



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 1- Physics



NOVEMBER 2014
TIME: 3 HRS

Total 150

Instructions

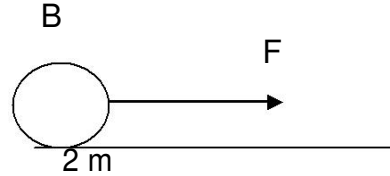
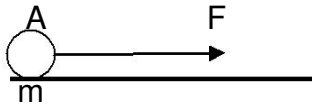
1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
SECTION B (130)

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 and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places

Question 1

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 (1.1 – 1.10) in the ANSWER BOOK.

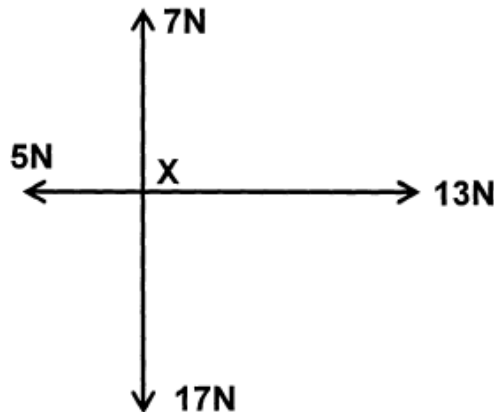
- 1.1 Two constant forces each of magnitude F Newton act at the same time, on two different bodies A and B. The mass of B is twice the mass A.



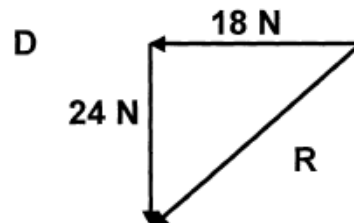
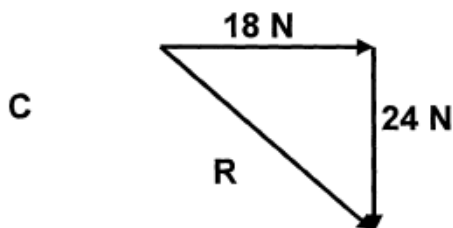
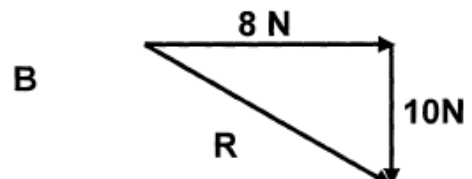
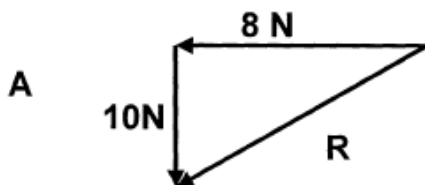
The magnitude of the acceleration of B is ... the acceleration of A (effect of friction is negligible).

- A twice
- B half
- C equal to
- D one fourth

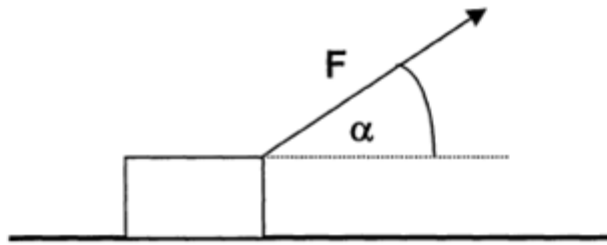
- 1.2 Four forces act at a point X as shown in the following sketch:



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

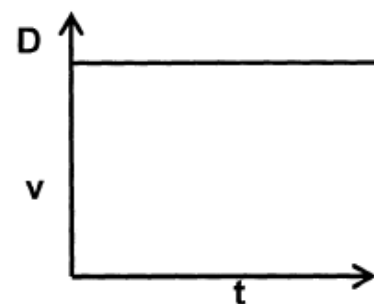
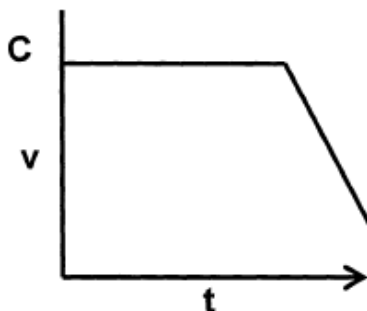
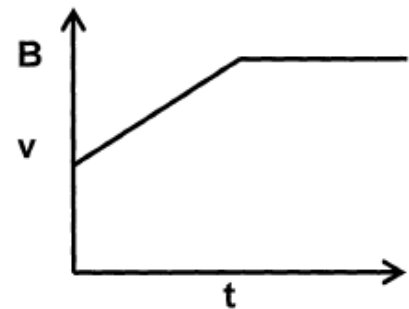
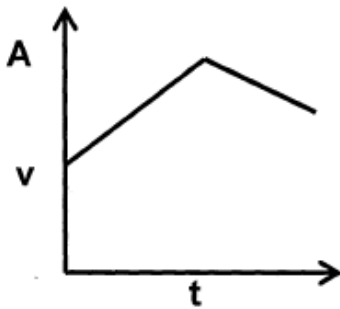


- 1.3 A block is being pulled with a force F at an angle α with the horizontal, as shown below. The surface is frictionless.

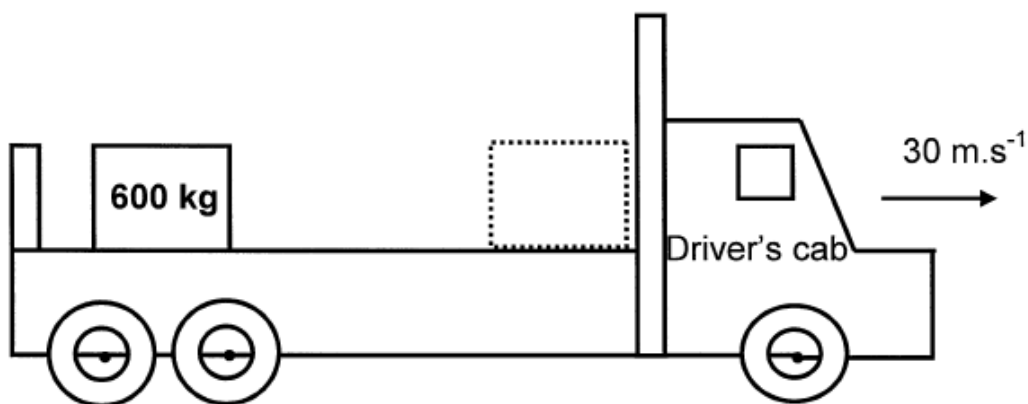


For which ONE of the following angles, α , will the block experience the biggest acceleration?

- A 0°
 - B 45°
 - C 60°
 - D 90°
- 1.4 A toy car is pulled across a **frictionless horizontal surface** by means of a string. The string exerts a constant force on the toy car. After a while the string breaks. Which ONE of the following graphs best represents the velocity-time graph of the toy car for its entire motion?

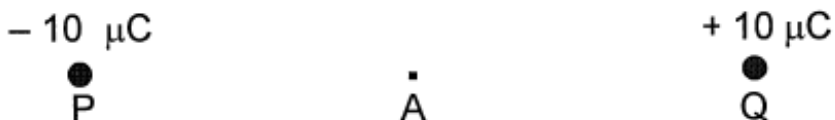


- 1.5 A flatbed truck carrying a 600 kg concrete block, near the back of its flatbed, is travelling to the right along a straight level road at 30 m.s^{-1} .



The truck collides head on with a stationary truck and stops immediately. The concrete block slides into the back of the driver's cab. Which ONE of the following is the best explanation why the block slides forward?

- A The truck exerts a force on the block.
- B The inertia of the concrete block causes it to slide forward.
- C The velocity of the concrete block relative to the ground remains constant.
- D The concrete block experiences an acceleration due to a resultant force.
- 1.6 An electron is placed at point A, halfway between charged particles P and Q. Which ONE of the following statements is TRUE?



The electron will ...

- A remain at rest.
- B be accelerated towards P.
- C be accelerated towards Q.
- D move towards P at a constant velocity.

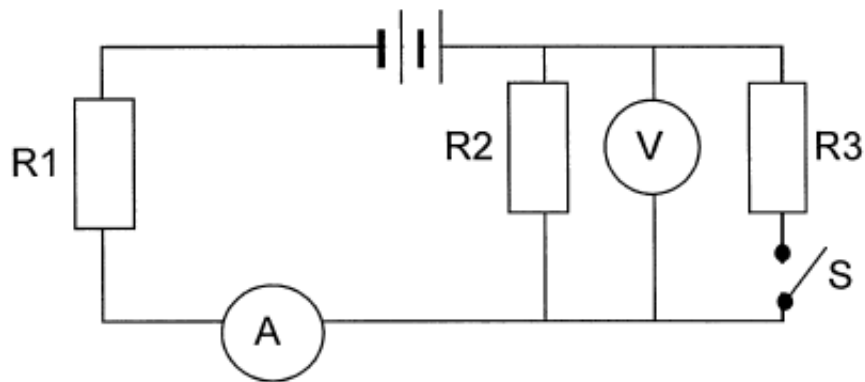
1.7 Consider the following equation:

$$F = \frac{Gm_1m_2}{r^2}$$

Which ONE of the following statements regarding the above formula is FALSE?

- A r represents the distance between the centres of m_1 and m_2 .
- B The force F is inversely proportional to r^2 .
- C The value of G is less on the moon than on earth.
- D The force F is directly proportional to the product of m_1 and m_2 .

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

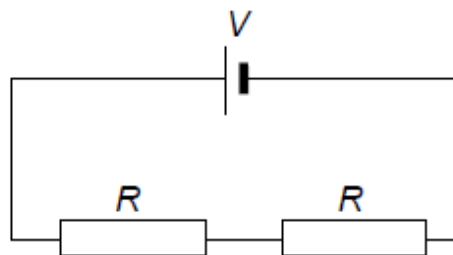


What will happen to the readings on the ammeter and the voltmeter if switch S is CLOSED?

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

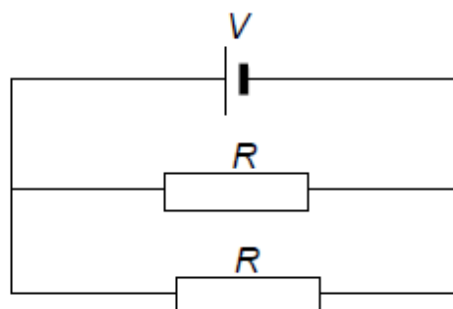
- 1.9 The two resistors in circuit 1 below are identical. They are connected in series to a cell of emf V and negligible internal resistance. The power dissipated (given off) by each resistor is P .

Circuit 1



The two resistors are now connected in parallel, as shown in circuit 2 below.

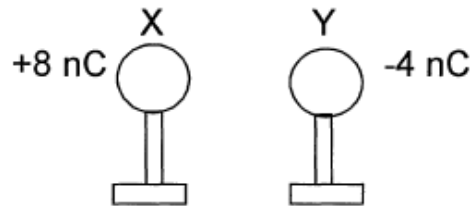
Circuit 2



The power dissipated (given off) by each resistor in circuit 2 is ...

- A $2P$.
- B $4P$.
- C $8P$.
- D $16P$.

- 1.10 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 x 10 = 20]

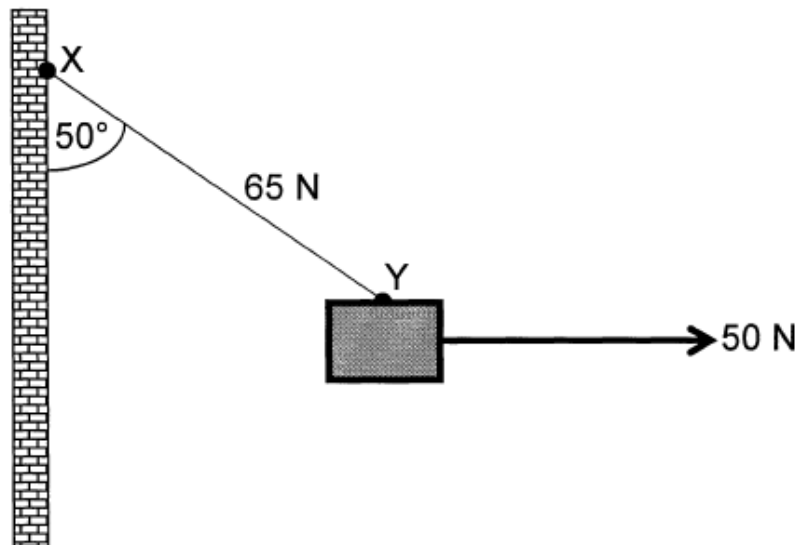
SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to **TWO decimal** places

Question 2

A light rope is attached to the side of a vertical wall at point X. A block of unknown mass is tied to the other end of the rope at Y. The block is pulled to one side by a horizontal force of 50 N, as indicated in the diagram and held there. The block is then in equilibrium while the angle between XY and the wall is 50° and the force in XY is 65 N.



- 2.1 Give a reason why the block is in equilibrium. (1)
- 2.2 Determine, by accurate construction **or** calculations the magnitude and direction of the force needed to keep the 50 N horizontal force and the force in rope XY in equilibrium (equilibrant) . Your calculations must be accompanied by a **labelled** vector triangle. (7)
- 2.3 Hence determine the unknown mass. (3)

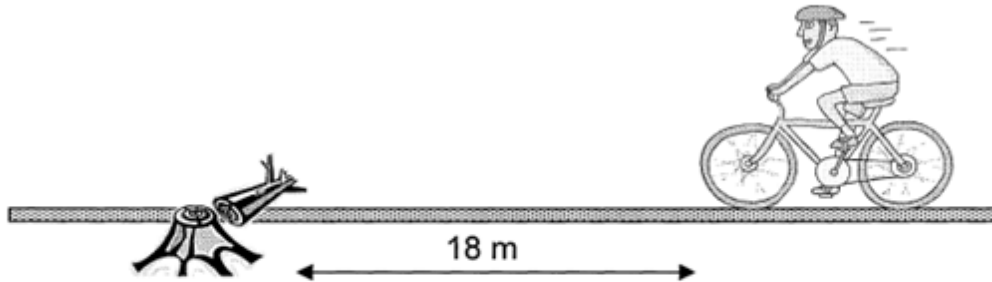
[11]

Question 3

A cyclist starts from rest and acquires a velocity of 6 m.s^{-1} in 4 s.

- 3.1 Calculate the magnitude of the acceleration of the cyclist. (4)

The cyclist maintains a constant velocity of 6 m.s^{-1} . He suddenly notices a tree trunk lying across the road 18 m ahead. However, he only applies the brakes of the bicycle 1 s after noticing the tree trunk.



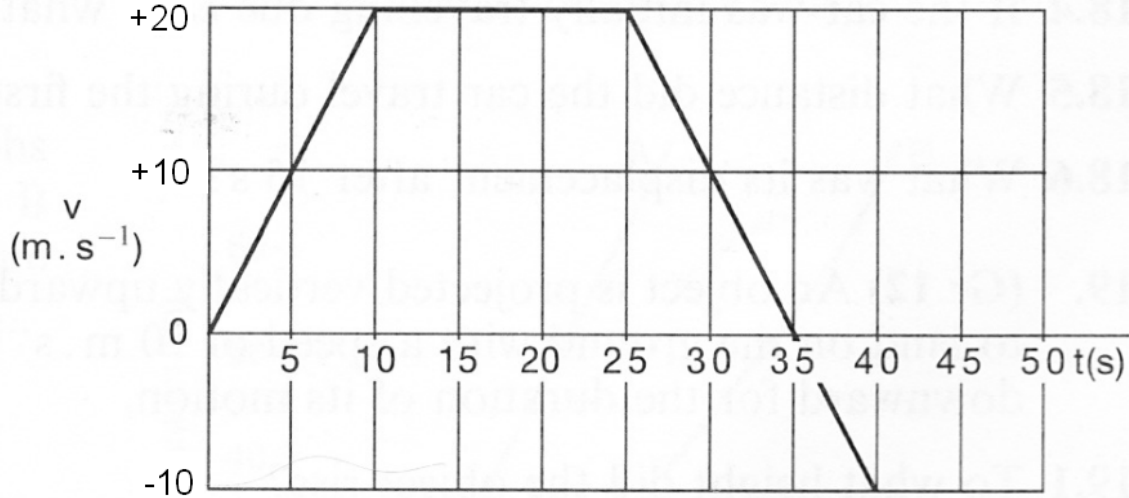
- 3.2 Show by calculation that the cyclist will crash into the tree trunk if the bicycle decelerates at 1 m.s^{-2} once the brakes are applied. (8)

*During the collision with the tree trunk the cyclist is separated from the bicycle. It is observed that the cyclist lands on the other side of the tree trunk and **the bicycle stops immediately** as it gets stuck to the tree trunk.*

- 3.3 Explain, using Newton's law of motion, why the cyclist lands on the other side of the tree trunk. (3)
[15]

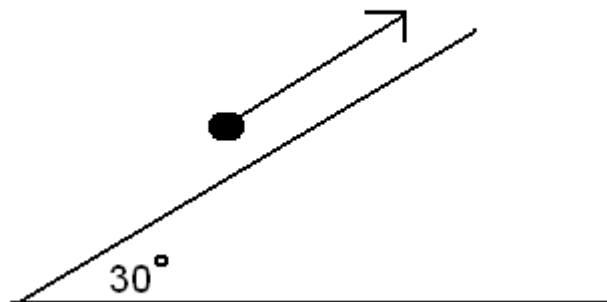
Question 4

The following graph shows Clayton's motion while he is cycling at the beach.



- 4.1 Using the graph, calculate his acceleration during the first ten seconds. (3)
- 4.2 Describe Clayton's motion in the time interval between 10 and 25 seconds. (2)
- 4.3 During the time interval of 10 and 25 seconds, Clayton exerts a force of 500 N while peddling his bicycle up a hill. The incline of the hill is 30° with the horizontal. If Clayton's mass is 65 kg, calculate the coefficient of kinetic friction during this time interval. (5)

$$F_a = 500 \text{ N}$$

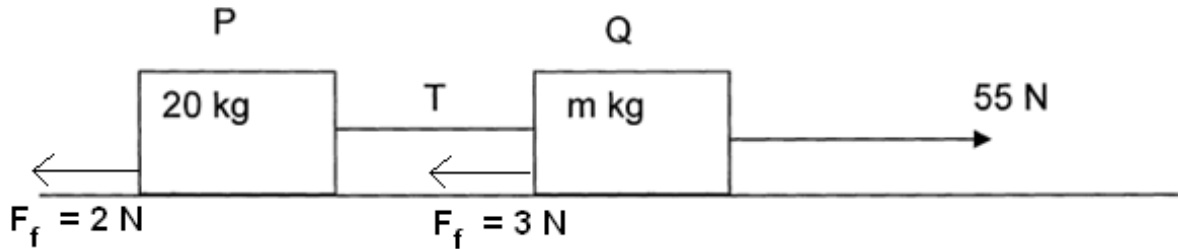


- 4.4 Using the graph, calculate Clayton's displacement for the entire motion (from 0 to 40 seconds). (4)

[14]

Question 5

A system of two blocks, P of mass 20 kg and Q of **unknown mass m kg** are linked by a thin rope of negligible mass and accelerated over a rough horizontal surface as indicated in the diagram below. The frictional forces on P and Q are 2 N and 3 N respectively. The applied force on Q is 55 N. The system accelerates to the right at 1 m.s^{-2} .

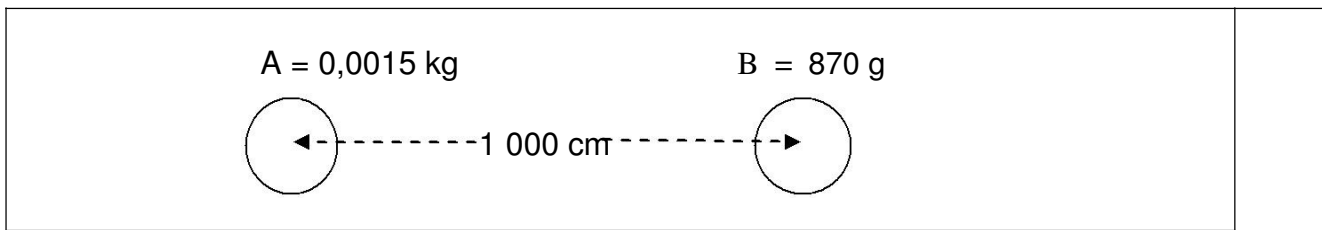


- 5.1 State, in words, Newton's Second Law of motion. (3)
- 5.2 Draw separate labelled force diagrams indicating only all the horizontal forces acting on P and Q. (5)
- 5.3 Calculate the magnitude of T (the force linking the blocks). (4)
- 5.4 Calculate the mass of block Q. (4)

[16]

Question 6

The diagram below shows two balls, the mass ball A is 0,0015 kg and the mass of B is 870 g. The centre-to-centre distance between the balls is 1 000 cm.



- 6.1 State Newton's law of universal gravitation. (2)
- 6.2 Calculate the magnitude of the force that ball A exerts on ball B (4)
- 6.3 Determine the magnitude of the force that ball B exerts on ball A. State which law you used to determine your answer. (2)
- 6.4 Determine by what factor the force would change if:
- 6.4.1 one of the objects' masses is doubled and the distance between the objects is trebled. (2)
- 6.4.2 both masses are tripled and the distance is halved. (2)
- 6.5 A friend of yours who is in Grade 11, but is not taking Physical Science as one of their subjects, comes to you and tells you that his weight is 60 kg. As a Physical Science learner explain the differences between weight and mass. (2)

[14]

Question 7

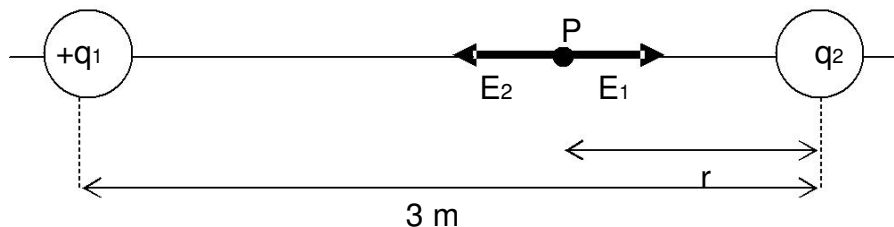
A certain planet is half the mass of earth and has half the radius of the earth.

If an object's weight is 200 N on earth, calculate the weight of the object on that planet.

[6]

Question 8

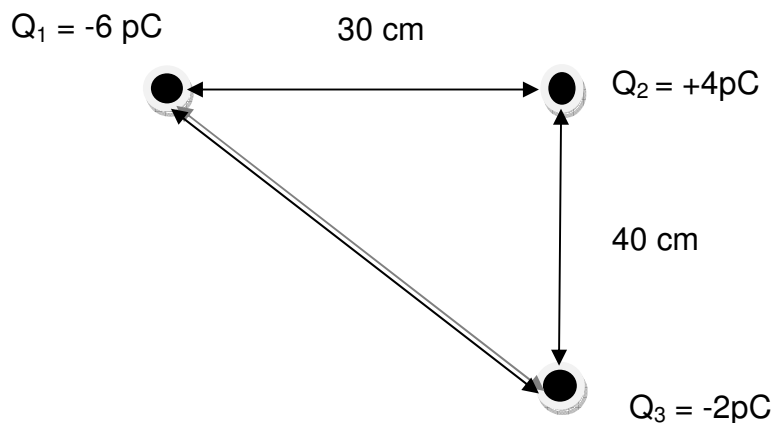
Two positive point charges, $q_1 = +16 \times 10^{-6} \text{ C}$ and $q_2 = +4 \times 10^{-6} \text{ C}$, are separated by a distance of 3 m.



- 8.1 Draw the electric field pattern between the charges. (2)
- 8.2 Define the term *electric field*. (2)
- 8.3 Calculate the distance r between the charges, given that the **net electric field** at P is zero. (5)
- 8.4 The two spheres are allowed to touch and then returned to their original positions. Calculate the NUMBER OF ELECTRONS which are transferred from one sphere to another when the spheres are in contact. (3)

[12]

Question 9

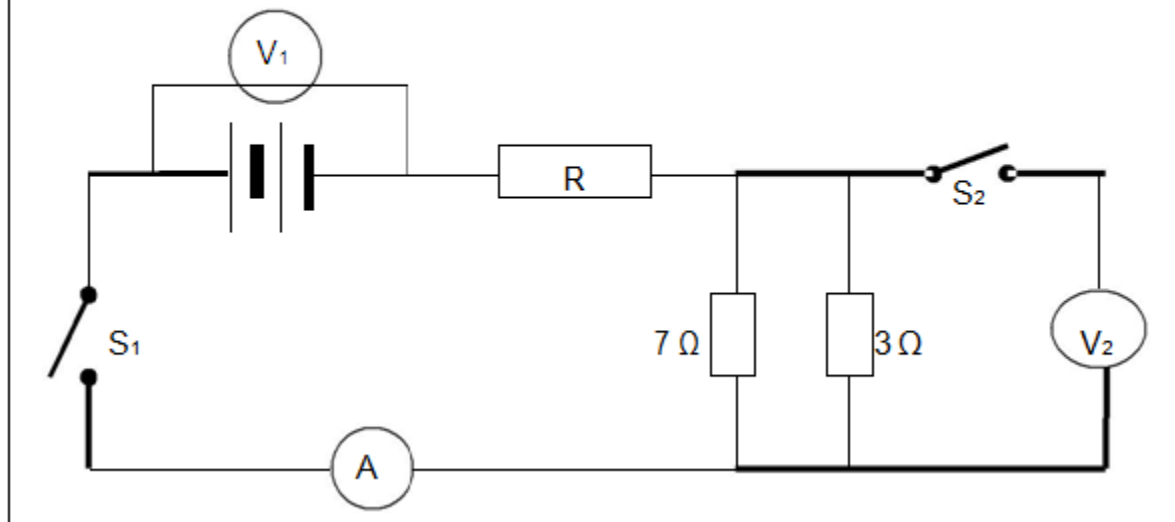


Calculate the net electrostatic force on Q_2 .

(7)
[7]

Question 10

In the circuit diagram below resistor R has an unknown resistance. When both switches are open the reading on V_1 is 30 V. When switch S_1 is closed, the reading on V_1 is 28,5 V and the reading on the ammeter is 3 A.



- 10.1 Define the term emf. (2)
- 10.2 Calculate the internal resistance of the battery. (4)
- 10.3 What is the reading on V_2 , when switch S_2 is open. (1)

Switch S_2 is now closed

- 10.4 What will happen to the ammeter reading? Write only INCREASE, DECREASE or REMAIN CONSTANT. (1)
- 10.5 Calculate the new reading on voltmeter V_2 . (3)
- 10.6 Calculate the amount of heat energy dissipated in the battery in one minute as a result of its internal resistance. (3)
- 10.7 Calculate the resistance of R. (4)

The resistor of 3Ω now burns out.

- 10.8 What effect will it have on the following: (State either INCREASE, DECREASE OR REMAINS THE SAME)
- 10.8.1 The reading on the ammeter. Explain your answer. (2)
- 10.8.2 The reading on the voltmeter, V_1 ? Explain your answer. (3)

[23]

Question 11

A group of learners were tasked to experimentally determine the relationship between the current and potential difference across a conductor at constant temperature, by changing the number of cells in the circuit. The following table shows the results they obtained.

Number of cells in series	Potential difference (V)	Current (A)
1	2	1
2	4	2
3	6	3
4	8	4

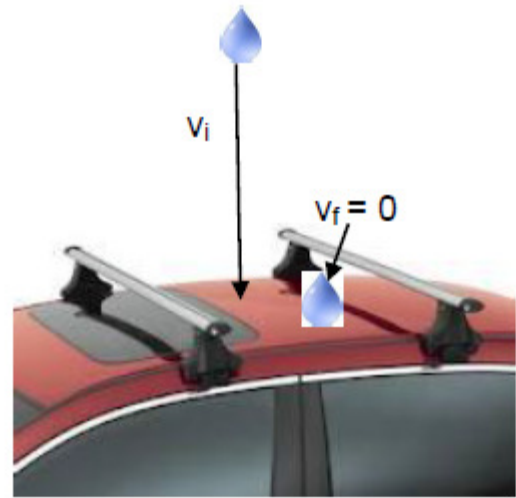
- 11.1. Write down an investigative question for this experiment. (2)
- 11.2. Write a possible hypothesis for the above experiment. (1)
- 11.3. Draw a graph of V vs I. (4)
- 11.4 Determine the gradient of the graph, what does this value represent. (3)
- 11.5 Is your hypothesis correct? Explain. (2)

[12]

Bonus Question

Question 12

Clay, with a mass of 0,06 kg, is dropped straight down and hits the roof of a car with a velocity of $15\text{m}\cdot\text{s}^{-1}$. The clay deforms in 1s and sticks to the roof.

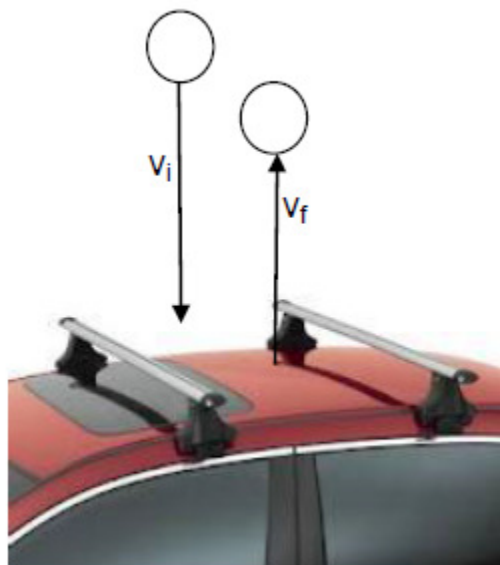


12.1 Define a net force in terms of momentum. (2)

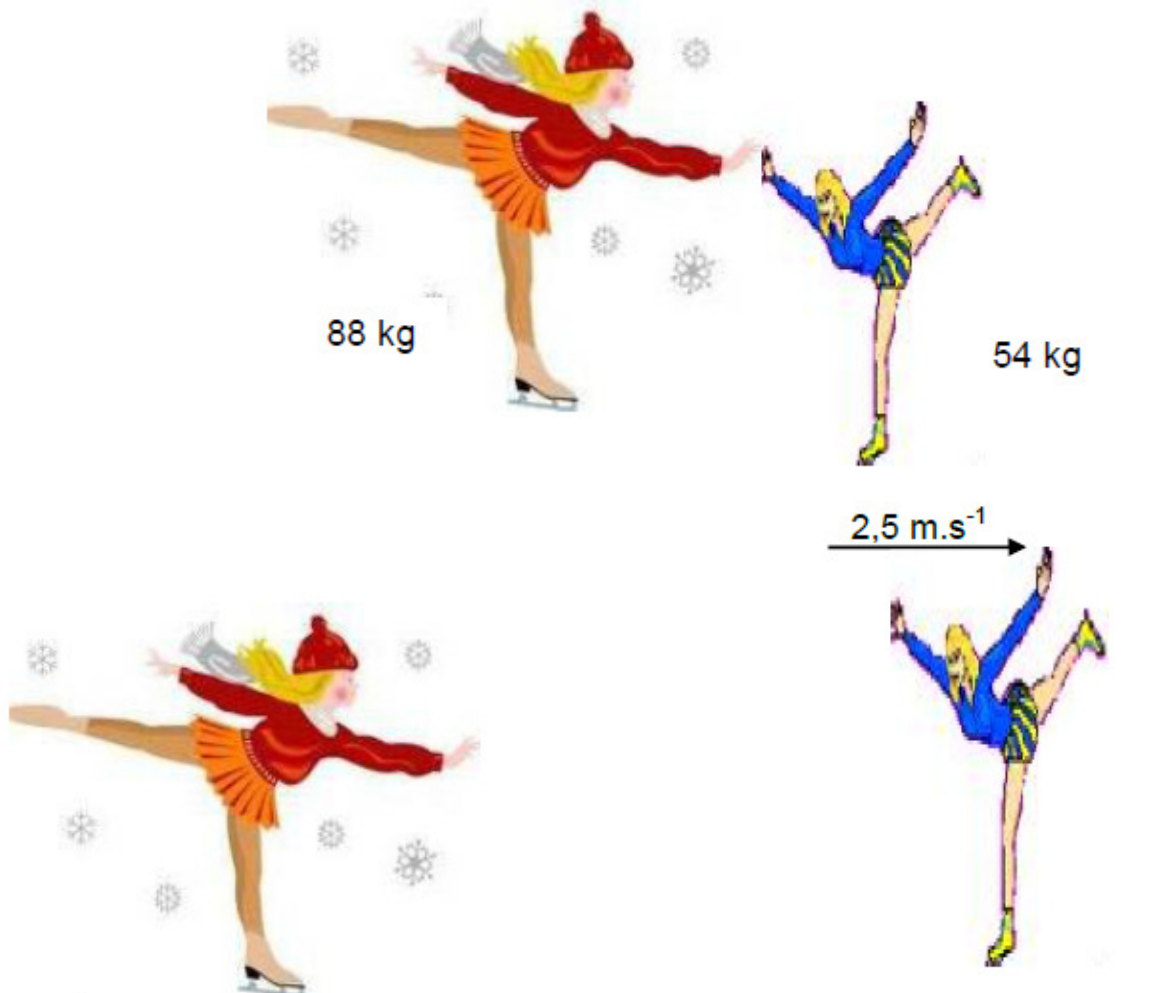
12.2 Determine the magnitude of the net force exerted by the clay on the roof. (4)

12.3 Suppose a rubber ball is falling instead of clay. The mass of the ball is 0,06 kg and the velocity with which it strikes the roof is also $15\text{ m}\cdot\text{s}^{-1}$. However, unlike clay the ball does not come to rest. Instead, after being in contact with the roof for 1 s, it bounces straight up in the air.

Would the force on the roof be **smaller than / equal to / greater than** the calculated value in QUESTION 12.2 above? Explain. (4)



12.4 Starting from rest two skaters “push off” against each other on smooth level ice, where friction is negligible. The two skaters have a mass of 54 kg and 88 kg respectively. The 54 kg skater moves away with a velocity of $2,5 \text{ m}\cdot\text{s}^{-1}$



Calculate the velocity of the 88 kg skater.

(5)

[15]

Total 150 (plus bonus = 165)

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

**GEGEWENS VIR FISIESTE WETENSKAPPE 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>Spoed 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

$F_{\text{net}} = ma$	$p = mv$
$w = mg$ $F_g = m \cdot g$	$F_{\text{net}} \Delta t = \Delta p$
$F = \frac{Gm_1 m_2}{r^2}$	$\Delta p = mv_f - mv_i$
$g = \frac{Gm}{r^2}$	
$f_s^{\text{max}} = \mu_s \cdot N$ or $f_s^{\text{max}} = \mu_s \cdot F_N$	
$f_k = \mu_k \cdot N$ or $f_k = \mu_k \cdot F_N$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1 Q_2}{r^2}$ ($k = 9,0 \times 10^9 \text{ N} \cdot \text{m}^2 \cdot \text{C}^{-2}$)	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ ($k = 9,0 \times 10^9 \text{ N} \cdot \text{m}^2 \cdot \text{C}^{-2}$)	$V = \frac{W}{Q}$

CURRENT ELECTRICITY/STROOMELEKTRISITEIT

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