education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GERT SIBANDE DISTRICT

GRADE 11

PHYSICAL SCIENCES TOPIC TEST

TOPIC: VECTORS

JANUARY 2023

MARKS: 50

TIME: 1 hour

This question paper consists of 6 pages including the data sheet

Please turn over

INSTRUCTIONS AND INFORMATION

1. Attempt ALL questions.
2. Round off your final answers to a minimum of TWO decimal places.
3. Write neatly and legibly.
4 You are advised to use the attached data sheet.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various 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. Eg 1.6 E

1.1 Which one of the following consists of only VECTOR quantities?

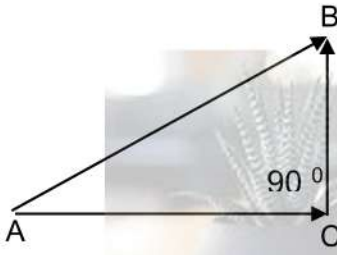
A Displacement, time, velocity

B Acceleration, velocity, speed

C Displacement, acceleration, velocity

D Velocity, distance, acceleration (2)

1.2 Consider the following vector diagram:



The vector which represents the resultant of the other two, is …

A AC

B AB

C CB

D BA

1.3 A river flows at a constant velocity of 20 m·s^{-1} in a westerly direction. A boat moves at a constant velocity of 15 m·s^{-1} in an easterly direction on the river. Which ONE of the following vectors best represents the resultant velocity of the boat?

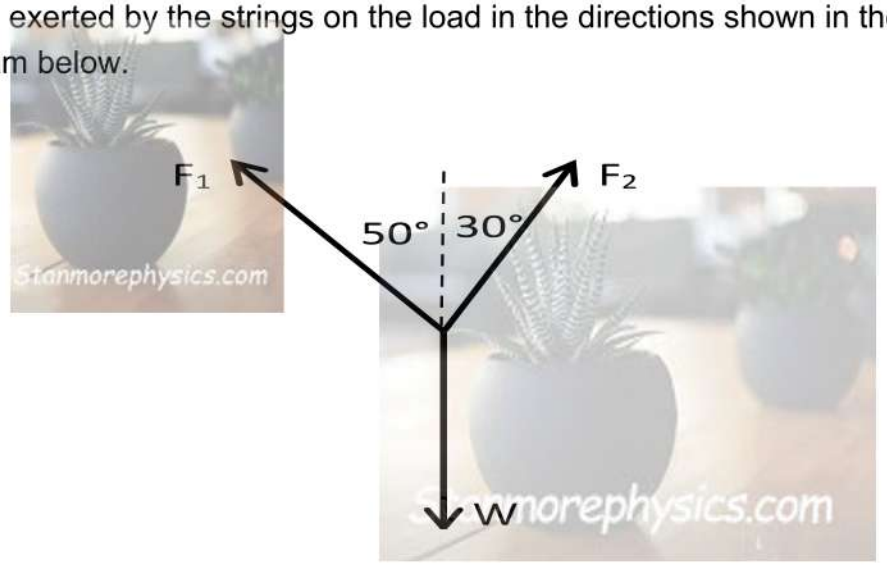
A → 5 m.s^{-1}

B ← 5 m.s^{-1}

C → 35 m.s^{-1}

D ← 35 m.s^{-1} (2)

1.4 An object of weight W is suspended from two strings. F_1 and F_2 are the forces exerted by the strings on the load in the directions shown in the diagram below.



Which ONE of the following equations is valid for this situation?

A $W = F_1^2 + F_2^2$

B $F_1 \sin 50° = F_2 \sin 30°$

C $F_1 \cos 50° = F_2 \sin 30°$

D $W = F_1 + F_2$ (2)

1.5 Vector **P** and vector **–P** are acting on a common point **O**. The angle between the two vectors is ...

A 0^0

B 90^0

C 180^0

D 270^0 (2)

[10]

QUESTION 2

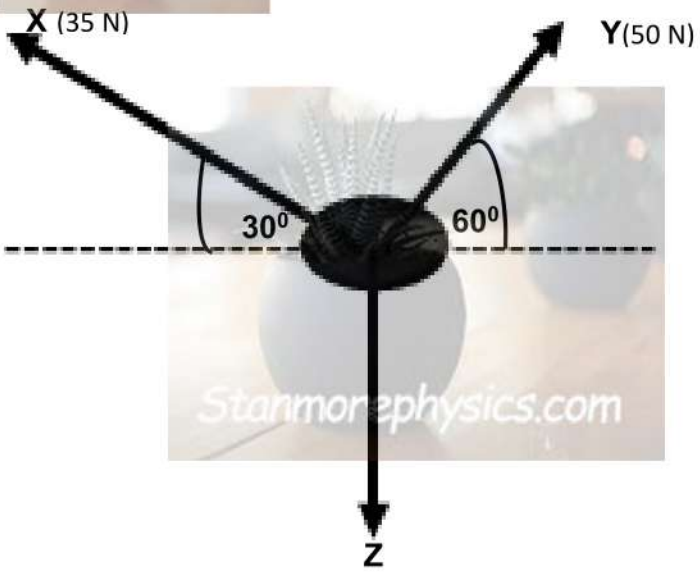
Two forces **x** and **Y** of magnitudes 35 N and 50 N respectively act horizontally on the body as shown in the diagram below.

2.1 Define the term *a vector*. (2)

2.2 Calculate the magnitude and direction of the resultant force of forces **X** and **Y**. (2)

2.3 Draw a scale vector diagram of the forces X and Y, and their resultant. Clearly indicate the forces and the resultant. (3)

2.4 The **X** and **Y** forces above and another force **Z**, are now made to hold the same body in a stationary position as shown in the diagram below. The forces are in EQUILIBRIUM, and **forces X** and **Y** make angles of 30° and 60° respectively with the horizontal**.**



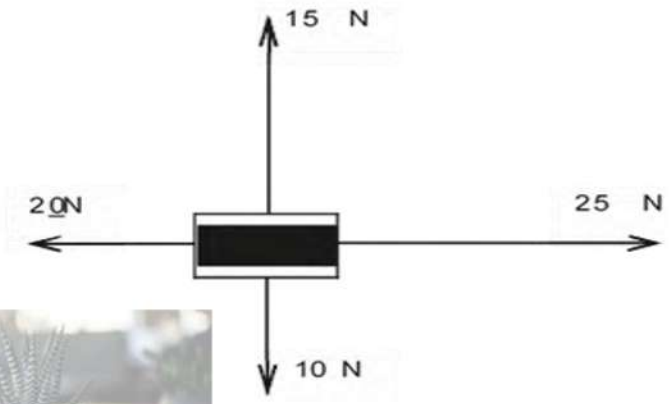
2.4.1 Calculate the sum of the magnitude of the vertical components of forces **X** and **Y**. (3)

2.4.2 Calculate the mass of the body in equilibrium. (3)

[13]

QUESTION 3

Four forces act on an object as shown in the diagram below. The forces are not drawn to scale.



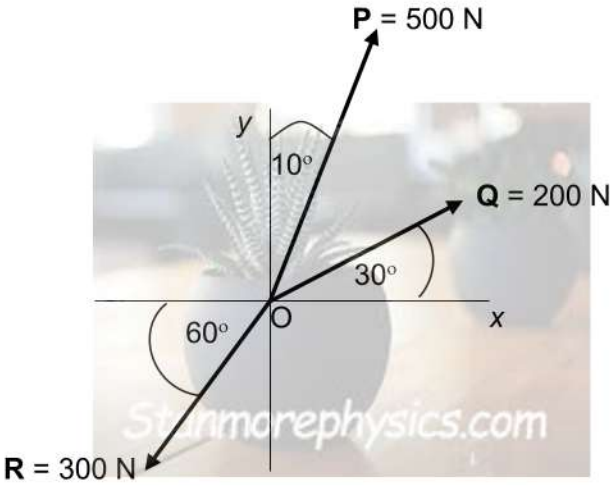
3.1 Use the diagram to calculate:

3.1.1 The resultant of the horizontal forces (Rx). (2)

3.1.2 The resultant of the vertical forces (Ry). (2)

3.1.3 The magnitude and direction of the resultant force acting on the object. (3)

3.2 Three forces, **P**, **Q** and **R**, of magnitudes 500 N, 200 N and 300 N respectively, act on a point **O** in the directions shown in the diagram below.
The forces are NOT drawn to scale.



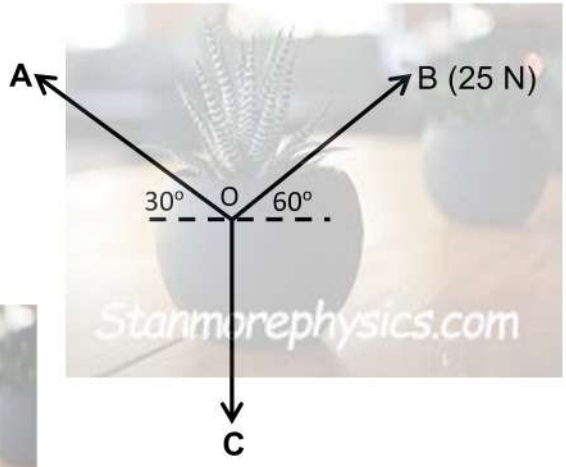
3.2.1 Refer to the information in the diagram above and give a reason why forces **P**, **Q** and **R** are classified as vectors. (1)

3.2.2 Determine the magnitude and direction of the resultant force, either by CALCULATION or by ACCURATE CONSTRUCTION AND MEASUREMENT. (Use scale 10 mm = 50 N.) (8)

[16]

QUESTION 4

Three forces, **A**,**B** and **C**, are holding a body of mass 4,76 kg in a stationary position as shown in the diagram below . The forces are in EQUILIBRIUM. Forces **A** and **B** make angles of 30° and 60° respectively with the horizontal.



4.1 Define the term a *resultant vector*. (2)

4.2 Give a reason why the forces in the diagram above are said to be in equilibrium. (1)

4.3 Draw a closed vector diagram to show all the forces acting on the body. (3)

4.4 Calculate the magnitude of force **A.** (5)

[11]

TOTAL: 50

PHYSICAL CONSTANT AND FORMULA

NAME	FORMULA	VALUE
Acceleration due to gravity	g	9,8 $m.s^{-2}$
W = mg		

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MARKING GUIDELINES

MARKS: 50

This memorandum consists of 5 pages

QUESTION 1

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

[10]

QUESTION 2

2.1 A quantity that has both magnitude and direction. ✓✓ **[2 or 0 mk]** (2)

2.2 R = 50-35 = 15 N ✓ right/ east ✓ **[If no direction, max= 1 mk]** (2)

2.3 Scale: 1cm : 10 N [**OR ANY OTHER SUITABLE SCALE]**

(3)

2.4.1 $F_{YX} = F_x \sin Ø$

$= 35 \sin 30 = 17,5$ N ✓

$F_{YY} = F_Y \sin Ø$

$= 50 \sin 60 = 17,5$ N $= 43, 30$ N ✓

$F_{Y\,(YX)} = 17, 5 + 43, 30 = 60, 80$ N ✓ (3)

2.4.2 $F_Z = F_{Y\,(YX)}$
$mg = 60, 80$ } any 1 ✓
$m(9, 8) = 60, 80$ ✓
$m = 6,20$ kg ✓ (3)

[13]

QUESTION 3

3.1.1 Rx= -20N + 25N✓ = +5N (Right)✓ (2)

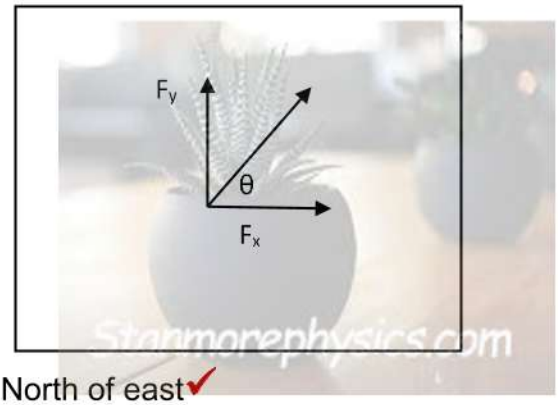
3.1.2 Ry = -10N + 15N✓ = +5N (Upwards)✓ (2)

3.1.3 $R^2 = Rx^2 + Ry^2$

$R^2 = 5^2 + 5^2$✓

$R = \sqrt{25 + 25}$

R = 7.07N



Direction: Tan ø = $\frac{Ry}{Rx} = \frac{5}{5}$

ø = 45°

R = 7, o7 N ✓ in direction N 45° / 45° North of east✓

[If no direction, max= 2 mks]

(3)

3.2.1 Each of them has magnitude and direction. ✓ (1)

3.2.2 **OPTION 1: CALCULATION**

$F_x = P \cos 80° + Q \cos 30° + (-R \cos 60°)$

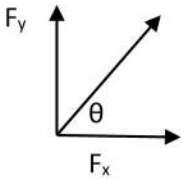
$= 500 \cos 80° + 200 \cos 30° - 300 \cos 60°]$ ✓

$\therefore F_x = 110,03$ N

$F_y = P \sin 80° + Q \sin 30° + (-R \sin 60°)$

$= [500 \sin 80° + 200 \sin 30° - 300 \sin 60°]$ ✓

$\therefore F_y = 332,60$ N



$F_R = \sqrt{(110,03)^2 + (332,60)^2}$ ✓

= 350,33 N

$\theta = \tan^{-1}\frac{(332,60)}{(110,03)}$ ✓✓ = 71,69° ✓ (71,7°)

Resultant force = 350,33 N✓ in direction N 18, 3(1)° E(accept 71,69° North of east)✓

[ACCEPT ANSWERS CORRECTED TO 1 DEC PLACE FOR BEARING / DIRECTION]

NOTE ALSO;

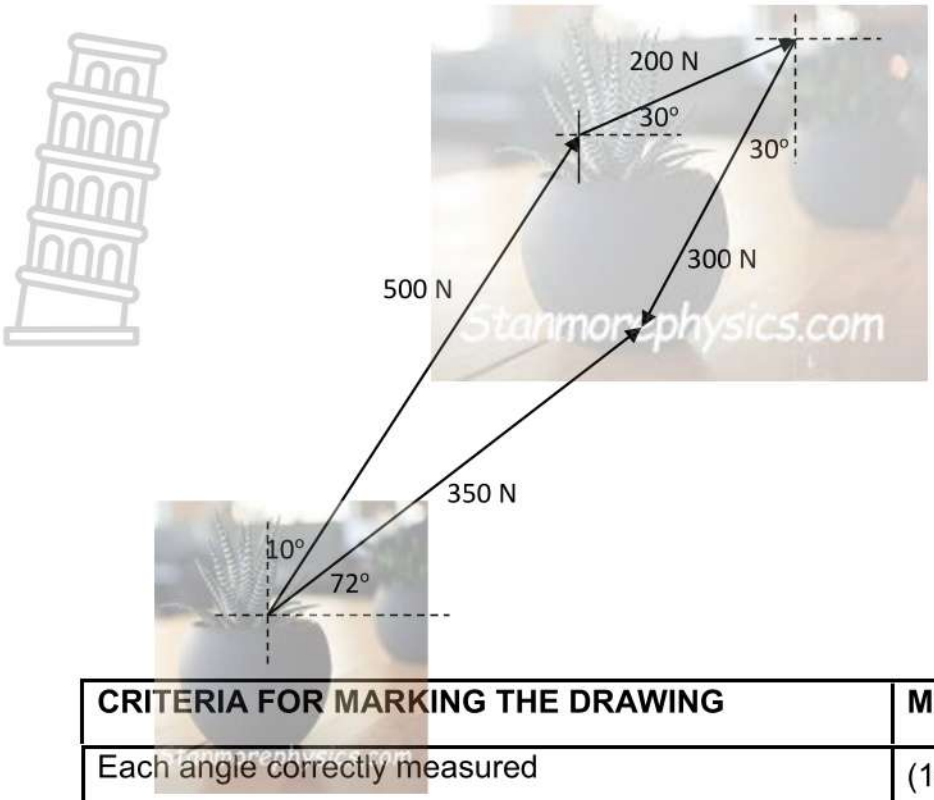
$F_x = P \sin 10° + Q \sin 60° + (-R \sin 30°$

$[500 \sin 10° + 200 \sin 60° - 300 \sin 30°]$✓

$F_y = P \cos 10° + Q \cos 60° + (-R \cos 30°)$

$[500 \cos 10° + 200 \cos 60° - 300 \cos 30°]$✓

OPTION 2: SCALE DRAWING



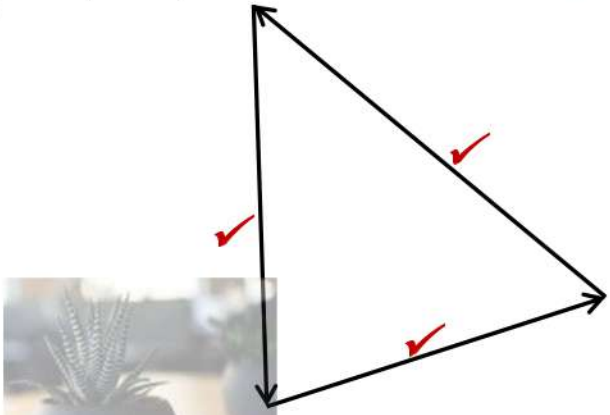
CRITERIA FOR MARKING THE DRAWING	MARK
Each angle correctly measured	(1x3)✓✓✓
Correct tail-to-head drawing of PQR	(1 x3)✓✓✓
For both magnitude and direction correct starting from origin to meet 'head' of vector R	(1x2) ✓✓
ACCEPT: P, Q and R in place of 500 N, 200 N and 300 N respectively.	
Penalise ONE MARK if arrows are omitted.	

(8)
[16]

QUESTION 4

4.1 A single vector having the same effect as two or more vectors together
OR: The vector sum of two or more vectors. ✓✓ **[2 or 0 mk]** (2)

4.2 Fnet = 0 / (Vector) sum of the forces is zero. ✓ (1)

4.3  (3)

4.4 $F_{R(V)} = F_{AV} + F_{BV}$
$= F_A \sin 30° ✓ + 25\sin 60° ✓$
$= F_A \sin 30° + 21{,}651$

$F_C/W = mg$
$F_A \sin 30° + 21{,}651 ✓ = (4{,}76)(9{,}8) ✓$
$F_A = 49{,}99\ N ✓ /50N$ (5)
[11]

TOTAL: 50