Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2020

TECHNICAL SCIENCES P1 (EXEMPLAR)

MARKS: **150**

TIME: **3 hours**

This question paper consists of 18 pages, including a data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER SHEET.
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 subquestions, 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. 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, etc. where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 The bearing of a force which is acting in a westerly direction is …

A 0°

B 90°

C 180°

D 270° (2)

1.2 The resultant of two forces acting on an object is 15 N, west.

The magnitude and direction of the forces can be one of the following combinations:

A 5 N west and 20 N west

B 5 N east and 20 N west

C 5 N north and 20 N west

D 5 N south and 20 N west (2)

1.3 An object of mass **M** rests on a frictionless horizontal surface. The minimum force required to be applied on the object to just about to move it, is **f**.

The minimum force required to be applied on an object of mass **2M** on the same frictionless horizontal surface to just about to move it is …

A **½f**

B **f**

C 2**f**

D 4**f** (2)

1.4 Consider the following statements regarding wave motion:

(i) Particles of the medium vibrate parallel to the direction of motion of the wave.
(ii) The speed of particle motion is the same as the speed of wave motion.
(iii) The particles vibrate perpendicularly to the direction of motion of the wave.

Which ONE of the following is CORRECT regarding a longitudinal wave?

A (i) only

B (i) and (ii)

C (ii) and (iii)

D (i) and (iii) (2)

1.5 Six complete waves pass a specific point in 2 seconds.

Which ONE of the following combinations represents the **frequency** and **period** of the wave motion?

	FREQUENCY (Hz)	**PERIOD (s)**
A	3	3
B	3	0,33
C	0,33	3
D	0,33	0,33

(2)

1.6 In which ONE of the following mediums is the speed of sound the HIGHEST?

A Air

B Solids

C Liquids

D Vacuum (2)

1.7 Astronauts in space are at risk of being irradiated by the solar winds because they are …

A inside the magnetosphere.

B inside the Earth's gravitational field.

C outside the magnetosphere.

D outside the Earth's gravitational field. (2)

1.8 Which ONE of the following statements is correct regarding a positively charged object?

A positively charged object …

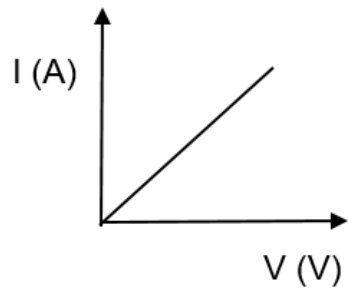
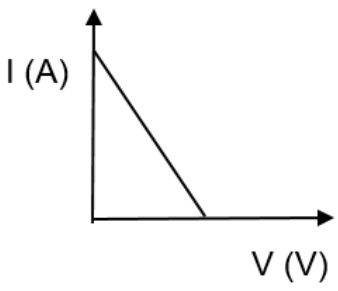
A has only protons and no electrons.

B has more protons than neutrons.

C has more protons than electrons.

D has an equal number of electrons and protons. (2)

1.9 Which ONE of the following graphs illustrates the relationship between current and potential difference for an ohmic conductor?

<table>
<tr><td>A</td><td> 
</td><td>B</td><td> 
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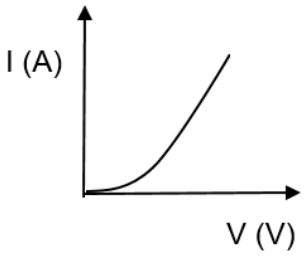
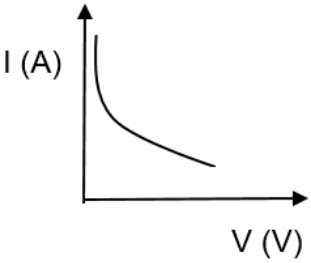
<tr><td>C</td><td> 
</td><td>D</td><td> 
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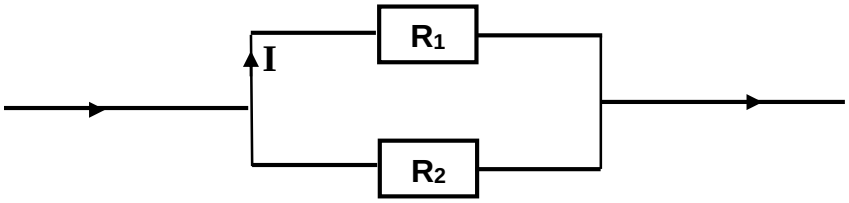
</table>

(2)

1.10 R_1 and R_2 are two resistors connected in parallel as shown in the figure. Resistance of R_1 is double the resistance of R_2 ($R_1 = 2R_2$) and the current through R_1 is I.



The current through R_2 is …

A $\frac{1}{2}I$

B I

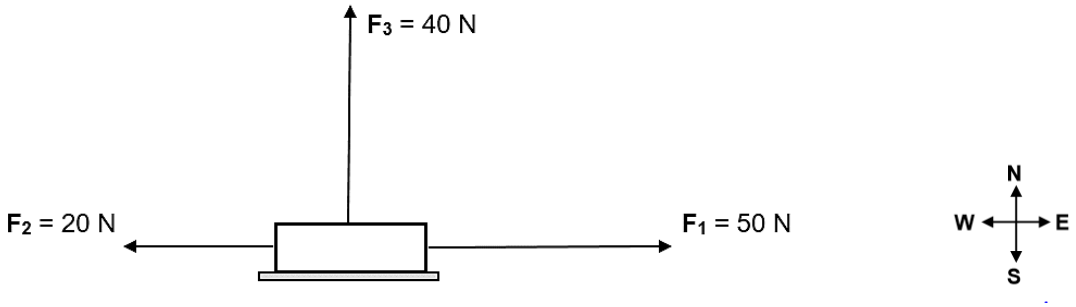
C $2I$

D $3I$ (2)

[20]

QUESTION 2 (Start this question on a new page.)

Three forces $\mathbf{F_1}$= 50 N east, $\mathbf{F_2}$ = 20 N west and $\mathbf{F_3}$ = 40 N north, act on an object as shown in the figure below.



2.1 Define the term *resultant* of two vectors. (2)

2.2 Identify TWO forces that are collinear in the diagram. (2)

2.3 Determine the resultant of the 20 N and 50 N forces. (2)

2.4 Hence determine the magnitude and direction of the resultant of all the forces acting on the object. (5)

2.5 If the magnitude of $\mathbf{F_2}$ is changed to 50 N, what is the magnitude and direction of the resultant of all the forces acting on the object? (2)

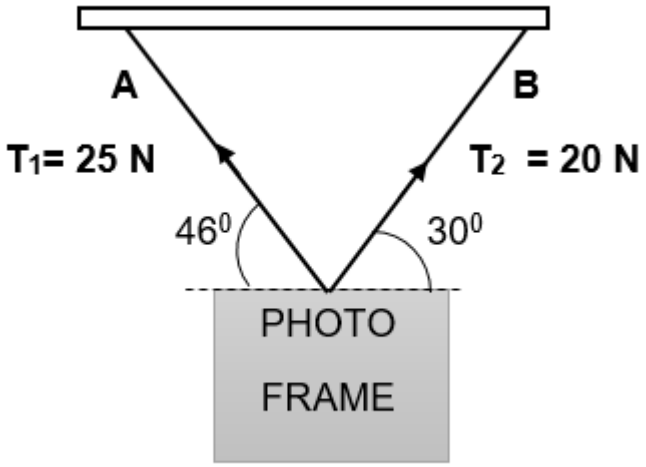
[13]

QUESTION 3 (Start this question on a new page.)

A photo frame is supported by two pieces of strings **A** and **B** as shown in the figure. String **A** is making an angle of 46° with the horizontal and string **B** is making an angle of 30° with the horizontal.

The tensions on strings **A** and **B** are:

String A is $\mathbf{T_1 = 25\ N}$ and string B is $\mathbf{T_2 = 20\ N}$.



3.1 State the parallelogram law of forces. (2)

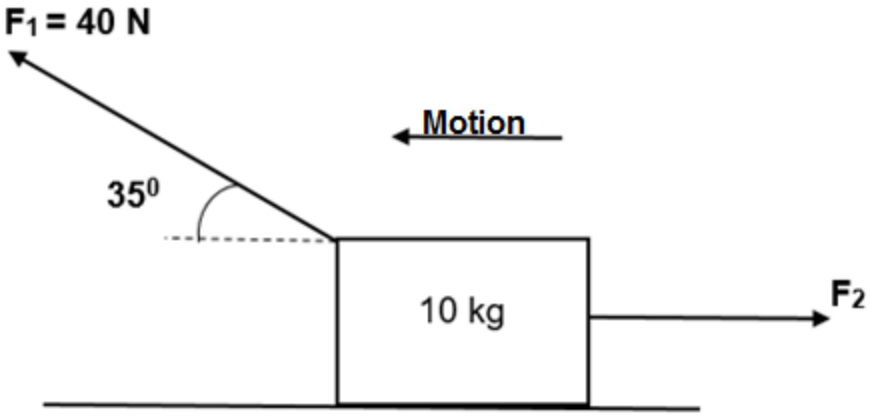
3.2 Calculate the resultant of tensions $\mathbf{T_1}$ and $\mathbf{T_2}$ using the parallelogram method. (Scale: 5 N : 5 mm) (6)
[8]

QUESTION 4 (Start this question on a new page.)

4.1 A block of mass 10 kg is on a rough horizontal surface. A force of **F_1 = 40 N** is applied at an angle of 35° with the horizontal and another force **F_2** due east is applied on the block as shown in the figure.

The block moves due west with a **constant velocity**.

The coefficient of kinetic friction between the block and the surface is 0,38.



4.1.1 Calculate the horizontal component of force **F_1**. (3)

4.1.2 Define the term *kinetic frictional force.* (2)

4.1.3 Draw a free body diagram of all the forces acting on the 10 kg block. (5)

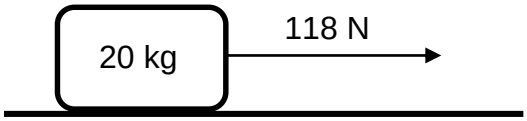
4.1.4 Calculate the magnitude of force **F_2**. (5)

4.2 How does the coefficient of kinetic friction change if another identical block is placed over the first one?

Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

4.3 A girl applies a force of 118 N on a block resting on a rough horizontal surface.

The coefficient of static friction between the block and the surface is 0,6.

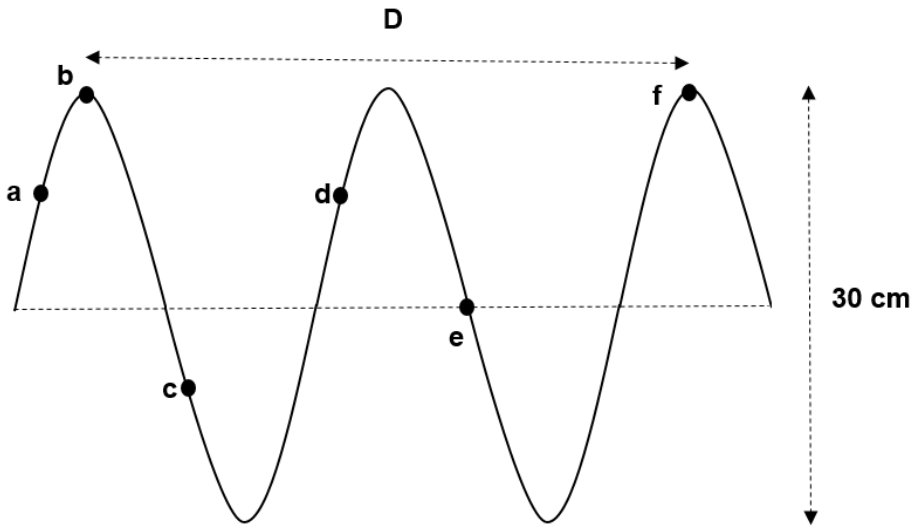


Determine by calculation whether the block will **ACCELERATE**, **MOVE WITH CONSTANT VELOCITY** or **NOT MOVE AT ALL** when the girl applies a 118 N force. (5)

[21]

QUESTION 5 (Start this question on a new page.)

The figure below shows a transverse wave motion. The speed of the wave motion is 20 $m.s^{-1}$ and its period is 0,02 s.



5.1 What is meant by a *transverse* wave? (2)

5.2 Write down two pairs of points which are in phase. (2)

5.3 Write down the amplitude of the wave motion. (2)

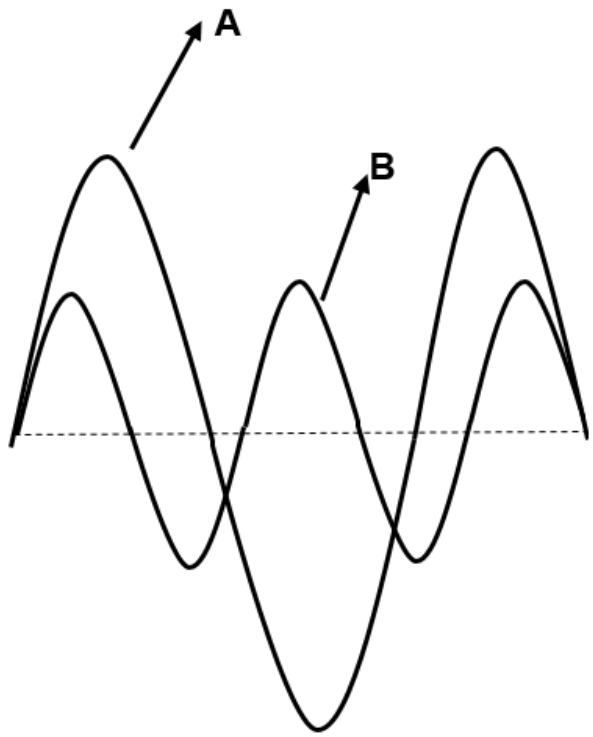
5.4 Calculate the frequency of the wave motion. (3)

5.5 Calculate the distance **D** between **b** and **f.** (4)

[13]

QUESTION 6 (Start this question on a new page.)

6.1 Sources of two sound waves, **A** and **B**, are connected to an oscilloscope. The figure below shows the sound waves measured over the same time interval.



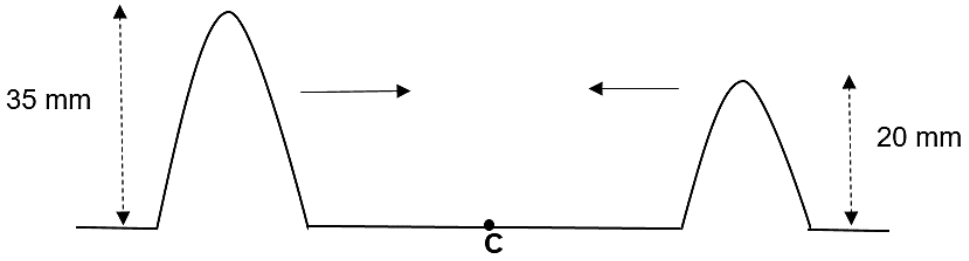
6.1 6.1.1 Define the term *pitch.* (2)

Which ONE of the sound waves:

6.1.2 Has a higher PITCH? Explain the answer. (3)

6.1.3 Is LOUDER? (1)

6.2 The figure below shows two transverse pulses travelling in opposite directions in the same region. The crests of the pulses meet at point **C.**



6.2.1 Define the term *constructive interference*. (2)

6.2.2 Draw the resultant of the two pulses at point **C**. Indicate the resultant amplitude of pulses at **C** in your diagram. (3)

6.3 A sound wave from a source strikes a cliff and is then reflected.

The speed of sound in air is 340 $m.s^{-1}$ and the time it takes to hear the echo is 2,02 s.

6.3.1 Are sound waves LONGITUDINAL or TRANSVERSE? (1)

6.3.2 Calculate the distance between the cliff and the sound source. (4)

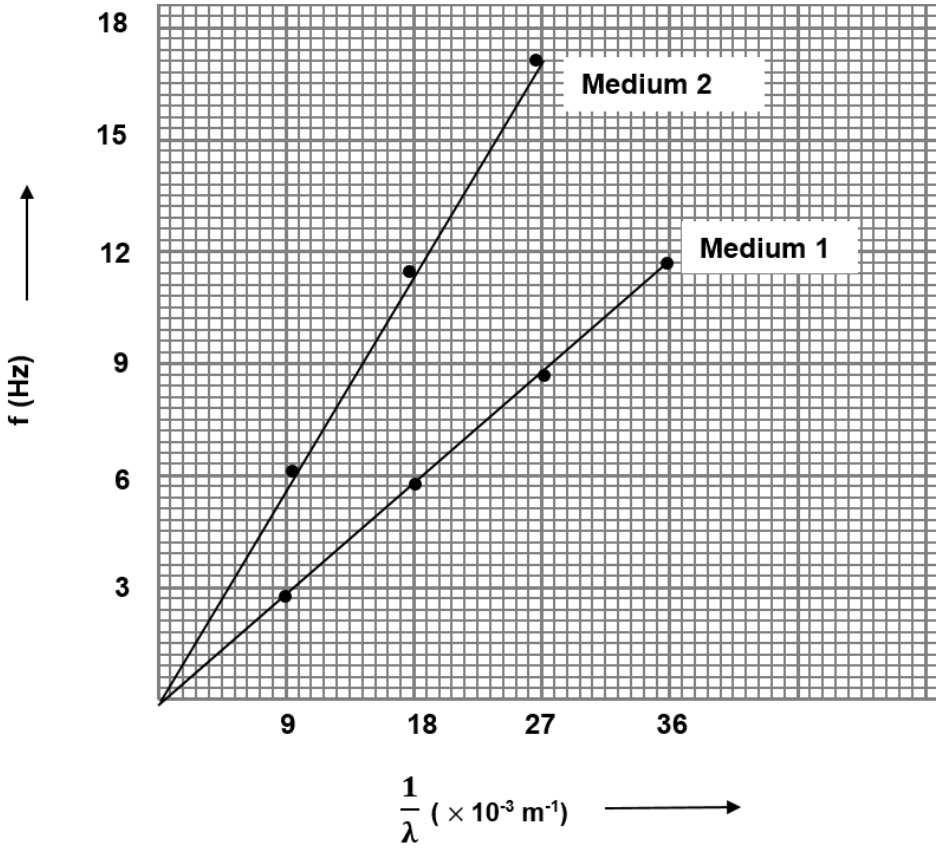
[16]

QUESTION 7 (Start this question on a new page.)

Students are investigating the speed of sound in two different media. They measured frequencies of sound for various values of wavelength in both media.

The results are shown in the following frequency (f) vs 1/wavelength (1/λ) graph.

Frequency vs 1/wavelength



7.1 7.1.1 Define the term *frequency*. (2)

7.1.2 Calculate the speed of sound in MEDIUM 1. (4)

7.1.3 In which medium (MEDIUM 1 or MEDIUM 2) is the speed of sound higher?

Explain your answer by referring to the graph. (2)

7.2 The frequencies produced by three sound sources **A**, **B** and **C** are given below.

Frequency of **A**: 10 Hz

Frequency of **B**: 100 Hz

Frequency of **C**: 100 000 Hz

Which ONE of the give frequencies represents:

7.2.1 Infrasound? (1)

7.2.2 Audible sound? (1)

7.2.3 Ultrasound? (1)

7.2.4 Give TWO applications of sound source **C** in the field of technology. (2)
[13]

QUESTION 8 (Start this question on a new page.)

8.1 A bar magnet has a pair of opposite poles called North and South.

The figure below shows a bar magnet with its poles.

8.1.1 Define the term *magnetic field*. (2)

8.1.2 Draw the magnetic field pattern around a bar magnet. (3)

8.2 The North pole of the bar magnet is brought closer to the South pole of another bar magnet.

8.2.1 Is the force experienced by the magnets when they are brought closer ATTRACTION or REPULSION?

Explain the answer. (2)

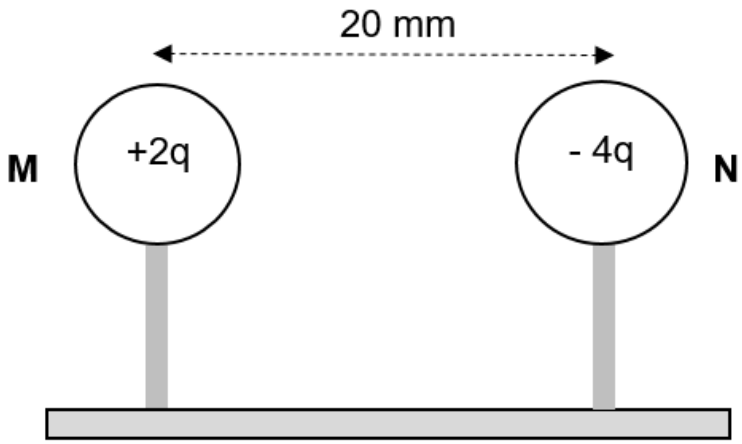
8.2.2 What would happen to the force if the distance between the poles is increased? (2)

8.3 Explain how a geomagnetic storm is formed. (2)
[11]

QUESTION 9 (Start this question on a new page.)

9.1 Two identically charged conducting spheres, **M** and **N**, on insulated stands carry charges of **+2q** and **-4q** respectively. The spheres are placed 20 mm from each other as shown in the diagram.

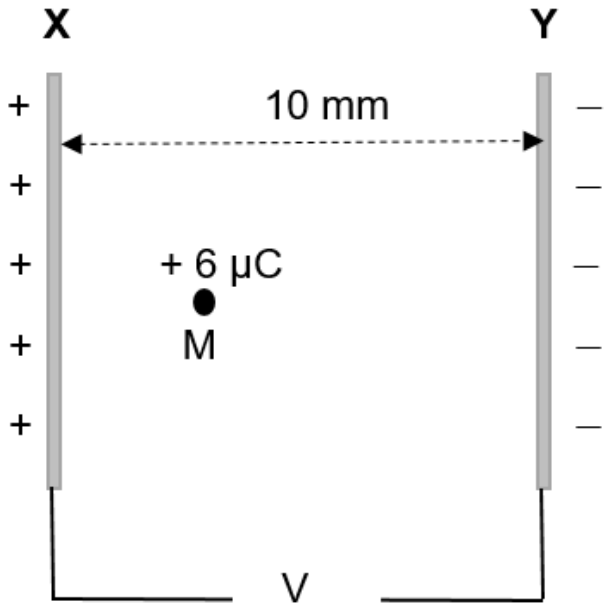
The force exerted by **M** on **N** is 6 840 N.



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

9.1.2 Calculate the magnitude of charge **q** in Coulomb (C). (4)

9.2 **X** and **Y** are two parallel plates placed at a distance of 10 mm apart. A charge + 6 µC placed at point **M** experiences a force of 0,21 **N**.



9.2.1 Define the term *electric field*. (2)

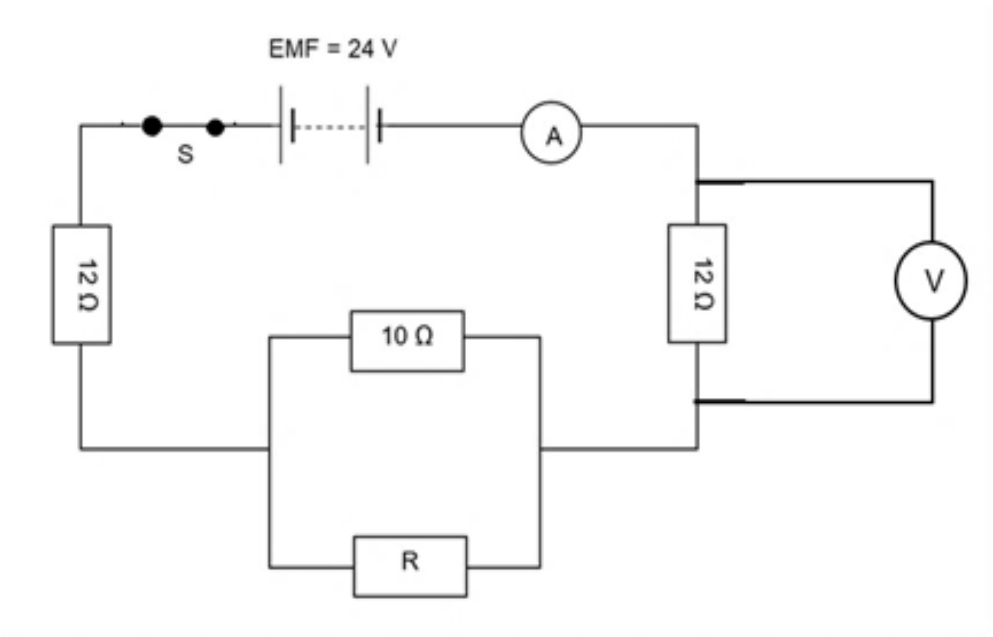
9.2.2 What is the direction of force experienced by the + 6 µC charge? (TOWARDS **Y** or TOWARDS **X**.) (1)

9.2.3 Calculate the potential difference, V, across the plates. (5)

[14]

QUESTION 10 (Start this question on a new page.)

10.1 In the circuit shown below the resistance of **R** is unknown.
The EMF of the battery is 24 V.
(Ignore the resistance of connecting wires and the ammeter.)



When switch **S** is closed, the ammeter shows a reading of 0,89 A.

10.1.1 State Ohm's law in words. (2)

10.1.2 Calculate the total resistance of the circuit. (3)

10.1.3 Calculate the resistance of **R**. (5)

10.2 Write down the reading on the voltmeter V when switch **S** is open. (1)

10.3 What is the total amount of work done to move 1 Coulomb of charge through the circuit? (1)

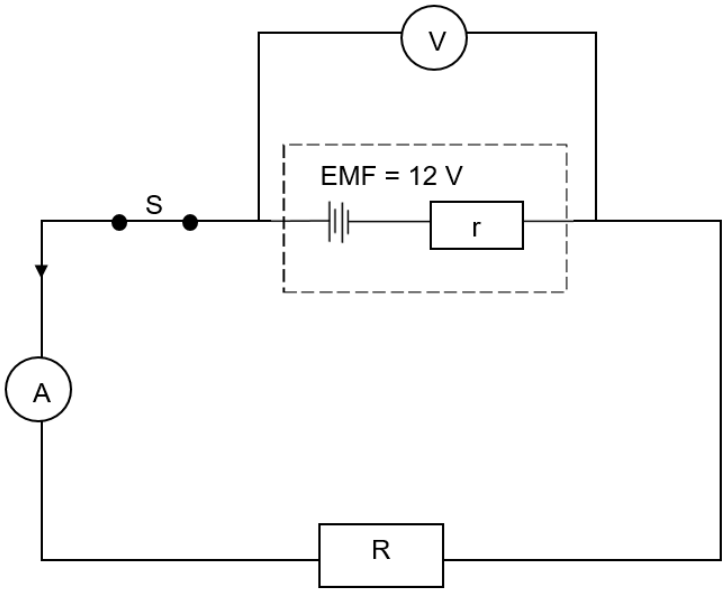
10.4 What will happen to the reading on the ammeter if **R** burns out while switch **S** is still closed?

Write down INCREASES, DECREASES or REMAINS THE SAME.

Explain the answer. (No calculation is required.) (3)

10.5 A group of learners conducts an experiment to determine the internal resistance of a battery. They set up a circuit diagram as shown in the figure below.

The battery has internal resistance **r** and an EMF of 12 V.



10.5.1 Define the term *internal resistance* of the battery. (2)

10.5.2 What is the reading on the voltmeter when switch **S** is open? (1)

10.5.3 What would happen to the reading when switch is closed?

Write down only INCREASES, DECREASES or REMAINS THE SAME.

Explain your answer. (3)
[21]

TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 11 PAPER 1

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m \cdot s^{-2}$
Coulomb's constant	k	9 x 10^9 $N.m^2.C^{-2}$

TABLE 2: FORMULAE

FORCE

$F_{net} = ma$	$f_k = \mu_k N$
$f_s^{max} = \mu_s N$	$F_g = mg$

ENERGY

$K = \frac{1}{2}mv^2$ **OR** $E_k = \frac{1}{2}mv^2$	$U = mgh$ **OR** $E_P = mgh$
$M_E = E_k + E_p$	

ELECTROSTATICS

$E = \frac{V}{d}$	$F = Eq$	$F = \frac{kQ_1Q_2}{r^2}$

CURRENT ELECTRICITY

$R = \frac{V}{I}$	$q = I \Delta t$	$W = VQ$
$W = VQ$		
$R_s = R_1 + R_2 + ...$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	