education

Department of Education
FREE STATE PROVINCE

EXAMINATION

GRADE 11

PHYSICAL SCIENCES (PAPER 1: PHYSICS)

NOVEMBER 2022

MARKS: 100

TIME: 2 HOURS

This paper consists of 10 pages and two data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of SEVEN questions. Answer ALL 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 pocket 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 where applicable.

11. Give brief motivations, discussions, et cetera where required.

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 down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 Which one of the following is an example of a vector quantity?

A Distance

B Velocity

C Energy

D Inertia (2)

1.2 The statements below refer to scalars and vectors:

(i) Vectors can be added together but scalars cannot.
(ii) A scalar quantity can be associated with direction.
(iii) A vector quantity is always associated with direction.

Which of the statements above are TRUE?

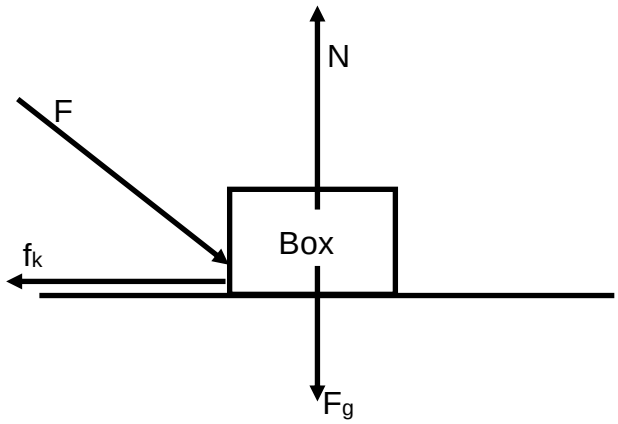
A (i) and (ii) only

B (ii) and (iii) only

C (i) only

D (iii) only (2)

1.3 Consider the force diagram of a box pushed across a rough, horizontal floor to the right by a force *F*.



Which one the following gives the magnitude of the kinetic frictional force, f_k, acting on the box?

A $f_k = mg - F_v$

B $f_k = mg + F_v$

C $f_k = \mu_k\,(mg - F_v)$

D $f_k = \mu_k\,(mg + F_v)$ (2)

1.4 The weight of an object on the surface of the earth is *w*, and its weight on planet **X** is *2w*. How does the gravitational acceleration on planet **X** compare to that on earth, where it is *g*?

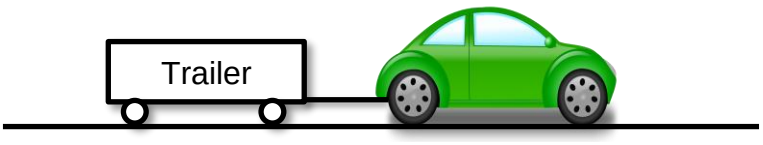
A $\frac{1}{2}g$

B g

C $2g$

D $4g$ (2)

1.5 A car, towing a trailer, moves along a straight road as shown.



Which one of the following combinations CANNOT be considered an action-reaction pair according to Newton's 3rd law of motion?

A $F_{\text{Earth on car}}$ and $F_{\text{car on Earth}}$

B $F_{\text{trailer on car}}$ and $F_{\text{car on trailer}}$

C $F_{\text{Earth on car}}$ and $F_{\text{trailer on car}}$

D $F_{\text{Earth on trailer}}$ and $F_{\text{trailer on Earth}}$ (2)

1.6 Two small, charged objects, separated by a distance *d* between their centres, exert an electrostatic force *F* on each other. The distance between their centres is now reduced to ¼ *d*. What is the new force, in terms of *F*, each one exerts on the other?

A F

B 4F

C 8F

D 16F (2)

1.7 Two oppositely charged objects, **P** and **Q**, with magnitudes of -2 nC and +4 nC respectively, are positioned as shown below.

Object **Q** exerts an electrostatic force of magnitude *F* on object **P**. Which one of the following combinations is correct for this situation?

	Magnitude of the electro-static force on Q	**Free-body diagram of the electrostatic force on P**
A	F	●→
B	F	←●
C	2F	●→
D	2F	←●

(2)

1.8 The magnitude of the induced emf in a coil is ...

A directly proportional to the rate of change in the magnetic flux linkage with the coil.

B inversely proportional to the rate of change in the magnetic flux linkage with the coil.

C directly proportional to the magnetic flux linkage with the coil.

D inversely proportional to the magnetic flux linkage with the coil. (2)

1.9 Which one of the following SI units is equivalent to joule (J)?

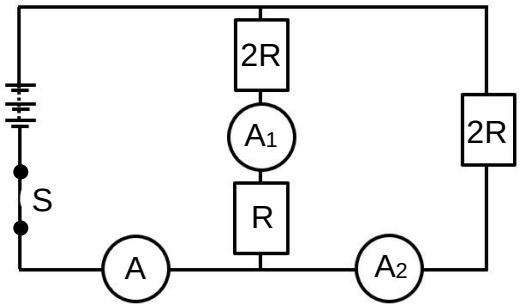
A W

B W·s

C V·A

D $V \cdot A^{-1}$ (2)

1.10 The battery, ammeters and conducting wires in the circuit diagram on the right have negligible resistance.



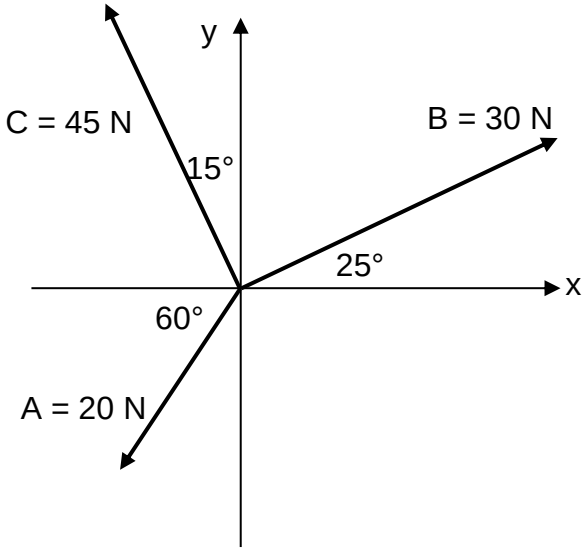
With switch **S** closed, the reading on ammeter **A** is equal to I. What are the readings on ammeters **A_1** and **A_2** in terms of I?

	A_1	**A_2**
A	$\frac{1}{3}I$	$\frac{1}{2}I$
B	$\frac{2}{5}I$	$\frac{3}{5}I$
C	$\frac{1}{2}I$	$\frac{1}{3}I$
D	$\frac{3}{5}I$	$\frac{2}{5}I$

(2)
[20]

QUESTION 2

2.1 Three forces, **A**, **B** and **C**, with magnitudes of 20 N, 30 N and 45 N respectively, are acting on an object in the same Cartesian plane.



2.1.1 Why is a force classified as a vector quantity? (2)

For the THREE forces, calculate the magnitude and direction of the:

2.1.2 x-component of the resultant force (3)

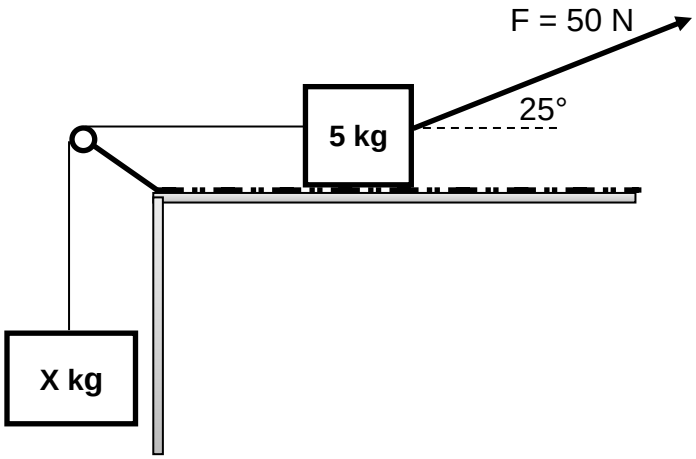
2.1.3 y-component of the resultant force (3)

2.1.4 Resultant force itself. Give the direction anti-clockwise from the positive x-axis. (3)

2.2 A boy travels to a shop by moving 15 km north and then 10 km east. Determine, by means of an accurate scale drawing, the magnitude of the boy's displacement from his starting point. Use 10 mm to represent 2 km (4)
[15]

QUESTION 3

A block of mass 5 kg is connected by means of a light, inextensible string, running over a light, frictionless pulley, to another block of mass X kg as shown below. A force *F* of 50 N is applied to the 5 kg block at an angle of 25° to the horizontal.



The 5 kg block accelerates at 3 m·s^{-2} TO THE LEFT and the coefficient of kinetic friction (μ_k) between the 5 kg block and the surface is 0,2. Ignore the effects of the air resistance.

3.1 State *Newton's second law of motion* in words. (2)

3.2 Draw a free-body diagram showing ALL the forces acting on the 5 kg block. (5)

3.3 Calculate the:

3.3.1 Magnitude of the normal force acting on the 5 kg block. (3)

3.3.2 Mass, X, of the hanging block (6)

3.4 How will the frictional force on the 5 kg block be affected if the angle of the 50 N force is increased to 30° to the horizontal? Write only INCREASE,-DECREASE or STAY THE SAME. Explain your answer. (3)
[19]

QUESTION 4

A satellite of mass 550 kg is in orbit around the earth. The earth exerts a force of 4 027,88 N on the satellite.

4.1 State *Newton's law of universal gravitation* in words. (2)

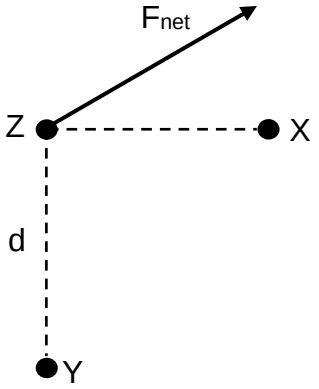
4.2 Give the magnitude of the force that the satellite exerts on Earth. (1)

4.3 Write down the wording of the law you have used to arrive at your answer to question 4.2. (2)

4.4 Calculate the HEIGHT of the satellite, in **km**, ABOVE the SURFACE of the earth. (5)
[10]

QUESTION 5

Three point charges, **X**, **Y** and **Z**, are placed at right angles with one another as shown on the right. The NET electrostatic FORCE, F_{net}, on **Z**, due to **X** and **Y**, is in the direction as indicated.



X, with a magnitude of 3 µC, is 1 m from **Z**.
Y, with a magnitude of 5 µC, is a distance *d* from **Z**.
Z, with a magnitude of 2 µC, is **POSITIVELY** CHARGED.

5.1 Is point charge **X** positive or negative? (1)

5.2 What is the direction of the electrostatic force that **Y** exerts on **Z**? Choose your answer from UP or DOWN. (1)

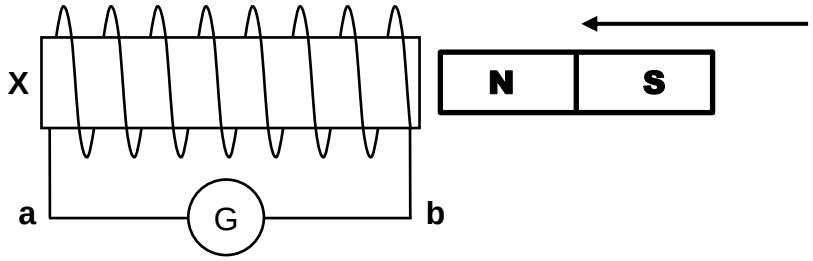
5.3 State *Coulomb's law* in words. (2)

5.4 The net electrostatic force, F_{net}, on **Z**, due to **X** and **Y**, is 5,85 x 10^{-2} N in the direction shown above. Calculate distance *d*. (6)

5.5 Calculate the magnitude of the NET ELECTRIC FIELD at the point where **Z** is placed. (3)
[13]

QUESTION 6

A bar magnet is pushed INTO a coil as shown below.



6.1 What will be observed on the galvanometer if the bar magnet is held stationary inside the coil? Give a reason for your answer. (2)

6.2 What is the polarity of the magnetic field of the coil at **X**? (1)

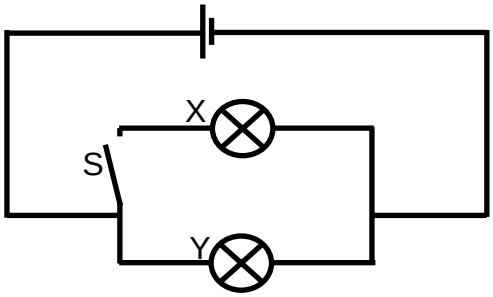
6.3 Which rule can be used to predict the direction of the induced current? (1)

6.4 In which direction does the induced current flow in the galvanometer? From **a** to **b** or from **b** to **a**? (2)

[6]

QUESTION 7

7.1 The circuit diagram on the right is used to compare the brightness of bulbs **X** and **Y**.

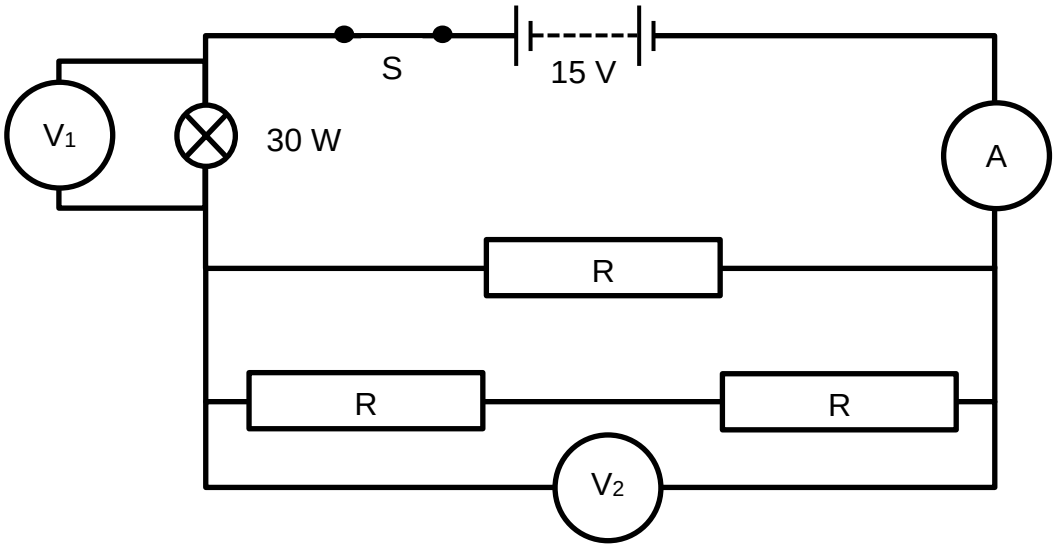


Bulb **X** has a resistance of 4 Ω and bulb **Y** has a resistance of 2 Ω.

7.1.1 Define the term *power* in words. (2)

7.1.2 Which bulb, **X** or **Y**, glow brighter when switch **S** is closed? Explain your answer. (4)

7.2 When switch **S** is closed in the circuit diagram below, the reading on voltmeter $\mathbf{V_1}$ is 10 V. Each of the three identical resistors has a resistance R. The internal resistance of the battery and the resistance of ammeter **A** and the connecting wires are negligible. Voltmeter $\mathbf{V_1}$ is connected across a bulb that glows at a POWER rating of 30 W.



7.2.1 State *Ohm's law* in words. (2)

7.2.2 Calculate the reading on ammeter **A**. (3)

7.2.3 What the reading on voltmeter $\mathbf{V_2}$? (1)

7.2.4 Calculate the value of R. (5)

[17]

GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 11 (PHYSICS)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (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	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
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	$9,11 \times 10^{-31}\ kg$
Mass of the earth *Massa van die aarde*	M	$5,98 \times 10^{24}\ kg$
Radius of the earth *Radius van die aarde*	R_E	$6,38 \times 10^{6}\ m$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{GM}{r^2}$
$f_s^{max} = \mu_s N$ $\quad f_s^{maks} = \mu_s N$	$f_k = \mu_k N$

ELECTROSTATIC/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{Q}$
$V = \frac{W}{Q}$	$E = \frac{kQ}{r^2}$
$n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	$I = \frac{Q}{\Delta t}$
$R_s = R_1 + R_2 + \cdots$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
$W = VQ$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$