KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

# PROVINCIAL STANDARDISED ASSESSMENT

## GRADE 11

## PHYSICAL SCIENCES

## COMMON TEST

## MARCH 2026


**MARKS: 100**

**DURATION: 2 hours**

**This question paper consists of 13 pages and 1 data sheet.**

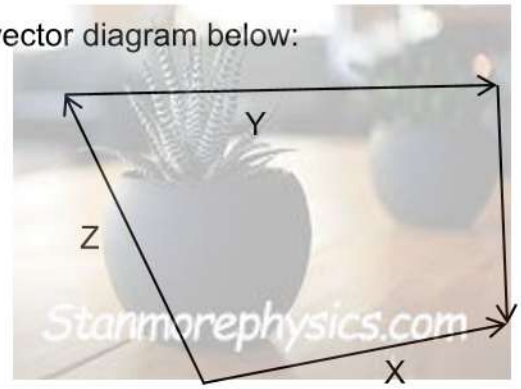
**INSTRUCTIONS AND INFORMATION**

1. This question paper consists of SEVEN 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. Stanmorephysics,com
4. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEET.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. 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 only the letter (A–D) next to the question number (1.1–1.7) in the ANSWER BOOK, for example 1.8 E.

1.1 Consider the vector diagram below:




Which ONE of the following represents the resultant vector of the other three?

A W

B X

C Y

D Z (2)

1.2 The forces acting on an object are in equilibrium.
Consider the following statements:

(i) The object could be stationary
(ii) The object could be moving at a constant velocity
(iii) The acceleration of the object is zero

Which of the above statements is/are true?

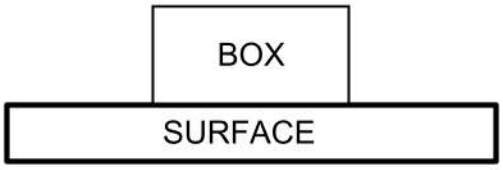
A (i) only

B (ii) only

C (i) and (iii) only

D (i), (ii) and (iii) (2)

1.3 A box is at rest on a horizontal surface.




Which of the following forces is the reaction force to the WEIGHT of the box?

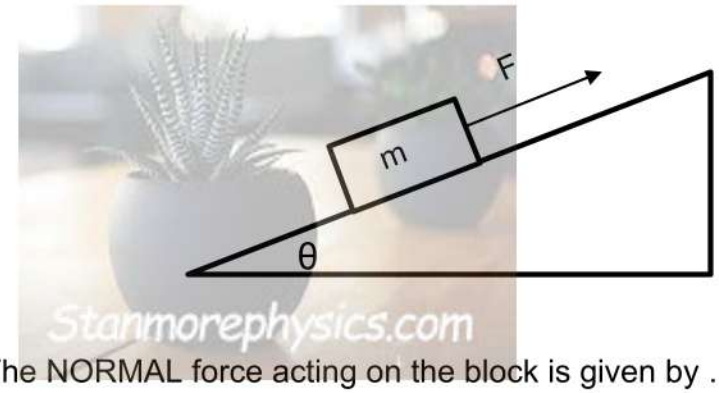
A Normal force acting on the box

B Force that Earth exerts on the box

C Force that the box exerts on Earth

D Force that the box exerts on the surface (2)

1.4 A block of mass **m** is pulled up an incline by a force **F**, as shown in the diagram below. The incline makes an angle θ with the horizontal




The NORMAL force acting on the block is given by …

A mg sinθ

B mg cosθ

C mg sinθ – Fcosθ

D mg cosθ - Fsinθ (2)

1.5 The acceleration due to gravity on the surface of Earth is **g**.

Which ONE of the following is the gravitational acceleration on another planet which has HALF the mass of Earth and ONE-QUARTER of Earth's radius?

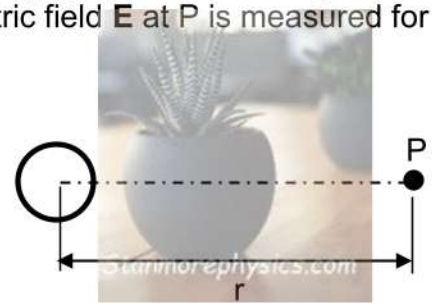
A 2g

B 4g

C 8g

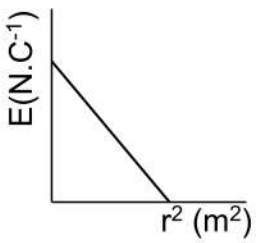
D 16g (2)

1.6 A small sphere, carrying a constant charge is placed **r** metres from a fixed point, **P**. The electric field **E** at P is measured for different values of **r**.

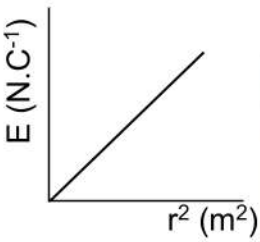



Which of the following graphs correctly shows the relationship between the electric field **E** at P and $\mathbf{r^2}$?

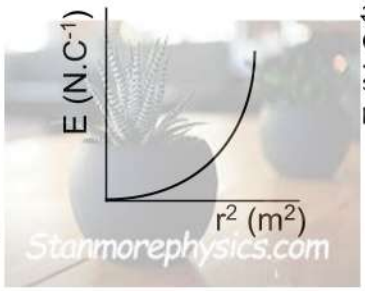
A



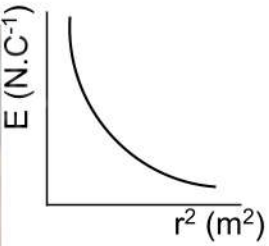

B




C




D




(2)

1.7 Two identical conducting spheres carrying charges Q and -2Q are placed r metres apart. The electrostatic force acting on each sphere is **F**. The spheres are brought into contact and are then separated so that the distance between them remains r metres.
Which ONE of the following is the magnitude of the electrostatic force that the spheres exert on each other after they are separated?

A $\frac{\mathbf{F}}{2}$

B $\frac{\mathbf{F}}{4}$

C $\frac{\mathbf{F}}{8}$

D 2**F**

(2)

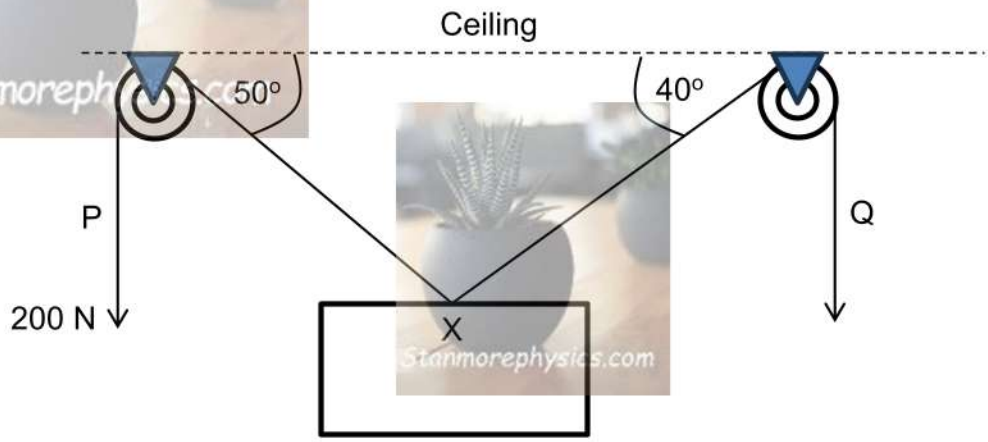
**[2 X 7 = 14]**

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

A box is lifted vertically upwards at CONSTANT VELOCITY using two light, inextensible strings, **P** and **Q**. The strings pass over frictionless pulleys attached to a horizontal ceiling and are attached to the box at point X, as shown in the diagram below. Stanmorephysics,com

- The tension in string **P**, which makes an angle of 50° with the ceiling, is 200 N.
- String **Q** makes an angle of 40° with the ceiling.

Ignore the effects of air resistance and assume that the box does not rotate while being lifted.




2.1 What is meant by a *closed vector diagram*? (2)

2.2 Draw a fully labelled closed vector diagram representing all forces acting on the box. Indicate any TWO angles. (3)

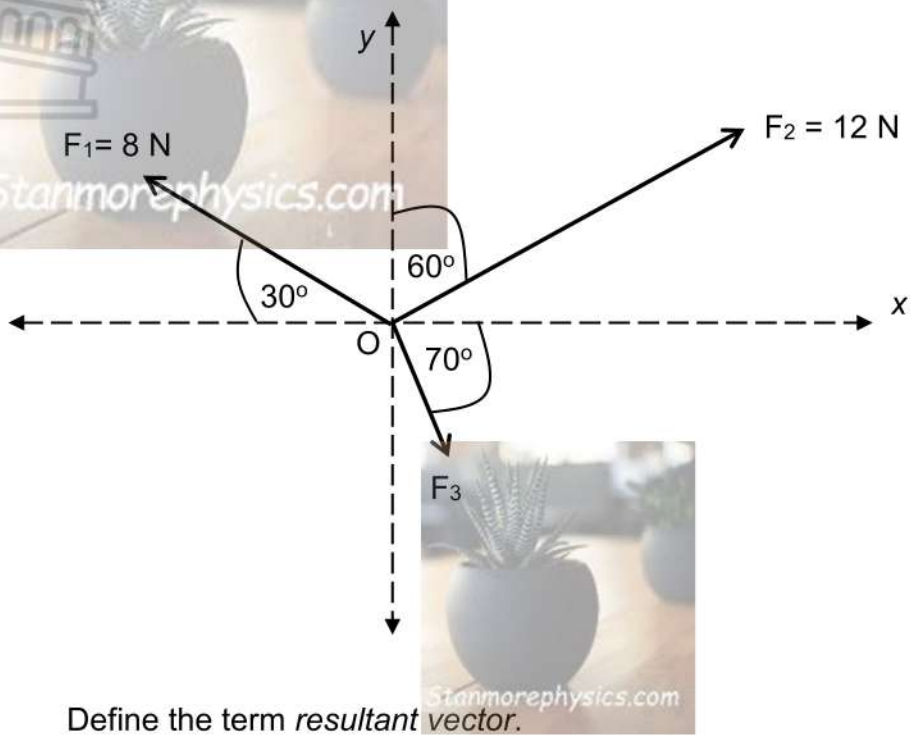
2.3 Calculate:

2.3.1 The magnitude of the tension in string Q (3)

2.3.2 The mass of the box (3)
**[11]**

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

When three forces, $F_1$, $F_2$ and $F_3$ act on an object at point O as shown in the diagram below, the object moves from rest in a straight line at a bearing of 25°.
The forces are not drawn to scale.




3.1 Define the term *resultant vector*. (2)

3.2 Calculate the magnitude of the RESULTANT of:

3.2.1 The horizontal components of $F_1$ and $F_2$ ONLY (2)

3.2.2 The vertical components of $F_1$ and $F_2$ ONLY (2)

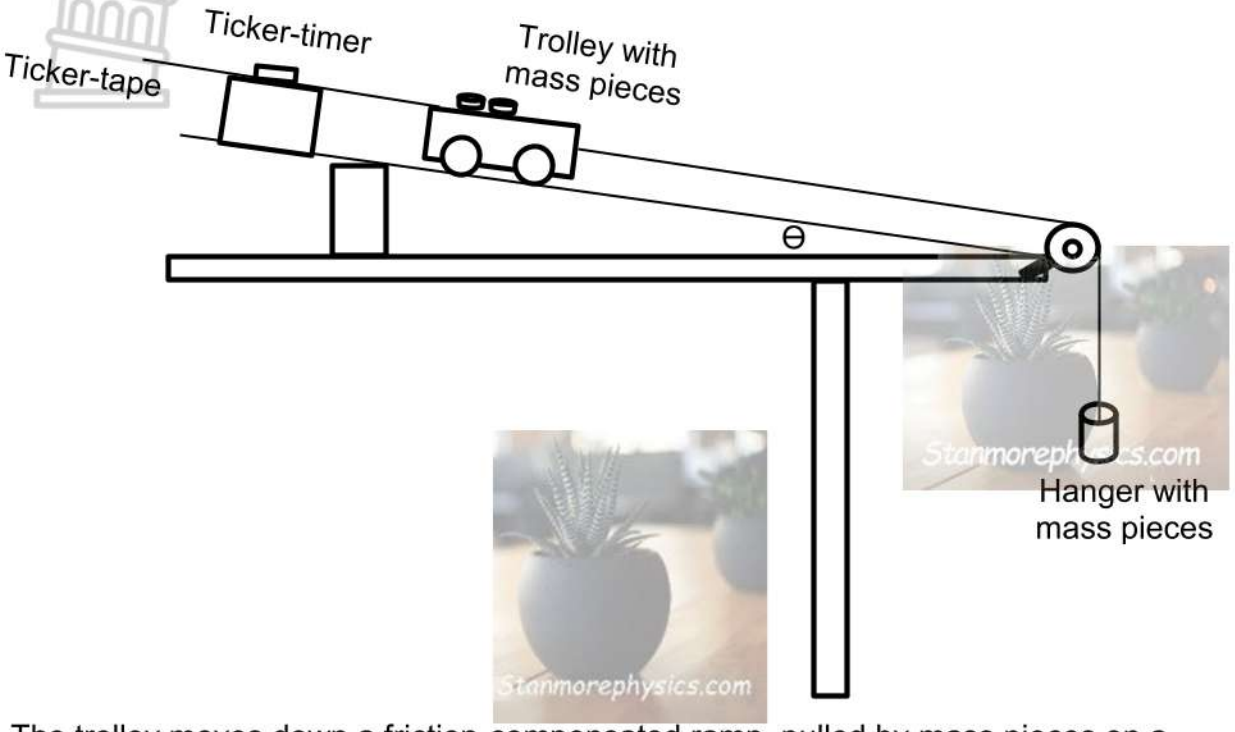
3.3 Determine the magnitude of $F_3$. (6)

3.4 A fourth force $F_4$ now also acts at point O along the vertical axis, so that the object moves due EAST, along the positive x-axis.

Determine the magnitude and bearing of $F_4$. (3)
**[15]**

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

An investigation is conducted to determine the relationship between the net force acting on an object and its acceleration. The apparatus used in the experiment is shown below.




The trolley moves down a friction-compensated ramp, pulled by mass pieces on a mass hanger. The hanger is attached to the trolley by a light, inextensible string that passes over a frictionless pulley. The net force is increased by moving mass pieces from the trolley to the hanger.

4.1 Explain how a ticker-timer and ticker-tape is used to adjust the ramp in order to compensated for friction. Stanmorephysics,com (3)

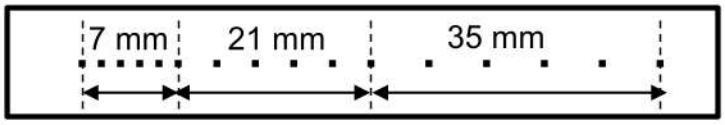
4.2 Identify:

4.2.1 The dependent variable (1)

4.2.2 A controlled variable (1)

4.3 Write down an investigative question for this experiment. (2)

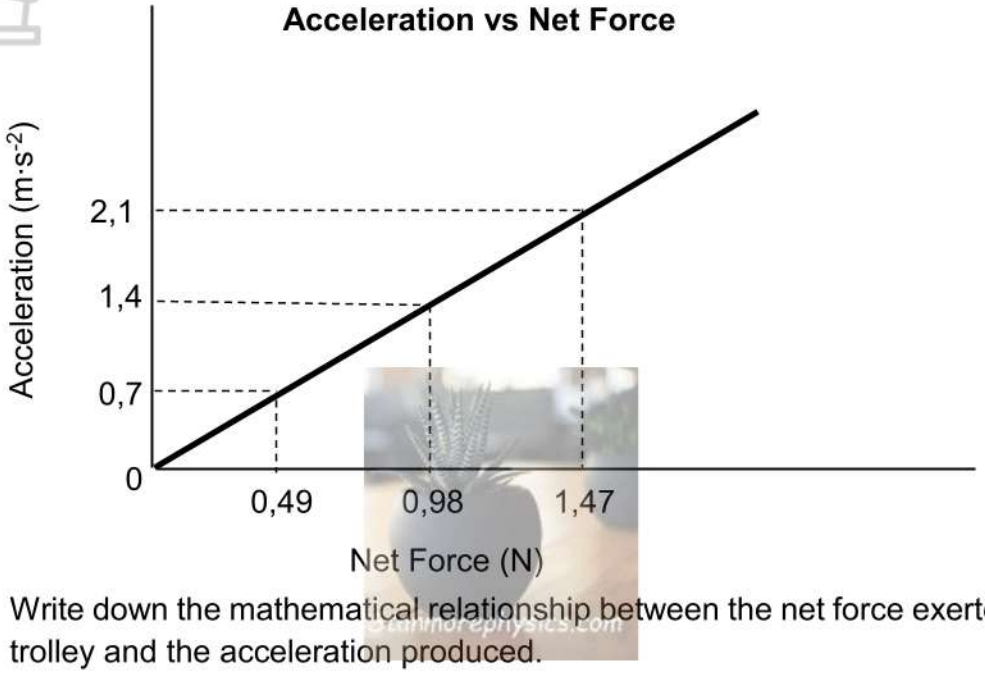
The ticker timer has a frequency of 50 Hz, and the ticker tape shown below (not drawn to scale) is divided into intervals of five dots.



4.4 Determine the time elapsed for every 5-dot section of the tape. (3)

4.5 Using the data on the ticker-tape above, calculate the magnitude of the trolley's acceleration. (4)

The results obtained is shown on the graph below:



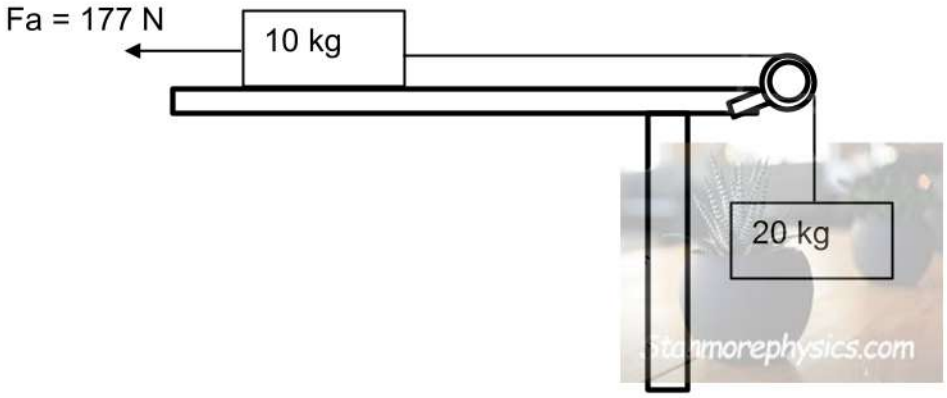

4.6 Write down the mathematical relationship between the net force exerted on the trolley and the acceleration produced. (1)

4.7 Give a reason why the mass pieces added to the hanger were initially placed on the trolley. (2)

**[17]**

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

A 10 kg block resting on a rough horizontal surface is connected to a 20 kg block, by a light, inextensible string passing over a frictionless pulley. The 20 kg block hangs vertically, as shown in the diagram below.



A force of 177 N is applied to the left of the 10 kg block, to control the LOWERING of the 20 kg block to the ground. The kinetic frictional force between the 10 kg block and the surface is 11,5 N.

5.1 State *Newton's second law of motion* in words. (2)

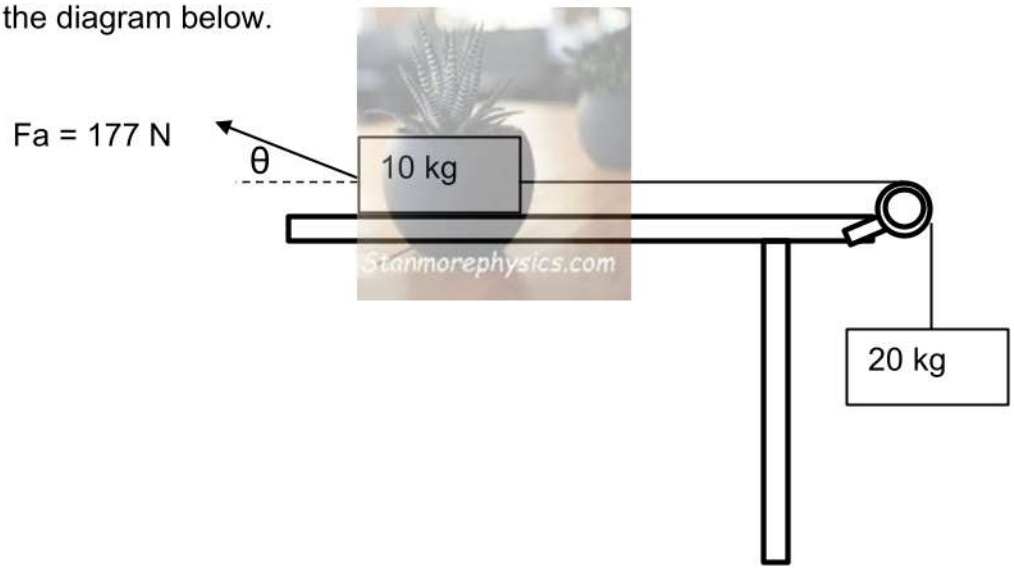
5.2 Draw a labelled free-body diagram showing all forces acting on the 20 kg block. (2)

5.3 Calculate the magnitude of the:

5.3.1 Acceleration of the 20 kg block (5)

5.3.2 Tension in the string connecting the blocks (2)

5.4 The 177 N force is now applied at an angle θ to the horizontal as shown in the diagram below.




Will the kinetic frictional force on the 10 kg block INCREASE, DECREASE or REMAIN THE SAME? Explain the answer. (3)

**[14]**

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

A rocket, with its fuel, has a mass of 20 000 kg on the surface of Earth. The rocket is launched vertically upwards and its mass decreases uniformly as the fuel burns. At a height of 6,4 x $10^6$ m above the surface of Earth, the rocket's mass DECREASES by 5000 kg.

6.1 State *Newton's law of universal gravitation* in words. (2)

6.2 Calculate the weight of the rocket on the surface of Earth. (2)

6.3 Determine the percentage reduction in the rocket's weight when it is 6,4 x $10^6$ m above the surface of Earth. (5)

The rocket's mass decreased by 25% as it ascends from the ground to 6,4 x $10^6$ m above the surface of Earth

6.4 Explain why the percentage reduction in the rocket's weight is considerably larger than the percentage reduction in the rocket's mass. (2)

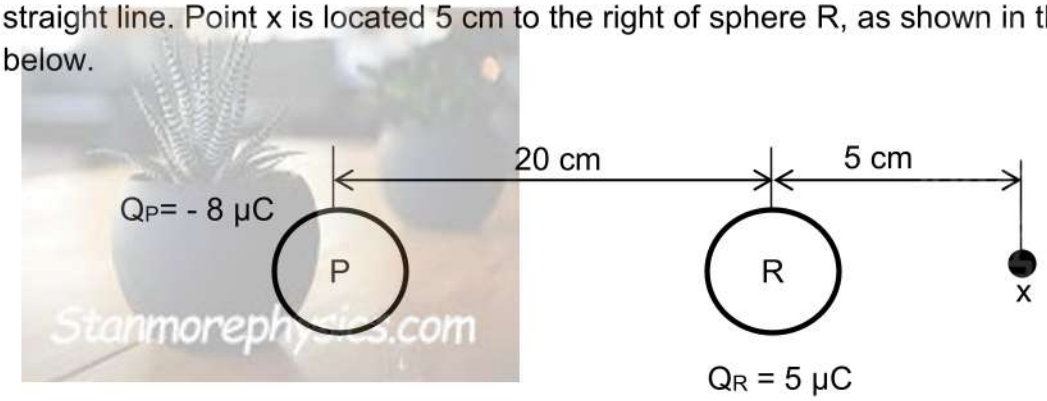
**[11]**

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

A metal sphere P, which was initially neutral, is given a charge of – 8 μC.

7.1 Determine the number of electrons added to P to obtain a charge of – 8 μC. (3)

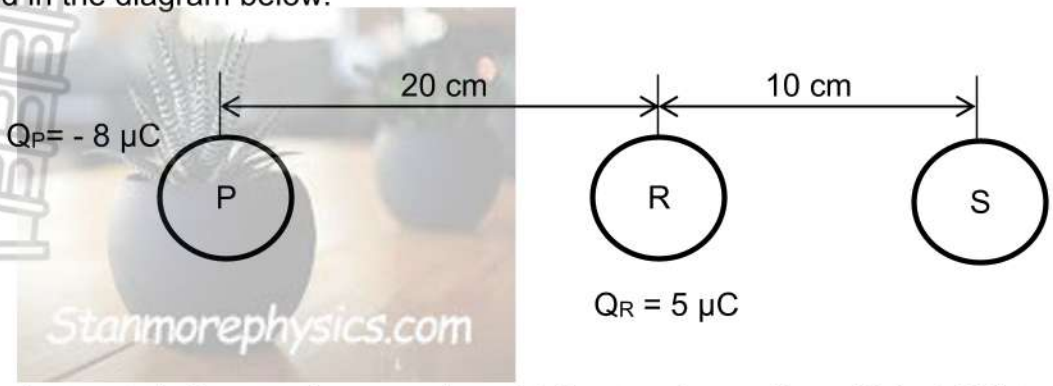
Sphere R, carrying a charge of 5 μC, is placed 20 cm to the right of sphere P along a straight line. Point x is located 5 cm to the right of sphere R, as shown in the diagram below.




7.2 Define the term *electric field at a point* in words. (2)

7.3 Calculate the net electric field at point x. (5)

A third sphere S, of unknown charge, is placed 10 cm to the right of sphere R, as indicated in the diagram below.




The net electrostatic force acting on **sphere P** due to spheres R and S is 6,6 N to the right.

7.4 Determine the:

7.4.1 Electrostatic force that sphere S exerts on sphere P (5)

7.4.2 Charge on sphere S (3)

**[18]**

**TOTAL: 100**

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

## TABLE 1: PHYSICAL CONSTANTS

| NAME | SYMBOL | VALUE |
|---|---|---|
| Acceleration due to gravity | g | 9,8 $m.s^{-2}$ |
| Universal gravitation constant | G | 6,67 x $10^{-11}$ $N{\cdot}m^2{\cdot}kg^{-2}$ |
| Radius of the Earth | $R_E$ | 6,4 x $10^6$ m |
| Mass of the Earth | $M_E$ | 5,98 x $10^{24}$ kg |
| Coulombs constant | k | 9 x $10^9$ $N{\cdot}m^2{\cdot}C^{-2}$ |
| Charge on electron | $q_e$ | -1,6 x $10^{-19}$ C |
| Electron mass | $m_e$ | 9,11 x $10^{-31}$ kg |

## TABLE 2: FORMULAE

### MOTION

| | |
|---|---|
| $v_f = v_i + a\Delta t$ | $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ |
| $v_f^2 = v_i^2 + 2a\Delta x$ | $\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ |



### FORCE

| | |
|---|---|
| $F_{net} = ma$ | $w = mg$ |
| $f_s^{max} = \mu_s N$ | $f_k = \mu_k N$ |
| $F = \frac{Gm_1m_2}{r^2}$ | $g = G\frac{M}{r^2}$ |

### ELECTROSTATICS

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

KWAZULU-NATAL PROVINCE
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# NATIONAL SENIOR CERTIFICATE

## GRADE 11

## PHYSICAL SCIENCES

## PROVINCIAL STANDARDISED ASSESSMENT

## MARKING MEMORANDUM

## MARCH 2026


**MARKS: 100**

**DURATION: 2 hours**

**QUESTION 1:**

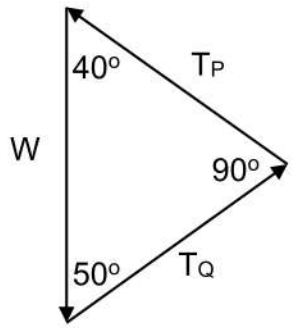
| | | |
|---|---|---|
| 1.1 | B ✓✓ | (2) |
| 1.2 | D ✓✓ | (2) |
| 1.3 | C ✓✓ | (2) |
| 1.4 | B ✓✓ | (2) |
| 1.5 | C ✓✓ | (2) |
| 1.6 | D ✓✓ | (2) |
| 1.7 | C ✓✓ | (2) |
| | | **[14]** |

**QUESTION 2**

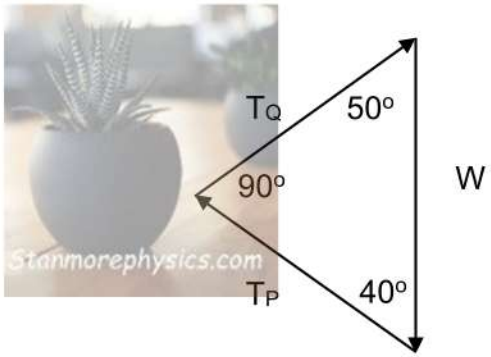
2.1 A closed vector diagram is a representation of several vectors and the resultant is zero✓ so that the last vector ends where the first vector starts. ✓ (2)

2.2

**OPTION 1**




**OPTION 2**




**Marking Criteria:**

- Three forces correctly drawn and labelled in a right-angled triangle. ✓
- Direction of forces correctly shown. ✓
- Any two angles correctly shown on triangle. ✓ (3)

2.3.1

| **OPTION 1** | **OPTION 2** | **OPTION 3** |
|---|---|---|
| $\tan 50^\circ = \frac{T_P}{T_Q}$ | $\tan 40^\circ = \frac{T_Q}{T_P}$ | $\frac{\sin 50^\circ}{T_P} = \frac{\sin 40^\circ}{T_Q}$ |
| $\tan 50^\circ$ ✓$= \frac{200}{T_Q}$ ✓ | $\tan 40^\circ$ ✓$= \frac{T_Q}{200}$ ✓ | $\frac{\sin 50^\circ}{200}$ ✓$= \frac{\sin 40^\circ}{T_Q}$ ✓ |
| $T_Q$ = 167,82 N ✓ | $T_Q$ = 167,82 N ✓ | $T_Q$ = 167,82 N ✓ |

(3)

2.3.2 **POSITIVE MARKING FROM 2.3.1 (FOR OPTION 3)**

| **OPTION 1** | **OPTION 2** | **OPTION 3** |
|---|---|---|
| $\sin 50^o = \frac{T_P}{W}$ | $\cos 40^o = \frac{T_P}{W}$ | $W = \sqrt{T_P^2 + T_Q^2}$ |
| $\sin 50^o = \frac{200}{W}$ ✓ | $\cos 40^o = \frac{200}{W}$ ✓ | $W = \sqrt{200^2 + 167,82^2}$ ✓ |
| W = 261,08 N | W = 261,08 N | W = 261,08 N |
| W = mg | W = mg | W = mg |
| 261,08 = m(9,8) ✓ | 261,08 = m(9,8) ✓ | 261,08 = m(9,8) ✓ |
| m = 26,64 kg✓ | m = 26,64 kg✓ | m = 26,64 kg✓ |

(3)

**[11]**

**QUESTION 3**

3.1 A single vector that has the same effect as two or more vectors added together. ✓✓ (2)

3.2.1 $F_x = 12\cos(30^o) - 8\cos(30^o)$ ✓ {Note: sin(60°) could replace cos(30°) in either substitution}

$= 3,46$ N ✓ (East) (2)

3.2.2 $F_y = 12\sin(30^o) + 8\sin(30^o)$ ✓ {Note: cos(60°) could replace sin(30°) in either substitution}

$= 10$ N ✓ (North) (2)

3.3 **POSITIVE MARKING FROM Q3.2.1 AND Q3.2.2**

$F_{3x} = F_3\cos(70^o)$ OR $F_{3x} = F_3\sin(20^o)$ ✓

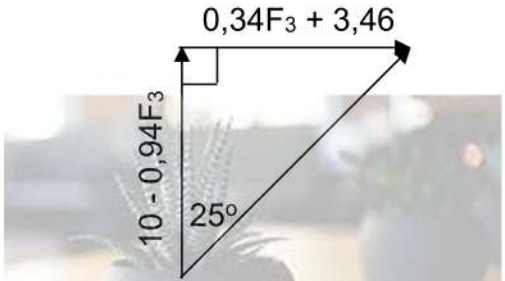
$= 0,34F_3$ East

$F_{3y} = F_3\sin(70^o)$ OR $F_{3x} = F_3\cos(20^o)$ ✓

$= 0,94F_3$ South

$F_X = 0,34F_3 + 3,46$ ✓ East

$F_Y = 10 - 0,94F_3$ ✓ North




$\tan(25^o) = \frac{0,34F_3 + 3,46}{10 - 0,94F_3}$ ✓ OR $\tan(65^o) = \frac{10 - 0,94F_3}{0,34F_3 + 3,46}$ ✓

$F_3 = 1,55$ N ✓ (6)

3.4 **POSITIVE MARKING FROM QUESTION 3.3**

$F_4 = 10 - 0,94F_3$

$= 10 - 0,94(1,55)$ ✓

$= 8,54$ N ✓ at a bearing of 180° ✓ (3)

**[15]**

**QUESTION 4**

4.1 Ticker tape is attached to the trolley, and threaded through the ticker timer. ✓
The trolley is gently pushed down the ramp without any mass pieces attached.✓
The angle of the incline is adjusted until the dots on the ticker-tape are equally spaced. ✓ (3)

4.2.1 Acceleration✓ (1)

4.2.2 Mass (of the system) / angle of the incline (any one) ✓ (1)

4.3 What is relationship between the resultant force acting on the trolley and the acceleration it produces?✓ ✓ (2)

4.4 $T = \frac{1}{f}$

$= \frac{1}{50}$ ✓

$= 0,02$ s

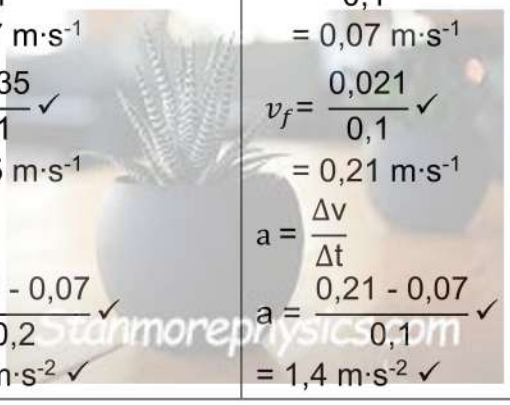
Time for 5 dot interval $= 0,02 \times 5$ ✓

$= 0,1$ s ✓ (3)


4.5

| **OPTION 1** | **OPTION 2** | **OPTION 3** |
|---|---|---|
| $v = \frac{\Delta x}{\Delta t}$ | $v = \frac{\Delta x}{\Delta t}$ | $v = \frac{\Delta x}{\Delta t}$ |
| $v_i = \frac{0,007}{0,1}$ ✓ | $v_i = \frac{0,007}{0,1}$ ✓ | $v_i = \frac{0,021}{0,1}$ ✓ |
| $= 0,07$ m·s$^{-1}$ | $= 0,07$ m·s$^{-1}$ | $= 0,21$ m·s$^{-1}$ |
| $v_f = \frac{0,035}{0,1}$ ✓ | $v_f = \frac{0,021}{0,1}$ ✓ | $v_f = \frac{0,035}{0,1}$ ✓ |
| $= 0,35$ m·s$^{-1}$ | $= 0,21$ m·s$^{-1}$ | $= 0,35$ m·s$^{-1}$ |
| $a = \frac{\Delta v}{\Delta t}$ | $a = \frac{\Delta v}{\Delta t}$ | $a = \frac{\Delta v}{\Delta t}$ |
| $a = \frac{0,35 - 0,07}{0,2}$ ✓ | $a = \frac{0,21 - 0,07}{0,1}$ ✓ | $a = \frac{0,35 - 0,21}{0,1}$ ✓ |
| $= 1,4$ m·s$^{-2}$ ✓ | $= 1,4$ m·s$^{-2}$ ✓ | $= 1,4$ m·s$^{-2}$ ✓ |

(4)




4.6 Acceleration is directly proportional ✓to the net force (OR a α Fnet) (1)

4.7 It ensures that the mass of the system remains constant ✓✓ (2)

**[17]**

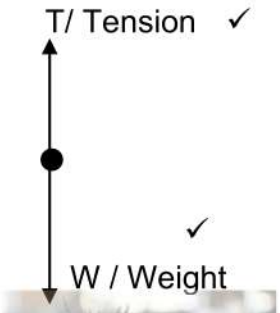
**QUESTION 5**

5.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the (net) force✓ and inversely proportional to the mass of the object. ✓ (2)

**NOTE**:

If the first sentence is not stated (for correct context), maximum $\frac{1}{2}$.

5.2 (2)




Note: subtract 1 mark for additional forces

5.3.1

| **10 kg block** | **20 kg block** |
|---|---|
| $F_{net} = ma$ | Fnet = ma |
| $T + (-F_a) + (-f_k) = ma$ ✓ Any one | $W + (-T) = ma$ |
| $T - 177 - 11,5$ ✓ $= 10a$ ✓ | $(20 \times 9,8) - T = 20a$ ✓ |
| $T - 188,5 = 10a$ _____ (eqn 1) | $196 - T = 20a$ _____ (eqn 2) |

(eqn 1) + (eqn 2): $196 - 188,5 = 30a$

$7,5 = 30a$

$a = 0,25\ m \cdot s^{-2}$ ✓ (5)

5.3.2 **POSITIVE MARKING FROM QUESTION 5.3.1**

Substitute in eqn (1) or eqn(2)

| **OPTION 1** | **OPTION 2** |
|---|---|
| $T - 188,5 = 10a$ | $196 - T = 20a$ |
| $T - 188,5 = 10(0,25)$ ✓ | $196 - T = 20(0,25)$ ✓ |
| $T = 191$ N ✓ | $T = 191$ N ✓ |

(2)

5.4 Decrease. ✓

The vertical component of the applied force will cause the normal force to decrease. ✓

The kinetic frictional force is directly proportional to the normal force
The kinetic frictional force decreases as the normal force decreases
✓ Any one

(when $\mu_k$ is constant) (3)

**[14]**

**QUESTION 6**

6.1 Every body in the universe attracts every other body with a gravitational force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

6.2 $W = mg$
$= 20000 \times 9,8$ ✓
$= 196\ 000$ N ✓ (2)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

| OPTION 1 | OPTION 2 | OPTION 3 |
|---|---|---|
| $F = \frac{Gm_1m_2}{r^2}$ ✓<br>$\frac{6,67\times10^{-11}\times5,98\times10^{24}\times15000}{(6,4\times10^{6}+6,4\times10^{6})^2}$ ✓<br>$= 36\ 517,27$ N | $g = \frac{GM}{r^2}$ ✓<br>$\frac{6,67\times10^{-11}\times5,98\times10^{24}}{(6,4\times10^{6}+6,4\times10^{6})^2}$ ✓<br>$= 2,4345\ m\cdot s^{-2}$<br>$W = mg$<br>$= 15000 \times 2,4345$ ✓<br>$= 36\ 517,5$ N | $g_{new} = \frac{1}{4}\times9,8$ ✓✓<br>$= 2,45\ m\cdot s^{-2}$<br>$W = mg$<br>$=15000 \times 2,45$ ✓<br>$= 36\ 750$ N |

$$\%\ \text{Loss in weight} = \frac{196\ 000 - 36517,27}{196\ 000} \times 100 \checkmark$$
$$= 81,34\% \checkmark$$

(5)

6.4
- The rocket is further away from the centre of the Earth OR above the surface of the earth, therefore gravitational acceleration decreases. ✓
- Since BOTH the gravitational acceleration and mass decrease✓, there is a greater percentage reduction in weight.

OR

- The gravitational force is directly proportional to the product of the masses and inversely proportional to the square of the distance between the centres. ✓
- Since BOTH the mass of the rocket decreases and the distance between the rocket and centre of the earth increases, ✓there is a greater percentage reduction in weight.

(2)

**[11]**

**QUESTION 7**

7.1 $n = \frac{Q}{q_e}$ ✓

$= \frac{8 \times 10^{-6}}{1,6 \times 10^{-19}}$ ✓ ACCEPT : $= \frac{-8 \times 10^{-6}}{-1,6 \times 10^{-19}}$ ✓

$= 5 \times 10^{13}$ electrons ✓ (3)

7.2 The electrostatic force experienced per unit positive charge placed at the point. ✓✓ (2)

7.3 $E_p = \frac{kQ}{r^2}$ ✓

$= \frac{9 \times 10^9 \times 8 \times 10^{-6}}{0,25^2}$ ✓

$= 1,152 \times 10^6$ N·C$^{-1}$ left

$E_R = \frac{kQ}{r^2}$

$= \frac{9 \times 10^9 \times 5 \times 10^{-6}}{0,05^2}$ ✓

$= 1,8 \times 10^7$ N·C$^{-1}$ right

$E_{net} = E_R - E_P$ (Right +)

$= 1,8 \times 10^7 - 1,152 \times 10^6$ ✓

$= 1,6\,85 \times 10^7$ N·C$^{-1}$ right ✓

OR $E_{net} = E_P - E_R$ (Left +)

$= 1,152 \times 10^6 - 1,8 \times 10^7$ ✓

$= -1,6\,85 \times 10^7$ N·C$^{-1}$

$= 1,6\,85 \times 10^7$ N·C$^{-1}$ right ✓ (5)

7.4.1 $F_{RP} = \frac{kQ_RQ_P}{r^2}$ ✓

$= \frac{9 \times 10^9 \times 5 \times 10^{-6} \times 8 \times 10^{-6}}{0,2^2}$ ✓

$= 9$ N right

$F_{net} = F_{RP} + F_{SP}$

$6,6 = 9 + F_{SP}$ ✓

$F_{SP} = -2,4$ N

$= 2,4$ N left ✓ (5)

7.4.2 **POSITIVE MARKING FROM 7.4.1**

$F_{SP} = \frac{kQ_SQ_P}{r^2}$

$2,4$ ✓$= \frac{9 \times 10^9 \times Q_S \times 8 \times 10^{-6}}{0,3^2}$ ✓

Magnitude of $Q_S = 3 \times 10^{-6}$ C. ∴ $Q_S = -3 \times 10^{-6}$ C ✓ (3)

**[18]**

**TOTAL: 100**