GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

# JUNE EXAMINATION
# GRADE 12

# 2025

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## PHYSICAL SCIENCES (PHYSICS)

## (PAPER 1)

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**PHYSICAL SCIENCES P1**

C2841E

**TIME:** 3 hours

**MARKS:** 150

**15 pages + 3 data sheets**

X05

## INSTRUCTIONS AND INFORMATION

1. This question paper consists of 9 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line open between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round-off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief discussions, etc. where required.
10. You are advised to use the attached DATA SHEETS.
11. Write neatly and legibly.

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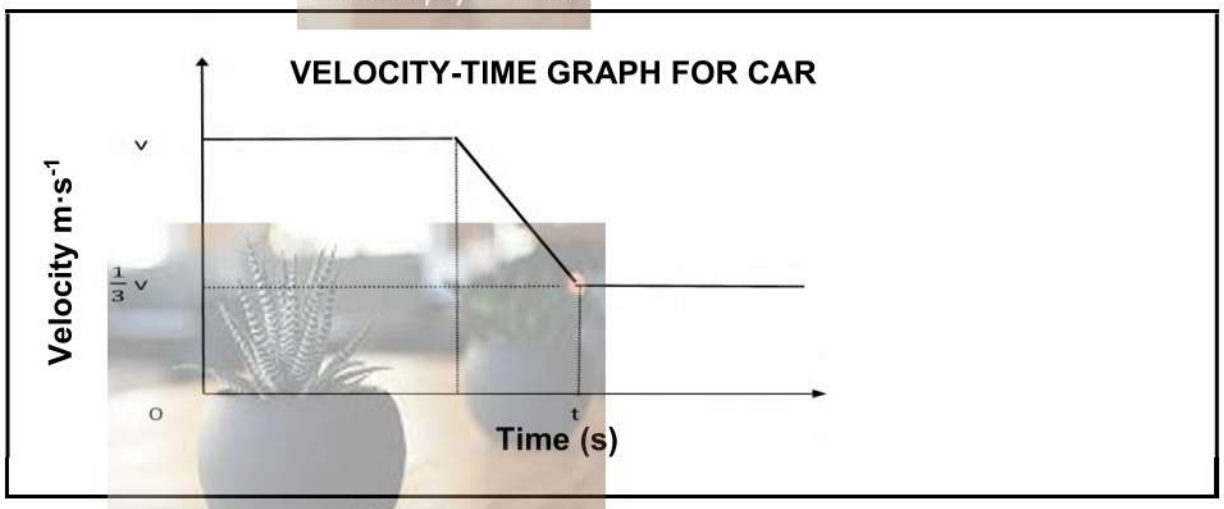
## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which of the following forces always acts perpendicular to the surface on which a body is placed?

A Tension
B Frictional force
C Normal force
D Gravitational force (2)

1.2 A car of mass **m** moves along a straight line at a constant velocity of **v** in an easterly direction. The velocity of the car decreases to a third of its original speed in **t** seconds as shown below. The graph is not drawn to scale.




What will be the change in momentum of the car?

A $\frac{1}{3}$ mv east

B $\frac{1}{3}$ mv west

C $\frac{2}{3}$ mv east

D $\frac{2}{3}$ mv west

(2)

1.3 Object **Y** exerts a gravitational force of 1 000 N on object **Z** when the distance between the centres of the two objects is **r**. The two objects each have a mass of **m**.

Which of the changes below will increase the gravitational force to 4 000 N?

A Double the distance between their centres.
B Halve the distance between their centres.
C Halve the mass of both objects.
D Double the mass of only object **Y**. (2)

1.4 A ball is kicked across a floor and it comes to a standstill after **t** seconds.

Which of the following statements correctly describes the total mechanical energy and the net work done on the ball?

| | TOTAL MECHANICAL ENERGY | NET WORK DONE |
|---|---|---|
| A | Not conserved | Negative |
| B | Conserved | Negative |
| C | Not conserved | Positive |
| D | Conserved | Positive |

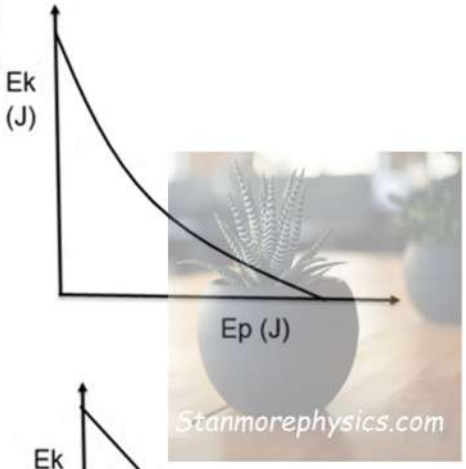
(2)

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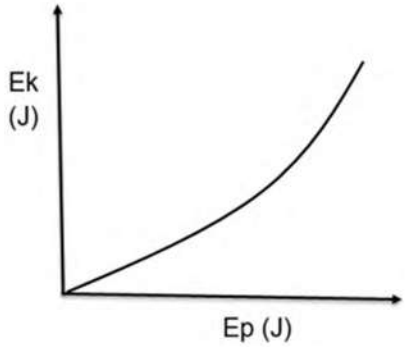
1.5 A crate is given an initial velocity, and it slides up a frictionless incline until it comes to a stop.

Which of the following graphs shows the CORRECT relationship between the kinetic energy ($E_k$) and the potential energy ($E_p$) of the crate?

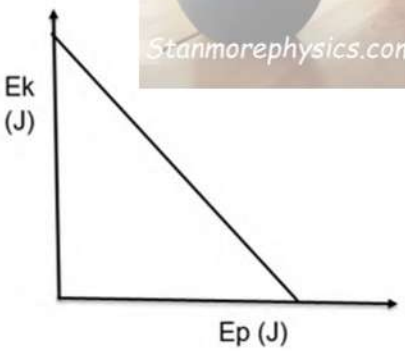
A



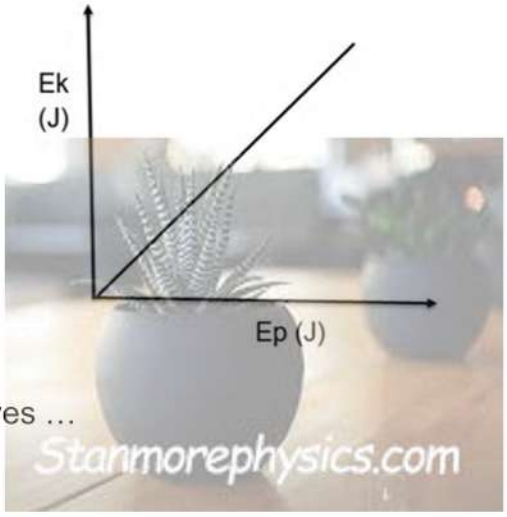

B




C




D




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(2)

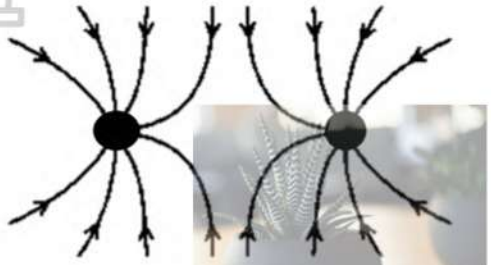
1.6 For light, a red shift indicates the light source moves …

A away from you.
B towards you.
C at right angles to you.
D parallel to you. (2)

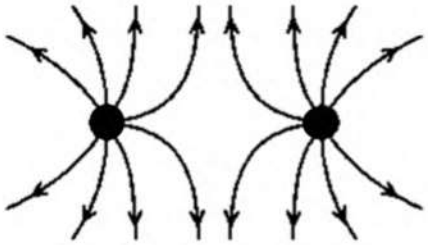
1.7 Two point charges of +7 nC and -5 nC are brought together until they touch. Immediately after that they return to their original positions.

Which field pattern correctly represents the charges when they are back in their original positions?

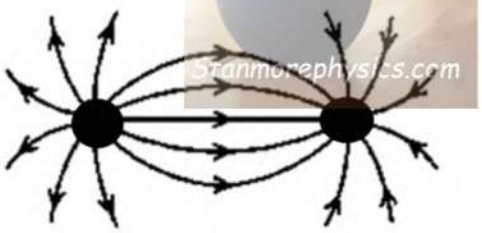
A



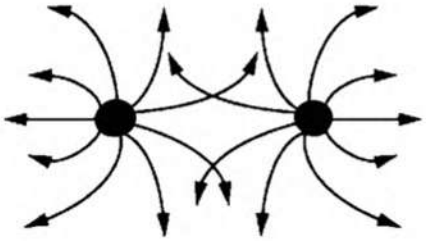
B



C



D



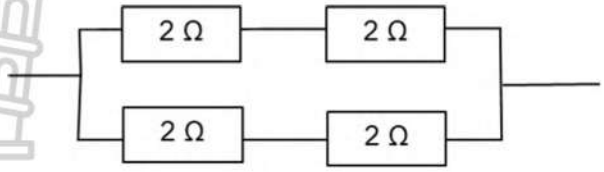
(2)

1.8 A non-ohmic resistor can be described as a resistor for which …

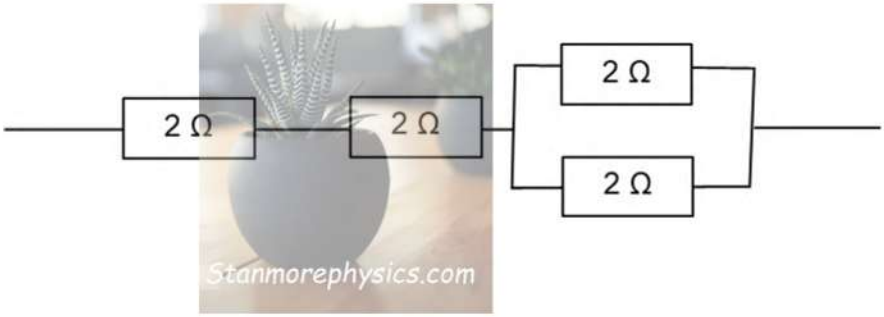
A Ohm's law is valid.
B the current-potential difference graph produces a straight line.
C the resistance does not vary with a change in temperature.
D the resistance is not constant and varies with the applied potential difference. (2)

1.9 Four identical resistors are connected as shown below. Which connection will result in a total resistance of 4 Ω?

A

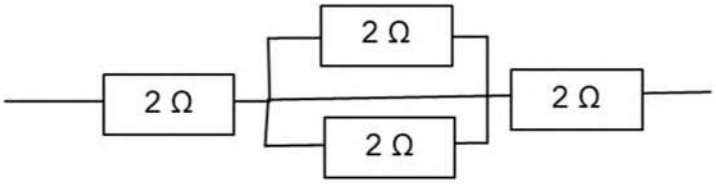



B

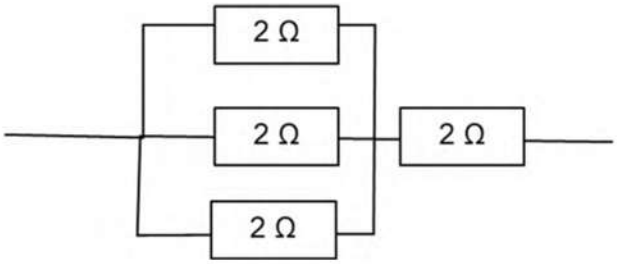



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C




D




(2)

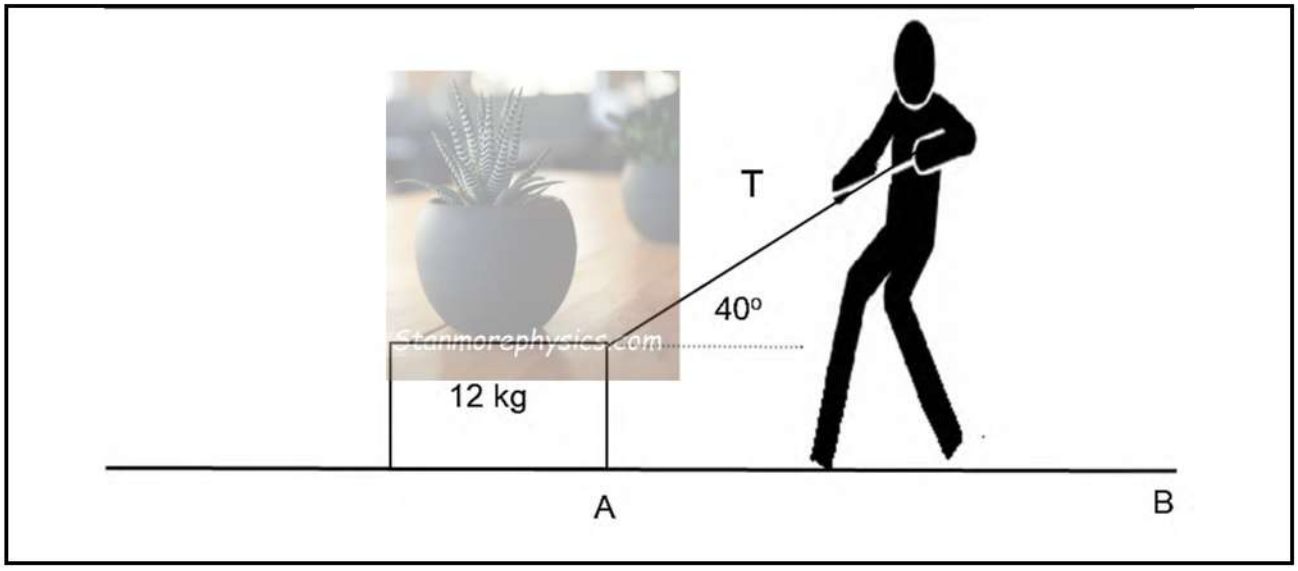
1.10 A kilowatt hour refers to:

A The use of electrical appliances
B The power of electrical appliances
C One kilowatt of electricity used for one hour
D The cost of electricity specifications (2)

**[20]**

**QUESTION 2 (Start on a new page.)**

A person pulls a block of mass 12 kg to the right using a light inextensible rope **T**. The block is pulled from point **A** to **B** at an angle of 40° between the rope and the horizontal surface. The coefficient of kinetic friction between the block and the surface is 0,31. The block is pulled at a CONSTANT VELOCITY of 10 $m \cdot s^{-1}$, as shown in the diagram below.




2.1 Define the term *kinetic frictional force.* (2)

2.2 Draw a labelled, free-body diagram of all the forces acting on the 12 kg block while it is moving at a constant velocity. (4)

2.3 Calculate the magnitude of the tension in the rope. (5)

2.4 The block is moved a horizontal distance of 24 m from point **A** to **B**.

2.4.1 Calculate the time it will take the block to reach **B**. (3)

2.4.2 If the block's velocity is increased to a constant velocity of 20 $m \cdot s^{-1}$, how will the frictional force be affected? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

2.5 The angle between the rope and the horizontal surface is increased to 50°.

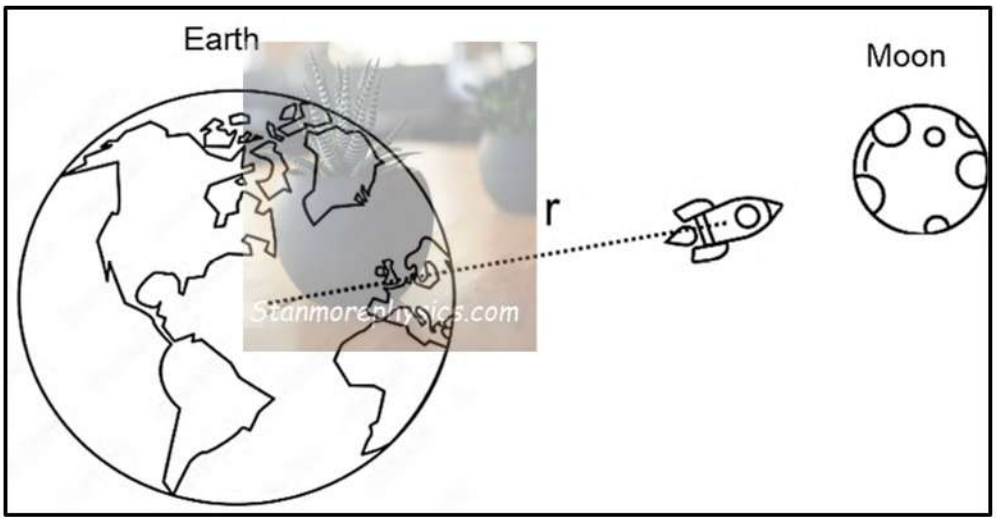
2.5.1 What will be the effect on the kinetic frictional force acting on the block? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

2.5.2 Explain the answer to QUESTION 2.5.1. (3)

**[19]**

**QUESTION 3 (Start on a new page.)**

A rocket of total mass **m** is launched from the surface of the Earth. The initial weight of the rocket is 5,38 x $10^6$ N. The mass of the rocket decreases due to the loss of fuel that is used to propel the rocket. When the distance between the centre of the rocket and the surface of the Earth is 9 000 m, the rocket experiences a gravitational force of 5,04 x $10^6$ N. The diagram below is not drawn to scale.




3.1 State Newton's Law of Universal Gravitation in words. (2)

3.2 Calculate the:

3.2.1 Total mass **m** of the rocket before it is launched (2)

3.2.2 Mass of the rocket when it is 9 000 m from the surface of the Earth (5)

3.2.3 Mass of the fuel that was consumed when the rocket reached 9 000 m from the surface of the Earth (2)

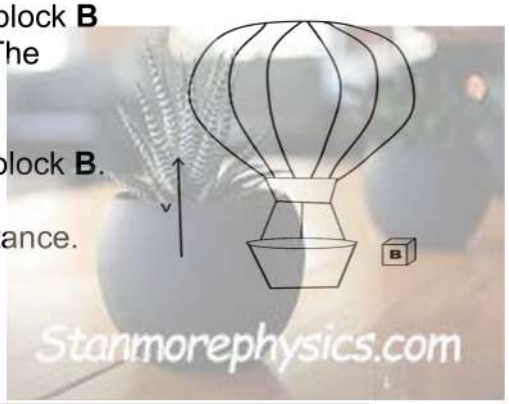
3.3 The rocket is on its way straight to the moon.

What will happen to the gravitational force between the Moon and the rocket as the distance between the Earth and the rocket increases?

Write only INCREASES, DECREASES or REMAINS THE SAME. (2)
**[13]**

**QUESTION 4 (Start on a new page.)**

A hot-air balloon moves upwards at a constant velocity when a block **B** is dropped from the side of the balloon and falls to the ground. The balloon is 50 m above the ground when the object is dropped.

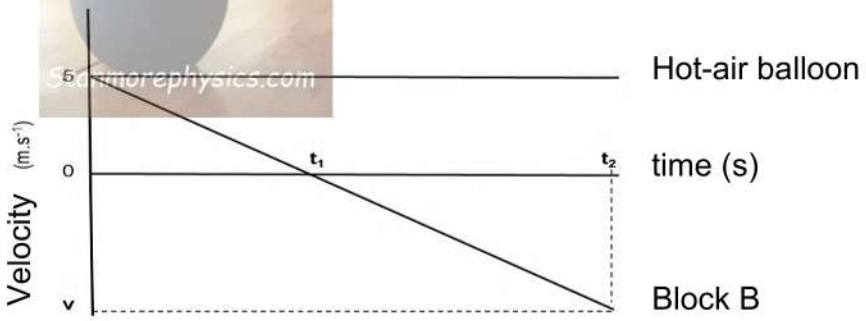



The graphs below show the motion of both the balloon and the block **B**.

The graphs are not drawn to scale. Ignore all effects of air resistance.

Use upwards as positive in all calculations.

**VELOCITY-TIME GRAPH FOR BALLOON AND BLOCK B**




4.1 Which one, the balloon or block **B**, is in freefall?

Give a reason for the answer. (2)

4.2 Using ONLY equations of motion, calculate the following values:

4.2.1 The time $t_1$ (3)

4.2.2 The velocity **v** of block **B** (3)

4.2.3 The time $t_2$ (3)

4.3 Sketch a position-time graph of block **B** from the moment it is dropped until it reaches the ground. Use the ground as zero reference point.

Clearly indicate the following values on the graph:

- The initial height
- The time at maximum height
- The time when block **B** reaches the ground

(5)
**[16]**

**QUESTION 5 (Start on a new page.)**

The vector diagrams below show the momentums of car **A**, mass 2 000 kg, which is traveling to the right, before and after a head-on collision with stationary car **B.** The collision lasted 0,5 seconds. After the collision, car **B** moves to the right with a speed of 20 $m \cdot s^{-1}$.

The diagrams below are not drawn to scale.

**VECTOR DIAGRAM FOR CAR A BEFORE AND AFTER COLLISION**




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

5.2 Calculate the:

5.2.1 Velocity of car **A** before the collision (3)

5.2.2 Mass of car **B** (4)

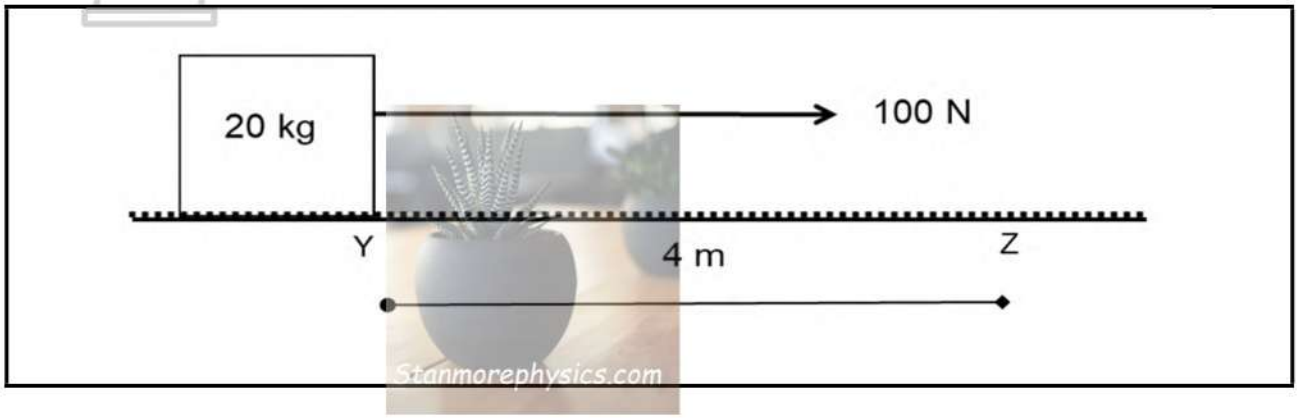
5.3 Draw a labelled vector diagram showing the magnitude and direction of the change in momentum of car **A**. (2)

5.4 Calculate the magnitude of the net force that car **A** exerts on car **B**. (3)

5.5 Use the impulse-momentum theorem to explain how an airbag, which inflates between the driver and the steering wheel of a car during a collision, protects the driver. (3)

**QUESTION 6 (Start on a new page.)**

A 20 kg box is initially at rest at point **Y** on a rough horizontal surface. The box is pulled to the right by a constant force of 100 N, parallel to the surface. The box is moved a horizontal distance of 4 m and experiences a frictional force of 65 N.



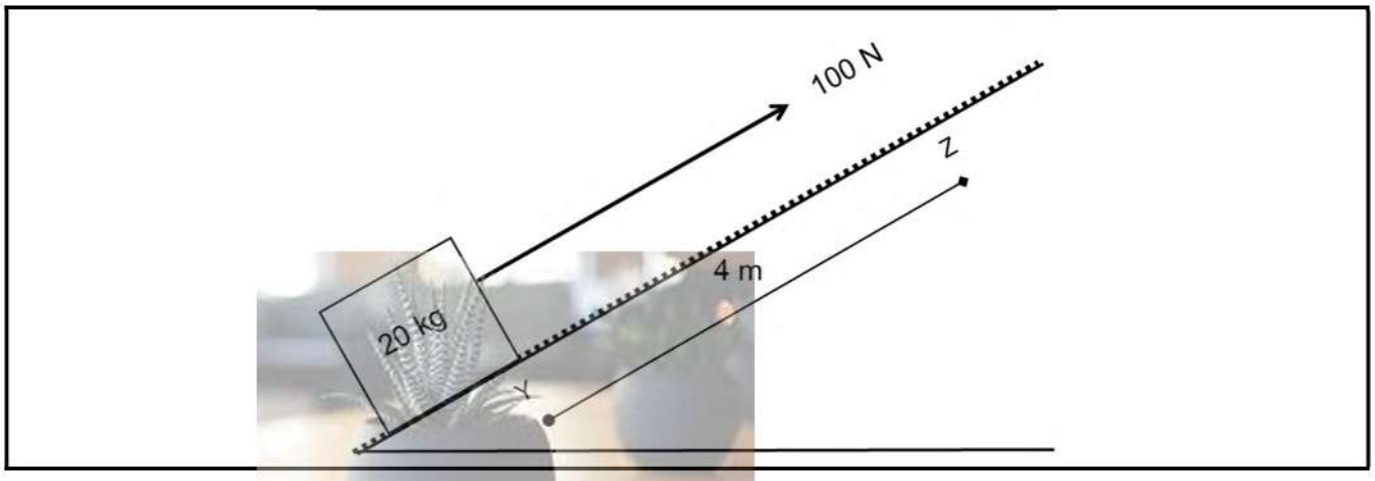

6.1 Define the term *non-conservative force*. (2)

6.2 Name the non-conservative force(s) acting on the 20 kg box. (2)

6.3 Using ENERGY PRINCIPLES ONLY, calculate the speed of the box at point **Z**. (5)

6.4 Calculate the average power dissipated by the 100 N force between point **Y** and point **Z**. (3)

6.5 The box is now pulled upwards by a 100 N force on the original surface which is now inclined at an angle as shown in the diagram below.




6.5.1 Draw a labelled, free-body diagram, showing all the CONSERVATIVE FORCES acting on the 20 kg box. (2)

6.5.2 Will the box still have the same speed after 4 m as in QUESTION 6.3? Write only YES or NO. Give a reason for the answer. (2)

**[16]**

**QUESTION 7 (Start on a new page.)**

A hawk emits a sound at a frequency of 90 Hz. The speed of sound in air is taken as 340 $m \cdot s^{-1}$.

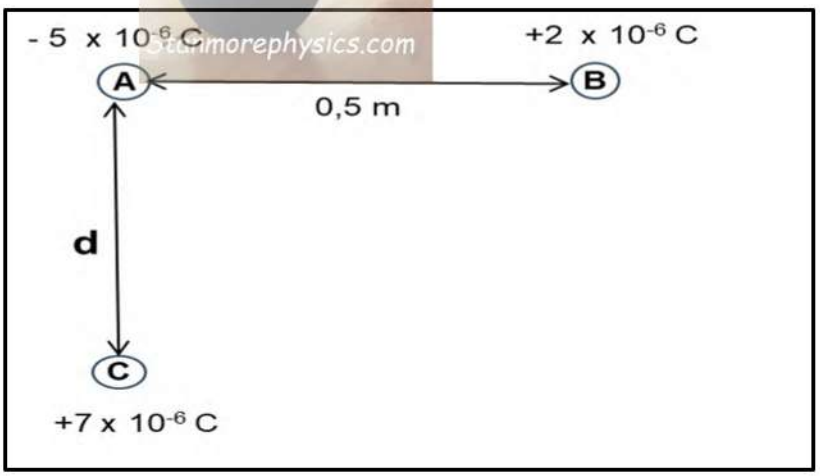
7.1 State the *Doppler effect* in words. (2)

7.2 A stationary observer hears the sound at 88 Hz. Is the hawk flying TOWARDS or AWAY from the observer? (1)

7.3 Calculate the speed at which the hawk is flying. (5)
**[8]**

**QUESTION 8 (Start on a new page.)**

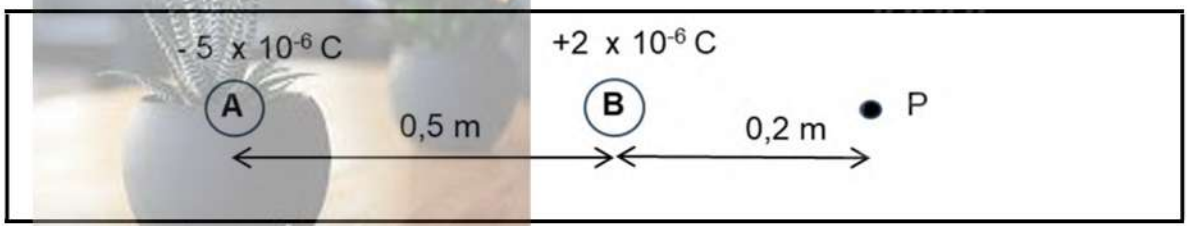
Three point charges, **A**, **B** and **C**, are placed as shown in the diagram below.




8.1 State Coulomb's law in words. (2)

8.2 The net force on charge **A** due to the charges **B** and **C** is 0,866 N. Calculate the distance **d** as indicated in the sketch above. (5)

8.3 Charge **C** is now removed. Point **P** is 0,2 m to the right of charge **B**.




8.3.1 Define *electric field at a point*. (2)

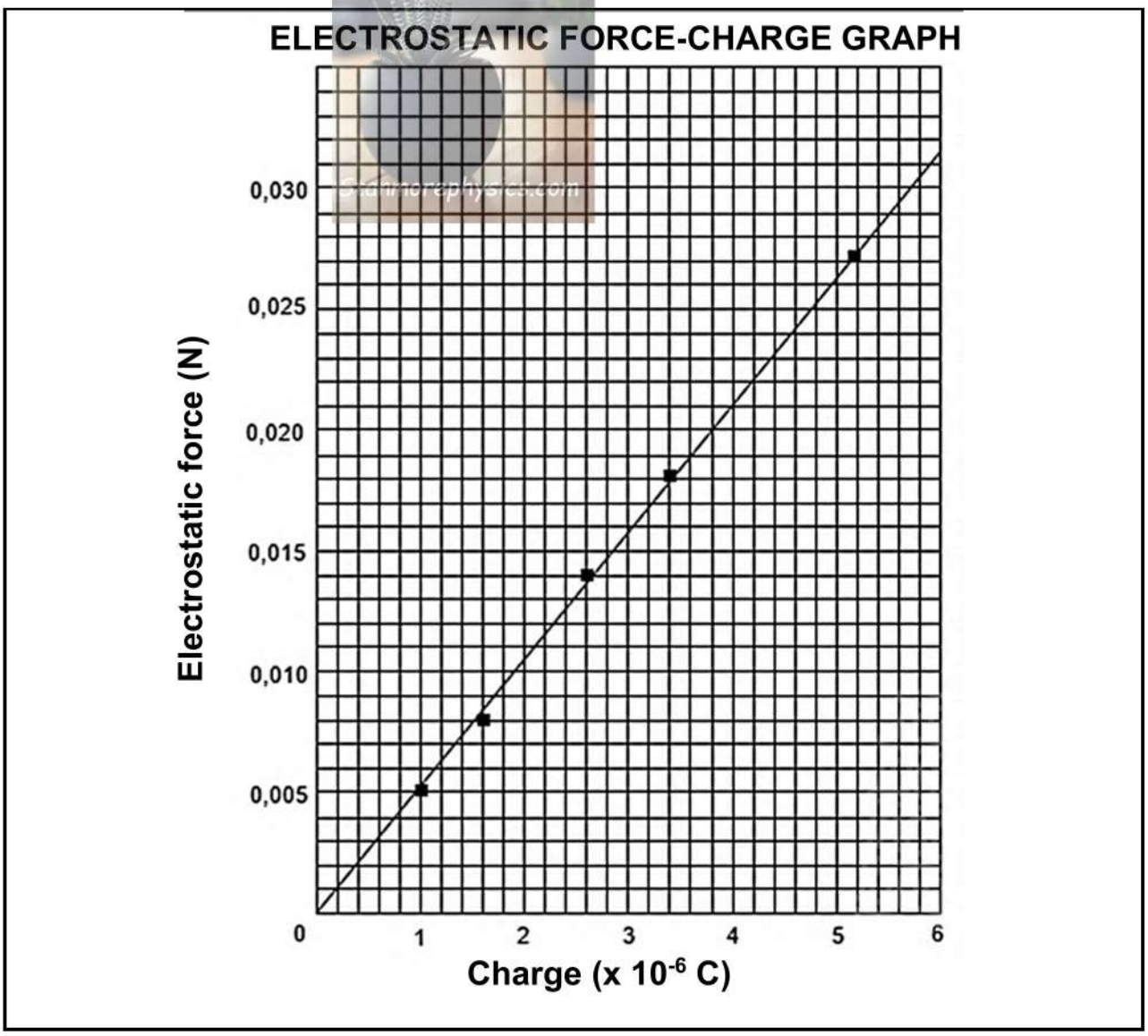
8.3.2 Draw a labelled vector diagram of the electric field at point **P** as a result of charges **A** and **B**. (2)

8.3.3 Calculate the magnitude of the net electric field at point **P**. (4)

8.3.4 If point **P** was between charges **A** and **B**, the net electric field would never be equal to zero at any point.

Explain the validity of this statement. (2)

8.4 The relationship between the electrostatic force and a charge is illustrated in the graph below. During this experiment, the second charge and the distance between the two charges are kept constant.



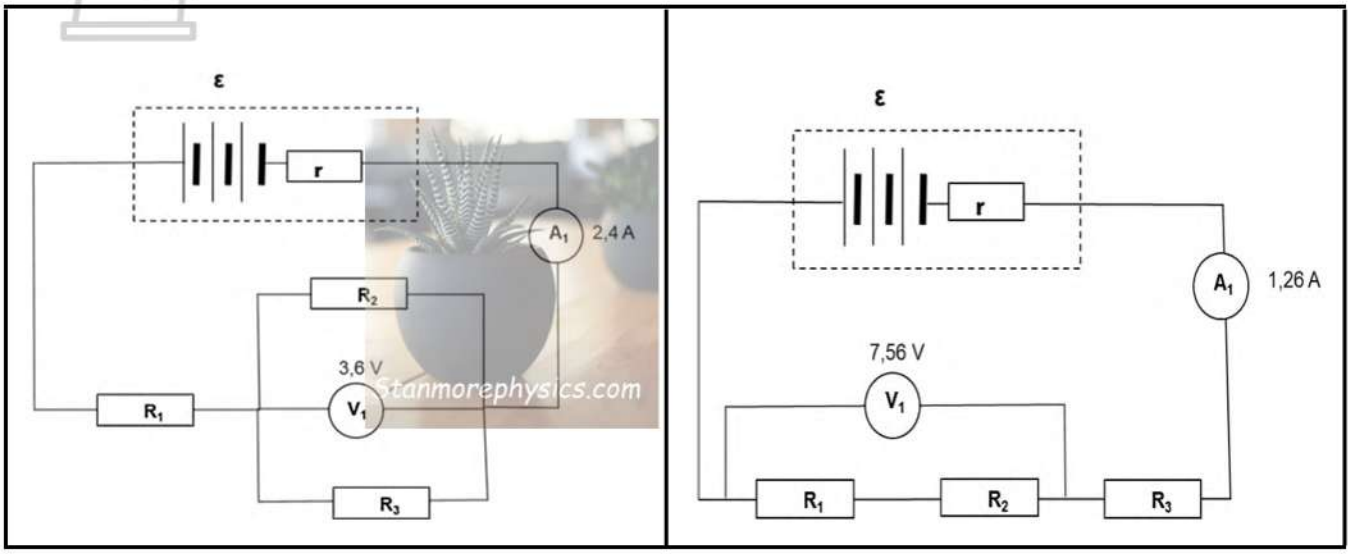

8.4.1 What mathematical relationship between the electrostatic force and the charge can be deduced from the graph? (1)

8.4.2 Use the information in the graph to calculate the magnitude of the electric field around the charge when it experiences a force of 0,005 N. (3)

**[21]**

**QUESTION 9 (Start on a new page.)**

CIRCUIT A and CIRCUIT B are connected as shown below. In both circuits, the same battery is used, and all resistors are identical with a resistance of 3 Ω each. The battery has an emf and internal resistance of unknown values. Voltmeter and ammeter readings are indicated in the diagrams below.




**CIRCUIT A** **CIRCUIT B**

9.1 Define *power*. (2)

9.2 For CIRCUIT A:

9.2.1 What would be the current through resistor $R_2$? (2)

9.2.2 Calculate the power dissipated by both $R_2$ and $R_3$. (3)

9.3 For CIRCUIT B:

9.3.1 Calculate the energy used for resistor $R_1$ if the current flows for 10 minutes. (3)

9.3.2 How would the current be affected if $R_1$ burnt out and was not removed?

Write only INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)

9.4 Define the term *emf*. (2)

9.5 Resistor $R_1$ is replaced by a new 3 Ω resistor. Calculate the value of the emf and the internal resistance of the battery used in CIRCUIT A and CIRCUIT B. (6)

**[20]**

**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<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Universal gravitational constant<br>*Universele gravitasiekonstante* | G | 6,67 x $10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$ |
| Radius of the Earth<br>*Radius van die Aarde* | $R_E$ | 6,38 x $10^6$ m |
| Mass of the Earth<br>*Massa van die Aarde* | $M_E$ | 5,98 x $10^{24}$ kg |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | 3,0 x $10^8$ $m \cdot s^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | 6,63 x $10^{-34}$ J·s |
| Coulomb's constant<br>*Coulomb se konstante* | k | 9,0 x $10^9$ $N \cdot m^2 \cdot C^{-2}$ |
| Charge on electron<br>*Lading op elektron* | e | 1,6 x $10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x $10^{-31}$ kg |

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## 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*

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

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### 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* $W_{net} = \Delta E_k$<br>$\Delta K = K_f - K_i$ 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*

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ / $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$ | $E = hf$ or/*of* $E = h\frac{c}{\lambda}$ |
| $E = W_o + E_{k(max)}$ or/*of* $E = W_o + K_{max}$ where/*waar*<br>$E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$ | |

## 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 ($\varepsilon$) = I(R + r)<br>emk ($\varepsilon$) = I(R + r) |
| $R_s = R_1 + R_2 + \ldots$<br>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ | $q = I\Delta t$ |
| $W = Vq$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |

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## ALTERNATING CURRENT/*WISSELSTROOM*

| | | | |
|---|---|---|---|
| $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ | / | $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ | $P_{ave} = V_{rms}I_{rms}$ / $P_{gemid} = V_{wgk}I_{wgk}$<br>$P_{ave} = I_{rms}^2R$ / $P_{gemid} = I_{wgk}^2R$ |
| $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ | / | $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$ | $P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemid} = \frac{V_{wgk}^2}{R}$ |