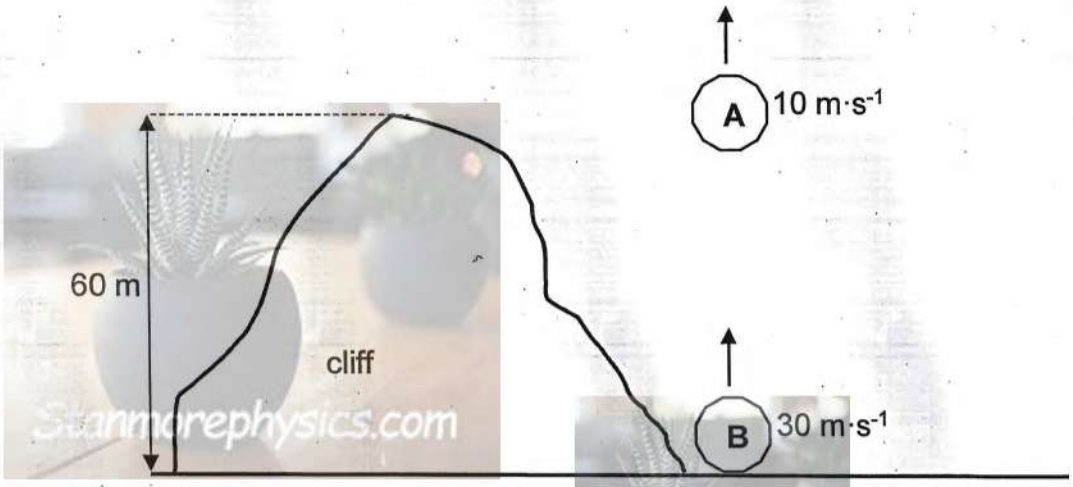
2.3.1 Magnitude of mass m (6)

2.3.2 Value of **X**, if the magnitude of maximum static friction is 9,59 N (3)
[15]

QUESTION 3 (Start on a new page.)

Stone A of mass 100 g is thrown vertically upward from the top of a cliff of height 60 m with an initial velocity of 10 m·s^{-1}. At the same instant, a second stone B of mass 45 g is thrown vertically upward from the ground at the base of the cliff with an initial velocity of 30 m·s^{-1}.

Ignore the effect of air resistance.



3.1 Define the term *projectile*. (2)

3.2 Using EQUATIONS OF MOTION ONLY, calculate the time it takes stone A to reach the maximum height. (3)

3.3 Stone A returns and passes the original position and collides with stone B.

Calculate the:

3.3.1 Speed of stone B when it collides with stone A (6)

3.3.2 The height above the ground where the two stones meet (2)

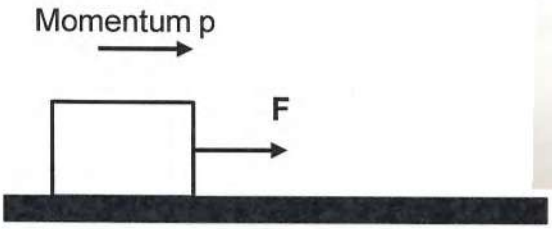
3.4 The stones collided inelastically. In which direction will stone B move after it collides with stone A? (1)

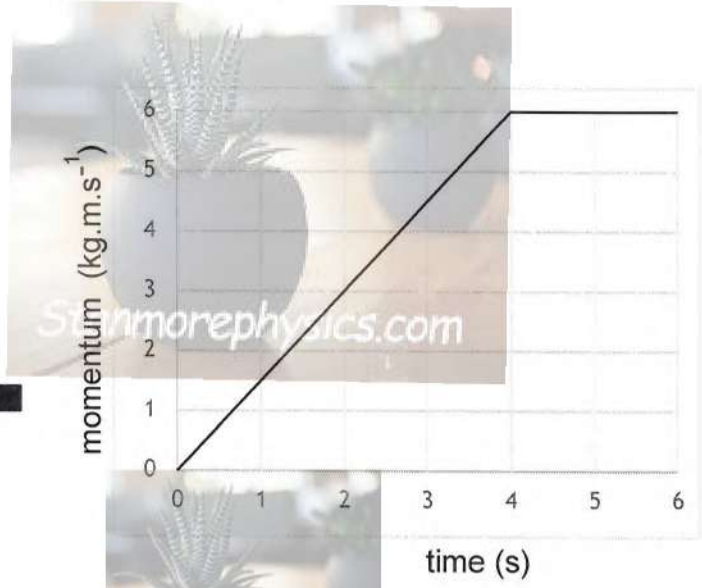
3.5 How will the collision time for stone B change when it moves with a smaller initial velocity? Choose from INCREASES, DECREASES or REMAIN THE SAME. (1)
[15]

QUESTION 4 (Start on a new page.)

A block of unknown mass is pulled along a rough horizontal surface with force F. The frictional force acting on the block is constant with a magnitude of 2 N.

The graph below shows the relationship between momentum and the time the force is acting on the block.





4.1 Define the term *momentum*. (2)

4.2 Calculate the:

4.2.1 Change in momentum during the first 4 s (3)

4.2.2 Magnitude of force F at t = 2 s (5)

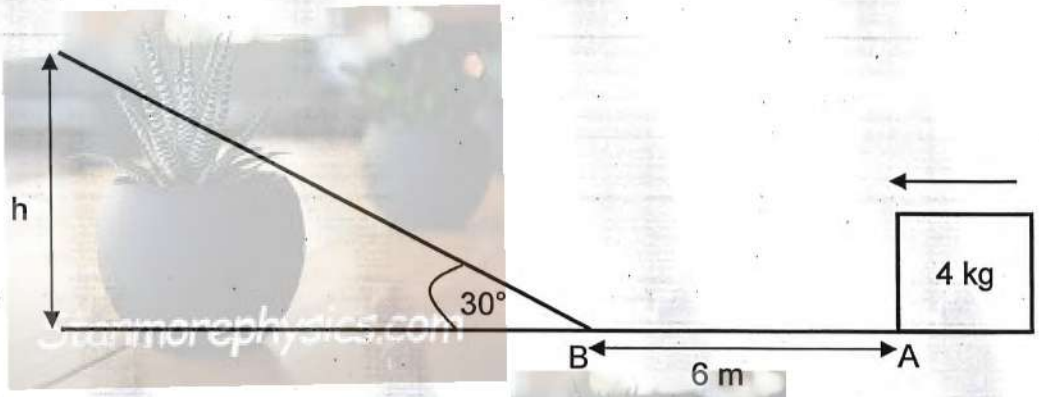
4.3 What is the magnitude of force F between t = 4 s and t = 6 s? Explain your answer. (3)

4.4 Sketch a graph of force F and the time between t = 0 s and t = 6 s. (3)
[16]

QUESTION 5 (Start on a new page.)

A block of 4 kg moves 6 m from rest on a rough horizontal surface from point A to B. The coefficient of the frictional force between the block and the surface is 0,3. On reaching point B, it then moves up the slope, which makes an angle of 30° with the horizontal of the same rough surfaces.

A constant horizontal force F of 25 N is applied to the block as it moves from A to B and up the slope.



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

5.2 Draw a labelled free-body diagram and identify the HORIZONTAL FORCES acting on the block while it moves on the horizontal surface. (2)

5.3 Using ENERGY PRINCIPLES ONLY, calculate:

5.3.1 The speed of the block at point B (5)

5.3.2 How far up the slope will the block move before coming to rest (5)

5.3.3 The maximum height the block reaches above point B (2)

5.4 How will the kinetic energy of the block change when the block moves up the slope? Choose from INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (3)
[19]

QUESTION 6 (Start on a new page.)

An ambulance with its siren on is moving towards a stationary observer at a constant speed of 30 $m \cdot s^{-1}$. The siren emits sound with a frequency of 850 Hz.

The speed of sound in air is 340 $m \cdot s^{-1}$.

6.1 Define the term *Doppler Effect.* (2)

6.2 Calculate the frequency of the sound detected by the observer. (4)

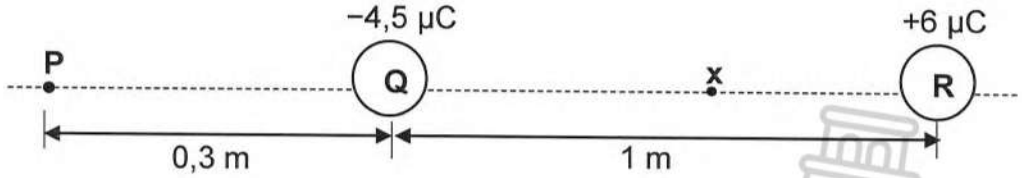
6.3 Now, the ambulance passes the observer and moves away at the same speed. Calculate the new frequency heard by the observer. (3)

6.4 Explain with reference to wavefronts, why the pitch of the ambulance's siren changes as the ambulance approaches and passes the observer. (2)

[11]

QUESTION 7 (Start on a new page.)

Two small charged spheres, Q and R, carry charges of −4,5 µC and +6 µC, respectively, and are placed 1 m apart on a straight horizontal line. P is a point that is a distance 0,3 m to the left of sphere Q as shown in the diagram below.



X is a point between spheres Q and R on a straight line.

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

7.2 Show, with the aid of a vector diagram, why the net electric field at point X cannot be zero. (3)

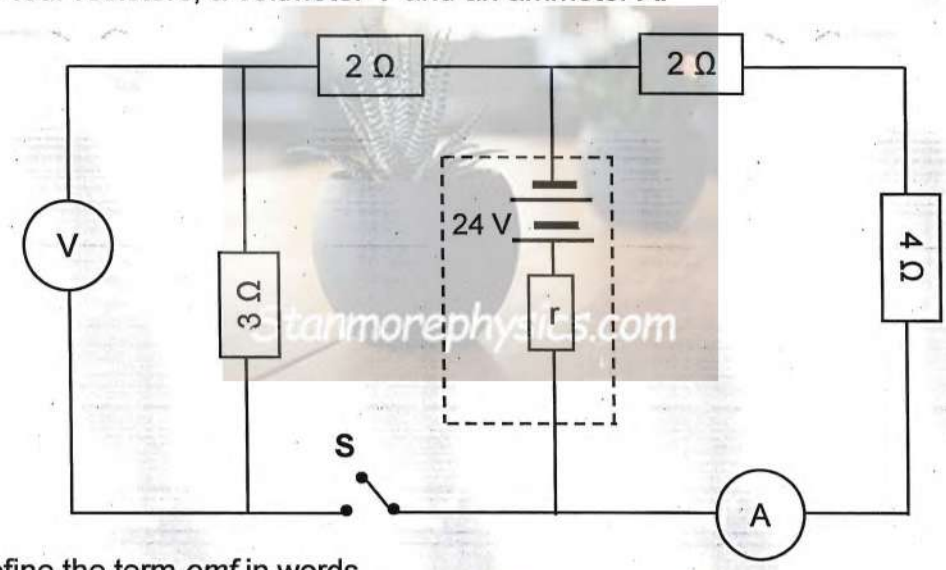
7.3 Calculate the net electric field at point P, due to the two charged spheres Q and R. (5)

7.4 Without doing any calculations, will it be possible for the net electric field to be zero at any point between spheres Q and R? Choose from YES or NO. (1)

[11]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows a battery with an emf of 24 V and unknown internal resistance *r*, four resistors, a voltmeter V and an ammeter A.



8.1 Define the term *emf* in words. (2)

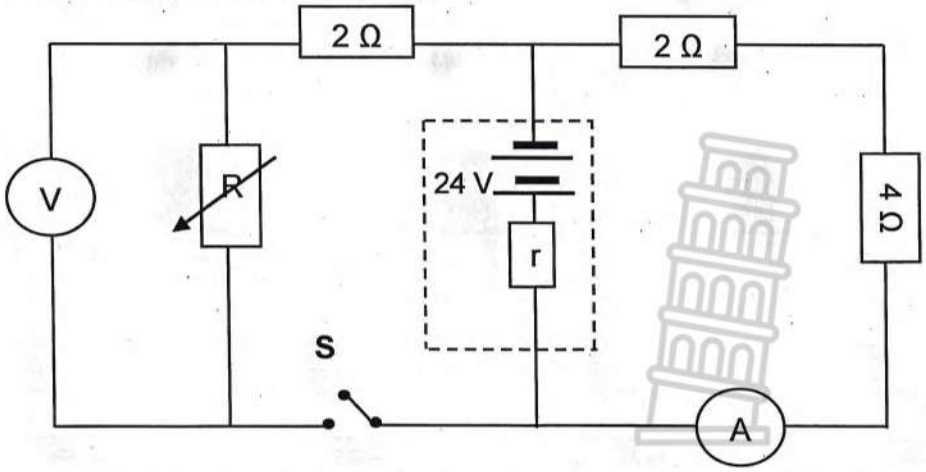
8.2 Switch S is closed. The ammeter A reading is 3,5 A.

Calculate the:

8.2.1 Equivalent resistance in the external circuit (3)

8.2.2 Internal resistance *r* (6)

While switch S remain closed, the 3 Ω resistor is now replaced with a variable rheostat R, and it is set to 3Ω.



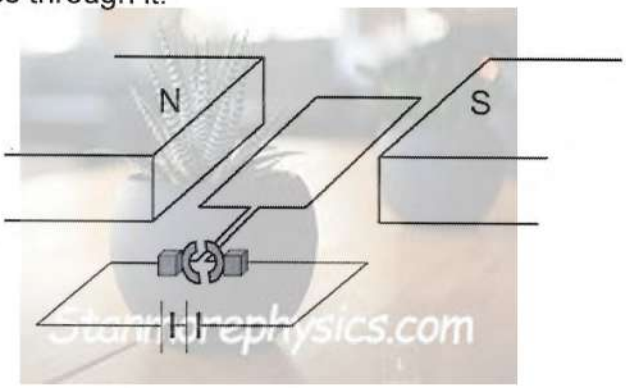
8.2.3 How much should the variable rheostat R be increased by for the overall current in the circuit to decrease by 6%? (5)

8.2.4 How will an increase in variable rheostat R affect the total power delivered by the battery to the external circuit? Choose from INCREASE, DECREASE or REMAIN THE SAME. Explain your answer. (3)

[19]

QUESTION 9 (Start on a new page.)

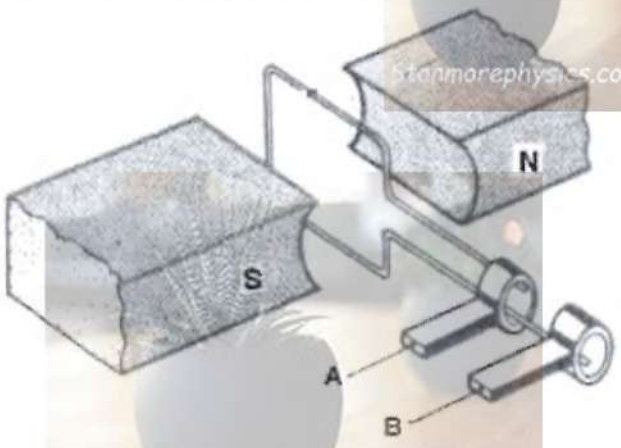
9.1 The diagram below shows a simplified motor. The coil rotates when the current passes through it.



9.1.1 Indicate whether the machine is an AC or DC motor. (1)

9.1.2 The motor is connected to the battery, and the coil starts to turn. Explain why the coil experiences a force when the current flows through the magnetic field from the same position as shown in the diagram above. (2)

9.2 An AC generator supplies 400 V and operates at a frequency of 50 Hz, which delivers a maximum current of 10 A.



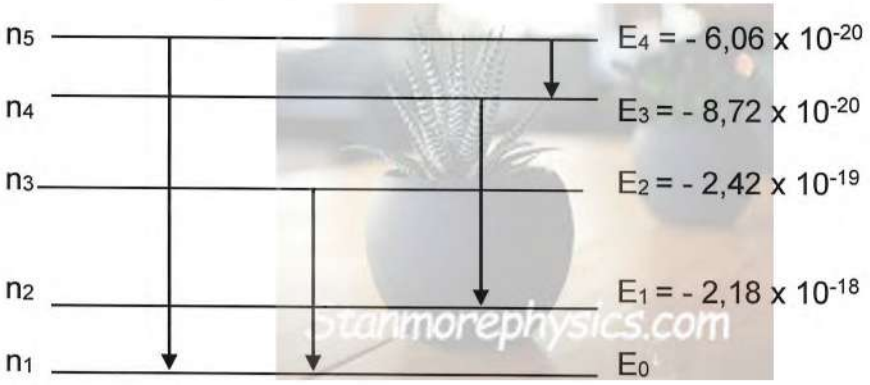
9.2.1 Calculate the average power required if the generator has an efficiency of 85%. (5)

9.2.2 Sketch an emf-time graph for TWO complete rotations of the coil, starting from the position of the coil as shown above. (3)

[11]

QUESTION 10 (Start on a new page.)

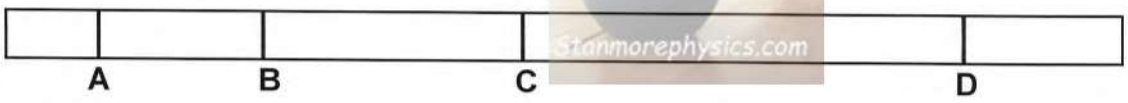
The energy level diagram for a certain atom is shown below. Energies of the photons are given below, with E_0 representing the ground state.



10.1 Name and explain how the above spectrum is formed. (3)

10.2 Refer to the diagram above and identify the energy radiation which will produce the maximum wavelength. (2)

10.3 The lines produced from the spectrum are shown below. The magnitudes of the wavelengths are given in the table below. A, B, C and D represent the coloured lines of the spectrum.



The magnitudes of the wavelengths are given in the table below.

	Wavelength ($x10^{-9}$ m)
A	410
B	434
C	486
D	656

10.3.1 Line C corresponds to the transition from level E_2 to E_1. Calculate the energy of the photon emitted. (3)

10.3.2 Line D is observed from a distant star at a velocity of 3×10^4 m·s^{-1} moving away from the observer. Calculate the observed wavelength. (3)

10.4 Explain why the star's light passing through a cooler gas produces dark lines in the spectrum. (2)

[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12 PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12VRAESTEL 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	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6,38 \times 10^6$ m
Mass of the Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}$ kg
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ J·s
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or/*of* $E = W_0 + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or $K_{max} = \frac{1}{2}mv_{max}^2$	
$E = W_0 + E_{k(maks)}$ *of* $E = W_0 + K_{maks}$ *waar* $E = hf$ *en* $W_0 = hf_0$ *en* $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$ *of* $K_{maks} = \frac{1}{2}mv_{maks}^2$	

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

ALTERNATING CURRENT/*WISSELSTROOM*

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

education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/*GRAAD* 12

PHYSICAL SCIENCES P1
FISIESE WETENSKAPPE V1

updated

SEPTEMBER 2026

MARKS/*PUNTE*: 150 (ENGLISH)
145 (AFRIKAANS)

MARKING GUIDELINES/*NASIENRIGLYNE*

This marking guideline consists of 16 pages.
Hierdie nasienriglyne bestaan uit 16 bladsye.

QUESTION/*VRAAG* 1

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

QUESTION/*VRAAG* 2

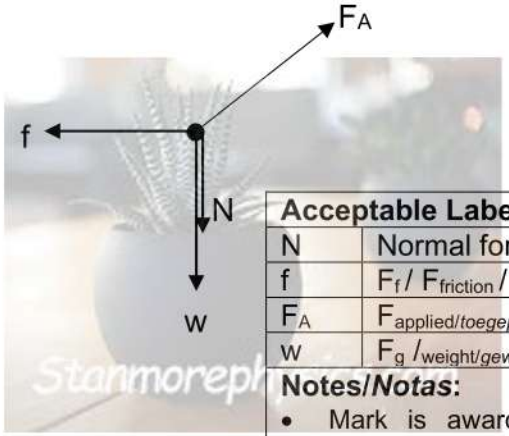
2.1

Marking criteria/*Nasienkriteria*
If any of the underlined keywords/phrases in the **correct context** are omitted, deduct 1 mark.
*Indien enige van die onderstreepte sleutelwoorde/-frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

When a net force acts on an object, the object accelerates in the direction of the force, and the acceleration is directly proportional to the force and inversely proportional to the mass of the object. ✓✓

Wanneer 'n netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag, en die versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp. (2)

2.2



Acceptable Labels/*Aanvaarde benoemings*	
N	Normal force/*Normaalktag* / F_{Normal} / F_N
f	F_f / $F_{friction}$ / $f_{kinetic}$ / f_k F_f / *Fwrywing* / $f_{kineties}$ / f_k
F_A	$F_{applied/toegepas}$ /F / 30 N
w	F_g /$_{weight/gewig}$ / w / mg / $F_{gravitation/gravitasie}$

Notes/*Notas*:
- Mark is awarded for label and arrow./*Punt word toegeken vir die benoeming en die pyl.*
- Do not penalise for the lengths of vectors./*Moenie vir die lengtes van vektore penaliseer nie*

Penalise once/*Penaliseer een keer*:
- If arrows do not touch the dot./*As pyle nie die kolletjie raak nie.* Max: $(^3/_4)$
- Any additional force(s)./*Addisionele kragte* Max: $(^3/_4)$
- No arrows drawn with correct labels./*Geen pyle met korrekte benoemings.* Max: $(^3/_4)$

(4)

2.3.1

Marking criteria

- Formula: $F_{net} = ma$ ✓
- Correct substitution of F_A ✓
- Correct calculation of N, thus $[16 \sin 60° - m\,(9,8)]$ ✓
- Correct calculation of f ✓
- Correct final answer 1,02 kg ✓

Nasienkriteria

- *Formule: $F_{net} = ma$* ✓
- *Korrekte vervanging van F_A* ✓
- *Korrekte berekening van N, dus $[16 \sin 60° - m\,(9,8)]$* ✓
- *Korrekte berekening van f* ✓
- *Korrekte finale antwoord 1,02 kg* ✓

OPTION/*OPSIE* 1

$F_{net} = ma$
$F_A - f_k = ma$
$F\cos\theta - f_k = ma$
✓ any one/*enige een*

✓

$30 \cos 60°$ ✓ $-(0,3)\,[30 \sin 60° - m\,(9,8)]$ ✓ $= m\,(10)$ ✓

$m = 1,02$ kg ✓

OPTION/*OPSIE* 2

$F_{net} = ma$
$F_A - f_k = ma$
$F\cos\theta - f_k = ma$
✓ any one/*enige een*

✓

$16 \sin 30°$ ✓ $-(0,3)\,[16 \cos 30° - m\,(9,8)]$ ✓ $= m\,(10)$ ✓

$m = 1,02$ kg ✓

(6)

2.3.2

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 2.3.1

$f_s^{max} = \mu_s N$ ✓

$9,59 = \mu_s [(30 \sin 60°) - (1,02)(9,8)]$ ✓

$\mu_s = 0,6$

$\therefore x = 0,6$ ✓

(3)

[15]

QUESTION/*VRAAG* 3

3.1 An object that has been given an initial velocity and then moves only under the influence of gravitational force. ✓✓
'n Voorwerp wat 'n aanvanklike snelheid gegee is en dan slegs onder die invloed van gravitasiekrag beweeg. **(2 OR/*OF* 0)**

Note: If freefall defined/*Nota: Indien vryval gedefinieer is* $^{0}/_{2}$ (2)

3.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
UPWARD POSITIVE *OPWAARTS POSITIEF*	**DOWNWARD POSITIVE** *AFWAARTS POSITIEF*
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = (10) + (-9,8)\Delta t$ ✓	$0 = (-10) + (9,8)\Delta t$ ✓
$\Delta t = 1,02$ s ✓	$\Delta t = 1,02$ s ✓

(3)

3.3.1

OPTION/*OPSIE* 1

POSITIVE UPWARD/*OPWAARTS POSITIEF*

Stone/*Klip* A:

$\Delta y_A = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓

$y_A - 60 = (10)(t) + \frac{1}{2}(-9,8)(t^2)$ ✓

$y_A = 60 + 10t - 4,9\ t^2$ ……eq (1)

Stone/*Klip* B:

$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$

$y_B = (30)(t) + \frac{1}{2}(-9,8)(t^2)$ ✓

$y_B = 30t - 4,9t^2$ ……..eq (2)

Time @ collision/*Tyd @ botsing*:

$y_A \overset{\checkmark}{=} y_B$ **(EQUATING/*GELYKSTEL*)**

$60 + 10t - 4,9\ t^2 = 30t - 4,9t^2$

$t = 3$ s

Speed @ collision/*Spoed @ botsing*:

$v_{f(B)} = v_i + a\Delta t$

$= (30) + (-9,8)(3)$ ✓

$= 0,6\ m{\cdot}s^{-1}$ ✓

OPTION/*OPSIE* 2

POSITIVE DOWNWARD/*POSITIEF AFWAARTS*

Stone/*Klip A*:

$\Delta y_A = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓

$-60 + y_A = (-10)(t) + \frac{1}{2}(9,8)(t^2)$ ✓

$y_A = 60 - 10t + 4,9\,t^2$ .....eq (1)

Stone/*Klip B*:

$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$

$y_B = (-30)(t) + \frac{1}{2}(9,8)(t^2)$ ✓

$y_B = -30t + 4,9t^2$ .....eq (2)

Time @ collision/*Tyd @ botsing*:

$y_A \overset{\checkmark}{=} y_B$ **(EQUATING/*GELYKSTEL*)**

$-60 - 10t + 4,9\,t^2 = -30t + 4,9t^2$

$t = 3$ s

Speed @ collision/*Spoed @ botsing*:

$v_{f(B)} = v_i + a\Delta t$

$= (-30) + (9,8)(3)$ ✓

$= -0,6$ m·s^{-1}

$= 0,6$ m·s^{-1} ✓

(6)

OPTION/*OPSIE* 3

POSITIVE UPWARD/*POSITIEF OPWAARTS*

Stone/*Klip A*:

$\Delta y_A = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓

$y_A = (10)(t) + \frac{1}{2}(-9,8)(t^2)$ ✓

$y_A = 10t - 4,9t^2$ .....eq (1)

Stone/*Klip B*:

$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$

$y_B = (30)(t) + \frac{1}{2}(-9,8)(t^2)$ ✓

$y_B = 30t - 4,9t^2$ .....eq (2)

$\Delta y_A + \Delta y_B = 60$ ✓ (sum of/*som van* Δy_A and/*en* Δy_B)

$-(10t - 4,9t^2) + (30t - 4,9t^2) = 60$

$t = 3$ s

Speed @ collision/*Spoed @ botsing*:

$v_{f(B)} = v_i + a\Delta t$

$= (30) + (-9,8)(3)$ ✓

$= 0,6$ m·s^{-1} ✓

OPTION/*OPSIE* 4

DOWNWARD POSITIVE/*AFWAARTS POSITIEF*

Stone/*Klip* A:

$\Delta y_A = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓

$y_A = (-10)(t) + \frac{1}{2}(9,8)(t^2)$ ✓

$y_A = -10t + 4,9t^2$ .....eq (1)

Stone/*Klip* B:

$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$

$y_B = (-30)(t) + \frac{1}{2}(9,8)(t^2)$ ✓

$y_B = -30t + 4,9t^2$ .....eq (2)

$\Delta y_A + \Delta y_B = -60$ ✓ (**sum of/*som van* Δy_A and/*en* Δy_B**)

$-(-10t + 4,9t^2) + (-30t + 4,9t^2) = -60$

$t = 3$ s

Speed @ collision/*Spoed @ botsing*:

$v_{f(B)} = v_i + a\Delta t$

$= (-30) + (9,8)(3)$ ✓

$= -0,6$ m·s^{-1}

$= 0,6$ m·s^{-1} ✓

(6)

3.3.2

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 3.3.1

$y_A = (60) + (10)(3) - 4,9(3)^2$ ✓ $= 45,9$ m ✓	$y_B = (30)(3) + (-4,9)(3)^2$ ✓ $= 45,9$ m ✓

OPTION/*OPSIE* 2

$\Delta y_A = v_i \Delta t + \frac{1}{2}a\Delta t^2$	$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$
$y_A = (-10)(3) + \frac{1}{2}(9,8)(3^2)$ ✓	$y_B = (-30)(3) + \frac{1}{2}(9,8)(3^2)$ ✓
$y_A = 45,9$ m ✓	$y_B = 45,9$ m ✓

OPTION/*OPSIE* 3	**OPTION/*OPSIE* 4**
$v_f^2 = v_i^2 + 2a\Delta y$ $(0,6)^2 = (30)^2 + 2(-9,8)\,\Delta y$ ✓ $\Delta y = 45,9$ m ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $= \left(\frac{0,6 + (30)}{2}\right)(3)$ ✓ $= 45,9$ m ✓

(2)

3.4 Downwards/*Afwaarts* ✓ (1)

3.5 Increases/*Toeneem* ✓ (1)
[15]

QUESTION/*VRAAG* 4

4.1 The product of an object's mass and its velocity. ✓✓
Die produk van 'n voorwerp se massa en sy snelheid. (**2 or/*of* 0**) (2)

4.2.1

$\Delta p = p_f - p_i$ ✓
$\Delta p = 6 - 0$ ✓
$\Delta p = 6$ kg·m·s^{-1} to the right ✓ (3)

4.2.2

OPTION/*OPSIE* 1

$F_{net}\,\Delta t = \Delta p$
$(F - f)\Delta t = \Delta p$ ✓ anyone
$(F - 2)$ ✓ (2) ✓ $= 3 - 0$ ✓
$F = 3,5$ N ✓

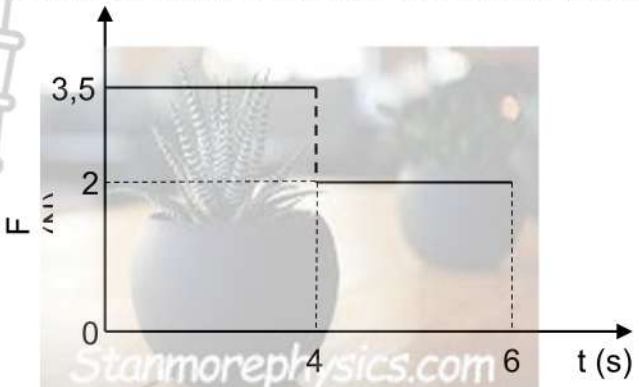
OPTION/*OPSIE* 2

$F_{net} = \frac{\Delta p}{\Delta t}$
$= \frac{3 - 0}{2 - 0}$ ✓ ✓
$= 1,5$ N

$F_{net} = ma$ ✓
$F_{net} = F - f$
$1,5 = F - 2$ ✓
$F = 3,5$ N ✓ (5)

4.3 2 N ✓
The change in momentum is zero; ✓ therefore, the object moves with a constant velocity, which results in the net force being equal to zero. ✓
Die verandering in momentum is nul, daarom beweeg die voorwerp met 'n konstante snelheid, wat daartoe lei dat die netto krag gelyk aan nul is. (3)

4.4 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 4.2.2.**



Marking criteria/*Nasienkriteria*	
Vector between 0 s and 4 s and F 3,5 N *Vektor tussen 0 s en 4 s en F 3,5 N*	✓
Change of graph (decrease) *Verandering van grafiek (afname)*	✓
Vector between 4 s and 6 s and F 2 *Vektor tussen 4 s en 6 s en F 2 N*	✓

(3)
[16]

QUESTION/*VRAAG* 5

5.1

Marking Criteria/*Nasienkriteria*
If any of the underlined keywords/phrases in the **correct context** are omitted, deduct 1 mark. *As enige van die onderstreepte sleutelwoorde/-frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

The work done on an object by a net force is equal to the change in the object's kinetic energy. ✓✓
Die arbeid wat deur 'n netto krag op 'n voorwerp verrig word, is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

5.2

Acceptable Labels/*Aanvaarde benoemings*	
f	F_f / $F_{friction/wrywing}$ / f_k / (kinetic) friction/*(kinetiese) wrywing*
F_A	$F_{applied/toegepas}$ / 25 N / F

Notes/*Notas*:
- Mark is awarded for label and arrow.*Punt word toegeken vir benoeming en pyl.*
- Do not penalise for the lengths of vectors.*Moenie vir lengte van vektors penaliseer nie.*

Penalise once/*Penaliseer een keer*:If arrows do not touch the dot.
Indien die pylties nie met kolletjies kontak maak nie. Max/*Maks*: ($^1/_2$)
- Any additional force(s).*Enige addisionele krag(te)* Max/*Maks*: ($^1/_2$)
- No arrows drawn with correct labels.
Geen pyltjies met korrekte benoemings geteken nie. Max/*Maks*: ($^1/_2$)

(2)

5.3.1

OPTION/*OPSIE* 1

$W_{net} = \Delta E_K$
$W_{FA} + W_f = \Delta E_K$ ✓ any one/*enige* een
$F_A\Delta x\cos\theta + F_f\Delta x\cos\theta = \Delta E_K$
$F_A\Delta x\cos\theta + F_f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$(25)(6)\cos 0°$ ✓ + $(0,3)(4)(9,8)(6)\cos 180°$ ✓ = $\frac{1}{2}(4)(v_f^2) - 0$ ✓

$v_f = 6,3\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 2

$W_{nc} = \Delta E_K + \Delta E_p$
$W_{FA} + W_f = \Delta E_K + \Delta E_p$
$F_A\Delta x\cos\theta + F_f\Delta x\cos\theta = \Delta E_K + \Delta E_p$ ✓ anyone *enige een*
$F_A\Delta x\cos\theta + F_f\Delta x\cos\theta = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$

$(25)(6)\cos 0°$ ✓ + $(0,3)(4)(9,8)(6)\cos 180°$ ✓ = $\frac{1}{2}(4)(v_f^2) - 0$ ✓ + 0

$v_f = 6,3\ m\cdot s^{-1}$ ✓

(5)

5.3.2

POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 5.3.1

Marking criteria/*Nasienkriteria*

- Correct substitution of f/*Korrekte vervanging van f* ✓
- Correct substitution of W_{FA} and calculation F_g /*Korrekte vervanging van W_{FA} en berekening F_g* ✓
- Correct of substitution/*Korrekte vervanging* $(\Delta x)\cos 180°$ ✓
- Correct of substitution/*Korrekte vervanging* ΔE_K ✓
- Correct final answer/*Finale antwoord* 7,38 m ✓

$W_f = F_f\Delta x\cos\theta$
$= (\mu_k)(mg\cos\theta)\,\Delta x\cos\theta$
$= (0,3)(4)(9,8)\cos 30°)\Delta x\cos 180°$ ✓
$= -10,18\,\Delta x$ N

$W_{net} = \Delta E_K$
$W_{FA} + W_w = \Delta E_K$
$F_A\Delta x\cos\theta + Fw\Delta x\cos\theta + W_f = \Delta E_K$
$F_A\Delta x\cos\theta + mg\sin\theta\Delta x\cos\theta + F_f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$(25)(\Delta x)\cos 0° + [(4)(9,8)\sin 30](\Delta x)\cos 180° - 10,18\Delta x = 0 - \frac{1}{2}(4)(6,3)^2$ ✓ ✓ ✓

$\Delta x = 16,61$ m ✓

(5)

5.3.3 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 5.3.2**

$h = \Delta x \sin \theta$
$= (16{,}61) \sin 30°$ ✓
$= 8{,}31$ m ✓ (2)

5.4 Decreases ✓
As the block moves up the slope, its kinetic energy is converted into gravitational potential energy/ speed decreases. ✓ Therefore, the kinetic energy continuously decreases until it reaches zero at the highest point. ✓
Neem af
Soos die blok teen die helling op beweeg, word sy kinetiese energie omgeskakel in gravitasiepotensiële energie. Daarom neem die kinetiese energie voortdurend af totdat dit nul bereik by die hoogste punt. (3)
[19]

QUESTION/*VRAAG* 6

6.1 **Marking criteria/*Nasienkriteria***
If any of the underlined keywords/phrases in the **correct context** are omitted, deduct 1 mark.
*Indien enige van die onderstreepte sleutelwoorde/-frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

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. ✓✓

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

OR/*OF*

The apparent change in frequency of a sound as a result of relative motion between the source and the observer.

Die skynbare verandering in frekwensie van 'n klank as gevolg van relatiewe beweging tussen die bron en die waarnemer. (2)

6.2 $f_L = \frac{v \pm v_L}{v \pm v_S} f_s$
$f_L = \frac{v}{v - v_L} f_s$ ✓ any one/*enige een*

$f_L = \frac{340}{340 - 30}$ ✓ 850 ✓
$= 932{,}26$ Hz ✓ (4)

6.3

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

$$f_L = \frac{340}{340 + 30}$$ ✓ 850 ✓

$= 781{,}08$ Hz ✓

(3)

6.4

- When the source of sound moves towards the observer, the wavefronts are compressed, resulting in shorter wavelengths and a higher frequency/pitch. ✓
- When the source moves away, the wavefronts are stretched, resulting in longer wavelengths and a lower frequency/pitch. ✓

  This is due to the relative motion between the source and the observer.
- *Wanneer die klankbron na die waarnemer toe beweeg, word die golffronte saamgepers, wat lei tot korter golflengtes en 'n hoër frekwensie/toonhoogte.*
- *Wanneer die bron wegbeweeg, word die golffronte uitgerek, wat lei tot langer golflengtes en 'n laer frekwensie/toonhoogte.*

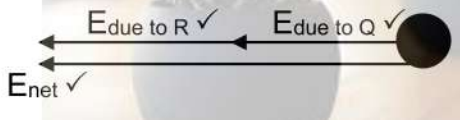
  Dit is as gevolg van die relatiewe beweging tussen die bron en die waarnemer.

(2)
[11]

QUESTION/*VRAAG* 7

7.1 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 is die elektrostatiese krag per eenheid positiewe lading wat by daardie punt geplaas word. **(2 OR/*OF* 0)** (2)

7.2



(3)

7.3

$E_Q = \frac{kQ}{r^2}$ ✓

$= \frac{(9 \times 10^9)(4{,}5 \times 10^{-6})}{(0{,}3)^2}$ ✓

$= 4{,}5 \times 10^5\ N \cdot C^{-1}$

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

$= \frac{(9 \times 10^9)(6 \times 10^{-6})}{(1{,}3)^2}$ ✓

$= 3{,}2 \times 10^4\ N \cdot C^{-1}$

$E_{net} = E_Q + E_R$

$= (4{,}5 \times 10^5) - (3{,}2 \times 10^4)$ ✓

$= \underline{4{,}18 \times 10^5\ N \cdot C^{-1}\ \text{to the right/}\textit{na regs}}$ ✓

(5)

7.4 No/*Nee* ✓ (1)

[11]

QUESTION/*VRAAG* 8

8.1 The maximum energy provided by a battery per unit charge passing through it. ✓✓
Die maksimum energie wat deur 'n battery per eenheid lading wat daardeur beweeg, verskaf word. **(2 or/*of* 0)** (2)

8.2.1

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $\frac{1}{R_P} = \left(\frac{1}{5} + \frac{1}{6}\right)$ ✓ $R_P = 2{,}73\ \Omega$ ✓	$R_P = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓ $= \frac{5 \times 6}{5 + 6}$ ✓ $= 2{,}73\ \Omega$ ✓

(3)

8.2.2

POSITIVE MAKING FROM/*POSITIEWE NASIEN VANAF* 8.2.1	
OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$R = \frac{V}{I}$ $6 = \frac{V}{3,5}$ ✓ $V = 21\ V$ $R = \frac{V}{I}$ $5 = \frac{21}{I}$ ✓ $I = 4,2\ A$ $I_T = 3,5 + 4,2 = 7,7\ A$✓ $\varepsilon = I(R + r)$ ✓ $24 = 7,7\ (2,73 + r)$ ✓ $r = 0,39\ \Omega$✓	$R = \frac{V}{I}$ $6 = \frac{V}{3,5}$ ✓ $V = 21\ V$ $R = \frac{V}{I}$ $5 = \frac{21}{I}$ ✓ $I = 4,2\ A$ $I_T = 3,5 + 4,2 = 7,7\ A$✓ $V_{int} = 24 - 21 = 3\ V$ $r = \frac{V}{I}$ ✓ $= \frac{3}{7,7}$ ✓ $= 0,39\ \Omega$ ✓

(6)

8.2.3

POSITIVE MAKING FROM 8.2.1 AND 8.2.2 *POSITIEWE NASIEN VANAF 8.2.1 EN 8.2.2*	
OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$I_{new} = (7,7) - (0,06)(7,7)$ ✓ $= 7,24\ A$ $\varepsilon = I\ R_{new} + r)$ $24 = 7,24\ (R_{new} + 0,39)$ ✓ $R_{new} = 2,92\ \Omega$ $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{2,92} = \frac{1}{2 + R_{3\Omega(new)}} + \frac{1}{6}$ ✓ $R_{3\Omega(new)} = 3,69\ \Omega$ ✓ $\Delta R_{3\Omega(new)} = 3,69 - 3 = 0,69\ \Omega$ ✓	$I_{new} = (7,7) - (0,06)(7,7)$ ✓ $= 7,24\ A$ $\varepsilon = I\ (R_{new} + r)$ $24 = 7,24\ (R_{new} + 0,39)$ ✓ $R_{new} = 2,92\ \Omega$ $R_P = \frac{R_1 \times R_2}{R_1 + R_2}$ $2,92 = \frac{(2+R3\Omega(new)\ ) \times 6}{(2+R3\Omega(new)\ ) + 6}$ ✓ $R_{3\Omega(new)} = 3,69\ \Omega$ ✓ % Increase $= \frac{3,69 - 3}{3} \times 100 = 2,3\%$ ✓

(5)

8.2.4 DECREASES ✓

- Increasing 3 Ω increases total resistance, which decreases total current. ✓
- According to $P = I^2R$, $P \alpha R$/ $P = \frac{V^2}{R}$, $P \alpha \frac{1}{R}$ ✓ a decrease in current results in reduced power delivered to the external circuit.

NEEM AF

Die verhoging van 3 Ω verhoog die totale weerstand, wat die totale stroom verminder. Volgens $P = I^2R$, $P \alpha R$, lei 'n afname in stroom tot verminderde drywing wat aan die eksterne stroombaan gelewer word. (3)

[19]

QUESTION/*VRAAG* 9

9.1.1 DC/*GS* ✓ (1)

9.1.2

- The magnetic field is induced in the conductor, resulting in the coil experiencing the magnetic force. ✓
- The forces on opposite sides of the coil act in opposite directions, producing a torque that rotates the coil. ✓
- Because the nagle between the magnetic field and the current is 90°.

- *Die magnetiese veld word in die geleier geïnduseer, wat veroorsaak dat die spoel 'n magnetiese krag ervaar.*
- *Die kragte op teenoorgestelde kante van die spoel werk in teenoorgestelde rigtings, wat 'n wringkrag veroorsaak wat die spoel laat roteer.* (2)

9.2.1

OPTION/*OPSIE* 1

$V_{rms} = \frac{400}{85} \times 100$ ✓

$= 470,588$ V

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

$= \frac{10}{\sqrt{2}}$ ✓

$= 7,071$ A

$P_{ave} = V_{rms} I_{rms}$ ✓

$= (470,588)(7,071)$ ✓

$= 3327,528$ W ✓

OPTION/*OPSIE* 2

$P = VI$ ✓

$= \frac{(400)(10)}{2}$ ✓✓

$= 2828,23$ W

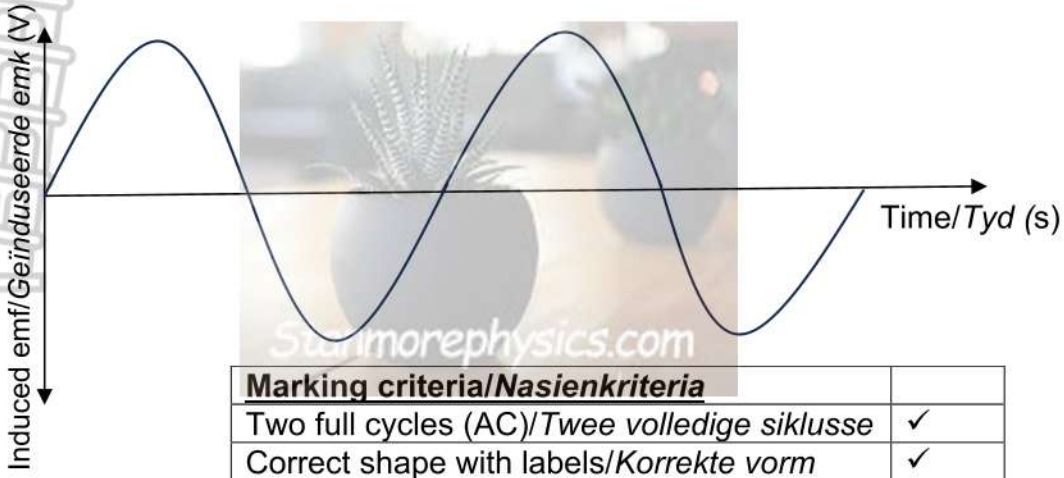
$P_{input/inset} = \frac{P_{output/lewering}}{effeciency/doeltreffendheid}$

$= \frac{2828,23}{0,85}$ ✓

$= 3\,327,56$ W ✓

(5)

9.2.2



Marking criteria/*Nasienkriteria*	
Two full cycles (AC)/*Twee volledige siklusse*	✓
Correct shape with labels/*Korrekte vorm met benoemings*	✓
Graph starts from zero	✓

(3)

[11]

QUESTION/*VRAAG* 10

10.1 Emission Spectrum ✓
It is formed when certain frequencies of electromagnetic radiation are emitted due to an atom/electron making a transition from a higher energy state to a lower energy state. ✓✓
OR
Electrons moves from higher to lower energy level whereby a bright/colourful spectral lines on a dark background will form.

Emissiespektrum
Dit word gevorm wanneer sekere frekwensies van elektromagnetiese straling uitgestraal word as gevolg van 'n atoom wat van 'n hoër energietoestand na 'n laer energietoestand oorgaan.
OF
Elektrom beweeg van hoër na laer energievlak waneer 'n helder/kleurvolle spektrum van spektrale lyne sal op 'n donker agtergrond vorm. (3)

10.2 $E_4 - E_3$ **OR/*OF*** n_5 to/*na* n_4 ✓✓ (2)

10.3.1
$$E = \frac{hc}{\lambda} \checkmark$$
$$= \frac{(6{,}63\times10^{-34})(3\times10^{8})}{486\times10^{-9}} \checkmark$$
$$= 4{,}10 \times 10^{-19}\ \text{J} \checkmark$$
(3)

10.3.2

OPTION/*OPSIE 1*	**OPTION/*OPSIE 2***
$c = f\lambda$ $3 \times 10^8 = f(656 \times 10^{-9})$ ✓ $f = 4{,}573 \times 10^{14}$ Hz $v = f\lambda$ $3 \times 10^4 = 4{,}573 \times 10^{14}\ \lambda$ ✓ $\lambda = 6{,}56 \times 10^{-11}$ m ✓	$\lambda = \frac{V}{C}$ $= \frac{3 \times 10^4}{3 \times 10^8}$ ✓ $= 1 \times 10^{-4}$ m $\lambda = (656 \times 10^{-9})(1 \times 10^{-4})$ ✓ $= 0{,}0656 \times 10^{-9}$ m ✓

(3)

10.4 Electrons occupy quantised energy levels; photons are emitted only for specific energy differences, producing discrete lines. ✓✓

ACCEPT:

When certain frequencies of electromagnetic radiation that passes through a medium, e.g. a cold gas, is absorbed.

Elektrone beset gekwantiseerde energievlakke; fotone word slegs vir spesifieke energieverskille uitgestraal, wat diskrete lyne produseer. (2)

[13]

TOTAL/*TOTAAL* 150