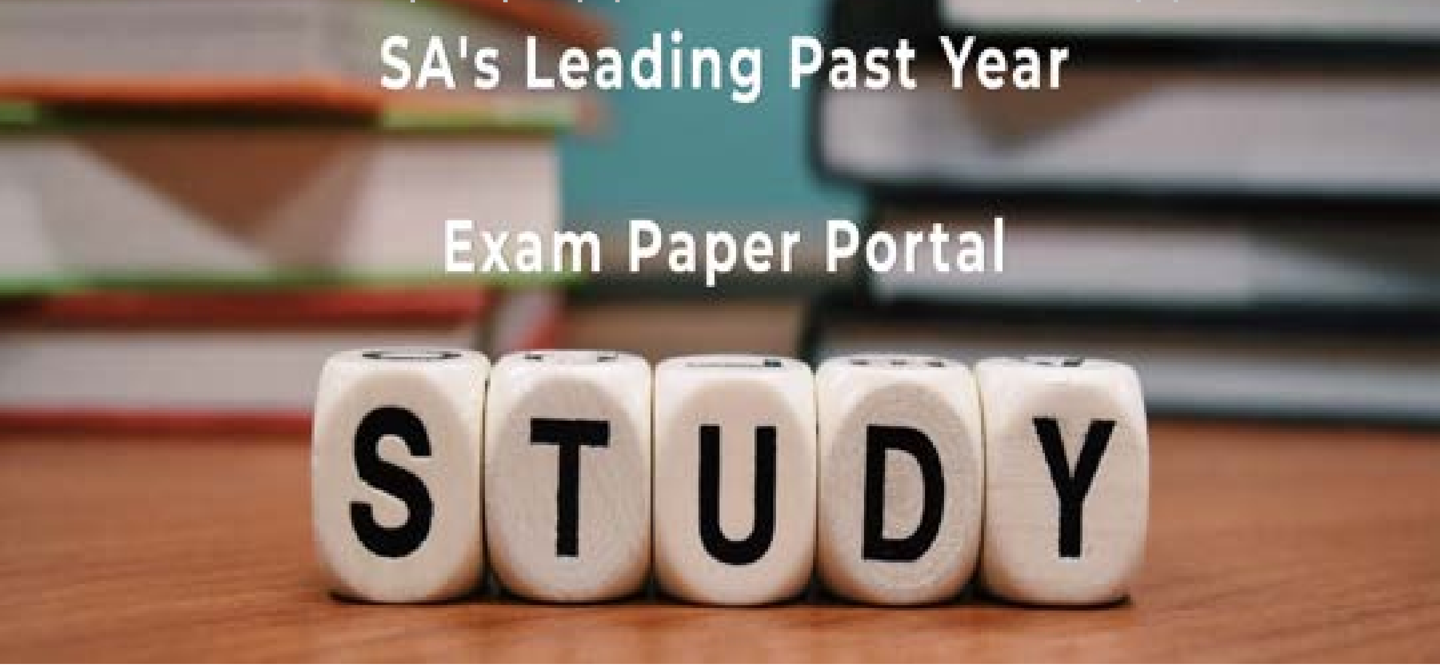
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JUNE EXAMINATION

GRADE 12

PHYSICAL SCIENCES (PAPER 1: PHYSICS)

JUNE 2025

MARKS: 150

TIME: 3 HOURS

This paper consists of 14 pages and three information 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 8 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

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 The force acting parallel to a surface and opposing the tendency of motion of a stationary object relative to the surface is …

A inertia.

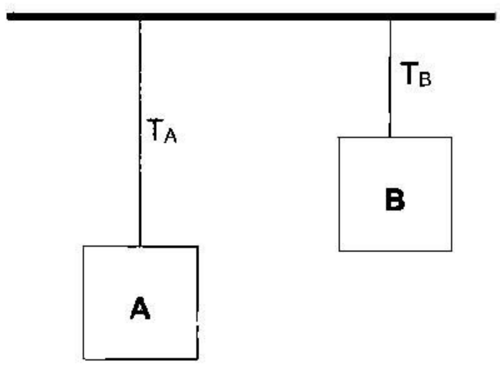
B frictional force.

C static frictional force.

D kinetic frictional force. (2)

1.2 The diagram below shows two blocks, **A** and **B**, suspended from the ceiling. The blocks are stationary and have the same mass. The length of the string connected to block **A** is twice the length of the string connected to block **B.**

The connecting strings are inextensible and have negligible mass. The tension in the strings attached to blocks **A** and **B** are $\mathbf{T_A}$ and $\mathbf{T_B}$ respectively.



Which one of the following statements about how the tensions compare to each other is correct?

A $T_A = T_B$

B $T_A < T_B$

C $T_A > T_B$

D $2T_A = T_B$ (2)

1.3 The ball is projected vertically upwards. Ignore the effect of air resistance.

Which one of the following statements about the acceleration of the ball at its MAXIMUM HEIGHT is correct?

The acceleration is equal to…

A 0 m·s^{-2}.

B 9,8 m·s^{-2} and is directed upwards.

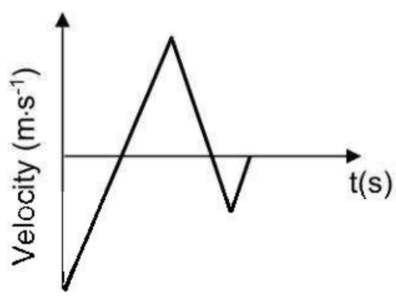
C 9,8 m·s^{-2} and is directed downwards.

D 9,8 m·s^{-2} in the direction of motion. (2)

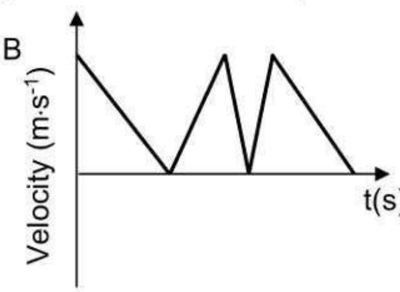
1.4 A ball is projected vertically upwards from the ground. It returns to the ground, makes an INELASTIC COLLISION with the ground over a short time interval and then bounces to a maximum height. Ignore air resistance.

Which one of the following graphs correctly describes the velocity of the ball?

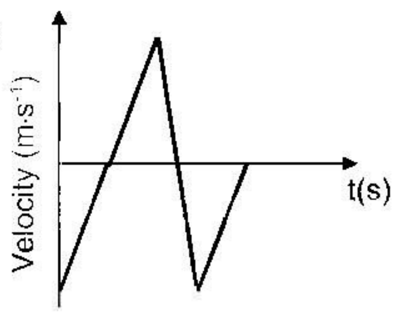
A



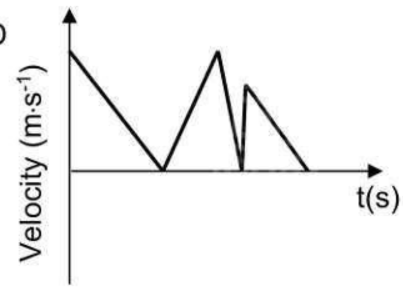
B



C



D



(2)

1.5 Object **A** is involved in an INELASTIC collision with object **B** which is travelling in the opposite direction. Ignore the effect of external forces.

Which one of the following statements regarding the collision is correct?

A Only momentum is conserved.

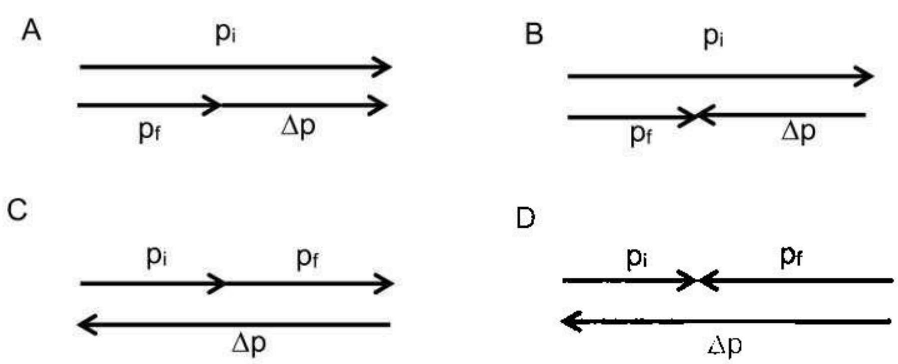
B Only the kinetic energy is conserved.

C neither momentum nor kinetic energy are conserved.

D both the kinetic energy and momentum are conserved. (2)

1.6 A car of mass **m** is travelling at a constant velocity and has momentum **p**. The driver notices an object ahead of him and applies the brakes so that the momentum of the car changes to $\frac{1}{2}$ **p**.

Which ONE of the diagrams below correctly shows the relationship between $\mathbf{p_i}$, $\mathbf{p_f}$ and $\Delta\mathbf{p}$?



(2)

1.7 The work done by the net force required to stop a moving object is equal to the … of the object.

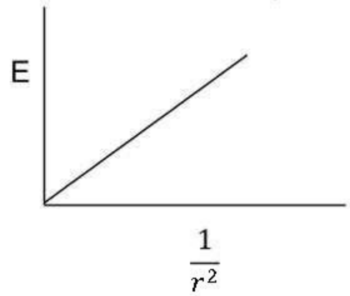
A increase in impulse

B change in kinetic energy

C increase in displacement

D change in potential energy (2)

1.8 The graph below shows the relationship between electric field, *E,* at a point and the square of the distance, r^2 from a point charge *Q*.

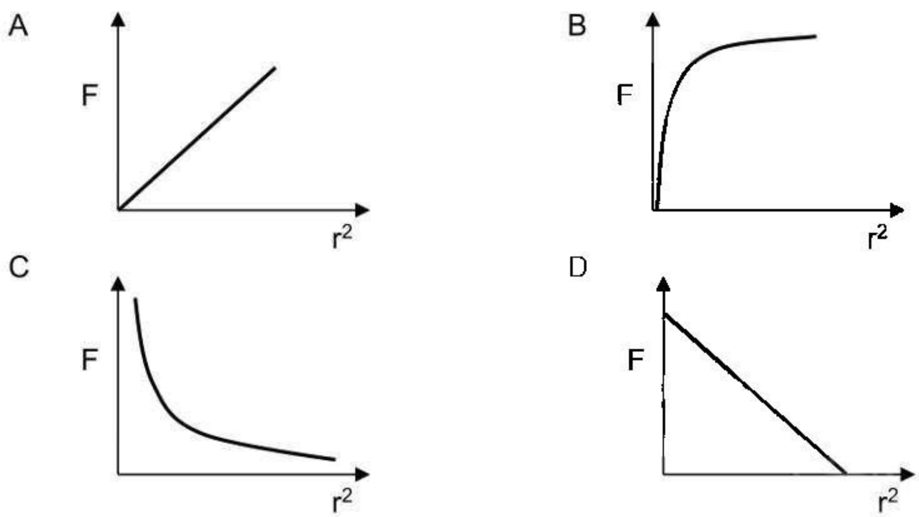


The gradient of the graph is equal ...

A F B Q

C k D kQ (2)

1.9 Which one of the graphs below correctly represents the relationship between the magnitude of the electrostatic force and the square of the distance between the two charges?

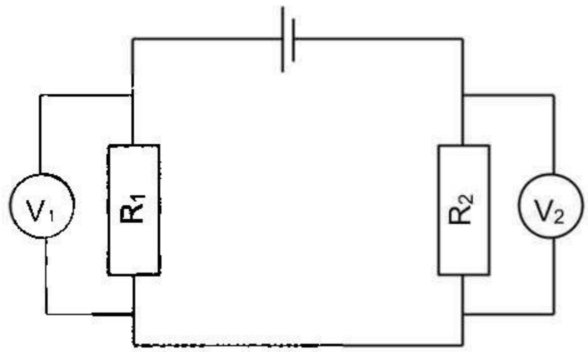


(2)

1.10 In the circuit diagram below, the resistance of R_1 is one third $\left(\frac{1}{3}\right)$ the resistance of resistor R_2

The two resistors are connected in series and identical high-resistance voltmeters are connected across each resistor.

The readings of voltmeter V_1 in term of V_2 is respectively by ...



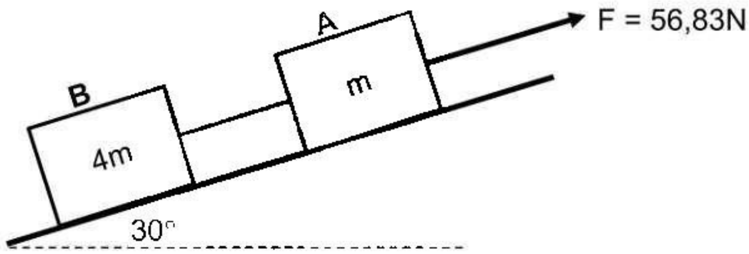
A	$V_1 = V_2$	B	$V_1 = \frac{1}{3} V_2$
C	$V_1 = 3V_2$	D	$V_1 = \frac{2}{3} V_2$

(2)
[20]

QUESTION 2

2.1 Two blocks, **A** and **B** having the same dimensions and masses *m* and *4m* are connected by a light inextensible string, are pulled up the inclined plane with a force of magnitude of 56,83 N. The incline is making an angle of 30° with the horizontal.

The mass of the string may be ignored. The system accelerates up the inclined plane at constant acceleration of 2 m·s^{-2}.



The coefficients of kinetic friction for *m* and 4 *m* are 0,1 and 0,4 respectively

2.1.1 Define the term *kinetic friction*. (2)

2.1.2 Explain why the coefficient of friction for the two blocks, **A** and **B** are different. (1)

2.1.3 Draw a labelled free-body diagram showing all the forces acting on block **A.** (5)

2.1.4 Calculate the mass of block **B**. (7)

2.2 A rock of mass 100 kg lies on the surface of a planet **Y**. The acceleration due to gravity on the surface of the planet is 12 m·s^{-2}.

2.2.1 State the *Newton's Law of Universal Gravitation* in words (2)

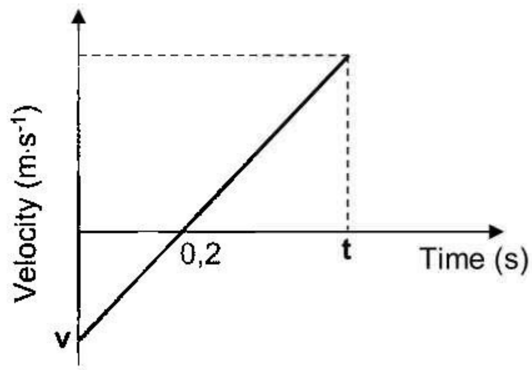
2.2.2 Calculate the mass of the planet **Y** if its radius is 700 km. (4)

[21]

QUESTION 3

The crate of mass 300 kg is lifted vertically upwards from the ground at a constant velocity. When the crate is 30 m above the surface, cable lifting the crate breaks. The velocity-time graph below not drawn to scale represents the motion of the crate from the moment the cable breaks until it hits the ground after time **t**.

TAKE DOWNWARD MOTION as POSITIVE and the effects of air resistance can be ignored.



3.1 What is the magnitude of the acceleration of the crate before the cable breaks? (1)

3.2 Define the term *projectile*. (2)

Use the graph to determine the:

3.3 Time it takes for the crate to reach maximum height after the cable has broken (1)

3.4 Magnitude of velocity **v** (3)

3.5 The maximum height crate reached by the crate after the cable has broken. (4)

3.6 Time it takes the crate to hit the ground. (3)

3.7 Speed of the crate at time t. (3)

3.8 Speed when the crate is 12 m above the ground on it way down? (3)

3.9 Draw a labelled position-time graph that represents the motion of the crate from the moment the cable breaks until it hits the ground. Use ground as the ZERO position.

Indicate the following on the graph:

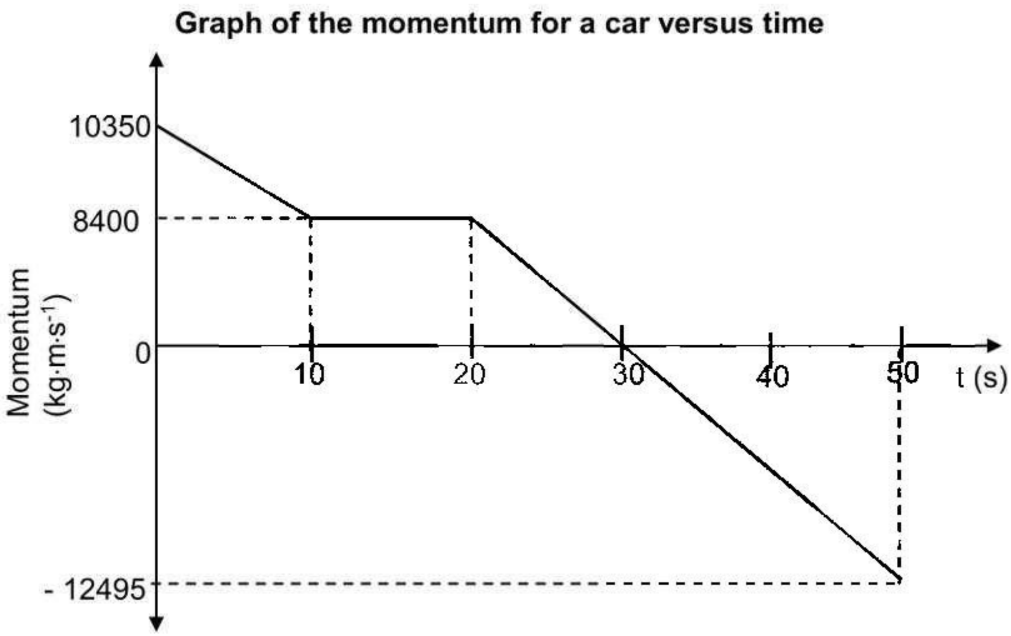
- the maximum height above the ground
- the height at which the cable snaps
- time 0,2 seconds

(4)

[24]

QUESTION 4

4.1 The graph of the momentum versus time for a car originally travelling horizontally eastward is shown below. Ignore the effects of friction.



4.1.1 State Newton's second law of motion in terms of momentum. (2)

The net force acting on the car is zero between time interval 10 seconds and 20 seconds.

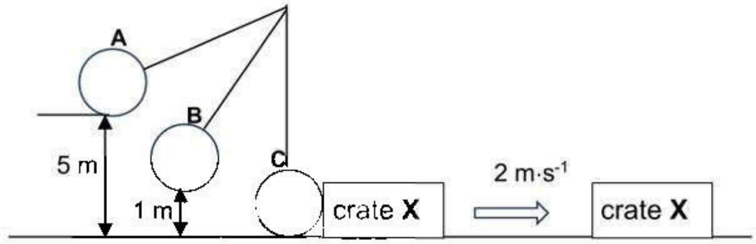
4.1.2 Is the above statement TRUE or FALSE. Explain your answer. (3)

4.1.3 At t = 50 s, the car collides with a bakkie, which has an initial momentum of 12 753 $kg{\cdot}m{\cdot}s^{-1}$ eastward. The final momentum of the car after the collision is 6 867 $kg{\cdot}m{\cdot}s^{-1}$ eastward. The collision lasted for 0,1 s. Calculate the momentum of the bakkie after the collision. (4)

4.1.4 Determine the magnitude of the force that the bakkie exerts on the car during the collision. (3)

4.1.5 Write down the magnitude and direction of the force that the car exerts on the bakkie. (1)

4.2 A pendulum of mass 12 kg is suspended at a height of 5 m above the ground, at position **A**. The pendulum is held in position **A** as shown in the sketch below. The pendulum swings down to position **C**, striking a stationary crate, **X**, of mass 4 kg. Ignore the effect of friction and mass of the string.



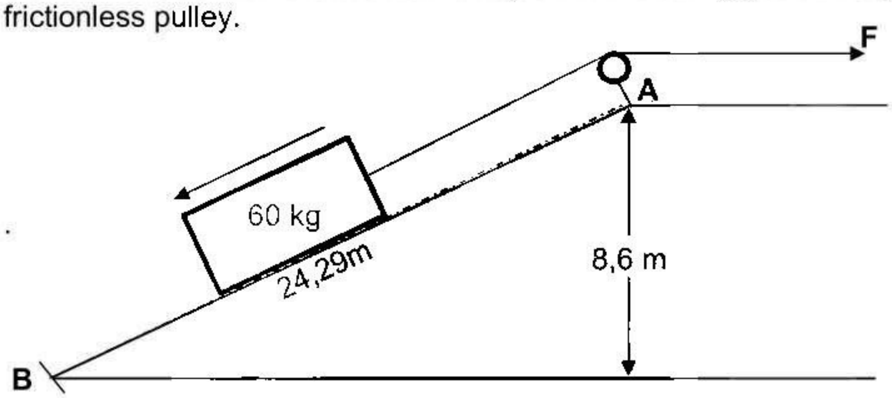
4.2.1 Calculate the speed of the pendulum just before it collides with the crate. (4)

After collision, crate, **X**, moves to the right with a velocity of 2 $m \cdot s^{-1}$ on a horizontal frictionless surface. The pendulum moves back and passes point **B** which is 1 m above the surface.

4.2.2 Calculate the momentum of the pendulum at point **B** after the collision. (6)
[22]

QUESTION 5

5.1 A constant force F is applied on the box of mass 60 kg by means of a string. The box moves 24,29 m down a rough inclined plane from point **A** to point **B** at CONSTANT VELOCITY. The kinetic friction between the surface and the box is 20,79 N. The string goes through frictionless pulley.



5.1.1 Define a *non-conservative force*. (2)

5.1.2 Is the work done by the applied force Positive or Negative? (1)

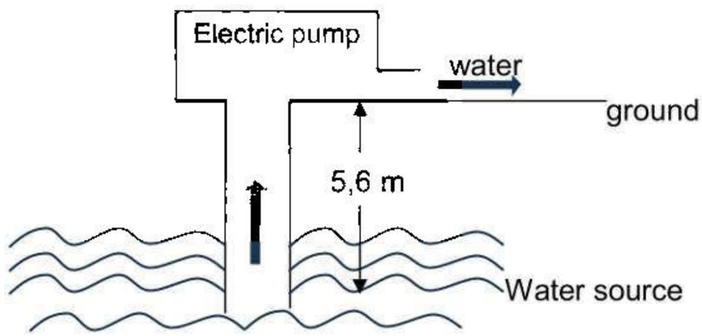
5.1.3 Name the non-conservative forces acting on the box. (2)

5.1.4 Draw a labelled free body diagram showing all the forces acting on the box. (4)

5.1.5 State the work energy theorem in words. (2)

5.1.6 Using energy principles only, calculate the magnitude of the force **F** exerted on the box. (6)

5.2 An electric pump is used to pump 400 kg of water from the borehole 5,6 m deep to the ground at a constant speed in 4 s.
Ignore ALL frictional and capillarity effects.



Calculate the average power dissipated by the pump.
Ignore energy losses in the form of heat and sound (3)
[20]

QUESTION 6

A hooter of a car travelling at a constant speed towards the detector emits sound waves of frequency 500 Hz.

A detector placed on the side road records sound waves of frequency 615 Hz.
The distance between the car and the detector is 30,85 m.
The speed of sound in air is 330 $m \cdot s^{-1}$.

6.1 Define the phenomenon describe above. (2)

6.2 Calculate the speed of the car. (4)

6.3 Calculate the time it takes the car to cover the distance of 30,85 m. (3)

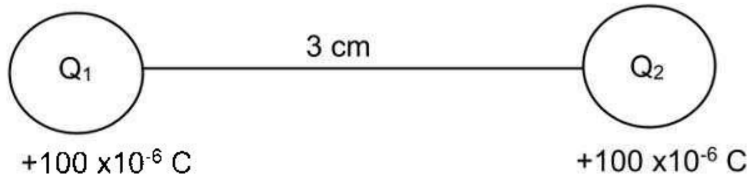
6.4 The spectrum of a distant star when viewed from the Earth is red shifted.

6.4.1 Is the star moving AWAY FROM or TOWARDS the Earth? Explain (3)

6.4.2 What conclusion can be made about the size of the universe. (1)
[13]

QUESTION 7

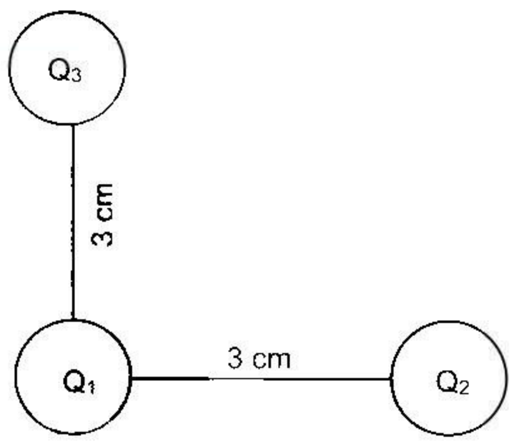
Two identical charges, Q_1 and Q_2 each carrying a charge of $+100 \times 10^{-6}$ C are placed 3 cm apart as shown in the diagram below.



7.1 Define in word *electric field at a point*. (2)

7.2 Draw electric field pattern associated with a single positive charge. (2)

A third POSITIVELY charge Q_3 is placed 3 cm away from Q_1 as indicated in the diagram below



7.3 State Coulombs law in words. (2)

7.4 Draw a free body diagram to indicate all electrostatic forces acting on Q_1. (2)

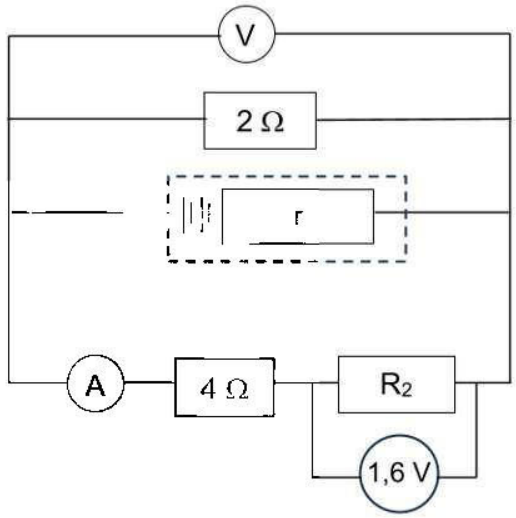
7.5 Calculate the magnitude of electrostatic force exerted by Q_2 on Q_1. (3)

The net electrostatics force experience by Q_1 due to Q_2 and Q_3 is $1{,}41 \times 10^5$ N.

7.6 Calculate the magnitude of charge Q_3. (4)
[15]

QUESTION 8

A battery of an emf of 3,11 V and unknown internal resistance, r is connected to three resistors, a high-resistance voltmeters and an ammeter of negligible resistance, as shown below.



The reading on the ammeter is 0,2 A

8.1 What is meant by emf of 3,11 V. (2)

8.2 Calculate the:

8.2.1 Reading on the voltmeter. (4)

8.2.2 Total current supplied by the battery (3)

8.2.3 Internal resistance of the battery (3)

8.2.4 Power dissipated by the battery to internal resistor. (3)
[15]

Grand Total = 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (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 gravitasiekonstant*	G	$6{,}67 \times 10^{-11}\ N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^6\ m$
Mass of the Earth *Massa van die Aarde*	M_E	$5{,}98 \times 10^{24}\ kg$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^8\ m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6{,}63 \times 10^{-34}\ J \cdot s$
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	$9{,}11 \times 10^{-31}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s}f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b}f_b$	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or/*of* $E = W_0 + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv^2_{max}$ or $K_{max} = \frac{1}{2}mv^2_{max}$	
$E = W_0 + E_{k(maks)}$ *of* $E = W_0 + K_{maks}$ *waar* $E = hf$ *en* $W_0 = hf_0$ *en* $E_{k(maks)} = \frac{1}{2}mv^2_{maks}$ *of* $K_{maks} = \frac{1}{2}mv^2_{maks}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F=\frac{kQ_1Q_2}{r^2}$	$E=\frac{kQ}{r^2}$
$V=\frac{W}{q}$	$E=\frac{F}{q}$
$n=\frac{Q}{e}$ or/*of* $n=\frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R=\frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s=R_1+R_2+...$ $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+...$	$q=I\Delta t$
$W=Vq$ $W=VI\Delta t$ $W=I^2R\Delta t$ $W=\frac{V^2\Delta t}{R}$	$P=\frac{W}{\Delta t}$ $P=VI$ $P=I^2R$ $P=\frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms}=\frac{I_{max}}{\sqrt{2}}$ / $I_{wgk}=\frac{I_{maks}}{\sqrt{2}}$ $V_{rms}=\frac{V_{max}}{\sqrt{2}}$ / $V_{wgk}=\frac{V_{maks}}{\sqrt{2}}$	$P_{ave}=V_{rms}I_{rms}$ / $P_{gemiddeld}=V_{wgk}I_{wgk}$ $P_{ave}=I_{rms}^2R$ / $P_{gemiddeld}=I_{wgk}^2R$ $P_{ave}=\frac{V_{rms}^2}{R}$ / $P_{gemiddeld}=\frac{V_{wgk}^2}{R}$