education

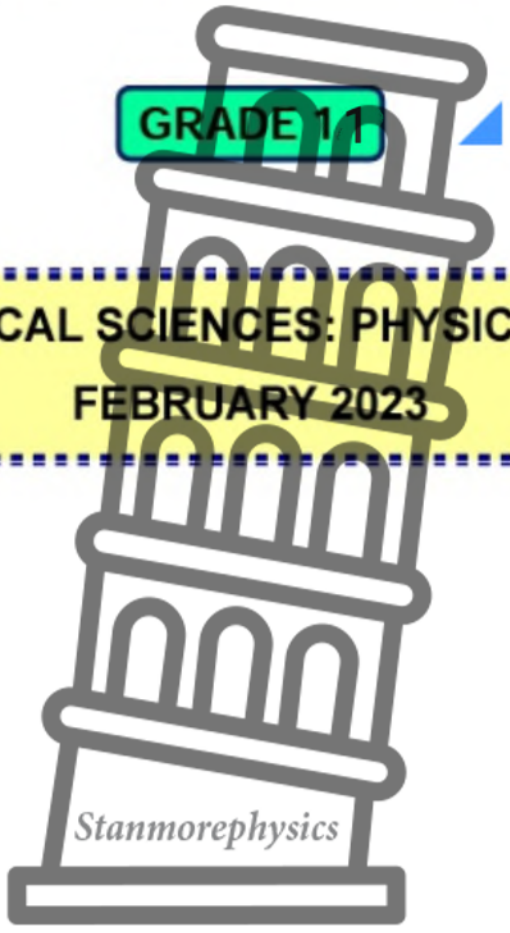
Department:
Education
PROVINCE OF KWAZULU-NATAL

AMAJUBA DISTRICT

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

FEBRUARY 2023



MARKS: 50

TIME: 1 hour

This question paper consists of 7 pages and 1 data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME in the appropriate spaces on the ANSWER BOOK provided.
2. Answer ALL the questions.
3. This question paper consists of ONE section.

   PAPER 1 (PHYSICS)
4. You may use a non-programmable calculator.
5. You may use appropriate mathematical instruments.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.

PAPER 1: PHYSICS

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 correct answer and write the letter (A – D) next to the question number (1.1 – 1.4)

1.1 The frictional force acting on a sliding object is …

A dependent of the apparent area of contact.

B proportional to the normal force.

C dependent of the velocity of object.

D independent of the type of surface. (2)

1.2 When a spaceship moves at constant velocity, it means that the resultant force acting on the body is zero. This phenomenon is best explained by

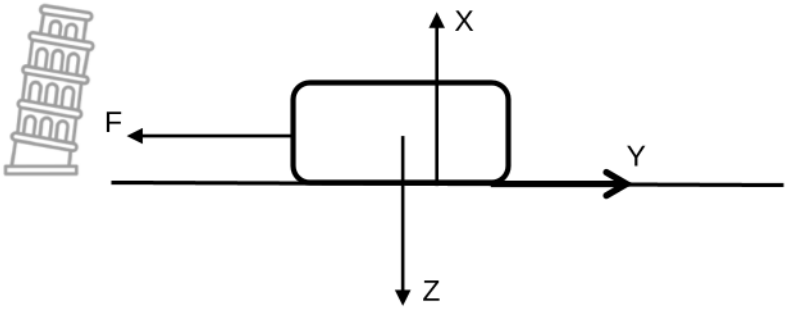
A Newton's First Law.

B Newton's Second Law.

C Newton's Third Law.

D Newton's Universal Gravitational Law. (2)

1.3 A learner pulls a block at a CONSTANT SPEED over a rough horizontal surface with a force F. The force diagram below shows all the forces acting on the block.



Which ONE of the following relationships between the magnitudes of the forces **F**, **X**, **Y** and **Z** is true?

A F > Y and X = Z

B F > Y and X < Z

C F = Y and X = Z

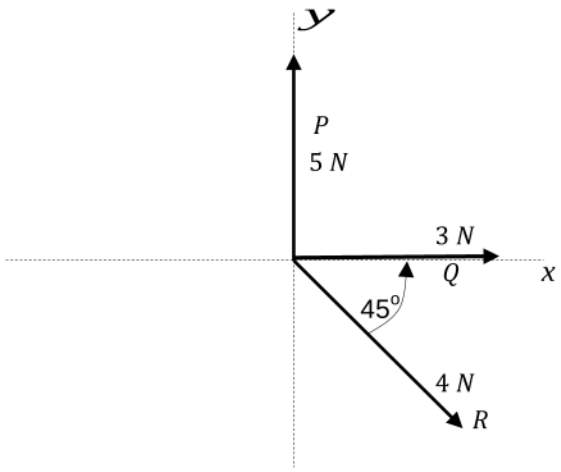
D F = Y and X < Z

(2)

[6]

QUESTION 2

The diagram below shows three forces P, Q and R of 5 N, 3 N and 4 N respectively acting on an object in the same Cartesian plane.



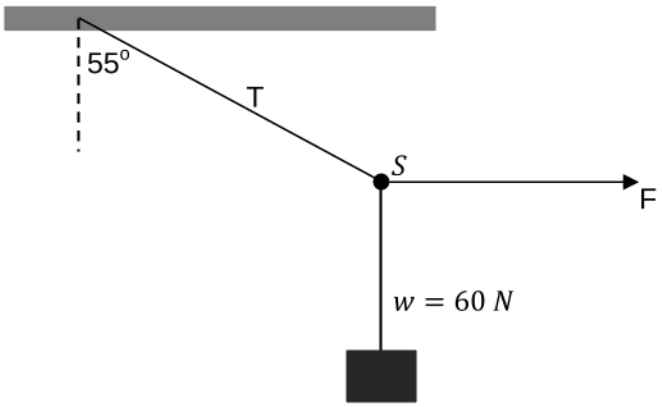
(2)

2.1 Give a reason why the three forces are classified as vectors.

2.2 Determine the magnitude and direction of the resultant force, either by CALCULATION or by ACCURATE CONSTRUCTION AND MEASUREMENT. Use scale 10 mm : 1N

(7)

A box of weight (w) 60 N hangs on a ceiling as shown in the sketch below. A horizontal force F acts horizontally to the right through knot **S**. The knot **S** is in equilibrium.



2.3 Explain what is meant by the knot S is in equilibrium. (2)

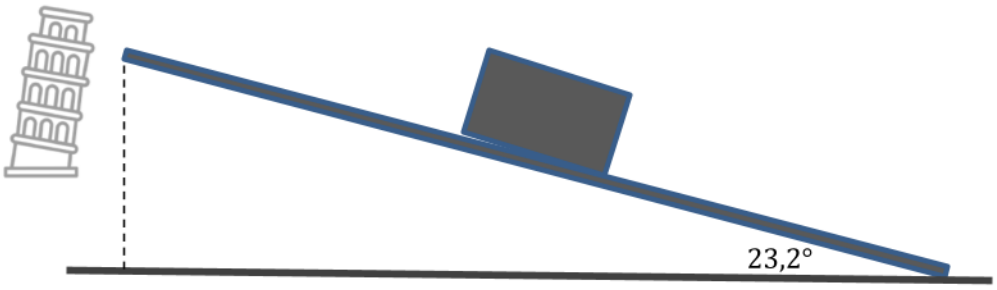
2.4 Draw the triangle of the three forces T, F and w. Clearly label the forces and all the angles. (3)

2.5 Calculate the magnitudes of the force F and the tension T. (4)

[18]

QUESTION 3

A crate of mass 95 kg crate lies on a plank inclined at 23,2°. At this angle the crate is just about to move down the incline. Refer to the diagram below.



3.1 Define the term *frictional force*. (2)

3.2 Sketch a free body diagram showing the force(s) acting on the crate at its current position. (3)

3.3 CALCULATE:

3.3.1 The magnitude of the static frictional force (3)

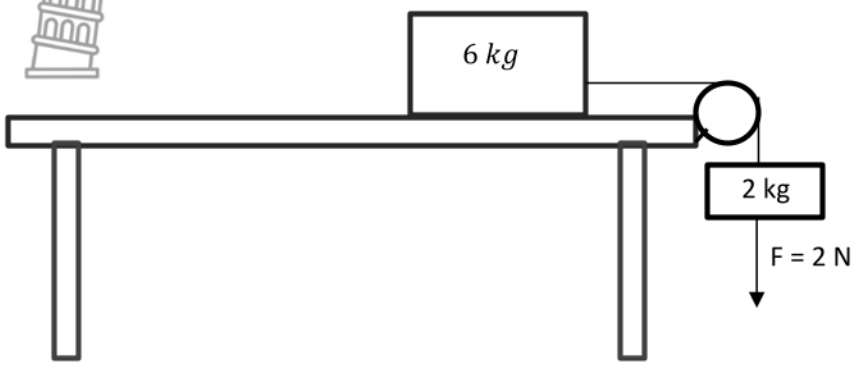
3..3.2 The coefficient of static friction between the plank and the block. (5)

3.4 The plank is now tilted at an angle of 20.0°. State whether the static friction force will be LESS THAN; EQUAL TO; OR GREATER THAN Question 3.3.1 above. (1)

[14]

QUESTION 4

A 6 kg block on a horizontal rough surface is joined to a 2 kg block by a light, inelastic string running over a frictionless pulley. The frictional force between the 6 kg block and the table is 11,76 N. A downwards force F of 2 N is applied to the 2 kg block as indicated in the diagram below.



4.1 State Newton's Second Law of motion in words. (2)

4.2 Identify ONE action-reaction force pair acting on the 6 kg block. (2)

4.3 CALCULATE:

4.3.1 The magnitude of the acceleration of the 6 kg block. (5)

4.3.2 The magnitude of the tension (T) in the string connecting the two blocks (2)

4.4 The rough surface is replaced by a smooth frictionless surface. How will this change affect the answer in QUESTION 4.4.1? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

[12]

DATA FOR PHYSICAL SCIENCES

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9{,}8\ m{\cdot}s^{-2}$
Universal gravitational constant	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Electron mass	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of Earth	M_E	$5{,}98 \times 10^{24}\ kg$
Radius of Earth	R_E	$6{,}38 \times 10^{6}\ m$

TABLE 2: FORMULAE

MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ 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

$F_{net} = ma$	$w = mg$
$f_{s(max)} = \mu_s N$	$f_k = \mu_k N$
$F = \frac{Gm_1m_2}{r^2}$ OR $F = \frac{Gm_1m_2}{d^2}$	$g = \frac{Gm}{r^2}$ OR $g = \frac{Gm}{d^2}$

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MEMORANDUM

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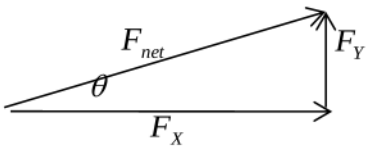
QUESTION 1

1.1	B ✓✓	(2)	
1.2	C ✓✓	(2)	
1.3	C ✓✓	(2)	
		[6]	

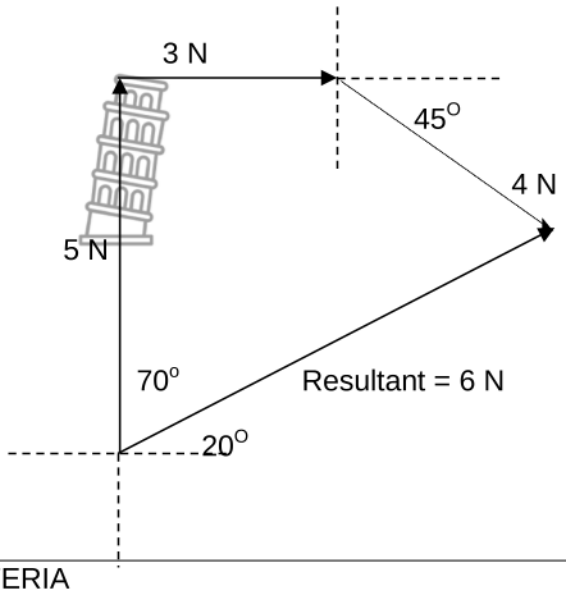
QUESTION 2

2.1	They have both magnitude and direction. ✓✓	(2)	

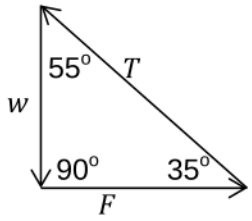
2.2			
	$F_x = Q + Rcos\,45°$ $= 3 + 4\cos 45°$✓ $= 5{,}828\ N$, right $F_y = P - Rsin\,45°$ $= 5 - 4\sin 45°$✓ $= 2{,}172\ N$, up  $F_{net} = \sqrt{F_x^2 + F_y^2}$ $= \sqrt{5{,}828^2 + 2{,}172^2}$ ✓ $= 6{,}22N$ $\tan\theta = \frac{F_y}{F_x}$ $\tan\theta = \frac{2{,}172}{5{,}828}$ ✓✓ $\theta = 20{,}44°$ Resultant force = 6,22 N✓ in direction: 20,44° ✓OR Bearing 69,56°, N69,56°E or 20,44° North of East	(7)	

2.2

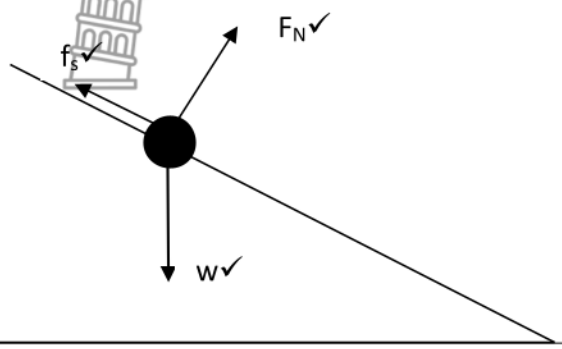
SCALE DRAWING:



CRITERIA	MARK
Each angle correctly measured	1 × 2
Correct tail to head drawing of PQR	1 × 3
Resultant both magnitude and direction correct starting from origin to head of vector R	1 × 2
TOTAL	7 MARKS

2.3	The resultant of all forces ✓acting at point S is zero ✓	(2)	
2.4	 • Correct shape of triangle ✓ • Forces labelled and point correct directions ✓ • Labelled angles are all correct ✓	(3)	
2.5	$\sin 35° = \frac{w}{T}$ $\sin 35° = \frac{60}{T}$✓ $T = 104{,}61\ N$✓ $\tan 35° = \frac{w}{F}$ $\tan 35 = \frac{60}{F}$✓ $F = 85{,}69\ N$✓	(4)	ACCEPT: Sine rule, cosine rule, component method and any other trigonometric method
		[18]	

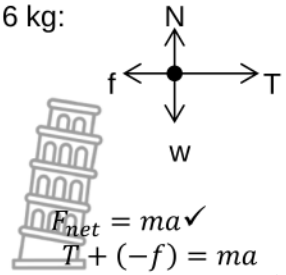
QUESTION 3

3.1	The force that opposes the motion of an object ✓and which acts parallel to the surface. ✓	(2)	
3.2		(3)	Other labels to be accepted: Normal/ N Friction/ f Weight/ gravity/ F_g

3.3	3.3.1 $f_s = \text{mg} \sin \theta$✓ $= 95{,}0 \times 9.8 \times \sin 23.2°$✓ $= 366.76\ \text{N}$ ✓	(3)	
	3.3.2 $\text{N} = \text{mg} \cos \theta$✓ $\text{N} = 95.0 \times 9.8 \times \cos 23.2°$ ✓ $\text{N} = 855.72\ \text{N}$ $f_s = \mu_s \text{N}$✓ $366{,}76 = \mu_s \text{x}\, 855{,}72$✓ $\mu_s = 0{,}43$✓	(5)	
3.4	Less than ✓	(1)	
		[14]	

QUESTION 4

4.1	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 force✓ and inversely proportional to the mass of the object. ✓	(2)	
4.2	Force of the block on the table ✓and the force of the table on the block. ✓ OR Force of the block on the string ✓and the force of the string on the block. ✓	(2)	

4.3			
	4.3.1 6 kg:  $F_{net} = ma$✓ $T + (-f) = ma$ $T - 11.76 = 6a$✓ ... ... (1) 2 kg:  $F_{net} = ma$ $w + F + (-T) = ma$ $(2 \times 9.8) + 2 - T = 2a$✓ $21,6 - T = 2a$ ... ... (2) (1) + (2): $9,84 = 8a$✓ $a = 1,23\ m \cdot s^{-2}$✓	**(5)**	
	4.3.2 T – 11,76 = 6(1,23) ✓ T = 19,14 N✓	**(2)**	
4.4	Increases ✓	**(1)**	
		[12]	