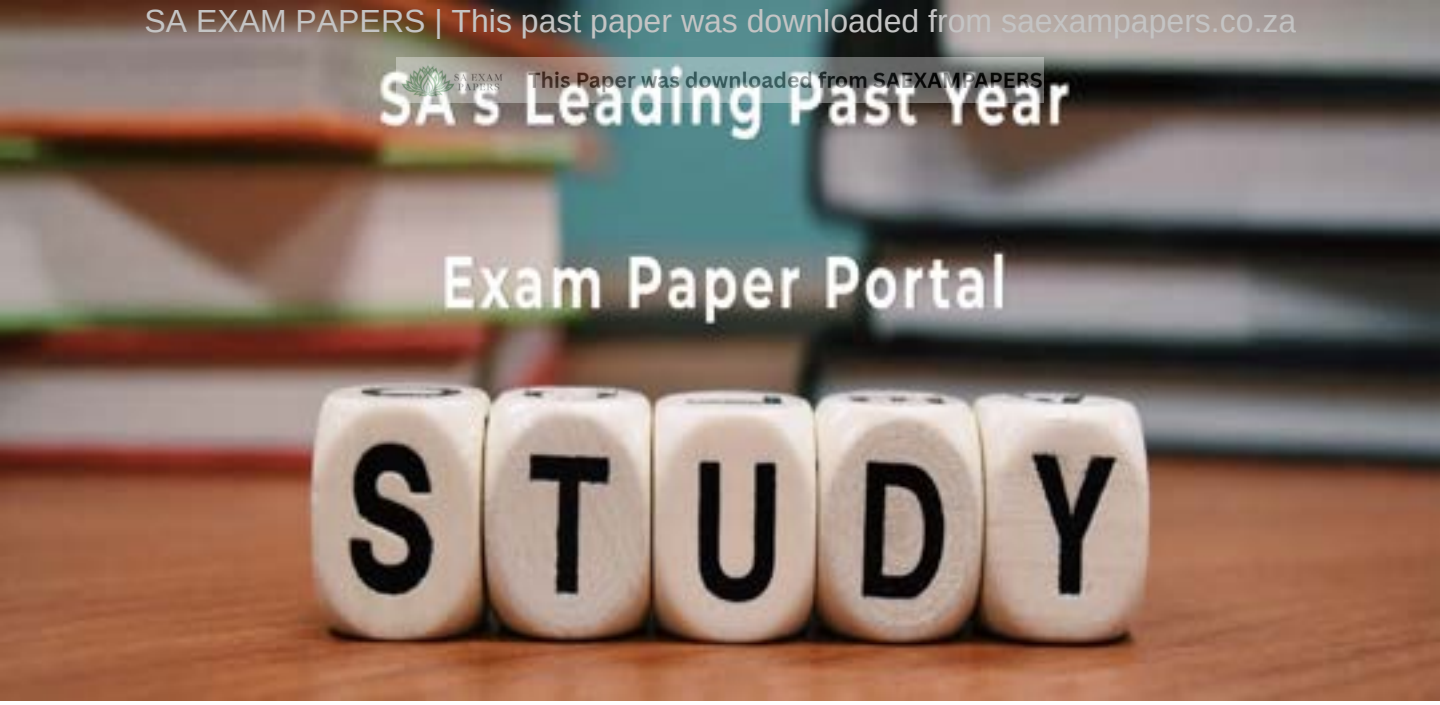


education

Department of
Education
FREE STATE PROVINCE

EXAMINATION

GRADE 12

PHYSICAL SCIENCES

PHYSICS (PAPER ONE)

JUNE 2026

MARKS: 150

TIME: 3 HOURS

This paper consists of 14 pages and three information sheets.

Grade 12

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of EIGHT 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 FALSE about the action-reaction pair of forces?

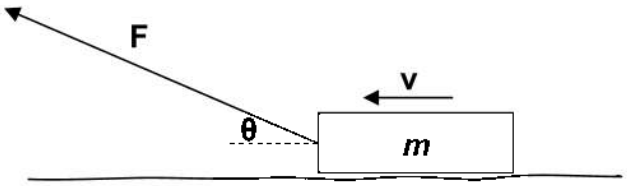
A They act on different objects.

B They have equal magnitudes.

C They act in the same direction.

D They cannot cancel each other. (2)

1.2 The diagram below shows a box of mass ***m*** being pulled at CONSTANT VELOCITY ***v*** to the left by force ***F*** acting at the angle ***θ*** to the horizontal. The surface is *rough*.



This means that for the box, the …

A kinetic frictional force is equal to the vertical component of force ***F*** to the right.

B kinetic frictional force is equal to the horizontal component of force ***F*** to the left.

C static frictional force is equal to the horizontal component of force ***F*** to the right.

D kinetic frictional force is equal to the horizontal component of force ***F*** to the right. (2)

1.3 Consider the equation $\Delta y = v_i\Delta t + \underline{\frac{1}{2}a\Delta t^2}$.

For an object starting from rest, which VECTOR quantity is represented by the underlined part of the equation?

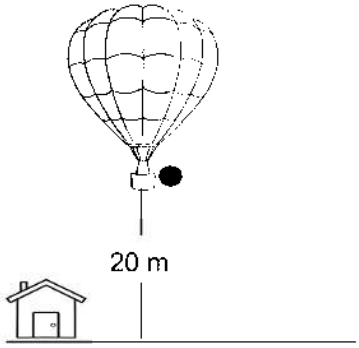
A Displacement.

B Acceleration.

C Distance.

D Velocity. (2)

1.4 A hot-air balloon is rising vertically upward at a constant velocity of 5 $m \cdot s^{-1}$. When the hot-air balloon is 20 m above the ground, the ball is dropped and the hot-air ballon continues to rise at the same constant velocity. Ignore the effects of air friction.



Acceleration of the hot-air ballon is … $m \cdot s^{-2}$.

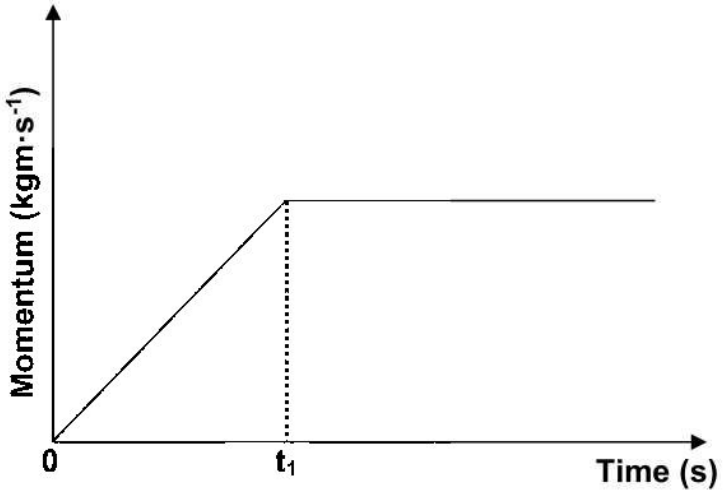
A + 9,8

B - 9,8

C + 5

D 0 (2)

1.5 The graph below shows the changes in momentum of an object over time.



The gradient of the graph between times 0 to t_1 is equal to the …

A impulse.

B net force.

C kinetic energy.

D change in momentum. (2)

1.6 The truck is moving down the steep and suddenly the brakes fail. The driver then moves the truck to the horizontal arrestor bed. Which one of the following quantities decreases as the truck enters the arrestor bed?

A time

B weight

C kinetic energy

D gravitational potential energy (2)

1.7 The force for which the work done in moving an object between two points is dependent of the path taken is ...

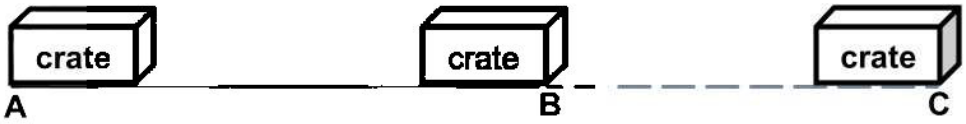
A normal force.

B gravitational force.

C conservative force.

D non-conservative force. (2)

1.8 A crate slides through a *smooth* path **AB** and then enters a *rough* path **BC**. Refer to the diagram below.

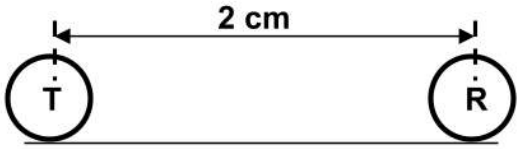


Which ONE of the following combinations is CORRECT about the kinetic energy (**K**) of the crate at points **B** and **C** respectively in comparison to the kinetic energy (K_A) of the crate at point **A**?

	At point B.	**At point C.**
A	K_A is equal to K_B	K_A is equal to K_C
B	K_A is equal to K_B	K_A is greater than K_C
C	K_A is greater than K_B	K_A is less than K_C
D	K_A is less than K_B	K_A is greater than K_C

(2)

1.9 Two metal spheres **T** and **R** with charges ***-2q*** and ***+q*** respectively are placed 2 cm away from each other on an insulated surface as shown below.



The spheres are allowed to make contact and are returned to their original positions.

Consider the following statements regarding the two metal spheres AFTER they made contact and were returned to their original positions:

i) They have equal magnitude of charges.

ii) Each metal sphere still has the original magnitude of charge they had before they made contact.

iii) The electrostatic force they exert on each other is smaller than the electrostatic force they exerted on each other before they made contact.

Which of the above statement(s) is/are CORRECT?

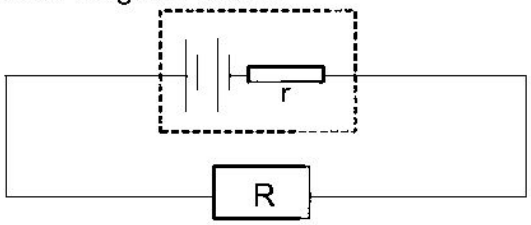
A i) and iii) only

B ii) and iii) only

C i); ii) and iii)

D i) only **(2)**

1.10 A battery with internal resistance *r* is connected to one external resistor *R* as shown in the circuit diagram below.



If *R* is **halved**, the energy dissipated inside the battery due to internal resistance will …

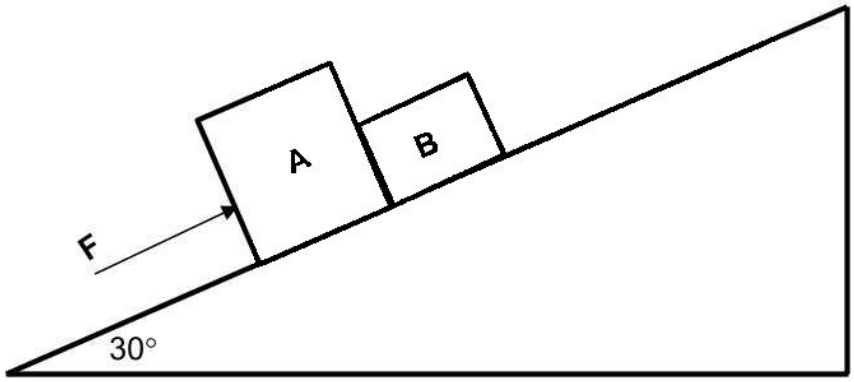
A remain the same.
B decrease.
C increase.
D be zero. (2)

[20]

Grade 12

QUESTION 2

Two blocks, **A** and **B** of mass 6 kg and 3 kg respectively are in contact with each other on an inclined plane as shown below.



Force, **F**, applied parallel to the incline, causes the blocks to accelerate up an incline at 2 $m \cdot s^{-2}$.

2.1 Define the term *normal force*. (2)

The magnitude of the kinetic frictional force acting on blocks **A** and **B** is 6,8 N and 3,4 N respectively.

2.2 Draw a labelled free body diagram showing ALL the forces acting on block **B** as it moves up the inclined plane. (4)

2.3 Calculate the magnitude of:

2.3.1 the normal force on block **A**. (2)

2.3.2 force **F** as the system moves up the inclined plane. (5)

2.4 The angle between the incline and the horizontal is changed to 20°.

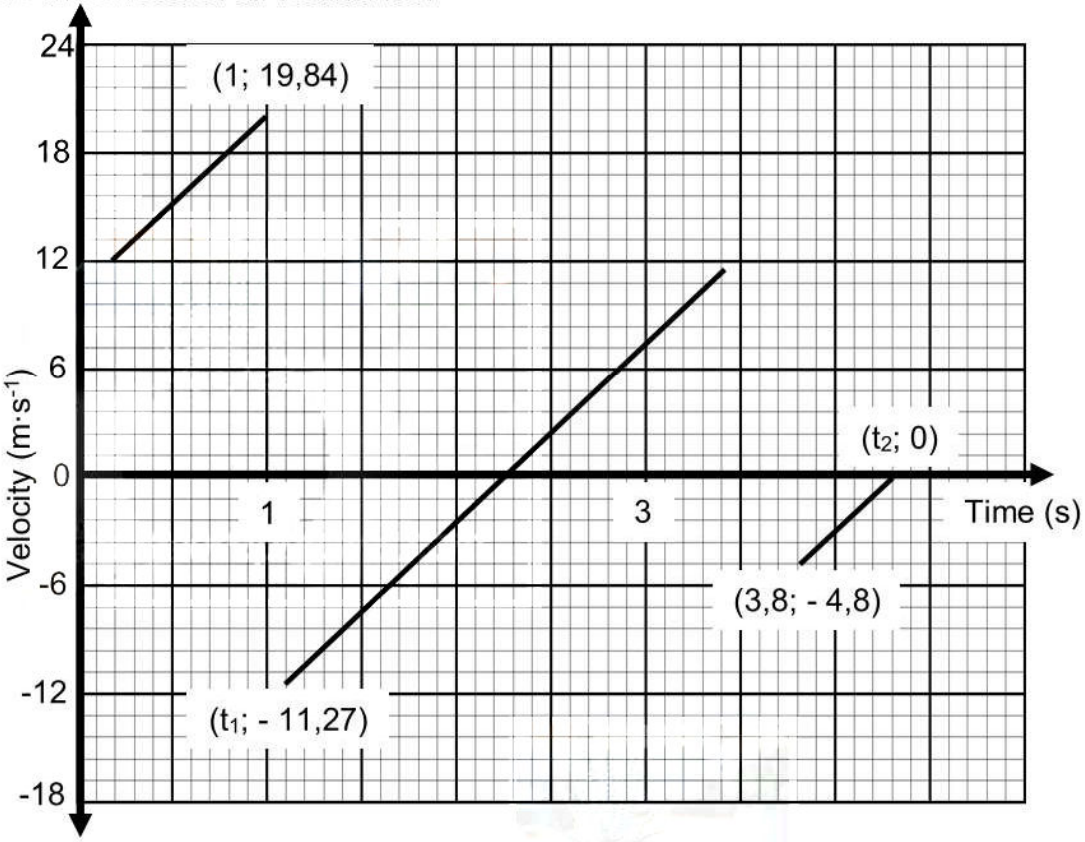
2.4.1 How will this change affect the magnitude of the kinetic frictional force on block **B**? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

2.4.2 Explain the answer to question 2.4.1. (2)

[16]

Grade 12
QUESTION 3

A learner studies the motion of a ball and draws a velocity time graph as shown below. She drew it FEW MOMENTS AFTER a ball was projected from a high platform. The ball has a mass of 450 g and bounced several times.
Ignore the effects of air resistance.



3.1 Define the term *projectile*. (2)

3.2 Was the ball initially projected UPWARDS or DOWNWARDS?
Give a reason for the answer. (3)

3.3 Determine the magnitude of initial velocity of the ball. (2)

3.4 For the first bounce, calculate the:

3.4.1 impulse on the ball. (3)

3.4.2 loss of kinetic energy of the ball. (5)

3.5 USING THE EQUATIONS OF MOTION ONLY, calculate the maximum height reached by the ball after the second bounce. (4)

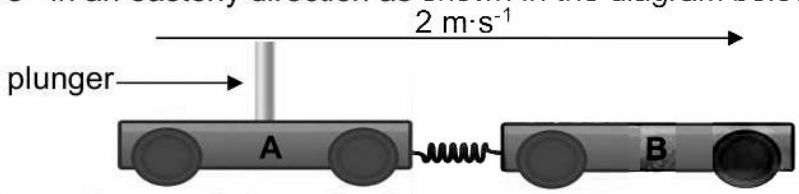
3.6 Draw the position time graph showing the motion of the ball from 0 s to t_2. Take GROUND as reference position and show the maximum height reached by the ball after the second bounce. (4)

[23]

Grade 12

QUESTION 4

The two trolleys **A** and **B** with masses 50 g and 20 g respectively are joined together by a compressed spring. The trolleys are moving on a *smooth surface* with the speed of 2 m·s^{-1} in an easterly direction as shown in the diagram below.



When the plunger is tapped, the spring is released and sound is produced. Trolley **B** then continues to move eastwards with the velocity of 10 m·s^{-1}.

4.1. State the *principle of conservation of linear momentum* in words. (2)

4.2 Is the explosion taking place during the separation of the trolleys elastic or inelastic? Give the reason for the answer. (2)

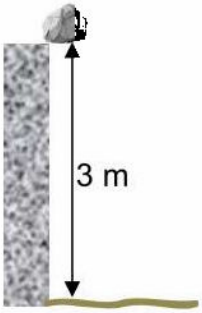
4.3 Calculate the:

4.3.1 velocity of trolley **A** after the spring has been released (4)

4.3.2 change in momentum of trolley **A.** (3)

4.4 Write down the DIRECTION of the change in momentum of trolley **B**. (1)

4.5 A rock of mass 2,5 kg is *dropped* from the top of a 3 m high building. Refer to diagram below.



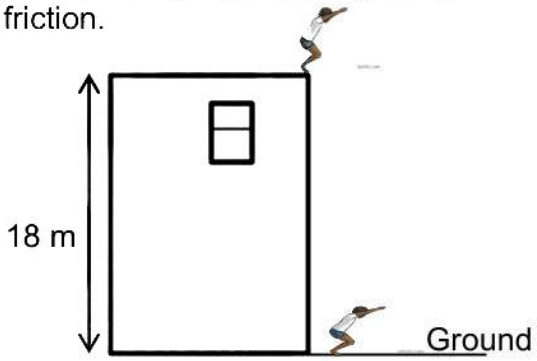
After reaching the *sand* ground, the rock does not bounce up and takes 0,3 s to come to rest on the ground. Ignore effects of any form friction.

4.5.1 While the rock is falling, the Earth is NOT exerting a force on the rock.
Is the above statement TRUE or FALSE? (1)

4.5.2 Calculate the net force exerted on the rock while in contact with the ground. (6)

[19]

5.1 The diagram below shows a man with a mass of 75 kg standing on top of a building that is 18 m high. The man jumps to the ground.
Ignore the effects of air friction.



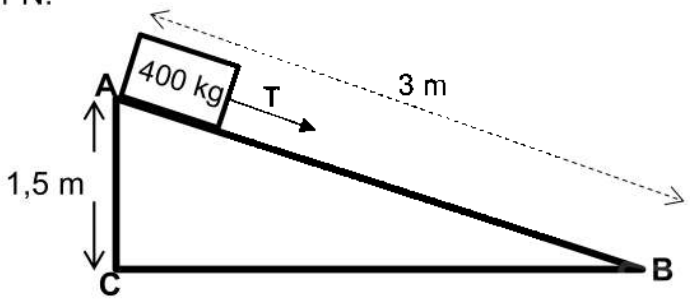
5.1.1 State the *principle of conservation of mechanical energy* in words. (2)

5.1.2 Calculate the speed of a man as he lands on the ground. (4)

The man bends his knees as he lands on the ground.

5.1.3 Give a reason for this action referring to a relevant law of physics. (3)

5.2 The simplified diagram below shows a slide **ABC** at the playground with the sides as shown. The box of mass 400 kg is pulled down the slide **AB** (3 m) from rest at post **A**, all the way to point **B** by tension **T** of magnitude 200 N. The kinetic frictional force experienced by box as it moves from **A** to **B** is 848,71 N.



5.2.1 State the *work-energy theorem*. (2)

5.2.2 Draw a *free-body* diagram showing *only* the conservative force acting on the box as it slides from **A** to **B**. (1)

5.2.3 Using *energy principles only*, calculate the speed of the box when it reaches point **B**. (6)

5.2.4 Calculate the *average power* delivered by tension **T** to move the box from point **A** to **B**. (4)

5.2.5 How would the work done by weight on the box compare if the box takes path **AC** instead of path **AB** to get to the ground?
Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)
[23]

Grade 12
QUESTION 6

An ambulance emits sound waves of wavelength 0,50 m. An observer *standing* on the side of the road records sound waves with a wavelength that is 10% longer than the wavelength of the emitted sound. Take the speed of sound in air as 340 $m \cdot s^{-1}$.

6.1 State *Doppler effect* in words. (2)

6.2 Is the ambulance moving TOWARDS or AWAY from the observer? Explain the answer. (2)

6.3 Calculate the:

6.3.1 Frequency of the sound emitted by the ambulance. (3)

6.3.2 The magnitude of the velocity of the ambulance. (5)

6.4 Two diagrams below represent spectral lines of an element.

Diagram 1 represents the spectrum of the same element in the laboratory on Earth.

Diagram 2 represents the spectrum of the same element from a distant star.

Diagram 1

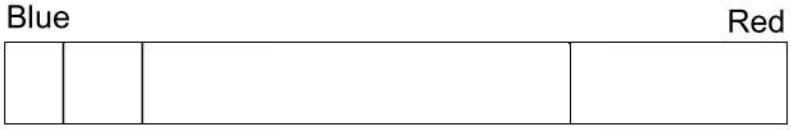
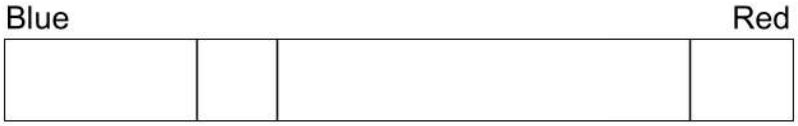


Diagram 2

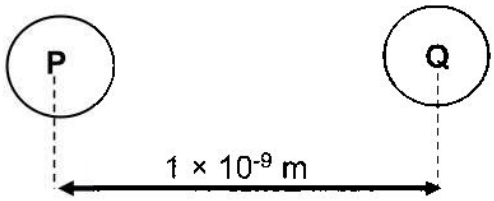


6.4.1 From the observation made in the two diagrams, can it be concluded that the universe is expanding? Write down YES or NO. (1)

6.4.2 Explain the answer to question 6.4.1. (3)
[16]

QUESTION 7

Two charges **P** and **Q** with magnitudes -3 nC and -3 nC exert an electrostatic force (F_e) on each other. There is gravitational force (F_g) that exist between the centres of the two charges. The distance between the centres of the two charges is 1×10^{-9} m.



7.1 Is the gravitational force, F_g, between the two charges, force of ATTRACTION or REPULSION?
Name the law of physics you used to justify the answer. (2)

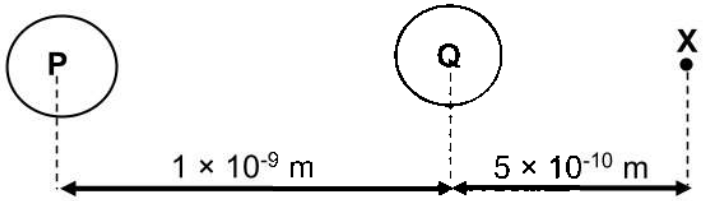
7.2 State *Coulomb's law* in words. (2)

7.3 In which direction (LEFT or RIGHT) is the electrostatic force experienced by charge **P** due to charge **Q**? (1)

7.4 Draw the resultant electric field pattern due to charges **P** and **Q**. (3)

7.5 Calculate the:

7.5.1 magnitude of the electrostatic force, F_e, between **P** and **Q**. (3)

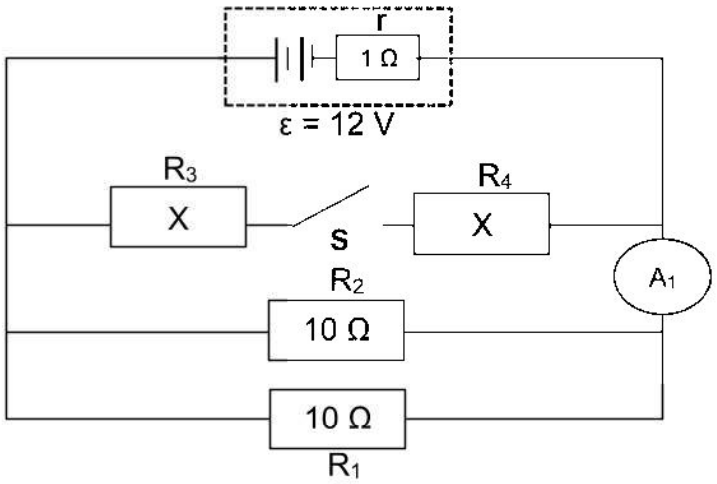


7.5.2 electric field strength due to charge **P** at point **X** which is 5×10^{-10} m to right of charge **Q**. (4)

[15]

Grade 12
QUESTION 8

The diagram below shows a circuit with a battery of emf 12 V, an internal resistance of 1 Ω and external resistors R_1 = 10 Ω, R_2 = 10 Ω, R_3 and R_4 with the same resistance X.



8.1 Write down *Ohm's law* in words. (2)

8.2 Will there be a reading on ammeter A_1 with switch **S** open? Explain the answer. (2)

8.3 Switch **S** is now **closed.** The *total external resistance* of the circuit is 2,2222 Ω.

8.3.1 Will the battery become HOTTER or COLDER. (1)

8.3.2 Calculate the:

(a) resistance of resistor R_4. (4)

(b) reading on ammeter A_1. (6)

A 2 kW electric heater is used in a household. The heater is switched on for 3 hours per day during June month. The cost of electricity from the municipality is R 4,45 per kilowatt-hour (kWh).

8.4 Calculate the total cost of electricity for operating the heater for 30 days. (3)

[18]

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES
GRADE 12 PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE
GRAAD 12VRAESTEL 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 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Mass of the Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} J·s
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 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 $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or $K_{max} = \frac{1}{2}mv_{max}^2$	
$E = W_0 + E_{k(maks)}$ *of* $E = W_0 + K_{maks}$ *waar* $E = hf$ *en* $W_0 = hf_0$ *en* $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$ *of* $K_{maks} = \frac{1}{2}mv_{maks}^2$	

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)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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