education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2020

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK**.
2. This question paper consists of NINE 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, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
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, et cetera where required.
12. Write neatly and legibly.

SECTION A

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Various 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 (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 A physics teacher of mass 80 kg is standing on a bathroom scale in a lift. The teacher observes that the reading on the bathroom scale is more than 784 N for a short time interval. During this short time interval the lift is …

A not moving.

B accelerating upwards

C accelerating downwards

D moving with constant velocity. (2)

1.2 Two identical metal spheres, each of mass m and separated by a distance r, exert a gravitational force of magnitude F on each other. The distance between the spheres is now HALVED. The magnitude of the force the spheres now exert on each other is:

A F

B ½F

C 2F

D 4F (2)

1.3 A rubber ball, of mass *m*, falls vertically and strikes the ground with a velocity of magnitude 2*v*. The rubber ball rebounds vertically upwards with a velocity of magnitude *v*. What is the magnitude of the change of momentum of the rubber ball?

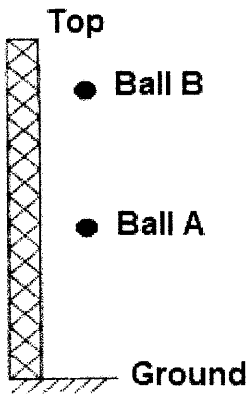
A 0

B *mv*

C 2*mv*

D 3*mv* (2)

1.4 Two identical bowling balls, A and B, are dropped from the top of a tall tower as shown in the diagram below. Ball B is dropped 1s after ball A. Both balls fall for some time before they strike the ground. Ignore air resistance.



Which ONE of the following statements is TRUE for the motion of A and B?

A The distance between A and B decreases as they fall.

B The velocity of ball A increases with respect to ball B

C The velocity of ball A decreases with respect to ball B

D The distance between A and B remains constant. (2)

1.5 A weight lifter lifts a mass *m* at CONSTANT SPEED to a height *h* in time *t*. What is the average power output of the weight lifter?

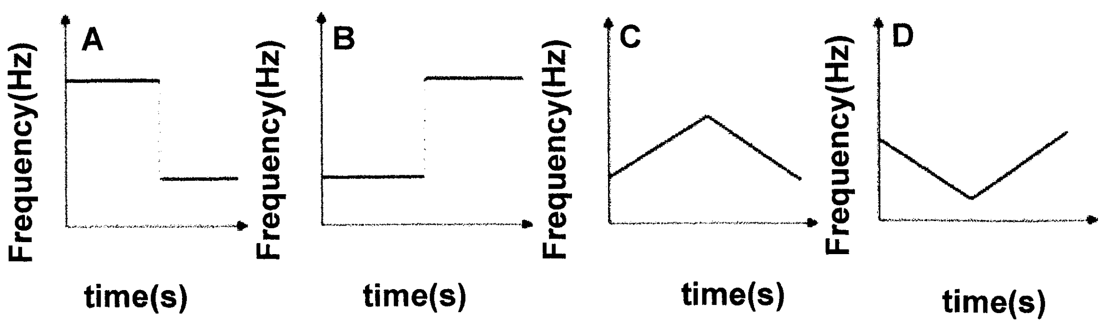
A *mg*

B *mgh*

C *mght*

D *mgh/t* (2)

1.6 A source of sound approaches a stationary listener in a straight line at constant velocity. It passes the listener and moves away from him in the same straight line at the same constant velocity. Which ONE of the following graphs best represents the change in observed frequency against time?

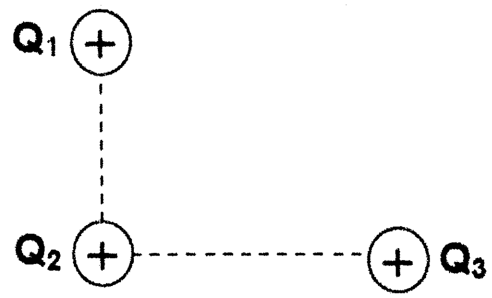


(2)

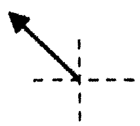
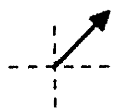
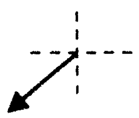
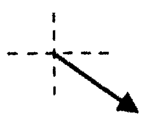
1.7 The shifting of a spectrum for a BLUE SHIFT is …

A to a longer wavelength.
B to a lower energy.
C towards the red end of the spectrum.
D to a higher energy. (2)

1.8 Three identical positive point charges, Q_1, Q_2 and Q_3, are placed on three corners of a right - angled triangle as shown in the sketch below.

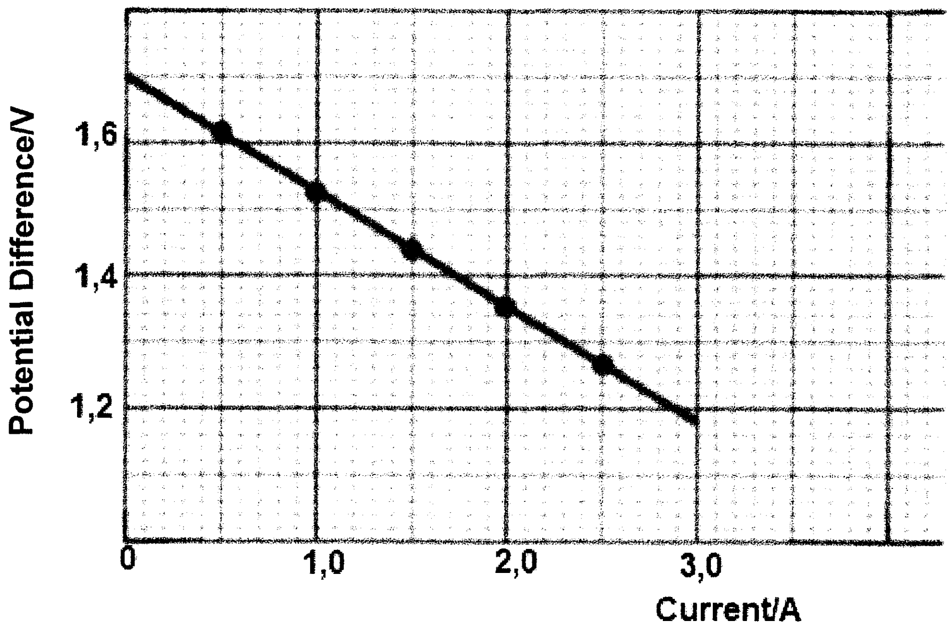


Which ONE of the following diagrams shows the direction in which Q_2 will move as a result of the electrostatic forces exerted by Q_1 and Q_3 on it?

A.	
B	
C.	
D.	

(2)

1.9 The graph below shows the change of potential difference, V, across the terminals of the battery with current, I, through the battery.



The magnitude of the emf of the battery is....

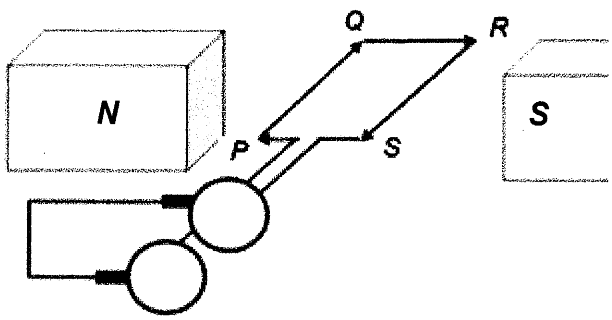
A 1,2 V

B 0 V

C 1,7 V

D 3,0 V (2)

1.10 A simplified diagram of an AC generator is shown below. PQRS represents a coil.



The direction of the INDUCED MAGNETIC FIELD on segment PQ of the coil is ...

A clockwise and parallel to the permanent magnetic field above and below segment PQ

B parallel and opposite to the current in segment PQ

C parallel and in the same direction to the current in segment PQ.

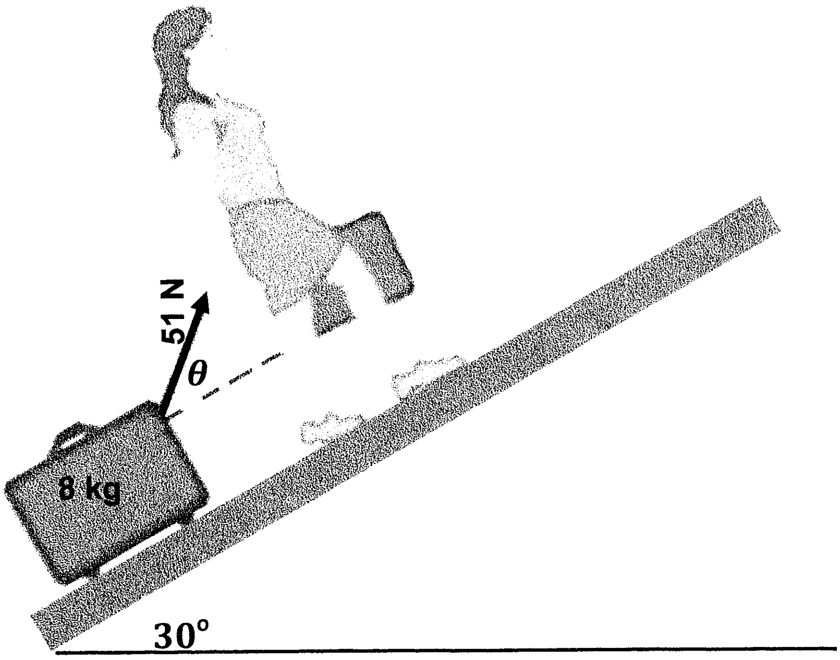
D anticlockwise and parallel to the permanent magnetic field above and below segment PQ. (2)

[20]

SECTION B

QUESTION 2

A woman is pulling a suitcase of mass 8 kg at CONSTANT SPEED up a ramp as shown in the sketch below. The ramp is inclined at an angle of 30^0 to the horizontal. She pulls on a strap with a force 51 N. The angle that the strap makes with suitcase is θ .
The kinetic frictional force on the suitcase is 1 N.



Ignore the rotational motion of the wheels of the suitcase.

2.1 Define a *normal force.* (2)

2.2 Draw a free-body diagram for the suitcase. (4)

2.3 Calculate the angle $\boldsymbol{\theta}$ that the strap makes with the incline. (3)

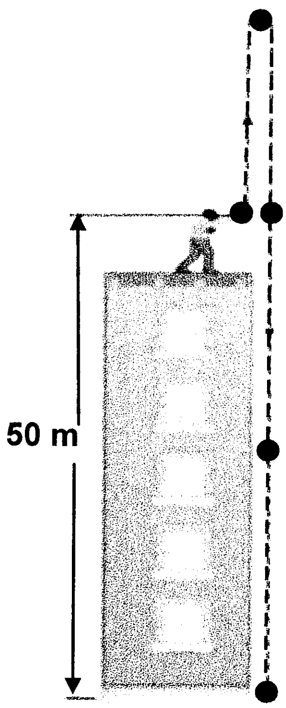
2.4 Determine the magnitude of the normal force that the ramp exerts on the suitcase. (3)

2.5 The pulling force on the suitcase is now applied PARALLEL to the inclined plane. How does this change affect the normal force calculated in question 2.4 above?
(Choose from: INCREASES, DECREASES OR REMAINS THE SAME.) (1)

[13]

QUESTION 3

A ball is thrown vertically upwards from the top of a building with an initial velocity of 12 m•s^{-1}. The ball leaves the thrower's hand at a point that is 50 m above the ground. The ball just misses the edge of the roof on its way down, and it bounces off the ground.



Ignore air resistance.

3.1 Determine ...

3.1.1 The time taken for the ball to reach the maximum height when it is thrown. (3)

3.1.2 The maximum height reached by the ball above the ground when it is thrown. (4)

3.1.3 The velocity of the ball at t = 4 s. (3)

3.1.4 The position of the ball above the ground at t = 4 s. (4)

3.2 On hitting the ground the ball bounces vertically upwards with an initial velocity of 25 m•s^{-1}. Draw a velocity vs time sketch graph for the motion of the ball from the time it was thrown vertically upwards to the time it reaches its maximum height AFTER THE FIRST BOUNCE.
Use the ground as a reference point.

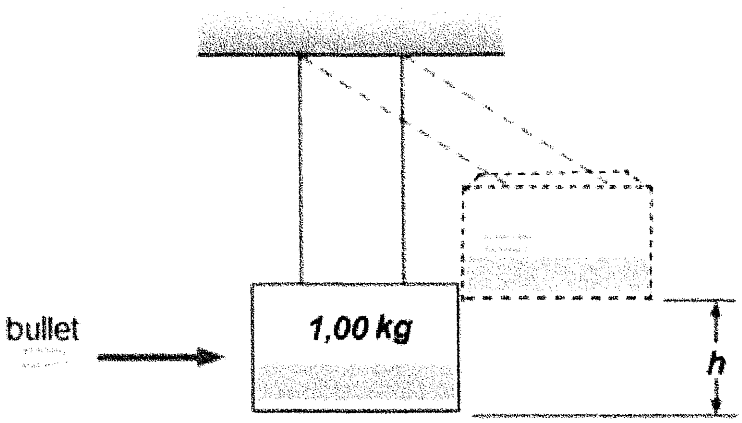
Indicate the following in your graph:

- Initial velocity of the ball when it was thrown
- Time taken to reach maximum height when it was thrown vertically upwards
- Initial velocity of the ball after the first bounce. (5)

[19]

QUESTION 4

A bullet of mass 5 g is fired into a block of wood of mass 1,00 kg that is suspended by two light strings. The bullet is stuck the block and the block-bullet system swings up to a height *h*. The height *h* is 50 cm.



4.1 State Newton's Second Law in terms of momentum in words. (2)

4.2 Calculate:

4.2.1 The velocity of the block – bullet system immediately after the bullet enters the block. (3)

4.2.2 The speed of the bullet before it struck the block. (4)

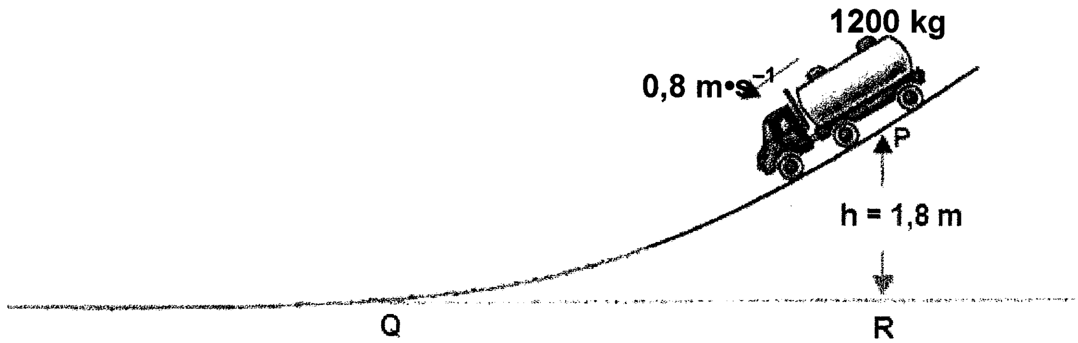
4.3 The mass of the block is doubled. How will the height now reached by the block be affected if it was shot by the same bullet as before?

(Choose from: GREATER THAN; LESS THAN or SAME AS BEFORE) (1)

[10]

QUESTION 5

5.1 A truck, mass 1200 kg, moving down a rough inclined track, has a speed of 0,8 m•s^{-1} at point P. Point P is 1,8 m above the ground level QR. The length of QP is 2,2 m. When the truck reaches point Q, it has a speed of 4 m•s^{-1}.

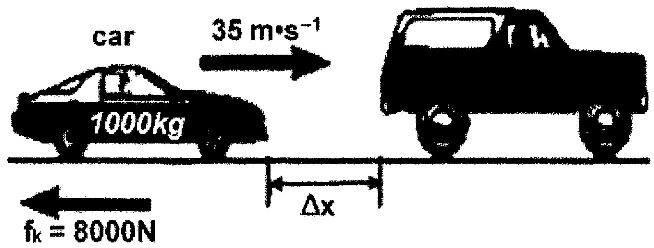


5.1.1 State the principle of conservation of Mechanical energy, in words. (2)

5.1.2 Is mechanical energy conserved as the truck moves from point P to point Q? Yes Or NO. (1)

5.1.3 Use ENERGY PRINCIPLES to calculate the frictional force acting on the truck as it moves from **P** to **Q**. (5)

5.2 The driver of a 1000 kg car traveling on a highway at 35 m•s^{-1} applies brakes to avoid hitting a van in front of him, which had come to rest because of traffic ahead. After the brakes are applied, a constant frictional force of 8000 N acts on the car.



5.2.1 State the WORK – ENERGY THEOREM in words. (2)

5.2.2 Using ENERGY PRINCIPLES, determine the minimum distance required for the brakes of the car to be applied to avoid a collision with the van. (4)

5.2.3 Use ENERGY PRINCIPLES to determine the speed at which the vehicles would collide if the driver had applied the brakes when his car was 30 m behind the van. (3)

5.2.4 How would the speed, calculated in question 5.2.3, change if it was raining during the incident? (Choose from INCREASE, DECREASE or REMAIN THE SAME) Give a reason. (2)

[19]

QUESTION 6

An ambulance with its siren on is moving at a constant speed of 20 m•s^{-1}. The siren emits sound waves at a constant frequency. A stationary detector placed on the side of the road records a frequency that is 50 Hz higher than the original frequency. Take the speed of sound in air as 340 m•s^{-1}.

6.1 Name and state the phenomenon described above. (3)

6.2 Is the ambulance moving AWAY from or TOWARDS the detector? (1)

6.3 Calculate the wavelength of the sound emitted by the siren. (7)

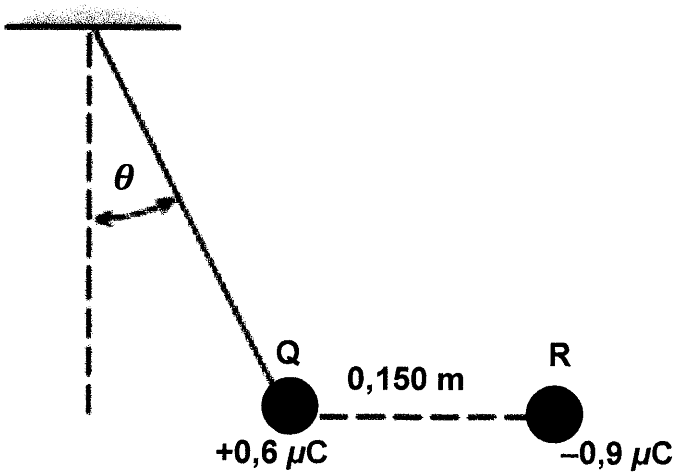
Some of the sound waves are reflected from the detector back towards the ambulance.

6.4 Will the frequency of the reflected sound waves as received by the ambulance be EQUAL TO, GREATER THAN or SMALLER THAN the frequency recorded by the detector? Give a reason. (2)

6.5 Give two medical applications of the phenomenon named in question 6.1 above. (2)
[15]

QUESTION 7

7.1 An insulated sphere Q of mass 8 x 10^{-2} kg and carrying a charge of +0.6 μC is hung by a string of negligible mass. Another charged sphere R carrying a charge of –0.9 μC is held 0.150 m away from Q and directly to the right of it, so that the string makes an angle θ with the vertical.



7.1.1 State Coulomb's Law of Electrostatics in words. (2)

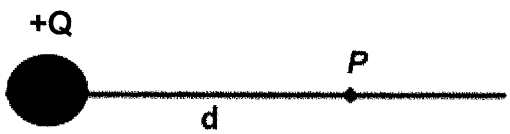
7.1.2 Draw the electric field pattern that exists between the two charged spheres in the sketch above. (3)

7.1.3 Draw a free body diagram for sphere Q. (3)

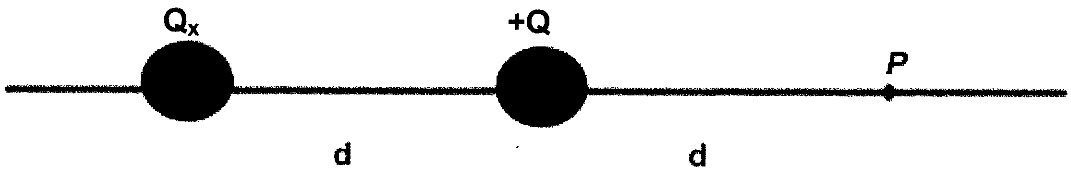
7.1.4 Calculate θ. (6)

7.1.5 Calculate the tension in the string. (3)

7.2 A point charge +Q is placed at a distance 'd' from position P. The field at P due to +Q is *E*.



When a second positive unknown charge Qx is placed at a distance 'd' to the left of +Q the net field at P due to the two charges is now 2*E*



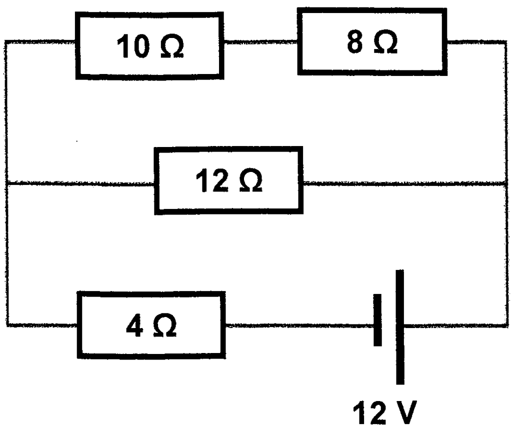
7.2.1 Define *electric field.* (2)

7.2.2 If the magnitude of the charge on +Q is +0,5 μC, calculate the magnitude of the charge Qx. (4)

[23]

QUESTION 8

Four resistors are connected to a battery with a voltage of 12 V, as shown below.



8.1 State Ohm's Law in words. (2)

8.2 Calculate:

8.2.1 The total current delivered by the battery. (5)

8.2.2 The power delivered to the 10 Ω resistor. (5)

8.2.3 The total energy used by the circuit if the current runs for 30 s. (3)

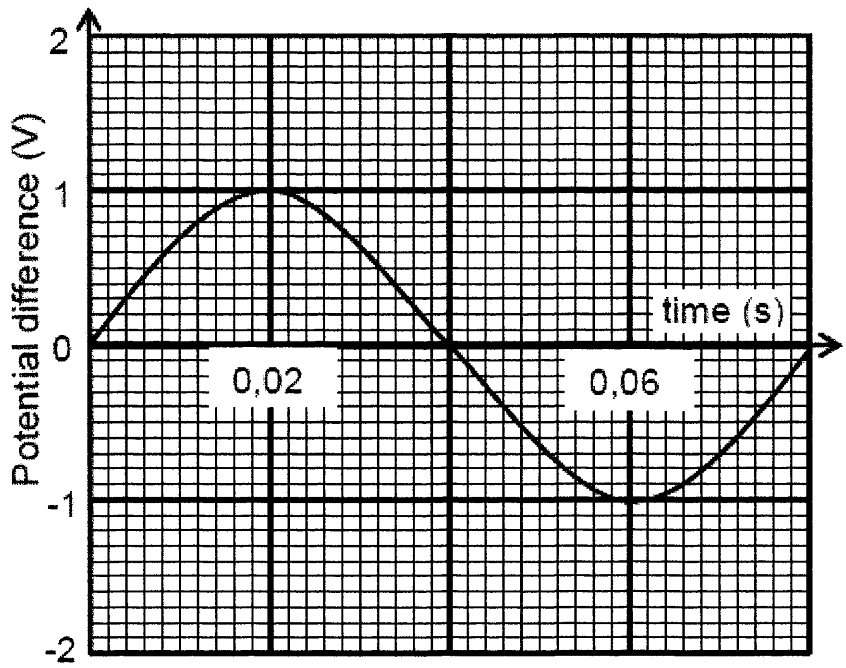
8.3 The 12 Ω resistor is now removed from the circuit. How will this affect the total current calculated in question 8.2.1?

(Choose from: INCREASES, DECREASES OR REMAINS THE SAME.
Explain. (3)

[18]

QUESTION 9

A coil is rotated in a magnetic field of a generator. The varying induced emf obtained is represented in the graph.



9.1 Which type of generator was used to produce the above type of graph? (1)

9.2 What structural feature of the generator allows it to produce the above type of graph? (1)

9.3 Define *rms voltage.* (2)

9.4 Calculate the induced rms voltage for the generator. (3)

9.5 The coil is now rotated at TWICE the original speed. Write down the period of the new wave. (1)

9.6 Calculate the average power generated if the generator produces a maximum current of 2 A. (3)

9.7 Give two advantages of using alternating current rather than direct current. (2)
[13]

TOTAL MARKS: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
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	$6{,}63 \times 10^{-34}\ J\cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^{9}\ N\cdot m^2\cdot C^{-2}$
Charge on electron *Lading op electron*	e^-	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of Earth *Massa van Aarde*	M	$5{,}98 \times 10^{24}\ kg$
Radius of Earth *Radius van Aarde*	R_E	$6{,}38 \times 10^{6}\ m$

TABLE 2: FORMULAE / TABEL 2: FORMULES

MOTION / BEWEGING

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/of $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE / KRAG

$F_{net} = ma$	$p = mv$
$f_{s(max)} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$

WORK, ENERGY AND POWER / ARBEID, ENERGIE EN DRYWING

$W = F\Delta x\cos\theta$	$U = mgh$ or/of $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/of $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ 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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = F\cdot v_{av}$ / $P_{gem} = F\cdot v_{gem}$	

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

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

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

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

education

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NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATIONS

SEPTEMBER 2020

MARKING GUIDELINE

Time: 3 Hours

Marks: 150

This marking guideline has 17 pages.

SECTION A

QUESTION 1

1.1 B✓✓ (2)

1.2 D✓✓ (2)

1.3 D✓✓ (2)

1.4 D✓✓ (2)

1.5 D✓✓ (2)

1.6 A✓✓ (2)

1.7 D✓✓ (2)

1.8 C✓✓ (2)

1.9 C✓✓ (2)

1.10 A✓✓ (2)

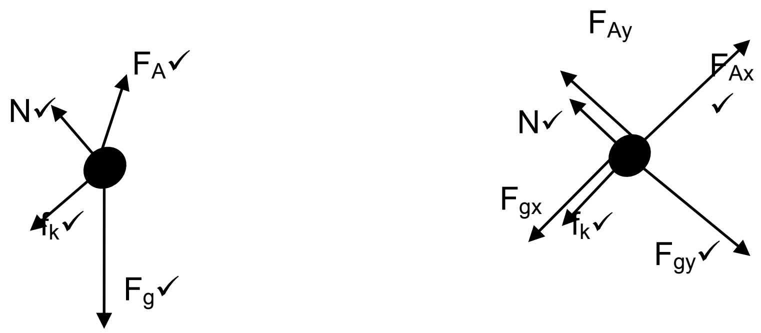
2 x 10 = **[20]**

SECTION B

QUESTION 2

2.1 Normal force is 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. ✓✓ (2)

2.2



	Accept the following symbols
N✓	F_N/Normal/Normal force
fk✓	Kinetic friction force/f/F_f/f_r
F_A✓	F/$F_{applied}$
F_g✓	W/78,4 N

Notes
- Mark is awarded for label and arrow.
- Do not penalise for length of arrows.
- Deduct 1 mark for any additional force.
- If force(s) do not make contact with body/dot : *Max:3/4*
- If arrows missing but labels are there: *Max:3/4*

(4)

2.3 **Considering the forces parallel to the plane::**

$F_{net} = ma$

$F_{net} = 0$ ✓

$F_{Ax} - f_k - F_{gx} = 0$

$F_A\cos\theta = f_k + F_{gx}$

$51\cos\theta = 1 + 8(9,8)\sin 30^\circ$✓

$\theta = 37,98^\circ$✓ (3)

2.4 **POSITIVE MARKING FROM 2.3**

Consider the forces perpendicular to the plane:

$F_{net} = ma$
$F_{net} = 0$
$F_{Ay} + N – F_{gy} = 0$
$F_A \sin\theta + N = F_{gy}$ ✓

51sin 37,98° + N = 8 x 9,8cos(30°)✓

∴ N = 36,51 N✓ (3)

2.5 Increases ✓ (1)

[13]

QUESTION 3

3.1

3.1.1

UPWARDS IS POSITIVE	**UPWARDS IS NEGATIVE**
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
$0 = 12 - 9{,}8\Delta t$✓	$0 = -12 + 9{,}8\Delta t$✓
$\Delta t = 1.2245 s$✓	$\Delta t = 1.2245 s$✓

(3)

3.1.2

OPTION 1

UPWARDS IS POSITIVE	**UPWARDS NEGATIVE**
$v_f^2 = v_i^2 + 2a\Delta y$✓	$v_f^2 = v_i^2 + 2a\Delta y$✓
$0 = 12^2 + 2(-9{,}8)\Delta y$✓	$0 = (-12)^2 + 2(9{,}8)\Delta y$✓
Δy = 7,35 m	Δy = – 7,35m
∴Max height = 50+✓7,35 = 57,35m✓	∴Maximum height = 50 +✓7,35 = 57,35m✓

OPTION 2
POSITIVE MARKING FROM 3.1.1

UPWARDS IS POSITIVE	**UPWARDS IS NEGATIVE**
$\Delta y = \left(\frac{v_i+v_f}{2}\right)\Delta t$✓	$\Delta y = \left(\frac{v_i+v_f}{2}\right)\Delta t$✓
$\left[\Delta y = \left(\frac{12+0}{2}\right)1{,}2245\right]$ ✓	$\left[\Delta y = \left(\frac{-12+0}{2}\right)1{,}2245\right]$✓
Δy = 7,35 m	Δy = –7,35 m
∴Max height = 50+✓7,35 = 57,35m✓	∴Max height = 50+✓7,35 = 57,35m✓

OPTION 3

POSITIVE MARKING FROM 3.1.1

UPWARDS IS POSITIVE

$\Delta y = v_i\Delta t + ½a\Delta t^2$✓

$\Delta y = \underline{(12)(1,23) + ½(-9,8)(1,23)^2}$✓

$\Delta y = 7,35$ m

∴Maximum height = 50+✓7,35
= 57,35m✓

UPWARDS IS NEGATIVE

$\Delta y = v_i\Delta t + ½a\Delta t^2$✓

$\Delta y = \underline{(-12)(1,23) + ½(9,8)(1,23)^2}$✓

$\Delta y = -7,35$ m

∴Maximum height = 50+✓7,35
= 57,35m✓

OPTION 4

$(K + U)_1 = (K + U)_2$✓

$(½mv^2 + mgh)_1 = (½mv^2 + mgh)_2$

$\underline{½m(12)^2 + m(9,8)(50)}$ ✓ = $\underline{½m(0)^2 + m(9,8)h}$ ✓

h = 57,35 m✓ (4)

3.1.3 **OPTION 1**

UPWARDS POSITIVE

$v_f = v_i + a\Delta t$✓

$v_f = \underline{12 + (-9,8)(4)}$ ✓

$v_f = -27,20\ m•s^{-1}$

∴ velocity of the ball is $\underline{27,20\ m•s^{-1}\ downwards}$✓

UPWARDS NEGATIVE

$v_f = v_i + a\Delta t$✓

$v_f = \underline{-12 + (9,8)(4)}$ ✓

$v_f = 27,20\ m•s^{-1}$

∴ velocity of the ball is $\underline{27,20\ m•s^{-1}\ downwards}$✓

OPTION 2

UPWARDS POSITIVE

$\Delta y = v_i\Delta t + ½a\Delta t^2$

$\Delta y = (12)(4) + ½(-9,8)(4)^2$

$\Delta y = -30,40$ m

$\Delta y = (\frac{v_i+v_f}{2})\Delta t$✓

$-30{,}40 = (\frac{12+v_f}{2})(4)$✓

v_f =–27,20 m•s^{-1}
∴ velocity of the ball is 27,20 m•s^{-1} downwards✓

UPWARDS NEGATIVE

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

$\Delta y = (-12)(4) + \frac{1}{2}(9{,}8)(4)^2$

$\Delta y = 30{,}40$ m

$\Delta y = (\frac{v_i+v_f}{2})\Delta t$✓

$30{,}40 = (\frac{-12+v_f}{2})(4)$✓

v_f =27,20 m•s^{-1}
∴ velocity of the ball is 27,20 m•s^{-1} downwards✓

OPTION 3

UPWARDS POSITIVE

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

$\Delta y = (12)(4) + \frac{1}{2}(-9{,}8)(4)^2$

$\Delta y = -30{,}40$ m

$v_f^2 = v_i^2 + 2a\Delta y$✓
$v_f^2 = (12)^2 + 2(-9{,}8)(-30.40)$ ✓
v_f =27,20 m•s^{-1}
∴ velocity of the ball is 27,20 m•s^{-1} downwards✓

UPWARDS NEGATIVE

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

$\Delta y = (-12)(4) + \frac{1}{2}(9{,}8)(4)^2$

$\Delta y = 30{,}40$ m

$v_f^2 = v_i^2 + 2a\Delta y$✓
$v_f^2 = (-12)^2 + 2(9{,}8)(30.40)$ ✓
v_f =27,20 m•s^{-1}
∴ velocity of the ball is 27,20 m•s^{-1} downwards✓ (3)

3.1.4 **OPTION 1**

UPWARDS POSITIVE

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$\Delta y = \underline{(12)(4) + ½(–9,8)(4)^2}$ ✓

$\Delta y = –30,40$ m

∴Position above the ground = $\underline{50 -}$ ✓30,40
= 19,60 m ✓

If candidate calculated 30.40 m in Q 3.1.3. above award 2 marks here.

UPWARDS NEGATIVE

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$\Delta y = \underline{(–12)(4) + ½(9,8)(4)^2}$ ✓

$\Delta y = 30,40$ m

∴Position above the ground = $\underline{50 -}$ ✓30,40
= 19,60 m ✓

OPTION 2

POSITIVE MARKING FROM 3.1.3

UPWARDS POSITIVE

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark$$

$$\Delta y = \left(\frac{12 + (-27,20)}{2}\right)(4) \checkmark$$

$\Delta y = – 30,40$ m

∴Position above the ground = $\underline{50 -}$ ✓30,40
= 19,60 m ✓

UPWARDS NEGATIVE

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark$$

$$\Delta y = \left(\frac{-12 + 27,20}{2}\right)(4) \checkmark$$

$\Delta y = 30,40$ m

∴Position above the ground = $\underline{50 -}$ ✓30,40
= 19,60 m ✓

OPTION 3

POSITIVE MARKING FROM 3.1.3

UPWARDS POSITIVE

$v_f^2 = v_i^2 + 2a\Delta y$✓

$(-27,20)^2 = (12)^2 + 2(-9,8)\Delta y$ ✓

$\Delta y = -30,40$

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m✓

UPWARDS NEGATIVE

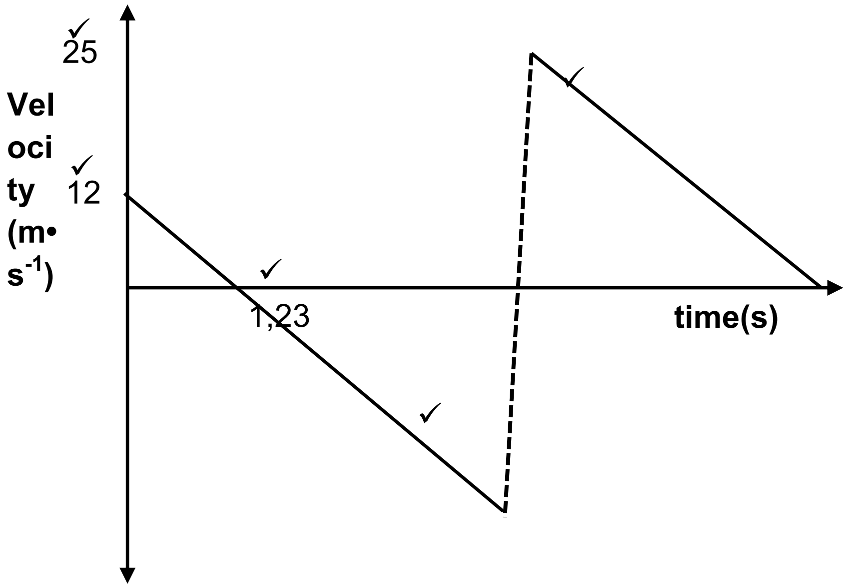
$v_f^2 = v_i^2 + 2a\Delta y$✓

$(27,20)^2 = (-12)^2 + 2(9,8)\Delta y$ ✓

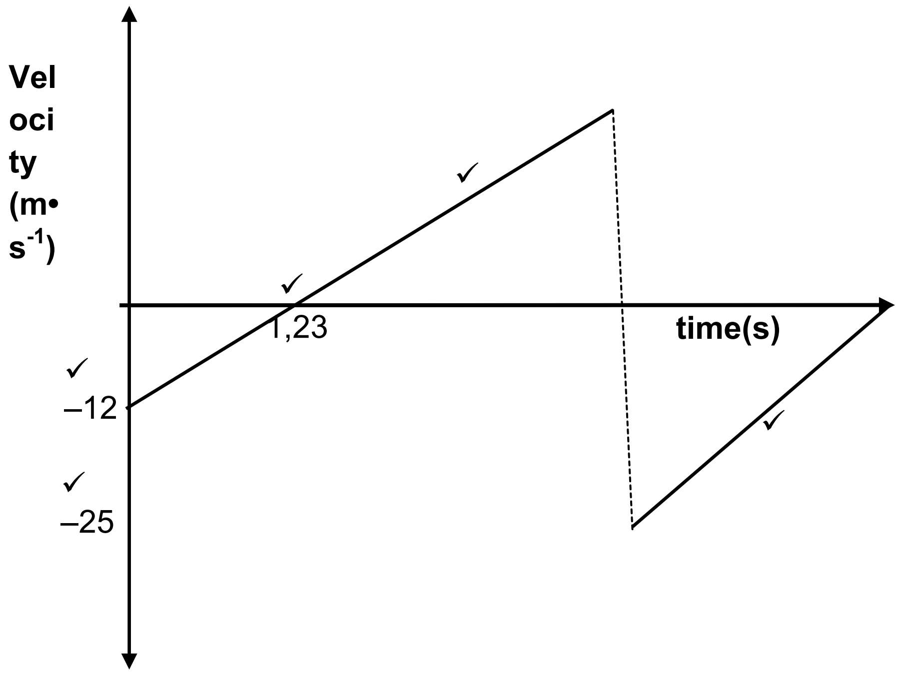
$\Delta y = 30,40$

∴Position above the ground $= \underline{50 -}$ ✓30,40
$= 19,60$ m✓ (4)

3.2



OR



CRITERIA FOR MARKING OF GRAPH	
Correct shape (the three lines must have same gradient)	✓
Indication of initial velocity (12 m.s^{-1})	✓
Indication of velocity of bounce (25 m.s^{-1})	✓
1.23s	✓
First line longer below x-axis than above	✓
If 25 m.s^{-1} line beyond x-axis then -1	
Do not penalise if dotted lines are solid	

(5)

[19]

QUESTION 4

4.1 The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.✓✓ (2)

4.2

4.2.1 $(K + U)_1 = (K + U)_2$

$(½mv^2 + mgh)_1 = (½mv^2 + mgh)_2$ ✓

$(½(1,005)v^2 + 0) = 0 + (1,005)(9,8)(0,5)$ ✓

$v_1 = 3,13\ m{\bullet}s^{-1}$

∴The velocity of the block – bullet system immediately after collision is 3,13 m•s^{-1}✓ (3)

4.2.2 **POSITVE MARKING FROM 4.2.1**

$\Sigma p_i = \Sigma p_f$

$m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$ ✓

$(0,005)v_{1i} + (1)(0)$ ✓ = $(0,005+ 1)(3,13)$ ✓

$v_{1i} = 629,13\ m{\bullet}s^{-1}$ ✓ (4)

4.3 Less than✓ (1)

[10]

QUESTION 5

5.1.1 Total mechanical energy of an isolated system remains constant✓✓ (2)

5.1.2 No,✓ (1)

5.1.3 **OPTION 1**

$(K + U)_P = (K + U)_Q – W_f$

OR

$W_{nc} = \Delta E_p + \Delta E_k$ ✓

$(½mv^2 + mgh)_P = (½mv^2 + mgh)_Q – W_f$

$[½(1200)(0,8)^2 + (1200)(9,8)(1,8)]_P$✓ = $[½(1200)(4)^2 + 0$ ✓$– W_f]_Q$

$W_f = –11952$ J

$W_f = F_f \Delta x \cos 180$ ✓

$–11952 = –F_f 2,2$

$F_f = 5432,73$ N✓

OPTION 2

$W_{net} = \Delta K$
$W_f + W_g = ½mv_f^2 - ½mv_i^2$
$W_f + mgh = ½m(v_f^2 - v_i^2)$
$W_f + mgh = ½mv_f^2 - ½mv_i^2$ } ✓

$W_f + \underline{1200(9,8)(2,2)\cos 324,90^o}$ ✓ $= \underline{½(1200)(4)^2 - ½(1200)(0,8)^2}$ ✓
(accept 35.1^o)
$W_f = –11952$ J

$W_f = F_f \Delta x \cos 180$ ✓
$–11952 = –F_f 2,2$
$F_f = 5432,73$ N✓ (5)

5.2

5.2.1 The <u>net/total work done</u> on an object <u>is equal</u> to the <u>change in the object's kinetic energy</u>. ✓✓.

OR

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

Note: -1 mark for each key word/phrase omitted in the correct context.

(2)

5.2.2 $W_{net} = \Delta K$

$W_f + W_g + W_N = ½mv_f^2 – ½mv_i^2$ } ✓

✓

$\underline{8000\cos 180^o \Delta x} + 0 + 0 = \underline{½(1000)(0)} – \underline{½(1000)(35^2)}$ ✓
$\Delta x = 76,56$ m✓ (4)

5.2.3 $W_{net} = \Delta K$

$W_f + W_g + W_N = ½mv_f^2 – ½mv_i^2$

$\underline{8000\cos 180^o(30) + 0 + 0}$✓ $= ½(1000)v_f^2 – ½(1000)(35^2)$ ✓
$v_f = 27,29 m•s^{-1}$✓ (3)

5.2.4 INCREASE✓
On a rainy day the road surface would have less frictional force needed for the braking. ✓ (2)

[19]

QUESTION 6

6.1 Doppler Effect. ✓
It is 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

Doppler Effect. ✓
It is the change in the observed frequency of a sound wave when the source of sound is moving relative to the listener. ✓✓ (3)

6.2 Towards✓ (1)

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

$(f_s + 50)$✓ $= \left(\frac{340+0✓}{340-20✓}\right) f_s$ OR f_L✓ $\left(\frac{340+0✓}{340-20✓}\right)(f_L - 50)$

f_s = 800 Hz (range: 800 – 833.33 Hz)

$v = f_s\lambda$✓
$340 = 800\lambda$✓
λ = 0,425 m✓ (range: 0,425 – 0,408) (7)

6.4 Greater than. ✓
The reflected waves are moving toward the ambulance. ✓ (2)

6.5
- blood flow meter ✓
- echocardiograms. ✓
- ultrasound technology
- monitor pregnancies
- examine soft tissue injuries. (any two) (2)

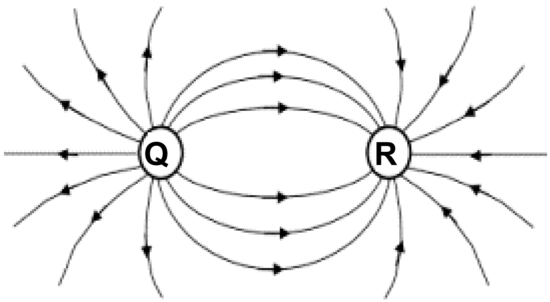
[15]

QUESTION 7

7.1.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them✓✓. (2)

Note: -1 mark for each key word/phrase omitted in the correct context.

7.1.2

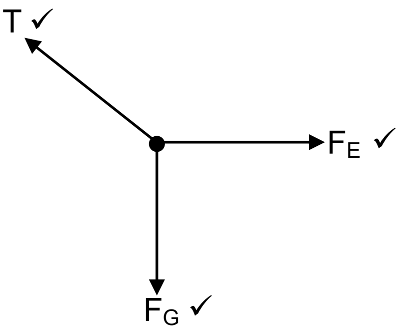


Accept: Density around R maybe greater than Q

Marking Criteria	
Correct Shape	✓
Field lines do not cross	✓
Direction of field lines correct	✓

(3)

7.1.3



(3)

7.1.4 **CONSIDERING THE HORIZONTAL FORCES:**

$F_{net} = 0$

$T\sin\theta = F_e$ ✓

$$T\sin\theta = \left\{9\times10^9\left[\frac{(0{,}6\times10^{-6})(0{,}9\times10^{-6})}{0{,}150^2}\checkmark\right]\right\}\checkmark$$

$T\sin\theta = 0{,}216$ .... (1)

CONSIDERING THE VERTICAL FORCES:

$F_{net} = 0$

$T\cos\theta = mg$✓

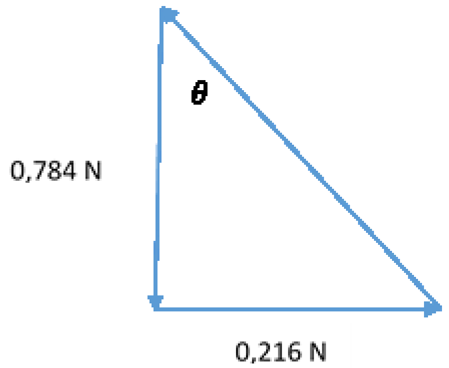
$T\cos\theta = 8\times10^{-2}\ (9{,}8)$ ✓ .... (2)

(1) ÷ (2)

tan θ = 0,26/(8 x 10^{-2} (9,8))

θ = 15,40°✓

OPTION 2



F = $\{9 \times 10^9 \left[\frac{(0,6 \times 10^{-6})(0,9 \times 10^{-6})✓}{0,150^2 ✓}\right]\}$

= 0.216N

F_g = mg✓
= 8 x 10^{-2} x 9,8✓
= 0,784 N

tan θ = F/F_g
= 0,216/0,784✓
θ = 15,40°✓

(6)

7.1.5 **POSITIVE MARKING FROM 7.2**
Tcos θ= 8 x 10^{-2} (9,8)
Tcos 15,40°✓= 8 x 10^{-2} (9,8) ✓
T = 0,81 N✓ (3)

7.2.1 *Electric field* is a region of space in which an electric charge experiences a force. ✓✓ (2)
(accept : force experienced per unit positive charged when placed at that point)

7.2.2 $E_1 = k\frac{q_1}{d^2}$ ✓

$E_{net} = [k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}]$✓ OR (E_1 = E_2)

✓
$2E_1 = k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}$

$$2\,k\frac{q_1}{d^2} = k\frac{q_1}{d^2} + k\frac{q_2}{(2d)^2}$$

$$2\,k\frac{q_1}{d^2} = k\frac{q_1}{d^2} + k\frac{q_2}{4d^2}$$

$$k\frac{q_1}{d^2} = k\frac{q_2}{4d^2}$$

$4q_1 = q_2$
$4 \times 0,5 \times 10^{-6} = q_2$
$q_2 = 2 \times 10^{-6}$ C✓ (4)

[21]

QUESTION 8

8.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature ✓✓

NOTE
If constant temperature is omitted -1 mark (2)

8.2

8.2.1 Total Resistance = $R_{series} + R_{parallel}$

Total Resistance = 4 +✓ $\left(\frac{1}{12} + \frac{1}{18}\right)^{-1}$✓

Total Resistance = 11,20

$I = \frac{V}{R}$✓

$I = \frac{12}{11,2}$✓

I = 1,07A✓ (5)

8.2.2 **POSITIVE MARKING FROM 8.2.1**

$V_{4\Omega} = IR$
$V_{4\Omega} = 1{,}07 \times 4$✓
$V_{4\Omega} = 4{,}28$ V
$V_{//} = 12 - V_{4\Omega}$
$V_{//} = 12 – 4{,}28$
$V_{//} = 7{,}72$ V
$I_{10\Omega} = \frac{V}{R}$
$I_{10\Omega} = \frac{7{,}72}{18}$✓
$I_{10\Omega} = 0{,}43$ A

$P = I^2R$✓ $P = (0{,}43)^2(10)$ ✓ P = 1,85 W✓	$V_{10\Omega} = IR$ $V_{10\Omega} = 0{,}43 \times 10$ $V_{10\Omega} = 4{,}3$ V $P = \frac{V^2}{R}$✓ $P = \frac{4{,}3^2}{10}$✓ P = 1,85 W✓	P = VI✓ P = 4,3 X 0,43✓ P = 1,85 W✓

(5)

8.2.3 **POSITIVE MARKING FROM 8.2.1**

$W = V.I\Delta t$✓ $= 12 \times 1.07 \times 30$✓ = 385,20 J✓	$W = I^2Rt$✓ $= 1{,}07^2 \times 11{,}2 \times 30$✓ = 384,69 J✓	$W = \frac{V^2}{R}t$ $= \frac{12^2}{11.2} \times 30$ $= 385{,}71$J

(3)

8.3 Decreases✓
If the 12 Ohm resistor stops working, the total resistance would increase✓. Resistance is inversely proportional to the current✓. (3)

[18]

QUESTION 9

9.1 AC (generator) ✓ (1)

9.2 Slip rings✓ (1)

9.3 The AC potential difference/voltage which dissipates the same amount of energy as DC. ✓✓

OR

(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy as AC. ✓✓ (2)

9.4

$$V_{RMS} = \frac{V_{Max}}{\sqrt{2}} ✓$$

$$V_{RMS} = \frac{1}{\sqrt{2}} ✓$$

V_{RMS} = 0,71 V✓ (3)

9.5 0,04 s.✓ (1)

9.6 Positive marking from Q 9.4

$$\left.\begin{array}{l} P_{Ave} = V_{RMS} I_{RMS} \\ P_{Ave} = V_{RMS}\left(\frac{I_{Max}}{\sqrt{2}}\right) \end{array}\right\} ✓$$

$$P_{Ave} = 0{,}71\left(\frac{2}{\sqrt{2}}\right) ✓$$

P_{Ave} = 1,00 W✓ (3)

9.7 Any two:
(i) easier to generate and transmit from place to place ✓
(ii) easier to convert from a.c. to d.c. than the reverse ✓
(iii) voltage can be easily changed by stepping it up or down
(iv) high frequency used in a.c. make it more suitable for electric motors (2)

[13]

TOTAL: 150