



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 1- Physics



NOVEMBER 2013
TIME: 3 HRS

Total 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (25)
SECTION B (125)

Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets is attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to two decimal places

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) in the ANSWER BOOK.

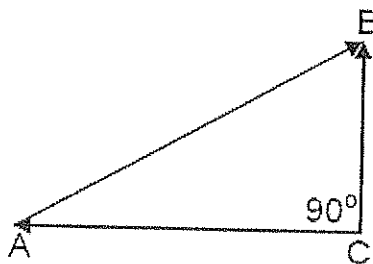
- 1.1 The state in which all forces acting on an object are balanced and there is no motion
- 1.2 The rate of flow of charge
- 1.3 The ratio of the force of friction to the normal force
- 1.4 A single force having the same effect as all the other forces acting together
- 1.5 The quantity represented by the gradient of a velocity time graph.

[1 x 5 =5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (2.1 – 2.10) in the ANSWER BOOK.

- 2.1 Consider the following vector diagram:



The vector which represents the resultant of the other two, is ...

- A AB.
- B AC.
- C CB.
- D BA.

2.2

A ball is dropped onto a concrete floor and bounces off the floor to the same height from which it was dropped. Which ONE of the following laws best explains why the ball experiences an upward force?

- A Newton's first law of motion
- B Newton's second law of motion
- C Newton's third law of motion
- D Newton's law of universal gravitation

2.3

A boy stands on a scale in a lift. The scale registers a reading of 588 N when the lift is stationary. The lift now starts moving. At one instant during its motion, the scale registers a reading of 600 N.

Which ONE of the following CORRECTLY describes the motion of the lift at this instant?

The lift is ...

- A accelerating upwards.
- B accelerating downwards.
- C moving upwards at constant velocity.
- D moving downwards at constant velocity.

2.4

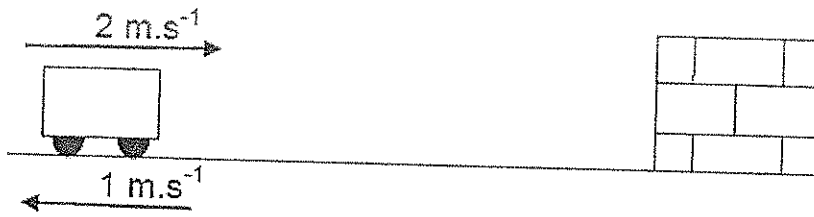
Two point charges, q_1 and q_2 , are placed a distance r apart. Point charge q_1 exerts a force of magnitude F on point charge q_2 .

The magnitude of each charge is now doubled and the distance between them is also doubled.

The magnitude of the force that q_1 now exerts on q_2 is ...

- A F .
- B $2F$.
- C $4F$.
- D $8F$.

- 2.5 A trolley in the diagram strikes the wall at a velocity of 2 m.s^{-1} and bounces back at a velocity of 1 m.s^{-1} . Take the direction towards the wall as positive.



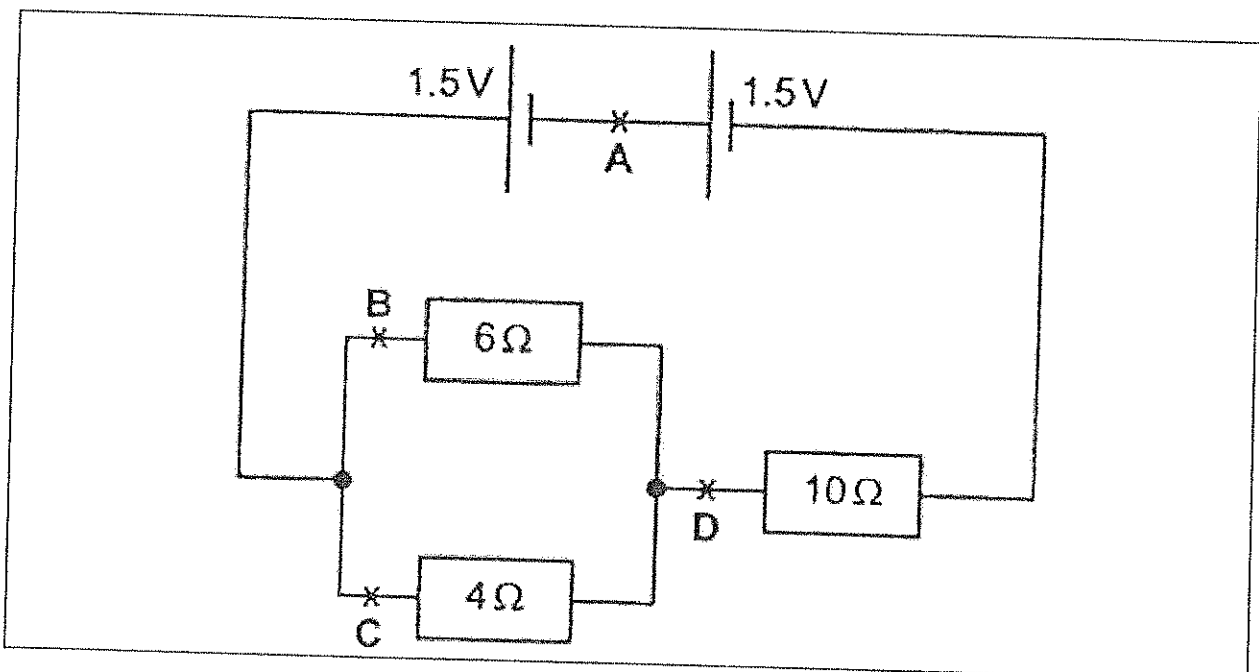
The change in the velocity of the trolley due to the collision is ...

- A 1 m.s^{-1} .
 - B -1 m.s^{-1} .
 - C 3 m.s^{-1} .
 - D -3 m.s^{-1} .
- 2.6 The driver of a motor car places a book on the level dashboard of his car in front of him. He observes that the book slides towards the windscreen when the brakes are applied.

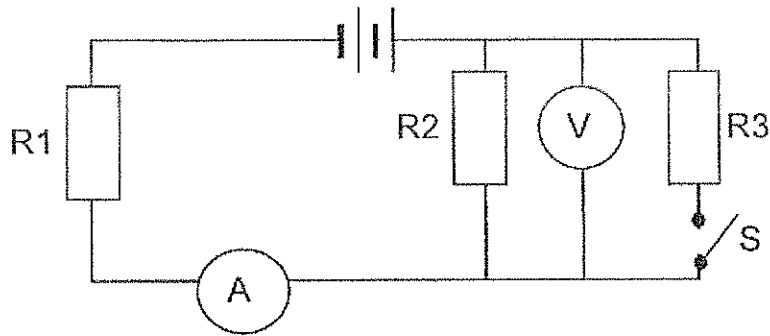
Which of Newton's Laws best explains this motion of the book?

- A. First Law
- B. Second Law
- C. Third Law
- D. Law of Universal Gravitation

- 2.7 At which point is the current the smallest in the circuit shown below?



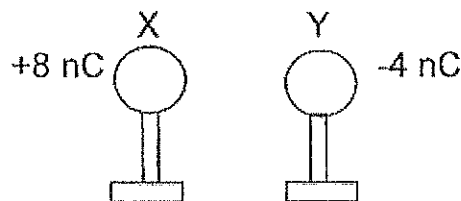
2.8 In the circuit below, the battery has negligible internal resistance.



What will happen to the readings on the ammeter and the voltmeter if switch S is CLOSED?

	AMMETER READING	VOLTMETER READING
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

2.9 Two identical metal spheres, X and Y, on insulated stands, carry charges of +8 nC and -4 nC respectively. X and Y are allowed to touch and are then separated again.

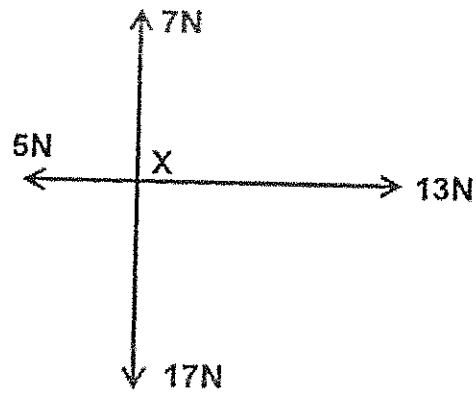


What is the polarity of the charges on X and Y and the nature of the force that they experience after they have been separated again?

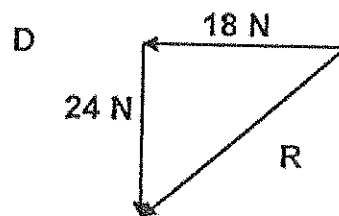
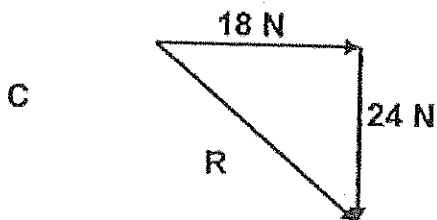
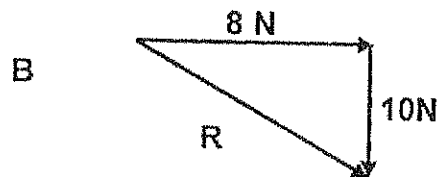
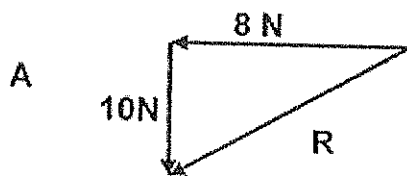
	POLARITY OF CHARGE	NATURE OF FORCE
A	negative	repulsive
B	negative	attractive
C	positive	repulsive
D	positive	attractive

2.10

Four forces act at a point X as shown in the following sketch:



Which ONE of the following can be used to find the resultant of the four forces in the diagram?



[2 x 10 = 20]

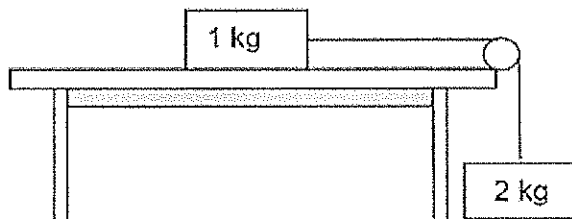
SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave ONE line between two sub questions, for example between QUESTION 3.1 and QUESTION 3.2.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to **TWO decimal** places

Question 3

In the diagram below, a 1 kg mass on a rough horizontal surface is joined to a 2 kg mass by a light, **inelastic** string running over a frictionless pulley. The coefficient of kinetic friction between the 1 kg mass and the surface is 0,13.



- 3.1 State *Newton's second law of motion* in words. (2)
- 3.2 Calculate the magnitude of the:
 - 3.2.1 Kinetic frictional force acting on the 1 kg mass (3)
 - 3.2.2 Acceleration of the system (5)

[10]

Question 4

A minibus-taxi travels at $30 \text{ m}\cdot\text{s}^{-1}$ in a westerly direction. When the driver sees a group of learners crossing the street, he immediately applies the brakes and brings the minibus-taxi to a stop in 7,5 s. The mass of the minibus-taxi and the passengers is 3 600 kg.

- 4.1 Calculate the force that is required to bring the minibus-taxi to a stop. (5)
- 4.2 The force that you calculated in QUESTION 4.1 is the maximum force that can be applied by the brakes. The number of passengers is increased so that the total mass of the minibus-taxi and the passengers is now 4 000 kg

Using this information, state how the following will be influenced:
 (Use only **INCREASES**, **DECREASES** or **REMAINS THE SAME** as your answer.)

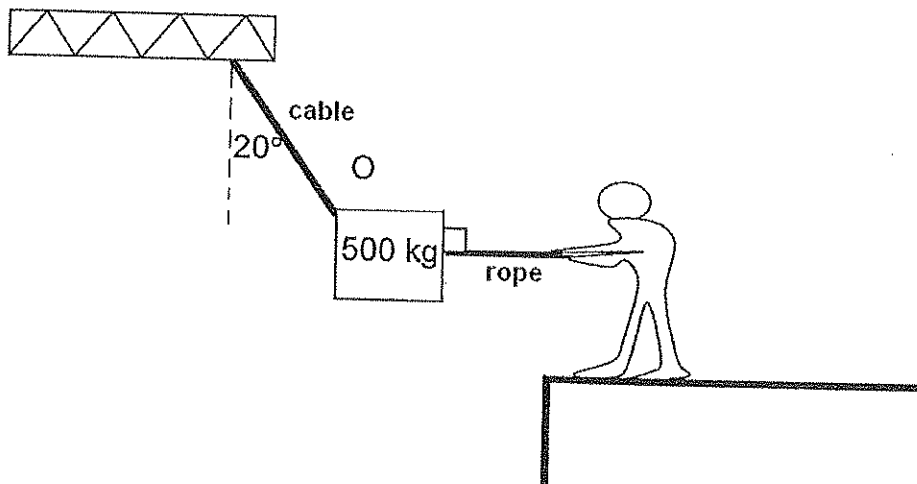
4.2.1 The time taken to stop the minibus-taxi. (1)

4.2.2 The magnitude of the acceleration. (1)

[7]

Question 5

A crane is used to lift a container of mass 500 kg from a dock onto a ship. The container must be pulled sideways in order to be positioned above the hold. A man on the deck of the ship fixes a rope to the container at the same point, O, where a cable is fixed to the container. He pulls horizontally until the cable makes an angle of 20° with the vertical. The container is now stationary above the hold.



5.1 What is the magnitude of the gravitational force acting on the container? (2)

5.2 Draw a labelled diagram of forces (a force triangle) not necessarily to scale showing all the forces acting on point O. Indicate all angles inside the triangle. (4)

5.3 Determine, either by calculation or by means of an accurate construction (using a scale where 1 cm represents 500 N), the magnitude of the horizontal force exerted by the man on the rope, AND the magnitude of the force exerted by the cable. (6)

[12]

Question 6

A truck travels at an initial speed of 20 m.s^{-1} along a straight horizontal road, and then accelerates at 2 m.s^{-2} for 10s.

6.1 Calculate the distance which the truck covers while it is accelerating. (4)

6.2 What is the speed of the truck after 10s? (4)

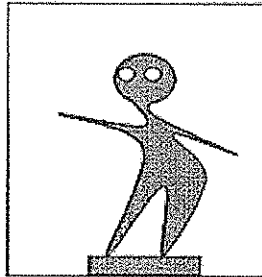
After 10s the truck moves at a constant velocity. The truck driver suddenly sees a stationary vehicle blocking the road 150 m ahead of him. He brakes immediately and the truck slows down at a constant acceleration of magnitude 6 m.s^{-2} .

6.3 Will the truck stop before reaching the stationary vehicle? Support your answer with an appropriate calculation. (5)

[13]

Question 7

A boy of mass 50 kg stands on a bathroom scale which is placed on the floor of a lift. The scale is calibrated in Newton.



7.1 What is the reading on the scale if the lift is standing still? (2)

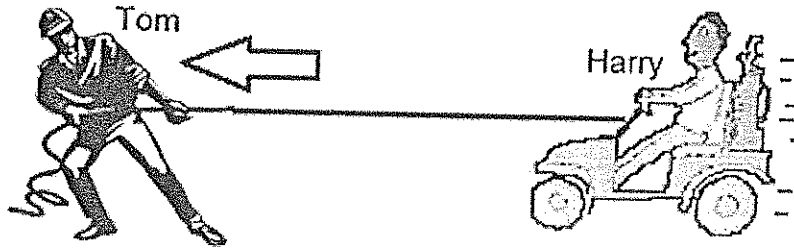
7.2 Calculate the reading on the scale while the lift accelerates upwards at 2 m.s^{-2} . (3)

7.3 Calculate the reading on the scale while the lift decelerates downwards at 4 m.s^{-2} . (4)

[9]

Question 8

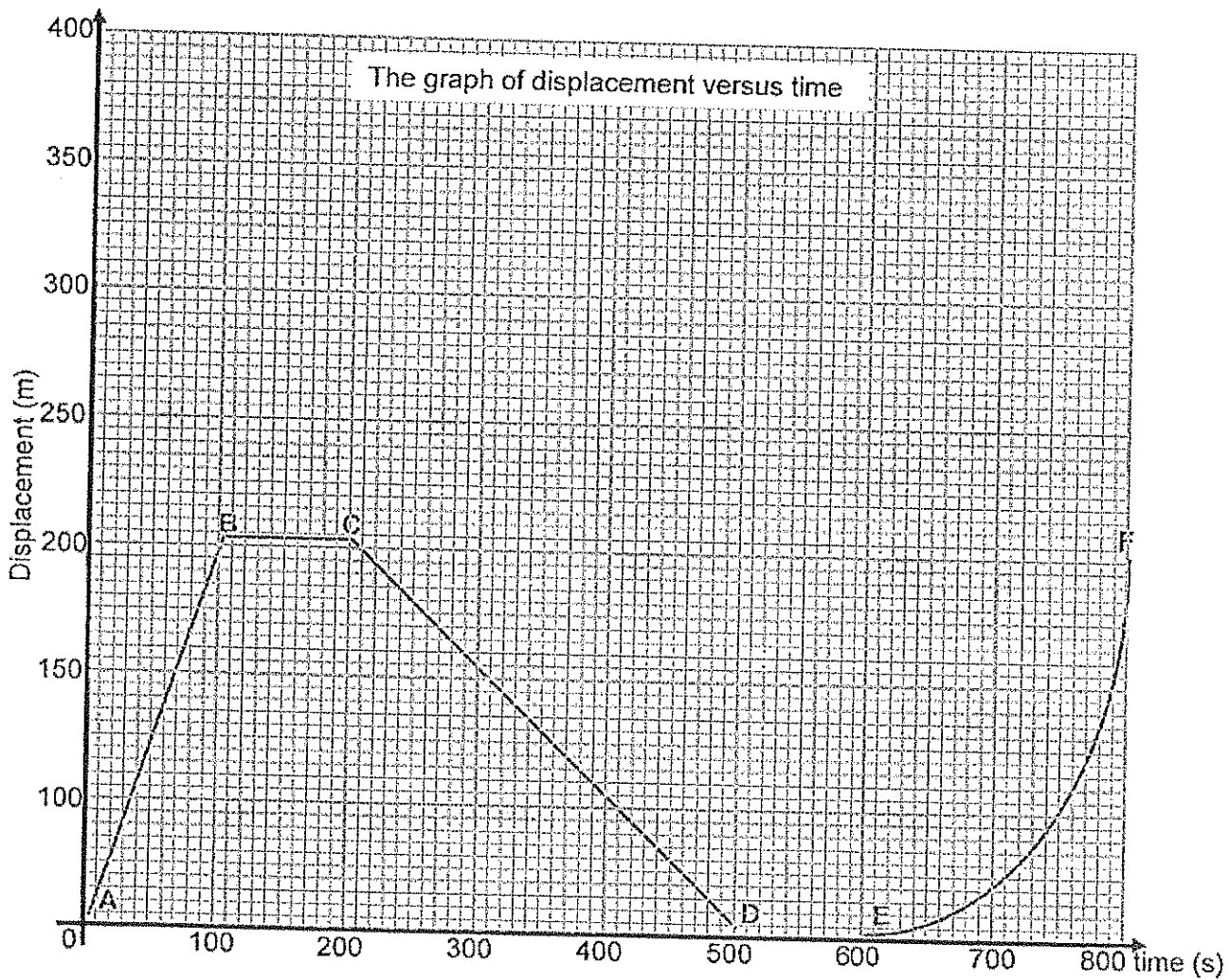
Tom pulls Harry on a homemade cart to the left as shown in the diagram below. Harry and the cart have a total mass of 55 kg. Tom applies a horizontal force of 115 N to the left and the cart accelerates at $2\text{m}\cdot\text{s}^{-2}$ to the left.



8.1 Calculate the frictional force experienced by the cart while being pulled by Tom. (6)

Question 9

The graph represents the motion of Sarah running along a straight road in a straight line. The letters A to F represent points in the motion of Sarah [6]

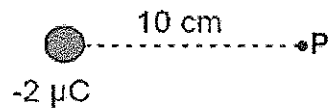


- 9.1 Between which two points on the graph is Sarah running at a constant velocity away from her starting point? (Use the symbols A, B, etc. in the graph.) (1)
- 9.2 Use the graph to calculate the constant velocity with which Sarah is running back towards her starting point. (3)
- 9.3 Between which points on the graph is Sarah resting? (2)
- 9.4 Determine from the graph the distance that Sarah covers in the first 500 s. (3)

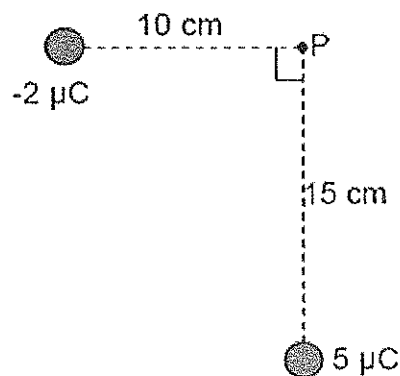
[9]

Question 10

A negative charge of $2 \mu\text{C}$ is positioned 10 cm from point P, as shown below.



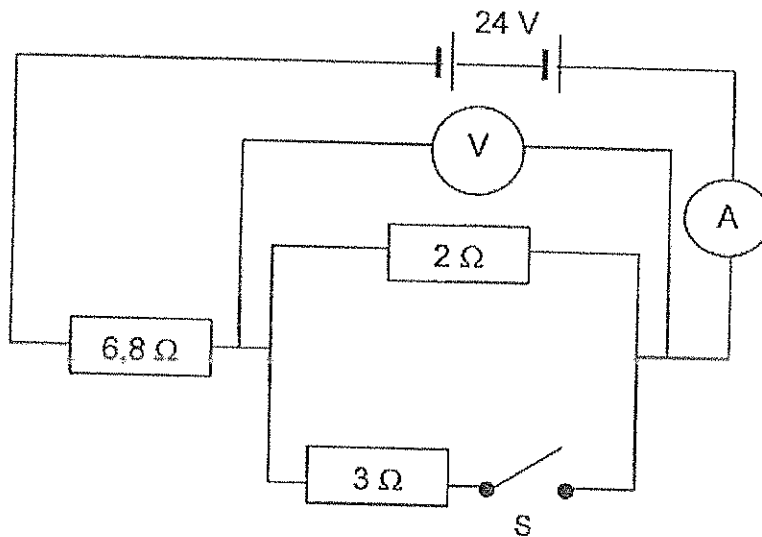
- 10.1 Define the *magnitude of the electric field at point P* in words. (2)
- 10.2 Draw the electric field lines associated with this charge. (2)
- 10.3 A positive charge of $5 \mu\text{C}$ is now positioned 15 cm from point P, as shown in the diagram below.



Calculate the magnitude of the electric field (E) at point P due to both charges. (7)
[11]

Question 11

The battery in the circuit diagram below has negligible internal resistance.



Switch S is OPEN.

- 11.1 The emf of the battery is 24 V. State briefly what is meant by this. (1)
- 11.2 Calculate the reading on the ammeter when switch S is OPEN. (3)

Switch S is now CLOSED.

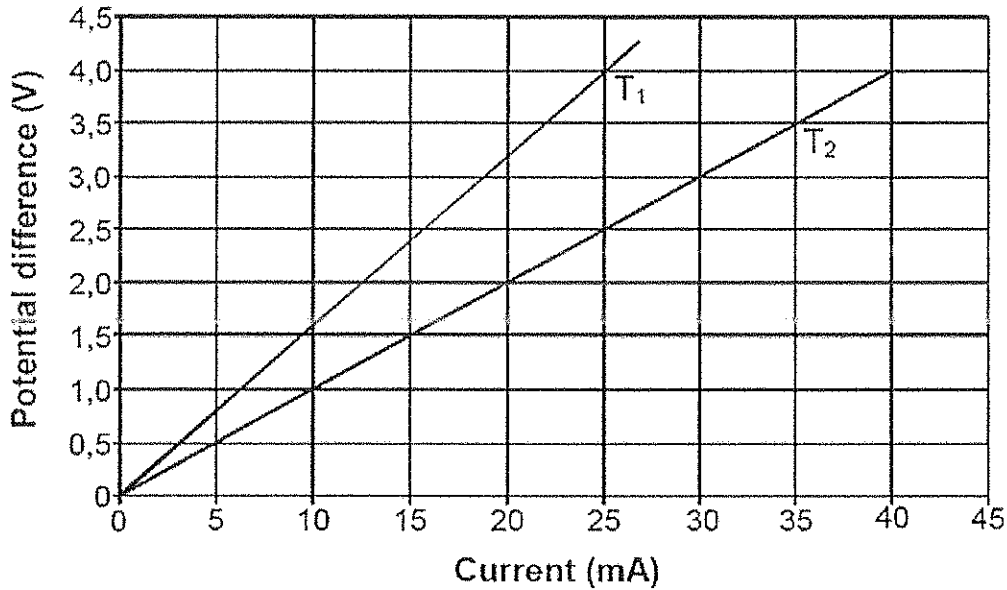
- 11.3 What will be the effect on the ammeter reading if switch S is closed? Answer only INCREASES, DECREASES or REMAINS THE SAME. Explain briefly. (2)
- 11.4 Calculate the total resistance of the circuit. (4)
- 11.5 Calculate the reading on the ammeter. (3)
- 11.6 Calculate the reading on the voltmeter. (3)
- 11.7 Calculate the current in the 3 Ω resistor of the parallel combination. (3)
- 11.8 Calculate the power output of the resistors connected in parallel. (4)

[23]

Question 12

The two graphs below represent the relationship between potential difference and current in a metal wire at two different constant temperatures, T_1 and T_2 .

GRAPHS OF POTENTIAL DIFFERENCE VERSUS CURRENT



- 12.1 Calculate the resistance of the metal wire at temperature T_1 . (3)
- 12.2 Which graph was obtained at the higher temperature? (T_1 or T_2)
Give a reason for the answer. (3)
- 12.3 The metal wire is an ohmic conductor. Justify this statement by referring to the graphs. (1)
- 12.4 Calculate the power dissipated in the metal wire when the current in it is 25 mA at temperature T_2 . (3)

[10]

Question 13

A 400 W heater and a 1500 W kettle are connected into a 220 V plug point. The circuit breaker is activated when a 16 ampere current flows through the circuit.

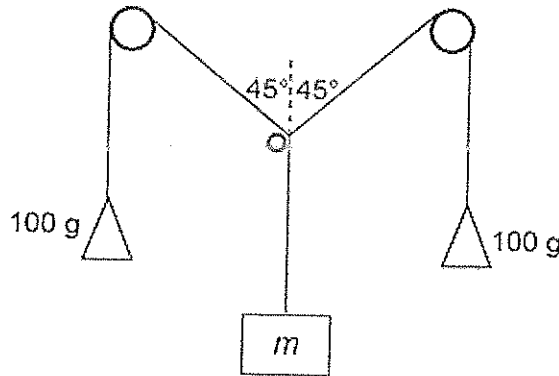
- 13.1 A number of appliances are connected to a multiple plug point. Are these appliances connected in series or in parallel? Give a reason for your answer. (2)
- 13.2 Determine whether the circuit breaker will be activated in the above example, by using a suitable calculation. (4)

[6]

Question 14

In an experiment to determine the unknown mass of an object, two 100 g masses and an object of unknown mass, m , are suspended from three strings, as shown in the diagram (not drawn to scale) below. The strings are light and **inelastic**. Two of the strings run over frictionless pulleys.

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



- 14.1 Write down the most important experimental error that can occur when conducting this experiment. (1)
- 14.2 Draw a **FREE BODY DIAGRAM** showing all the forces acting on knot O . Indicate the magnitude of each force on the diagram. (3)
- 14.3 Determine, by **ACCURATE CONSTRUCTION AND MEASUREMENT** or **CALCULATION**, the unknown mass m . Use scale 10 mm : 0,1 N. (5)

[9]

**DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 11
VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s ⁻²
Gravitational constant <i>Swaartekragkonstante</i>	G	6,67 x 10 ⁻¹¹ N·m ² ·kg ⁻²
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 x 10 ⁹ N·m ² ·C ⁻²
Speed of light in a vacuum <i>Spoe van lig in 'n vakuum</i>	c	3,0 x 10 ⁸ m·s ⁻¹
Charge on electron <i>Lading op elektron</i>	e	-1,6 x 10 ⁻¹⁹ C
Electron mass <i>Elektronmassa</i>	m _e	9,11 x 10 ⁻³¹ kg
Radius of earth <i>Radius van aarde</i>	R _E	6,38 x 10 ⁶ m
Mass of earth <i>Massa van aarde</i>	M _E	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

$F_{\text{net}} = ma$	$w = mg$ $F_g = mg$
$f_k = \mu_k F_N$	$f_{s(\text{max})} = \mu_s F_N$
$p = mv$	$F \Delta t = \Delta p = mv - mu$

ELECTROSTATICS/ELEKTROSTATIKA

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

CURRENT ELECTRICITY/STROOMELEKTRISITEIT

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I} \quad \text{emf/emk} = I(R+r)$
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$	$R = R_1 + R_2 + R_3 \dots$
$W = Vq$	$P = \frac{W}{\Delta t}$
$W = VI\Delta t$	$P = VI$
$W = I^2R\Delta t$	$P = I^2R$
$W = \frac{V^2\Delta t}{R}$	$P = \frac{V^2}{R}$