ALEXANDER ROAD HIGH SCHOOL

June 2022	**PHYSICAL SCIENCES JUNE PAPER 1**	2 HOURS
MH	**GRADE 11**	TOTAL = 100

Instructions:

- The question paper consists of 6 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- A formula sheet has been provided on the back of the answer sheet.

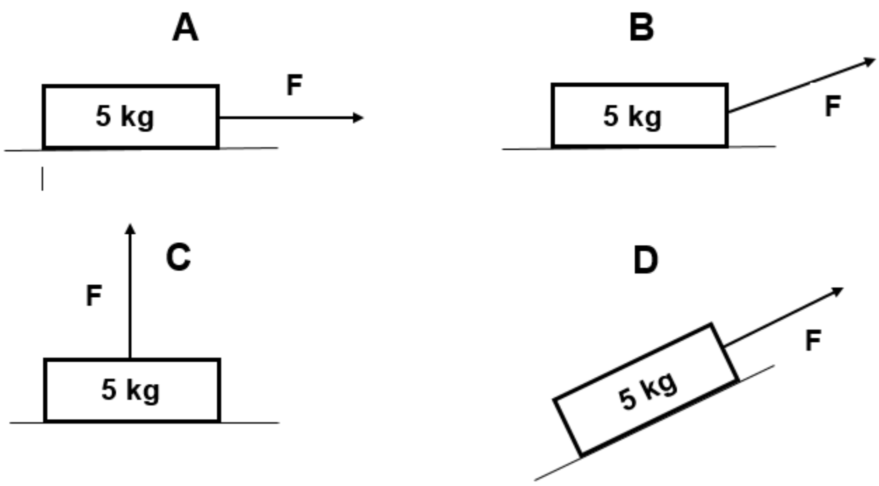
SECTION A

(answer on the answer sheet)

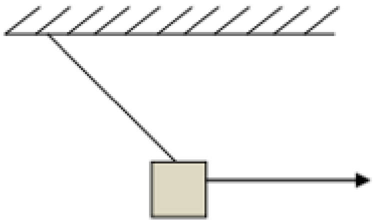
QUESTION 1:

Four possible options are provided as 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 relevant question number (1.1 – 1.10) on the answer sheet.

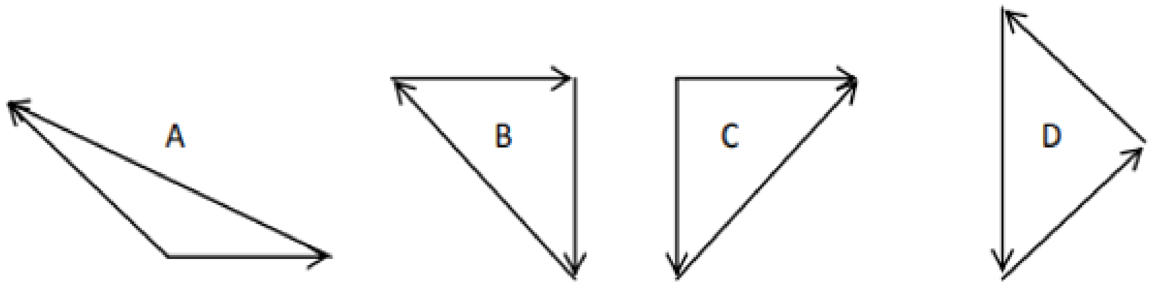
1.1 A 5 kg block is placed on a surface and pulled with a 5 N force (**F**). In which case will the normal force be the **GREATEST**?



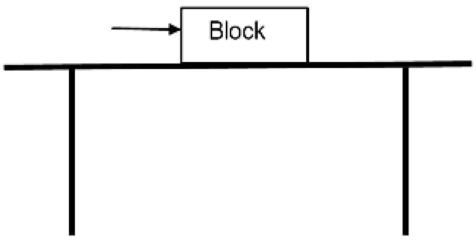
1.2 An object is suspended from the ceiling and pulled to the right. The object is at equilibrium.



If the force vectors are added, the correct representation of their addition is:



1.3 A wooden block placed on a table is pushed, causing it to accelerate to the right. Which ONE of the following statements regarding the frictional force is correct?



The frictional force is

A. increasing as the speed increases.

B. equal and opposite to the pushing force.

C. greater than the pushing force.

D. less than the pushing force.

1.4 Newton's first law of motion can be represented mathematically by:

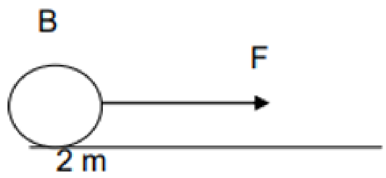
A. $F_{net} = ma$

B. $F_{net}.\triangle t = m\triangle v$

C. $F_{AB} = -F_{BA}$

D. $F_A + F_B + F_C + \ldots. = 0$

1.5 Two constant forces each of magnitude **F** N act at the same time on two different bodies A and B. The mass of B is twice the mass of A. Ignore friction.



The magnitude of the acceleration of B is …. the acceleration of A.

A. twice

B. half

C. equal to

D. one quarter

1.6 A net force of 1 N is the force which, when acting on an object of mass 1 kg, will …

A. move it a distance of 1 m.

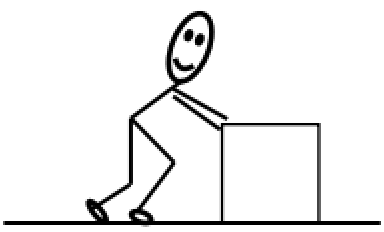
B. lift it a height of 1 m.

C. move it at a velocity of 1 $m.s^{-1}$.

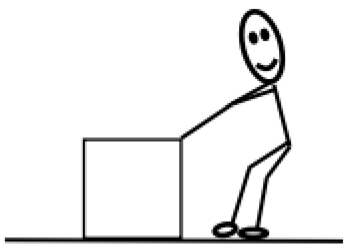
D. increase its velocity by 1 $m.s^{-1}$ in 1 second.

1.7 Olwethu needs to move a large box from left to right across a rough floor. Which ONE of the following diagrams, showing the options of exerting a force, will result in the least amount of friction on the box?

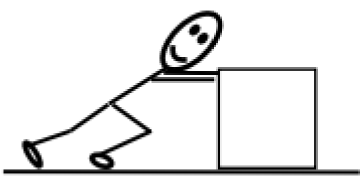
A. Pushing downwards



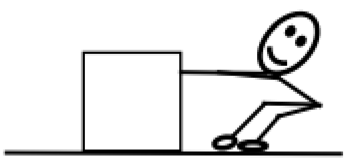
B. Dragging upwards



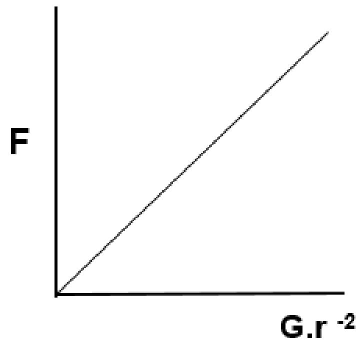
C. Pushing horizontally



D. Dragging horizontally



1.8 The relationship between the magnitude of the gravitational force **F** and the distance **r** between a satellite and the centre of the planet it orbits is investigated. The mass of the planet is **M** and the mass of the satellite is **m** respectively. The following graph is obtained.



The gradient of the graph is ….

A. $\frac{G}{m.M}$

B. $\frac{m.M}{r^2}$

C. $m.M$

D. $\frac{G.m.M}{r^2}$

1.9 The acceleration due to gravity on Earth is greater than that on the moon.
Which ONE of the following statements is CORRECT?

A. The weight of an object on Earth is the same as that on the moon.

B. The mass of an object on Earth is greater that on the moon.

C. The mass of an object on Earth is less than that on the moon.

D. The weight of an object on Earth is greater than on the moon.

1.10 When two objects with mass are a distance **r** apart, the gravitational force between them is **F**. If one object's mass is tripled, the other object's mass is halved and the distance between them is cut in half, then the new force will be….

A. 0,375**F**

B. 3**F**

C. 6**F**

D. 0,75**F**

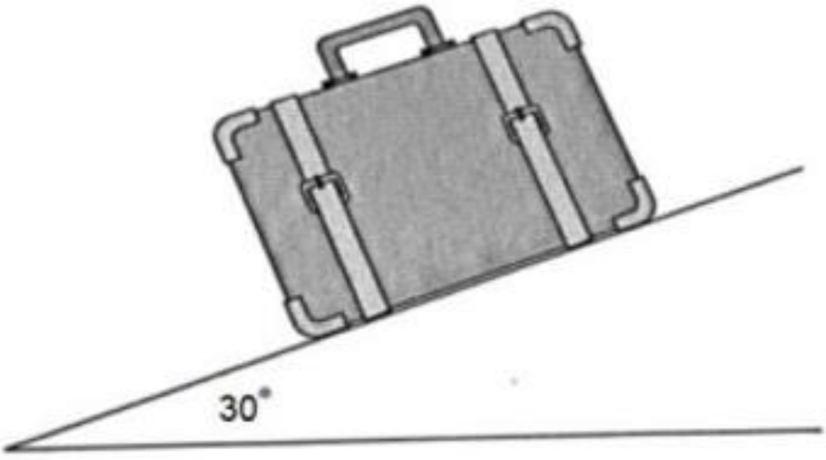
TOTAL SECTION A = [20]

SECTION B

(answer on folio paper)

QUESTION 2:

The sketch below shows a large suitcase with a mass of 23 kg resting on a rough incline at an angle of 30° to the ground.



2.1 Define *static friction* in words. (2)

2.2 Draw a labelled *vector* diagram of all the forces acting on the suitcase. (3)

2.3 Calculate the magnitude of the force of friction that keeps the suitcase stationary on the incline. (3)

2.4 Calculate the coefficient of static friction between the suitcase and the incline, if the suitcase is just about to move down the incline. (5)

[13]

QUESTION 3:

An empty lift is supported by a steel cable. The lift moves upwards at a constant speed while an upwards force of 2 000 N is applied by the cable. Ignore the mass of the cable and all frictional forces.

3.1 State *Newton's First Law of Motion* in words. (2)

3.2 Draw a labelled *force* diagram indicating all the forces acting on the lift while it is traveling upwards at a constant speed. (2)

3.3 Calculate the *mass* of the empty lift. (3)

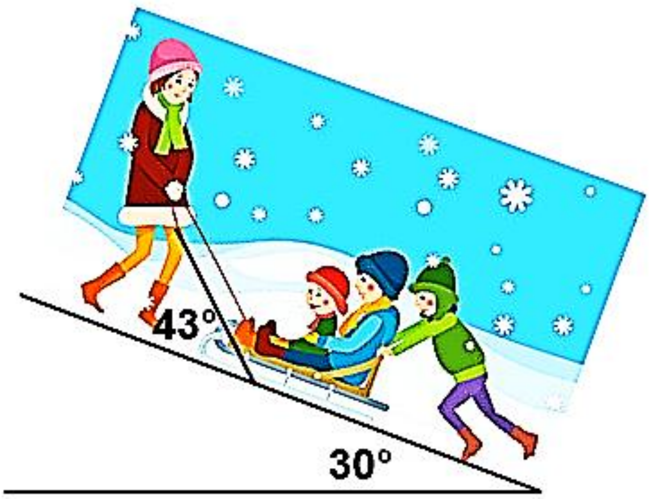
3.4 When the 2 000 N force of the cable is replaced by a force of 2 500 N, the lift accelerates upwards. Calculate the magnitude of this acceleration. (3)

3.5 Identify the force that forms a force pair with the weight of the empty lift according to Newton's Third Law of Motion. (1)

[11]

QUESTION 4:

A group of children wants to go sledding. Heidi is pulling the sled up the hill with a force of 200 N, at an angle of 43° with the slope. Peter is pushing the sled with a force of 150 N. Peter exerts the force parallel to the slope. The combined mass of the sled and Jack and Jill, sitting on the sled, is 50 kg. Ignore friction on the snow.



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

4.2 For the force that Heidi exerts on the sled, calculate the magnitude of the components parallel and perpendicular to the slope. (2)

4.3 Draw a free-body diagram of all the forces acting on the sled. (4)

4.4 Calculate the magnitude of the acceleration of the sled up the incline. (5)

4.5 Calculate the normal force acting on the sled. (4)

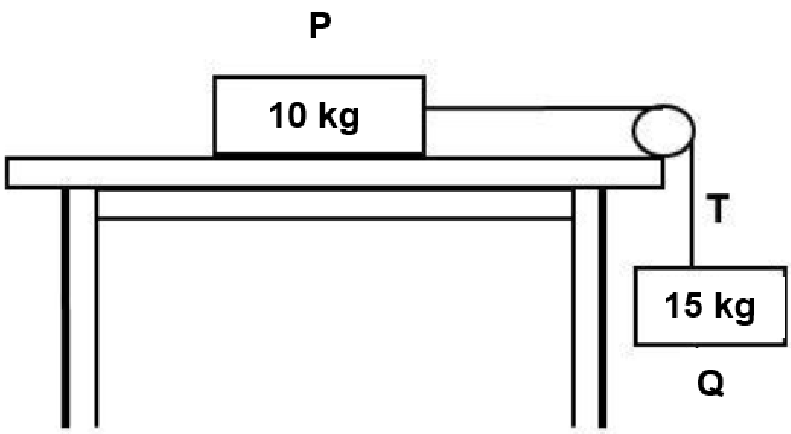
4.6 The children hit a grassy patch on the way up the slope. The coefficient of kinetic friction between the sled and the grass is 0,25. Calculate the magnitude of the kinetic friction of the sled on the grass. (3)

4.7 By how much must Peter increase the force he exerts on the sled in order for the sled to keep moving at *constant velocity* over the grassy patch? (4)

[24]

QUESTION 5:

Block **P**, with a mass of 10 kg, is connected to block **Q**, with a mass of 15 kg, with a light, inextensible string which passes over a frictionless pulley. Block **P** is on a rough plane.
See diagram below.



The coefficient of kinetic friction between block **P** and the surface is 0,25.

5.1 State *Newton's Third Law of Motion* in words. (2)

5.2 Draw a labelled *free-body* diagram of all the forces acting on block **P**. (4)

5.3 Calculate the kinetic friction on block **P** as it moves to the right. (4)

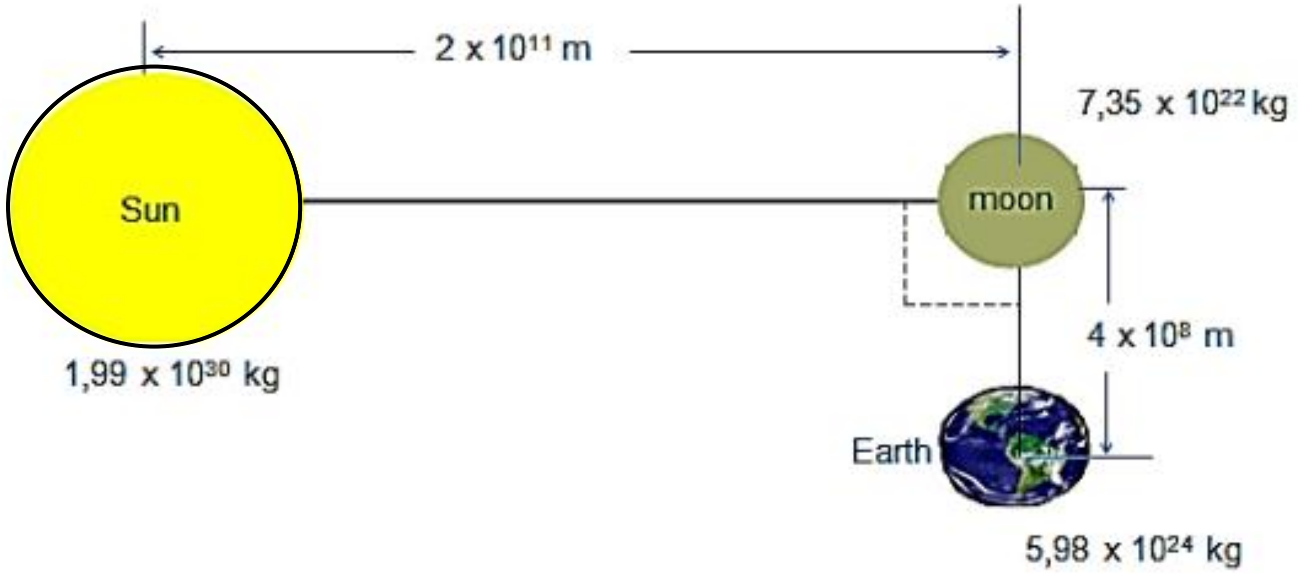
5.4 Calculate the acceleration of block **P**. (6)

5.5 Calculate the magnitude of the tension, **T**, in the string that connects block **P** and block **Q**. (2)

[18]

QUESTION 6:

Consider the diagram below, which is not drawn to scale.



The masses of the Sun, moon and Earth are 1,99 x 10^{30} kg, 7,35 x 10^{22} kg and 5,98 x 10^{24} kg respectively. The distance between the centres of the Sun and the moon is 2 x 10^{11} m and the distance between the centres of the moon and the Earth is 4 x 10^{8} m.

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

6.2 Calculate the magnitude of the gravitational force that the Sun exerts on the Earth when they are at the position indicated on the diagram. (4)

6.3 What is the magnitude of the gravitational force that the Earth exerts on the Sun when they are at the position indicated on the diagram? (2)

6.4 Most electronic scales measure weight rather than mass but are calibrated to give a reading in kg.

An astronaut takes a sample of moon rock. She places the sample on a scale. While on the moon, the scale reads 1,5 kg. When she returns to Earth and weighs the moon rock on the same scale, the reading is 8,67 kg. (6)

Calculate the radius of the moon.

[14]

TOTAL SECTION B = [80]

Formula Sheet

Physical Constants:

Name	Symbol	Value
Acceleration due to gravity	g	9,8 $m.s^{-2}$
Gravitational constant	G	$6,67 \times 10^{-11}$ $N.m^2.kg^{-2}$
Radius of Earth	R_E	$6,38 \times 10^6$ m
Mass of Earth	M_E	$5,98 \times 10^{24}$ kg

Formulae:

MOTION

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

FORCE

$F_{net} = ma$	$w = mg$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{r^2}$