education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GERT SIBANDE DISTRICT

GRADE 11

PHYSICAL SCIENCES TOPIC TEST

TOPIC: NEWTON'S LAWS

FEBRUARY 2023

MARKS: 50

TIME: 1:00 HOUR

This question paper consists of 6 pages including the data sheet

INSTRUCRIONS AND INFORMATION

1. Answer ALL questions.
2. Number all your answers correctly.
3. You are advised to use the attached DATA SHEET.
4. Write neatly and legibly.

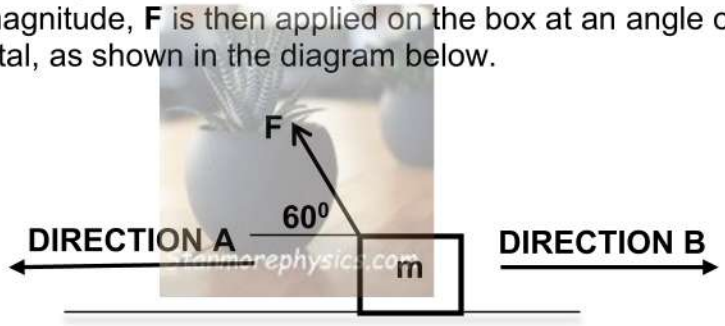
QUESTION 1

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question number (1.1 - 1.2) in the answer sheet, eg; 1.3 A.

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

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

1.2 A box of mass **m**, is **at rest** on a rough horizontal surface. A force of Constant magnitude, **F** is then applied on the box at an angle of 60° to the horizontal, as shown in the diagram below.



If the box has a uniform horizontal acceleration of magnitude, ***a***, the frictional force acting on the box is:

A F cos60° - ma in the direction of A

B F cos60° - ma in the direction of B

C F sin60° - ma in the direction of A

D F sin60° - ma in the direction of B (2)

[4]

QUESTION 2

In the diagram below, a box of mass 6 kg is pulled with a force of 40 N on a rough surface and it accelerates to the left.

The kinetic frictional force between the surface and the box is 22 N.

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

2.2 Calculate the magnitude of the acceleration of the box. (3)

2.3 The box above is now placed on a rough horizontal table and joined to a 8 kg mass by a light, inextensible string running over a frictionless pulley, as shown in the diagram below.

The kinetic frictional force between the 6 kg box and the surface is 7, 64 N. calculate:

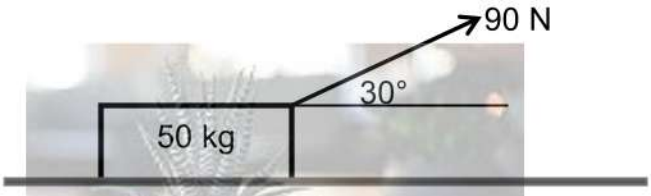
2.3.1 Draw a free body diagram of ALL forces acting on the 8 kg mass. (2)

2.3.2 The magnitude of the acceleration of the 6 kg box. (5)

[12]

QUESTION 3

In the diagram below, a force of 90 N is applied to a 50 kg block at an angle 30° to the horizontal. The block moves at a CONSTANT VELOCITY of 2 m·s^{-1} to the right on the rough surface.



3.1 State *Newton's second law* in words. (2)

3.2 Draw a free body diagram of ALL forces acting on the block. (4)

3.3 Calculate the magnitude of:

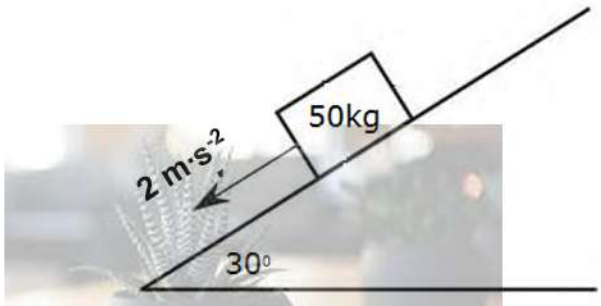
3.3.1 The vertical component of the applied force. (2)

3.3.2 The normal force. (3)

3.3.3 Frictional force. (3)

3.4 What will happen to the coefficient of frictional force between the block and the surface if the angle of the applied force is decreases from 30^0 to 26^0?
Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

3.5 The block above is now removed from the horizontal surface and then Placed on a slope that makes an angle of 30° with the horizontal as shown in the diagram below.



The block accelerates at 2 m·s^{-2} down the slope.

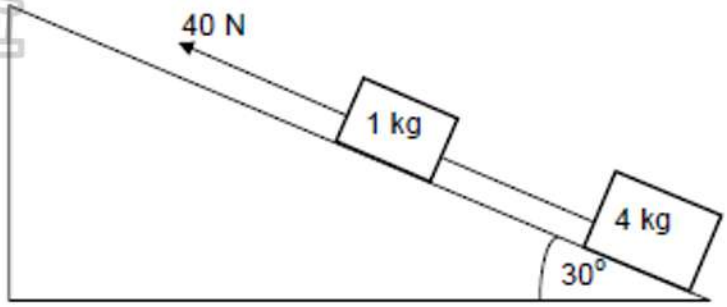
3.5.1 Define the term *kinetic frictional force* in words. (2)

3.5.2 Calculate the magnitude and direction of the frictional force which acts on the block (3)

[20]

QUESTION 4

A block of mass 1 kg is connected to another block of mass 4 kg by a light inextensible string. The system is pulled up a rough plane inclined at 30° to the horizontal, by means of a constant 40 N force parallel to the plane as shown in the diagram below.

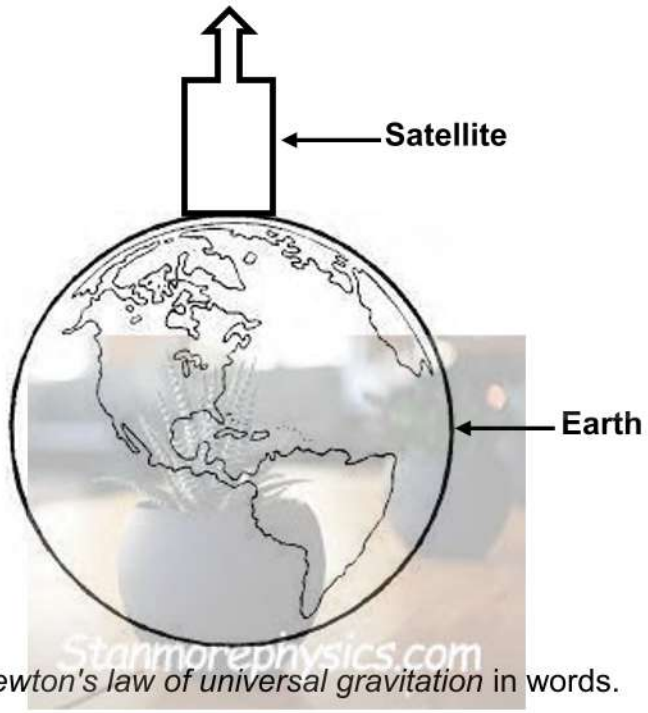


The magnitude of the kinetic frictional force between the surface and the 4 kg block is 10 N. The magnitude of the kinetic frictional force between the surface and the 1 kg block is 2,46 N.

4.1 Draw a labelled free-body diagram showing ALL forces acting on the **4 kg block** as it moves up the incline. (4)

4.2 Calculate the magnitude of the tension in the string connecting the two blocks. (5)

4.3 In the diagram below, a satellite on a research mission is on the earth's surface.



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

4.3.2 If the earth exerts a force of 5 900 N on satellite to keep it in its position, calculate the mass of the satellite. (3)

[14]

TOTAL:53

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant	G	6,67 × 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth	R_E	6,38 x 10^6 m
Mass of the earth	M	5,98 x 10^{24} kg

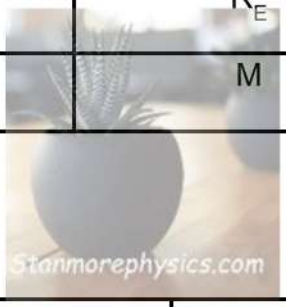


TABLE 2: FORCES

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

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MARKING GUIDELINES

MARKS: 50

This memorandum consists of 5 pages

QUESTION 1

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

[4]

QUESTION 2

2.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓ **[2 or 0 mk]** (2)

2.2
$F_{net} = ma$ ✓
$F + (-f_k) = ma$
$40 + (-22) = 6a$ ✓
$a = 3\ m.s^{-2}$ ✓ (3)

2.3.1

(2)

2.3.2

6 KG BOX	8 KG MASS
$F_{net} = ma$ ✓ $T + (-f_k) = ma$ $T + (-7,64) = 6a$ ✓ $T = 6a + 7,64$ --------- (1)	$F_{net} = ma$ $W - T = ma$ $9,8(8) - T = 8a$ ✓ $78,4 - T = 8a$ $T = 78,4 - 8a$-------- (2)
(1) = (2) $6a + 7,64 = 78,4 - 8a$ ✓ $a = 5,054\ \underline{m.s^{-2}}$ ✓	

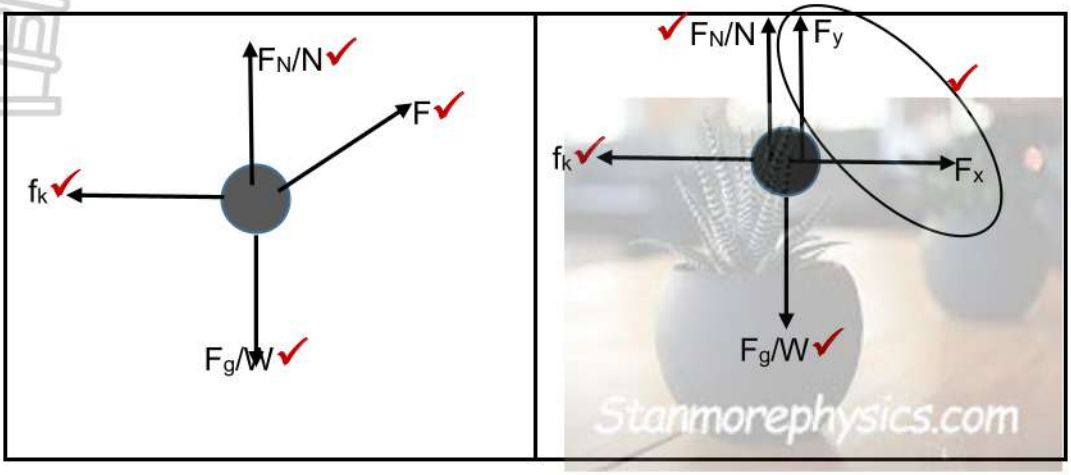
(5)

[12]

QUESTION 3

3.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at acceleration directly proportional to the force and inversely proportional to the mass of the object. ✓✓ **[2 or 0 mk]** (2)

3.2



(4)

3.3.1 $F_y = F \sin \theta$

$F_y = 90 \sin 30^0$ ✓

$F_y = 45$ N ✓ (2)

3.3.2 **POSITIVE MARKING FROM Q 3.3.1**

$N = W - F_y$ ✓

$N = 50 \times 9.8 - 45$ ✓

$N = 445$ N ✓ (3)

3.3.3 $F_{net} = ma$

$F\cos\theta + (-f_k) = 0$] **Any 1** ✓

$90 \cos 30^0 - fk = 0$ ✓

$fk = 77{,}942$ N ✓ (3)

3.4 REMAINS THE SAME ✓ (1)

3.5.1 the force that opposes the motion of a moving object relative to a surface. ✓✓ **[2 or 0 mk]** (2)

3.5.2 $F_{net} = ma$

$mg\sin\theta + (-f_k) = ma$] **Any 1** ✓

$50 \times 9{,}8 \sin 30^0 - f_k = 50 \times 2$ ✓

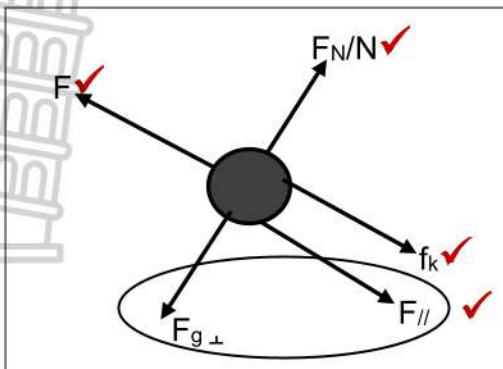
$f_k = -145$

$f_k = 145$ N up the slope ✓ **[If no direction, max= 2 mks]** (3)

[20]

QUESTION 4

4.1



(4)

4.2 $Fnet = ma$ ✓

1kg

$F_A + T + f + F_{G\|} = ma$

$40 - T - 2{,}46 - (1)(9{,}8)sin30° = 1a$ ✓

$40 - T - 2{,}46 - 4{,}9 = a$

$32{,}64 - T = a$ ……..**(1)**

4kg

$T + F_{G\|} + f = ma$

$T - (4)(9{,}8)sin30° - 10 = 4a$ ✓

$T - 19{,}6 - 10 = 4a$

$T - 29{,}6 = 4a$ ……..**(2)**

(1)+(2)

$32{,}64 - T = a$

$\underline{T - 29{,}6 = 4a}$

$3{,}04 = 5a$

$a = 0{,}608\ m \cdot s^{-2}$

$\therefore\ T - 29{,}6 = (4)(0{,}61)$ ✓

$\therefore\ T = 32{,}04\ N$ ✓

(5)

4.3.1 Any two objects in the universe attract each other with a force directly proportional to the product of their masses and ✓ inversely proportional to the square of the distance between their centres. ✓

(2)

4.3.2 $F_g = \frac{Gm_1m_2}{r^2}$ ✓

$5900 = \frac{(6{,}67 \times 10^{-11})(5{,}98 \times 10^{24})m}{(6{,}38 \times 10^{6})^2}$ ✓

m = 602,097 kg ✓

(3)
[14]

TOTAL: 50