Province of the
EASTERN CAPE
EDUCATION

AMATHOLE WEST DISTRICT

GRADE 11

PHYSICAL SCIENCES: PHYSICS P1

MAY/JUNE 2024

MARKS: 100

TIME: 2 HOURS

This question paper consists of 15 pages, including 2 data sheet.

INSTRUCTIONS AND INFORMATION

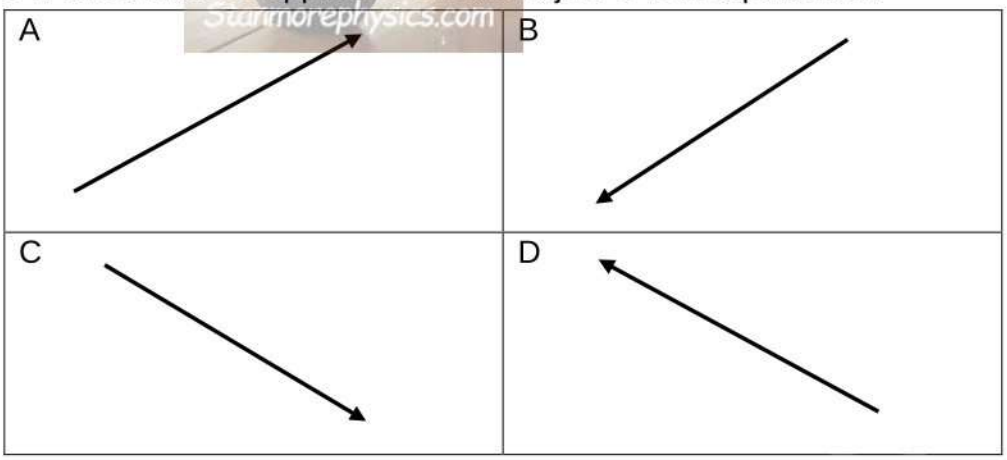
1. Write your FULL NAME and SURNAME on the ANSWER SCRIPT.
2. The question paper consists of 8 questions. Answer ALL the questions in the ANSWER SCRIPT.
3. Start EACH question on a new page in the ANSWER SCRIPT.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE-line open 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 SHEETS.
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 explanations, motivations, et cetera where required.
12. Write neatly and legibly.

QUESTION 1

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 (1.1–1.7) in the ANSWER BOOK, for example 1.8 E

1.1 The vector diagram shows two forces in the same plane acting on an object O.

Another 5 N force, in the same plane as the other forces, is applied on the object O. Which of the following represents the direction at which the 5 N force must be applied to ensure object O is in equilibrium?



(2)

1.2 Which ONE of the following is an example of a contact force?

A Normal force

B Electrostatic force

C Magnetic force

D Gravitational force (2)

1.3 The frictional force acting on a sliding object by the surface in contact with it ...

A depends on air resistance.

B depends on the normal force.

C depends on the area of contact.

D does not depend on the type of surface. (2)

1.4 An artificial satellite circles around the earth at a height where the gravitational force is a $\frac{1}{4}$ of that at the surface of the earth. If the earth's radius is **R**, the height of the satellite above the surface of the earth is…..

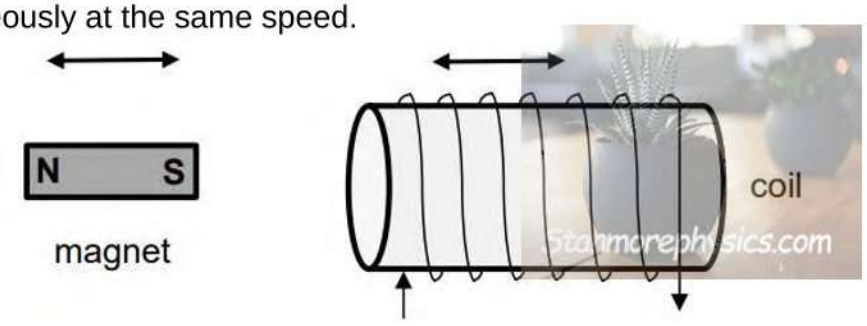
A 2 **R**

B **R**

C $\frac{1}{2}$ **R**

D $\frac{1}{4}$ **R** (2)

1.5 A coil and a magnet can each move horizontally to the left or to the right simultaneously at the same speed.



In which of the following will a conventional current be induced in the coil in the direction shown in the diagram when both the magnet and the coil are moving?

	Direction of motion of magnet	**Direction of motion of coil**
A	To the left	To the right
B	To the left	To the left
C	To the right	To the right
D	To the right	To the left

(2)

1.6 Two insulated spheres carry charges of + 2Q and – 4Q at a distance **x** apart. Each sphere experiences a force **F**, and are brought together to touch and then separated to half the original distance.

What will be the new force experienced by the spheres?

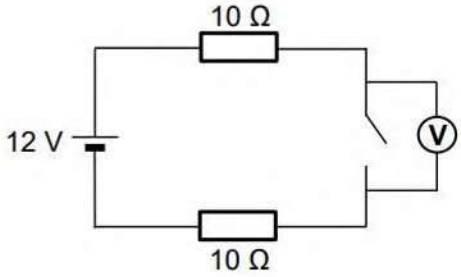
A 2 **F**

B 4 **F**

C $\frac{1}{2}$ **F**

D $\frac{1}{4}$ **F** (2)

1.7 In the circuit shown below, two identical resistors are connected to a 12 V cell and **the switch is open.**



What will be the reading on the voltmeter V?

A 0 V

B 6 V

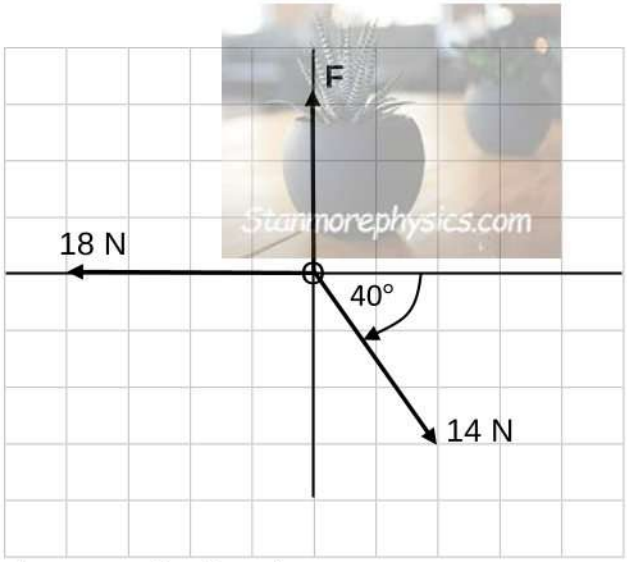
C 0.6 V

D 16 V (2)

[14]

QUESTION 2

2.1 The diagram below represent three force vectors acting on a point O.

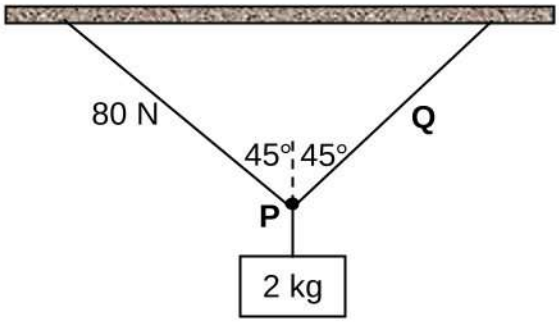


2.1.1 Define the term *resultant vector*. (2)

2.1.2 Calculate the magnitude of the horizontal component for 14 N. (2)

2.1.3 Determine the magnitude of **F**, if the resultant (net) acting on point O is **13.19 N** on a bearing of 326.50°. (5)

2.2 A box of mass 2 kg is suspended on a string from point **P**. Two strings, of 80 N and **Q** are light and inextensible. The strings are running over a frictionless pulley.



When the three forces acting on knot **P** are in equilibrium, the angles between the two strings and the vertical are 45° each, as shown in the diagram.

2.2.1 Describe the meaning of the term *equilibrium*. (1)

2.2.2 Calculate the weight of the box. (3)

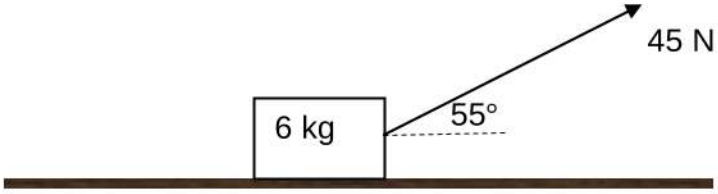
2.2.3 Calculate the tension on the **Q**. (3)

2.2.4 Draw a closed vector diagram of the three forces 80 N, Q and w by using the tail-to-head method. Clearly label the three forces and the relevant angle. (4)

[20]

QUESTION 3

A 6 kg block is pulled at a CONSTANT speed on a *rough* horizontal surface. The box is pulled with a force of 45 N at an angle of 55° to the horizontal.



3.1 Define the term *inertia*. (2)

3.2 Draw a labelled free-body diagram showing all the forces acting on the 6 kg block. (4)

3.3 Calculate the:

3.3.1 Magnitude of the frictional force acting on the block. (3)

3.3.2 Normal force exerted by the surface to the block. (3)

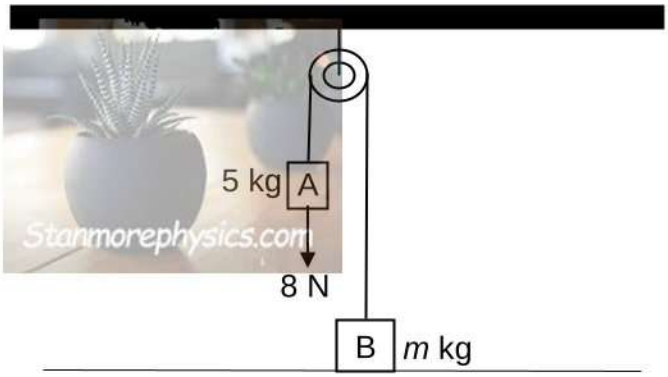
The angle between force applied and the horizontal is now decrease.

3.4 What effect will it have to the answer calculated in Question 3.3.1? Write only INCREASES, DECREASES or REMAINS THE SAME. Support your answer. (3)

[15]

QUESTION 4

Block **A** of mass 5 kg is connected to block **B** of an unknown mass ***m*** by light inextensible rope running over a frictionless pulley. Block **A** is initially held above the ground, while block **B** is initially stationary on the ground, as shown in the diagram below.



When a constant force of 8 N is applied to block **A**, it moves vertically downwards and strikes the ground. Block **A** accelerates downwards at 2 $m.s^{-2}$.
Ignore the effect of friction.

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

4.2 Draw a labelled free-body diagram showing ALL the forces acting on block **A** immediately after 8 N was applied. (3)

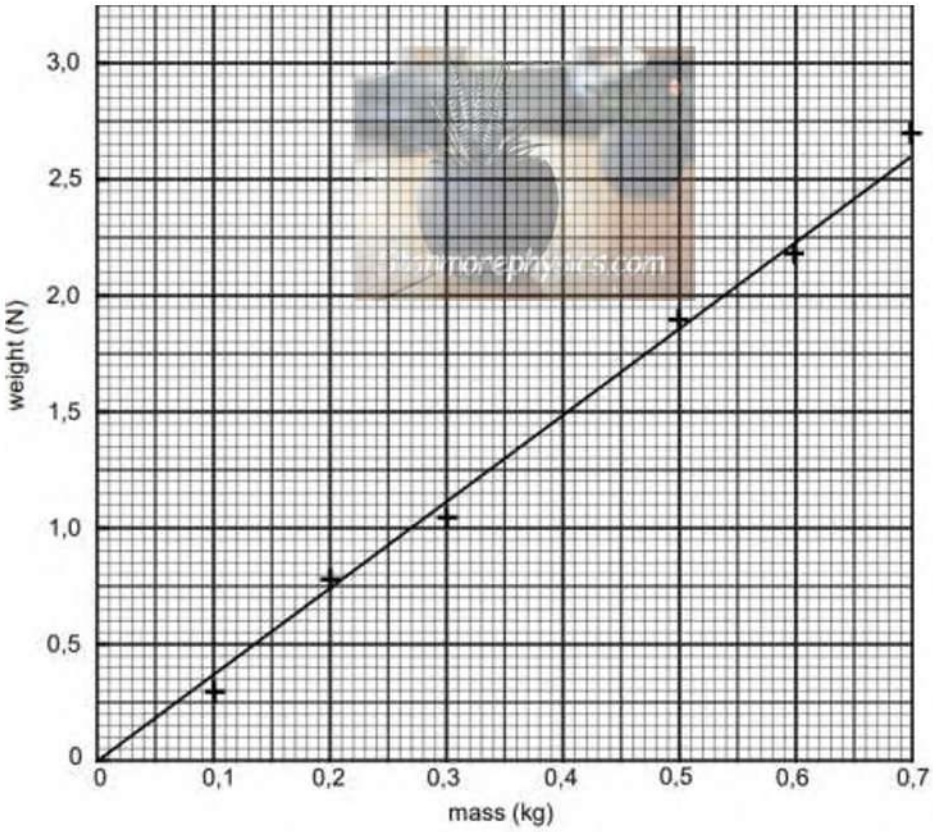
4.3 Calculate the tension of block **A** while the system was moving vertically downwards. (4)

4.4 Calculate the value of ***m***. (3)

[12]

QUESTION 5

An astronaut on a planet wants to determine the acceleration due to gravity. The astronaut has a number of different masses available and determines the weight of each mass.
The following measurements were recorded and the graph was drawn as shown below.



5.1 Distinguish between *mass* and *weight*. (2)

5.2 Calculate the gradient of the graph using the any coordinate that best fit the line from the graph. (3)

5.3 Hence, determine the acceleration due to gravity on the planet. (1)

The values g on different plants are shown on the table below. Refer to the table to answer the following questions.

Planet	g ($m \cdot s^{-2}$)
Venus	8,87
Mars	3,71
Jupiter	23,12
Pluto	0,58

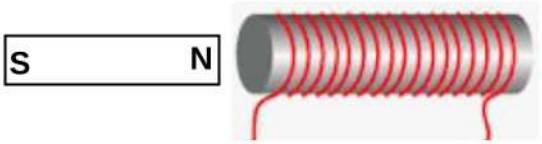
5.4 Which planet is the astronaut at? (1)

5.5 Determine the mass of Pluto if the radius is $1{,}19 \times 10^6$ m . (4)

[11]

QUESTION 6

A circular wire loop of radius 0.3 m contains 17 turns. When a bar magnet is pushed perpendicular into the coil, the magnetic field strength due to the magnet is $+3 \times 10^{-4}$ T. The magnet is pulled out of the solenoid so that the field changes to -2×10^{-4} T in a time of 1.5 s as shown in the diagram below.



6.1 Calculate the induced emf. (5)

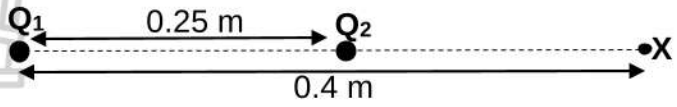
6.2 State one change that can increase the value calculated in 6.1.

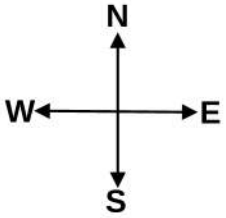
(1)

[06]

QUESTION 7

Two charged particles, Q_1 and Q_2 are placed 0.25 m apart along a straight line. The charge on Q_1 and Q_2 are + 2 nC and – 3 nC respectively. Point X is 0.4 m east of Q_1, as shown in the diagram below.





7.1 Calculate the electrostatic force exerted by Q_1 on Q_2. (4)

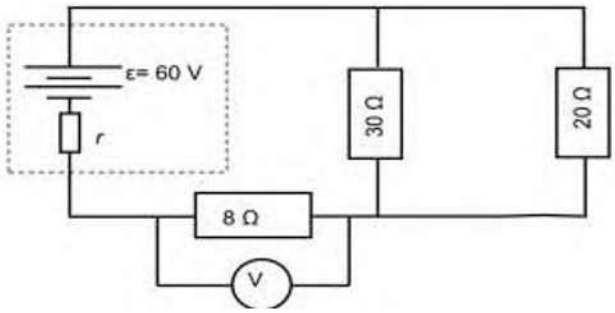
7.2 Define the *electric field at a point* in words. (2)

7.3 Calculate the magnitude of the net electric field at point X due to Q_1 and Q_2. (5)

[11]

QUESTION 8

The circuit diagram below shows a battery with an emf (ε) of 60 V and an unknown internal resistance r, connected to three resistors.



A voltmeter connected across the 8 Ω resistor reads 21,84 V. Calculate the:

Calculate the:

8.1 Current in the 8 Ω resistor (3)

8.2 Equivalent resistance of the resistors in parallel. (2)

8.3 Internal resistance r of the battery (4)

8.4 If 30Ω resistor is removed in the circuit. What will be the effect on the total resistance of the circuit. Choose from GREATER THAN, LESS THAN or EQUAL TO. (1)

8.5 Explain your answer in 8.4. (1)

[11]

TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 11 P/

TABLE 1: PHYSICAL CONSTANTS

NAME/*NAAM*	SYMBOL/*SIMBOOL*	
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth Radius *van die Aarde*	R_E	6,38 x 10^6 m
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of Earth *Massa van die Aarde*	M	5,98 x 10^{24} kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max/maks)}}{N}$
$\mu_k = \frac{f_k}{N}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9,0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9,0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$n = \frac{Q}{e}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

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PHYSICAL SCIENCES P1

MAY/JUNE 2024

MEMORANDUM

MARKS: 100

This memorandum consists of 6 pages

QUESTION 1

1.1 B✓✓ (2)

1.2 A✓✓ (2)

1.3 B✓✓ (2)

1.4 B✓✓ (2)

1.5 D✓✓ (2)

1.6 C✓✓ (2)

1.7 A✓✓ (2)

[14]

QUESTION 2

2.1.1 Single vector having the same effect as two or more vectors together. ✓✓ (2)

2.1.2 $F_x = 14 \cos 40°$✓
$F_x = 10.72$ N✓ (2)

n2.1.3 $R_x = 18 - 10.72$
$R_x = 7.28$ N✓

$R^2 = R_x^2 + R_y^2$
$(13.19)^2 = (7.28)^2 + R_y^2$✓
$R_y = 11$ N✓

$F_{y1} = 14 \sin 40°$
$F_{y1} = 9$ N✓

$R_y = F_{y2} - F_{y1}$
$11 = F - 9$
$F = 20$ N✓ (5)

2.2.1 Net /resultant force at a point is ZERO. ✓ (1)

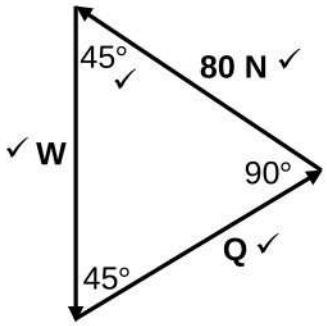
2.2.2 $w = mg$✓
$w = (2)(9.8)$ ✓
$w = 19.6$ N✓ (3)

2.2.3

Option 1	Option 2
Q cos 45° ✓= 19.6✓ Q = 27.72 N✓	Q sin 45° ✓= 19.6✓ Q = 27.72 N✓

(3)

2.2.4

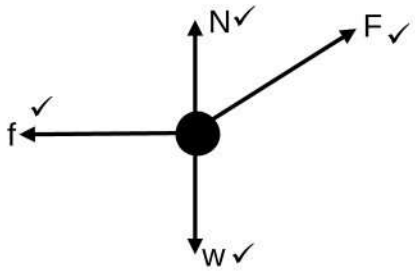


(4)
[20]

QUESTION 3

3.1 Resistance of an object to any change in its state of motion. ✓✓ (2)

3.2



(4)

3.3.1 $F_x + (-f) = 0$✓
45 cos 55° ✓+ $(-f) = 0$
f = 25.81 N✓ (3)

3.3.2 $N = w - F_y$
N = (6)(9.8) ✓ – 45 sin 55°✓
N = 21.94 N✓ (3)

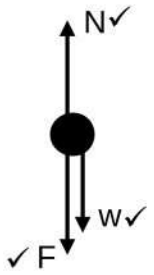
3.4 INCREASES. ✓
- *Normal force increases.* ✓
- *Frictional force directly proportional to the normal force*/f ∝ N✓ (3)

[15]

QUESTION 4

4.1 $F_{net} = ma$✓
$8 - (5)(9.8)$ ✓ $- T = (5)(2)$ ✓
$T = 51$ N✓ (4)

4.2



(3)

4.3 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an *acceleration directly proportional to the force* ✓and *inversely proportional to the mass of the object*. ✓ (2)

4.4 $F_{net} = ma$✓
$T - m(9.8)$ ✓ $= m(2)$
$m = 4.32$ kg✓ (3)
[12]

QUESTION 5

5.1 *Weight is the gravitational force exerted by the Earth on an object*✓, whilst *mass is the amount of matter in a body.*✓ (2)

5.2 Gradient $= \frac{\Delta w}{\Delta m}$✓
$= \frac{2.6-0}{0.7-0}$ ✓
$= 3.71$ N/kg or $m.s^{-2}$✓ (***3.60 – 3.90***) (3)

5.3 $g = 3.71\ m.s^{-2}$✓ (1)

5.4 Mars✓ (1)

5.5 $g = \frac{G\,M}{r^2}$ ✓
0.58✓ $= \frac{(6.67 \times 10^{-11})M}{(1.19 \times 10^{6})^2}$✓
$M = 1.23 \times 10^{22}$ kg✓ (4)
[11]

QUESTION 6

6.1 $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ ✓

$\varepsilon = -(17)$ ✓ $\frac{(\pi)(0.3)^2\cos 0°\,(-2\times10^{-4}-3\times10^{-4})}{1.5}$ ✓✓

$\varepsilon = 1.60 \times 10^{-3}$ V. ✓ (5)

6.2
- Increase relative speed between magnet and the coil. ✓
- Increase magnetic strength. ✓
- Increase number of turns in a coil ✓ (Any one)

(1)

[06]

QUESTION 7

7.1 $F = \frac{KQ_1Q_2}{r^2}$ ✓

$F = \frac{(9.0\times10^9)(2\times10^{-9})(3\times10^{-9})}{(0.25)^2}$ ✓✓

$F = 8.64 \times 10^{-7}$ N ✓ (4)

7.2 Electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)

7.3 $E = \frac{KQ}{r^2}$ ✓

$E_1 = \frac{(9.0\times10^9)(2\times10^{-9})}{(0.4)^2}$ ✓

$E_1 = 112.5$ N.C^{-1}

$E_2 = \frac{(9.0\times10^9)(3\times10^{-9})}{(0.4-0.25)^2}$

$E_2 = 1200$ N.C^{-1} ✓

$E_{net} = 1200 + (-112.5)$ ✓

$E_{net} = 1087.5$ N.C^{-1} ✓ (5)

[11]

QUESTION 8

8.1 $R = \frac{V}{I}$✓

$8 = \frac{21.84}{I}$ ✓

$I = 2.73\ A$ ✓ (3)

8.2 $R = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓

$R = \frac{20 \times 30}{20+30}$✓

R = 12 Ω✓ (3)

OR

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

$\frac{1}{R_p} = \frac{1}{20} + \frac{1}{30}$ ✓

Rp = 12 Ω✓

8.3 ε = I (R_{ext} + r) ✓

60✓ = 2.73 (20 + r) ✓

r = 1.98Ω✓ (4)

8.3 GREATER✓ (1)

8.4
- *Total resistances increase because there are more (two) resistors connected in series.* ✓

(1)

[11]

TOTAL: 100