Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

TECHNICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

This question paper consists of 17 pages, including a data sheet.

INSTRUCTIONS AND INFORMATION

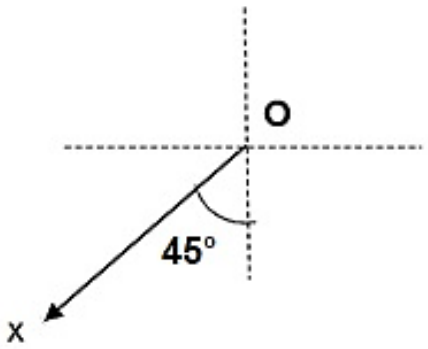
Read the following instructions carefully before answering the questions.

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER SHEET.
2. Answer ALL the questions.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. You may use non-programmable calculators.
5. You may use appropriate mathematical instruments.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions et cetera where required.
10. You are advised to use the attached DATA SHEET.
11. 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 Which ONE of the following is the CORRECT direction of the vector **OX**?



A Southeast

B Southwest

C On a bearing of 135°

D On a bearing of 45° (2)

1.2 A group of learners investigates the relationship between the acceleration produced for varying masses by applying a constant force.

The table below shows the results obtained.

MASS (kg)	ACCELERATION ($m.s^{-2}$)	F_{net} (N)
5	0,1210	0,605
10	0,0605	0,605
15	0,0403	0,605

Which ONE of the following is the CORRECT relationship between the acceleration and mass?

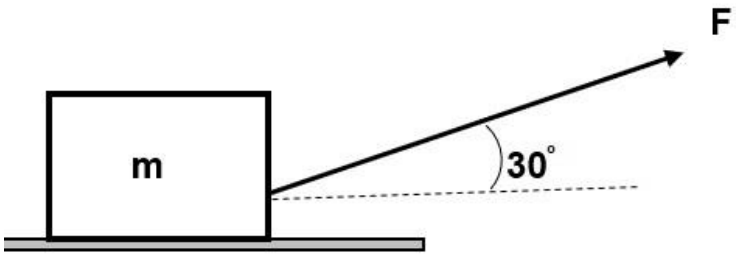
A Direct proportion

B Inverse proportion

C Linear proportion

D Exponential proportion (2)

1.3 An object of mass **m** is pulled over a rough surface with a force **F** which acts at an angle 30° to the horizontal as shown in the figure.



The magnitude of the force exerted by the surface on the object (Normal) is represented by …

A mg + Fcos 30°.

B mg + Fsin 30°.

C mg – Fcos 30°.

D mg – Fsin 30°. (2)

1.4 A pulse in which the particles of the medium vibrate at right angles to the direction of propagation of the pulse is called a … pulse.

A standing

B transverse

C longitudinal

D electromagnetic (2)

1.5 The distance travelled by a crest in 5 s is 10 m. The speed of the wave will be …

A 2 $m.s^{-1}$.

B 5 $m.s^{-1}$.

C 10 $m.s^{-1}$.

D 50 $m.s^{-1}$. (2)

1.6 Consider the following statements regarding sound waves:

(i) Sound waves are longitudinal waves.

(ii) Sound waves travel faster than light.

(iii) Sound waves need a material medium to propagate.

Which ONE of the following is correct?

A (i) only

B (i) and (ii) only

C (ii) and (iii) only

D (i) and (iii) only (2)

1.7 The force between two magnets DECREASES when …

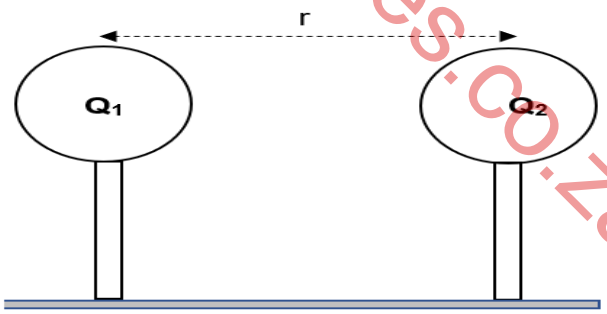
A two like poles come closer together.

B two unlike poles come closer together.

C the distance between like or unlike poles increases.

D the distance between like or unlike poles decreases. (2)

1.8 Two identical spheres carrying charges Q_1 and Q_2 exert a force **F** on each other when they are at a distance **r** apart as shown below.



The distance between the charges is now **doubled** and the charge on Q_1 is increased four times.

The magnitude of the new force between the charges is …

A **F**.

B 2**F**.

C 4**F**.

D 8**F**. (2)

1.9 Which ONE of the following is an example of an Ohmic conductor?

A Thermistor

B Nichrome wire

C Semiconductor

D Filament of light bulbs (2)

1.10 Which ONE of the following changes in potential difference and distance between two oppositely charged parallel metal plates would DOUBLE the electric field at a point?

	Distance between two parallel oppositely charged metal plates	Potential difference
A	doubled	doubled
B	halved	halved
C	doubled	quadrupled
D	doubled	halved

(2)
[20]

QUESTION 2: MATCHING THE ITEMS

Choose a description from COLUMN B that matches a term/phrase in COLUMN A. Write only the letter (A–I) next to the question numbers (2.1 to 2.8) in the ANSWER BOOK, for example 2.9 J. Use each description in COLUMN B only ONCE.

COLUMN A		COLUMN B	
2.1	The force that opposes the motion of an object and which acts parallel to the surface	A	Pulse
2.2	A term that describes forces that act in the same plane	B	Frictional force
2.3	A single disturbance in a medium	C	Crest
2.4	The uppermost point on a transverse wave	D	Co-planar
2.5	The perpendicular force exerted by a surface on an object that lies on that surface	E	Geographic north
2.6	Point in the northern hemisphere where the rotation axis of the earth meets the surface	F	Normal force
2.7	The ratio of the potential difference across a resistor to the current in the resistor	G	Magnetic north
2.8	Rate of flow of charges	H	Resistance
		I	Electric current

(8 x 1) **[8]**

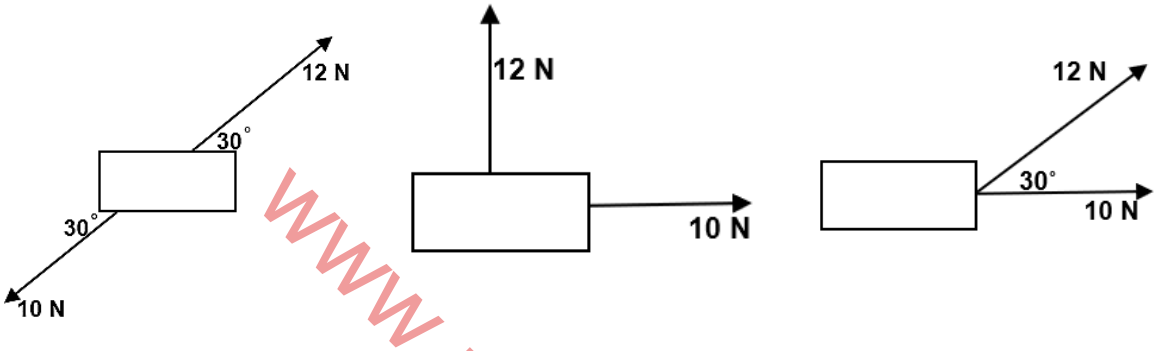
QUESTION 3 (Start on a new page.)

A group of Grade 11 learners investigate the effect of changing the angle between two forces on the resultant force.

They conducted three **EXPERIMENTS** using 10 N and 12 N forces in EACH experiment.

The figure below shows the set ups used for each experiment.

EXPERIMENT 1 **EXPERIMENT 2** **EXPERIMENT 3**



3.1 In which **EXPERIMENT** are the forces collinear? (1)

3.2 What is the magnitude of the RESULTANT of the forces in **EXPERIMENT 1**? (2)

3.3 Calculate the resultant of force in **EXPERIMENT 2** if the angle between the forces is 90°. (5)

3.4 Name the theorem used in QUESTION 3.3 to calculate the resultant force. (1)

3.5 Find the resultant of forces in **EXPERIMENT 3** using the parallelogram method. (6)

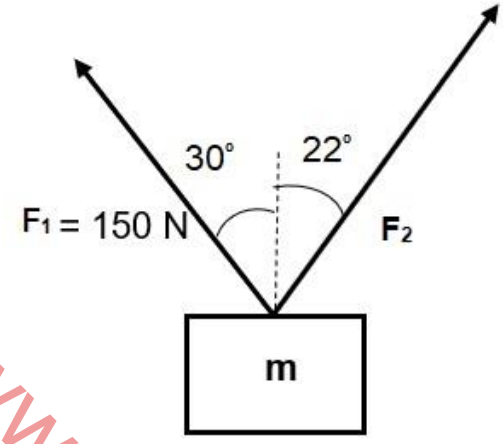
3.6 Write down the conclusion that you can make from the above investigation regarding the magnitude of the resultant of two forces and the angle between the forces. (2)

[17]

QUESTION 4 (Start on a new page.)

Two forces **F_1** and **F_2** keep an object of mass **m** stationary as shown below.

F_1 = 150 N acting at an angle 30° with the vertical and **F_2** acts at an angle of 22° with the vertical.



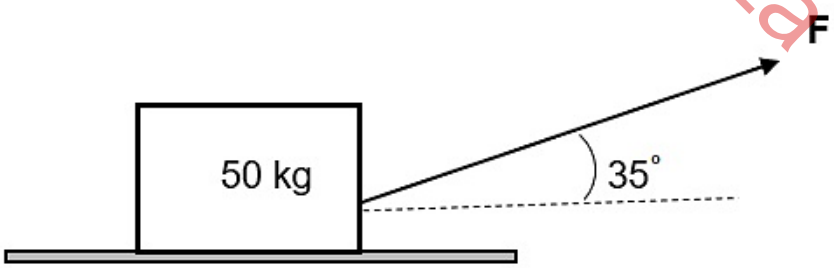
4.1 Calculate the force **F_2** using the horizontal components of forces **F_1** and **F_2**. (4)

4.2 Calculate the mass **m** of the object. (6)
[10]

QUESTION 5 (Start on a new page.)

A block of mass 50 kg rests on a rough surface as shown in the figure below. When a force **F** is applied on the object at an angle 35° with the horizontal the block starts to move.

The normal force experienced by the block is **one-third** of the gravitational force acting on the object and the coefficient of static friction is 0,4.



5.1 Define the term *static frictional force*. (2)

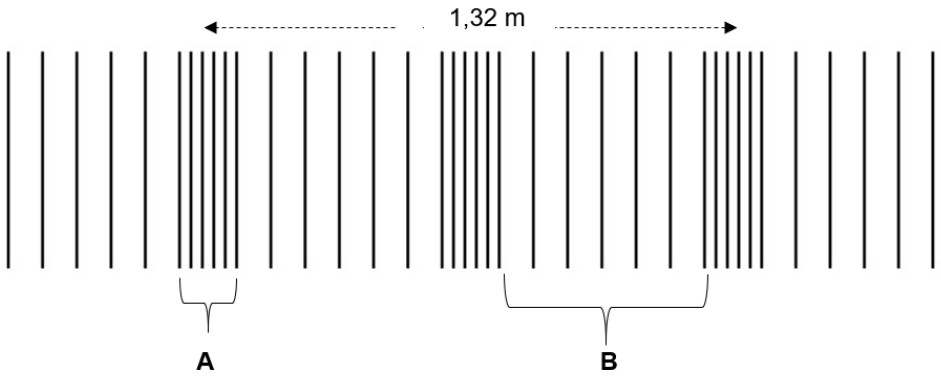
5.2 Draw a free body diagram showing all the forces acting on the block when it is about to move. (4)

5.3 Calculate the maximum static frictional force experienced by the block. (3)

5.4 Calculate the minimum force **F** required to move the block. (4)
[13]

QUESTION 6 (Start on a new page.)

6.1 Waves produced by a vibrating tuning fork are shown in the diagram below.



The frequency of vibration of the tuning fork is 512 Hz.

6.1.1 Name and define the kind of wave given in the diagram. (3)

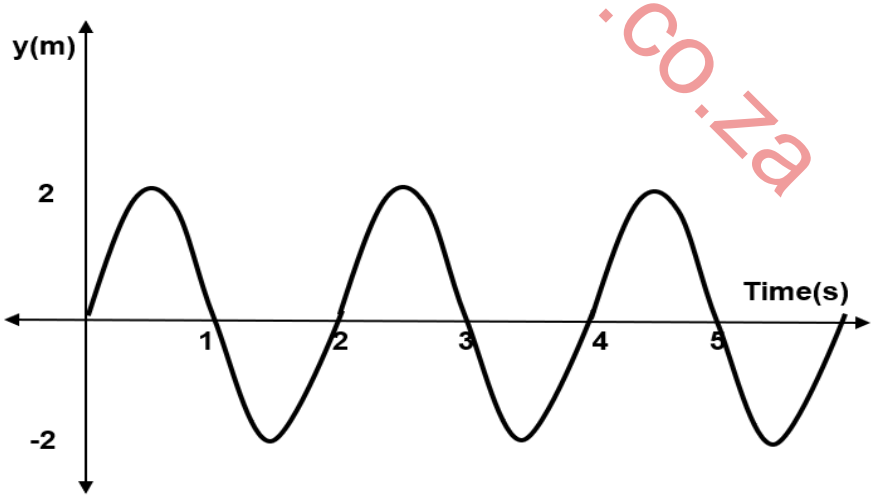
6.1.2 Name the part labelled **A**. (1)

6.1.3 Name the part labelled **B**. (1)

6.1.4 What is the wavelength of the wave motion? (2)

6.1.5 Calculate the speed of the wave motion. (3)

6.2 A wave on a string travel at a speed of 10 $m.s^{-1}$. The graphical representation of the wave motion over a period of time is given below.



6.2.1 What is the amplitude of the wave motion? (2)

6.2.2 What is the time taken for ONE complete vibration? (2)

6.2.3 Calculate the wavelength of the wave motion. (4)

[18]

QUESTION 7 (Start on a new page.)

7.1 Speed of sound in the same substance **X,** in three different phases of **X** are given in the table below.

Speed of sound ($m.s^{-1}$) in different phases of X
5 950
1 530
570

Which speed was measured when **X** was in the:

7.1.1 Gas phase? Explain the answer. (3)

7.1.2 Solid phase? Explain the answer. (3)

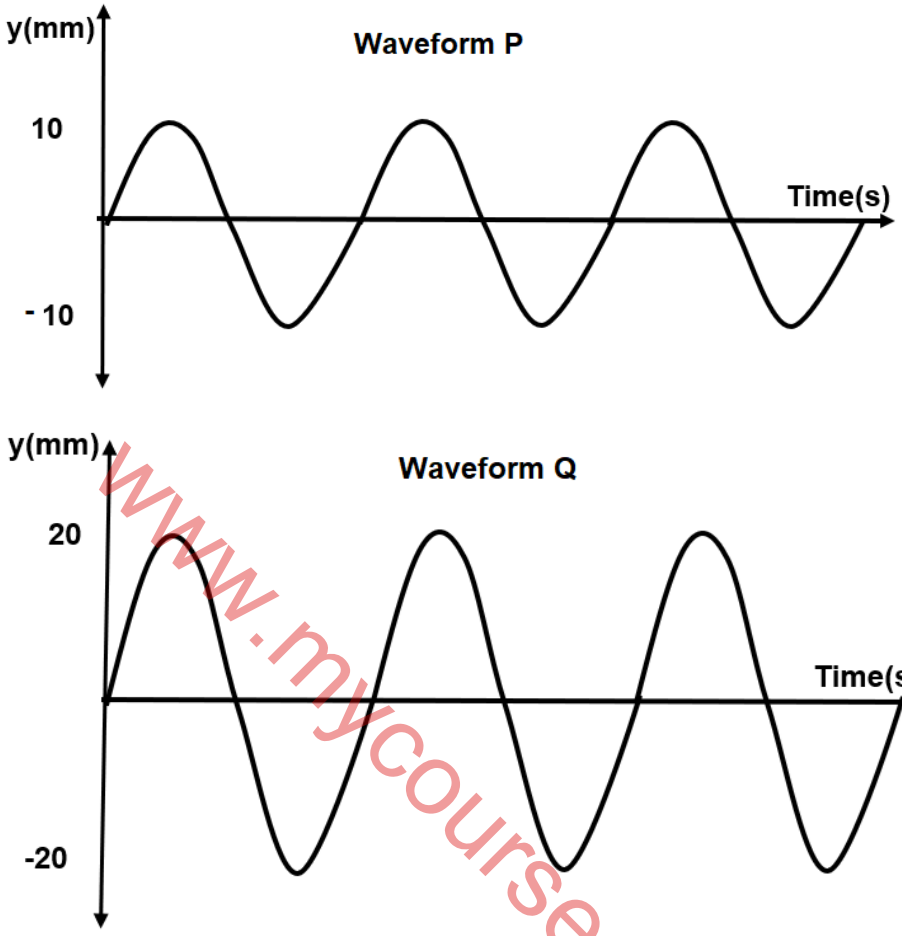
7.2 The captain of a ship wants to find the depth of the sea by using SONAR. An ultrasonic sound of frequency 32 kHz is produced and the sound that is reflected by the sea floor is received 0,25 s later.

The wavelength of sound signal is 0,05 m.

7.2.1 What is the name given to the *reflected sound*? (1)

7.2.2 Calculate the depth of the sea. (5)

7.3 Loudness and pitch are two important characteristics of sound. Two waveforms, **P** and **Q**, obtained in an oscilloscope and are shown in the diagram below.



7.3.1 Which ONE of the waveforms (Waveform **P** or Waveform **Q**) will produce a louder sound? Explain your answer. (3)

7.3.2 Write down the relationship between pitch and frequency. (2)

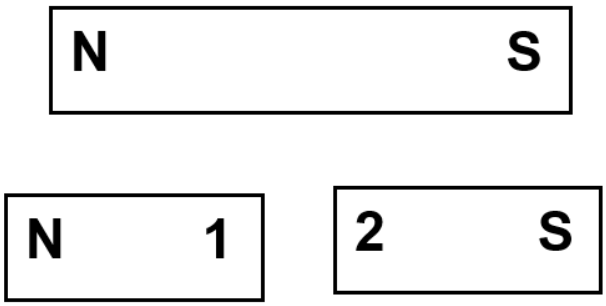
7.4 Ultrasonic, audible, and infra sound are three types of sound under three ranges of frequencies.

7.4.1 What is meant by *ultrasonic sound*? (2)

7.4.2 Write down the frequency range of audible sound. (2)
[21]

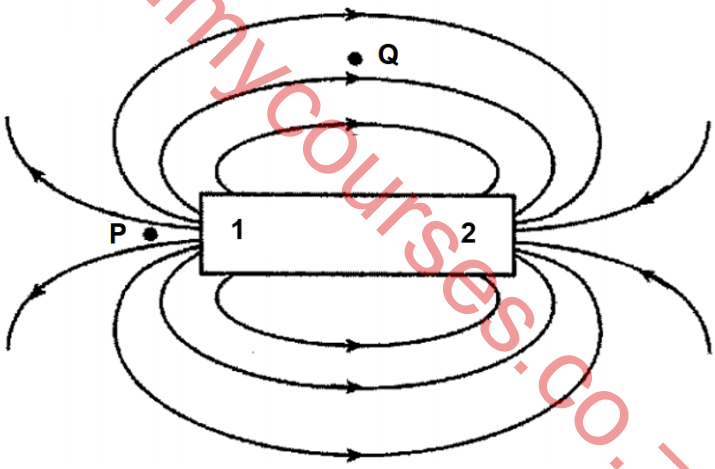
QUESTION 8 (Start on a new page.)

8.1 A bar magnet is divided in two pieces as shown in the diagram.



What is the nature of the force between the broken pieces if they face each other with a small separation? Explain the answer. (3)

8.2 The diagram below represents the magnetic field around a bar magnet. **P** and **Q** are two points in the magnetic field and **1** and **2** represent the magnetic poles.



8.2.1 Identify the pole labelled **1**. (1)

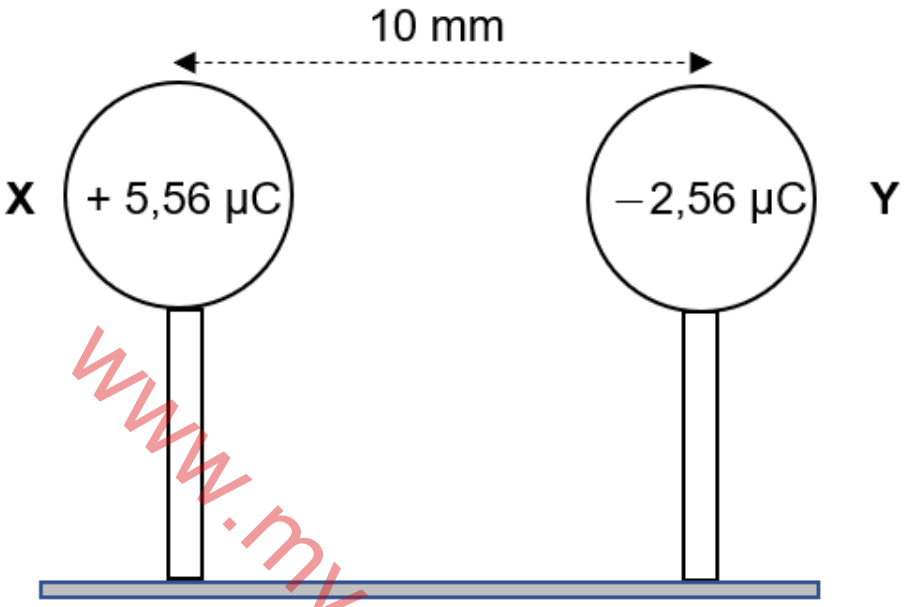
8.2.2 At which point, **P** or **Q**, the magnitude of the magnetic field of the bar magnet the greatest? Explain your answer. (3)

8.3 Give ONE example of a phenomenon that is caused by the earth's magnetic field. (1)
[8]

QUESTION 9 (Start on a new page.)

9.1 Two identical charged conducting spheres, **X** and **Y**, on insulated stands carry charges of + 5,56 µC and - 2,56 µC, respectively.

The spheres are placed 10 mm from each other as shown in the diagram.



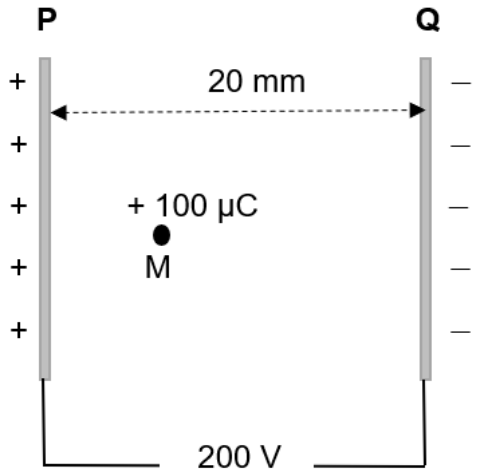
9.1.1 Draw the electric field pattern between the charges **X** and **Y**. (3)

9.1.2 State Coulomb's Law in words. (2)

9.1.3 Calculate the magnitude electrostatic force exerted by charged spheres **X** on **Y**. (4)

9.1.4 Is the force calculated by sphere **X** on **Y** (QUESTION 9.13) above, ATTRACTIVE or REPULSIVE? (1)

9.2 **P** and **Q** are two oppositely charged parallel metal plates placed at a distance of 20 mm apart. A charge +100 µC is placed at point **M** in the electric field between parallel metal plates **P** and **Q**. The potential difference across the parallel metal plates is 200 V.



9.2.1 In which direction will the charge move?

Choose from TOWARDS **P** or TOWARDS **Q**.

Explain your answer. (3)

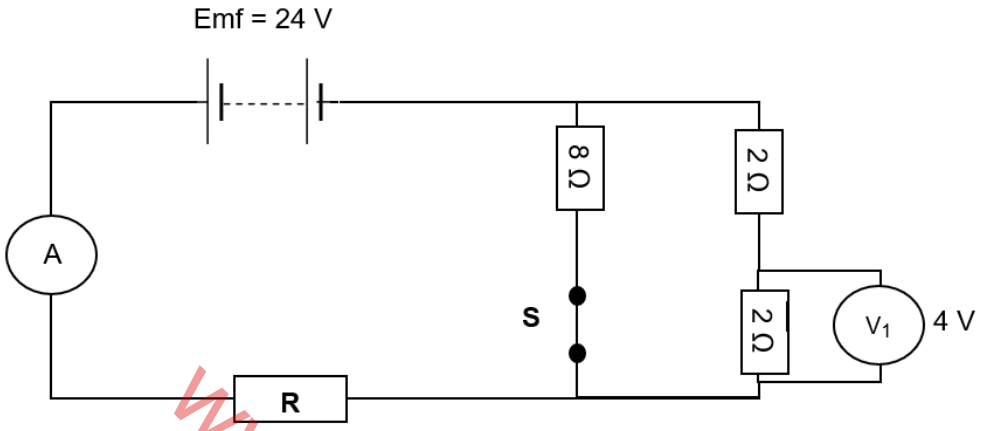
9.2.2 Calculate electric field **E** between the plates. (3)

9.2.3 Hence, calculate the electric force experienced by the charge. (3)
[19]

QUESTION 10 (Start on a new page.)

In the circuit given below the battery has an emf of 24 V.

The ammeter and the connecting wires have negligible resistance.



When switch **S** is closed, voltmeter V_1 registers a reading of 4 V.

10.1 Define the term *emf* of a battery. (2)

10.2 Calculate the current through each 2 Ω resistor. (3)

10.3 Calculate the current through the ammeter **A**. (3)

10.4 Calculate the resistance of resistor **R**. (5)

10.5 Switch **S** is now opened. State whether the reading on V_1 will INCREASE, DECREASE or REMAINS THE SAME.

Explain your answer. (3)
[16]

TOTAL: 150

GRADE 11 DATA SHEET / *GRAAD 11 GEGEWENSBLAD*

TECHNICAL SCIENCES: PAPER 1 / *TEGNIESE WETENSKAPPE: VRAESTEL 1*

TABLE/*TABEL* 1: PHYSICAL CONSTANTS/*FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekrag versnelling*	g	9,8 $m \cdot s^{-2}$
Coulomb's law	k	$9,0 \times 10^9 N \cdot m^2 \cdot C^{-2}$

TABLE/*TABEL* 2: FORMULAE/*FORMULES*

FORCE/*KRAG*

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

ENERGY/*ENERGIE*

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

ELECTROSTATICS/*ELEKTROSTATIKA*

$E = \frac{V}{d}$	$F = Eq$

CURRENT ELECTRICITY/*STROOM ELEKTRISITEIT*

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

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

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or $E = \frac{V}{d}$	