ALEXANDER ROAD HIGH SCHOOL

May 2019 | 2 HOUR

PHYSICAL SCIENCE PAPER 1

MH | TOTAL = 100

GRADE 11

Instructions

- The question paper consists of 7 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- Rule off after each question in Section B.
- 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.
- Formulas have been included at the end of the question paper.

SECTION A

- Answer on the answer sheet -

QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only 1 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 Two forces, X and Y, acting on a single point can be replaced by a single force of magnitude 10 N. If the magnitude of X is 4 N, which one of the following could be the magnitude of Y?

A 15 N

B 13 N

C 4 N

D 5 N

1.2 A block is suspended by a single, vertical string from the ceiling. Which force forms a Newton's third law force pair with the weight of the block?

A The gravitational force exerted by the block on the Earth.

B The force from the ceiling acting on the block.

C The weight of the block has no Newton's third law force pair as the block is suspended in the air.

D The force of tension in the string acting on the block.

1.3 Which set of physical quantities consist only of scalar quantities?

A Velocity, speed and time.

B Displacement, velocity and acceleration.

C Time, distance and speed.

D Acceleration, speed and distance.

1.4 A car is travelling west at 12 $m.s^{-1}$ when the driver notices a stop sign. The driver applies the brakes and the car stops at the stop sign. Which is the best description of velocity and acceleration of the car while it is slowing down?

	Velocity ($m \cdot s^{-1}$)	**Acceleration ($m \cdot s^{-2}$)**
A	East	East
B	West	East
C	East	West
D	West	West

1.5 A car travels WEST at constant velocity. The net force on the car is ….

A WEST

B EAST

C ZERO

D Not enough information to determine the net force.

1.6 A student weighing 500N stands on a scale in an elevator (lift) moving down. When the scale reads 540N, the elevator must be ….

A increasing speed
B decreasing speed
C moving at constant speed
D in free-fall

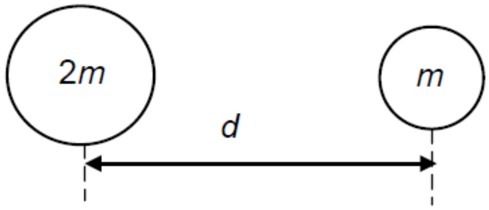
1.7 A bus stops suddenly. The standing passengers tumble forward as a result of their …

A velocity
B inertia
C acceleration
D weight

1.8 Jack is much stronger and bigger than Jill. They lean on each other and both are stationary.
Which one of the following statements is correct when they lean on each other?

A Jack exerts a bigger force on Jill because he is stronger than Jill.
B Jill must exert the bigger force because she has to stop the bigger, heavier Jack from falling on top of her.
C The action-reaction pair cancels each other out.
D Jack and Jill exert forces of equal magnitude on each other.

1.9 Two objects of masses *2m* and *m* are arranged as shown in the diagram below.



Which ONE of the changes below will produce the GREATEST increase in the gravitational force exerted by the one mass on the other?

A Double the larger mass.

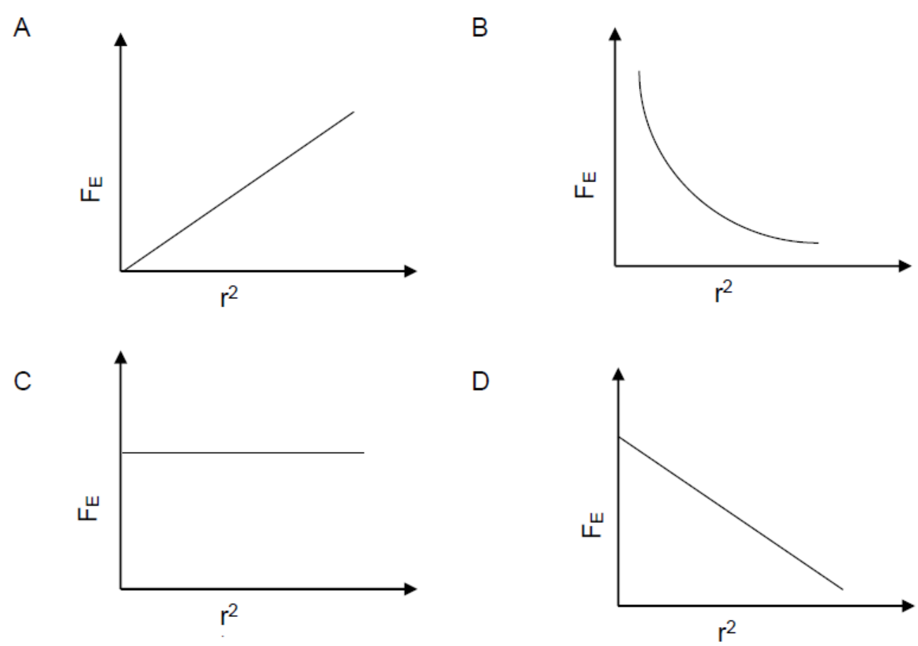
B Double the smaller mass.

C Double the distance between the masses.

D Halve the distance between the masses.

1.10 Two charged particles are placed a distance, r, apart. The electrostatic force exerted by one charged particle on the other is F_E.

Which ONE of the following graphs CORRECTLY represents the relationship between the electrostatic force, F_E, and the square of the distance, r^2, between the two charges?

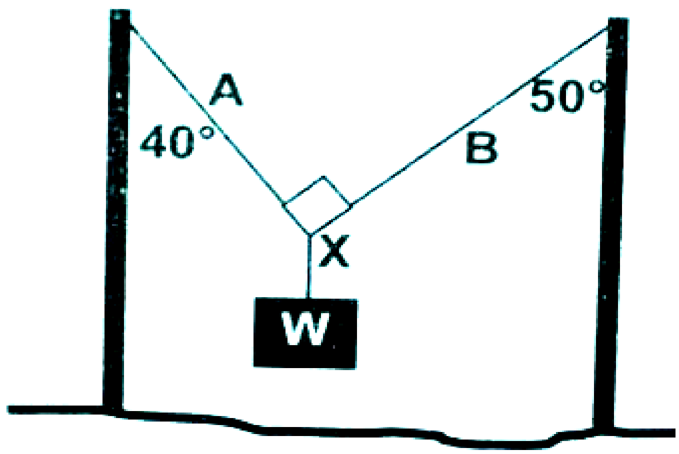


[2 x 10 = 20]

SECTION B

QUESTION 2

A crate with weight **W** is suspended from a light rope by means of a strong hook which is fixed at position **X**. The rope is strung between two vertical supports as shown in the sketch.



2.1 Why would a vector diagram of the forces acting on point **X,** joined tail to tip, result in a **closed** vector diagram? (1)

2.2 Define *resultant vector.* (2)

2.2 Draw the vector diagram mentioned in 2.1. Label each force and indicate the size of each angle. Drawing does **NOT** have to be to scale. (6)

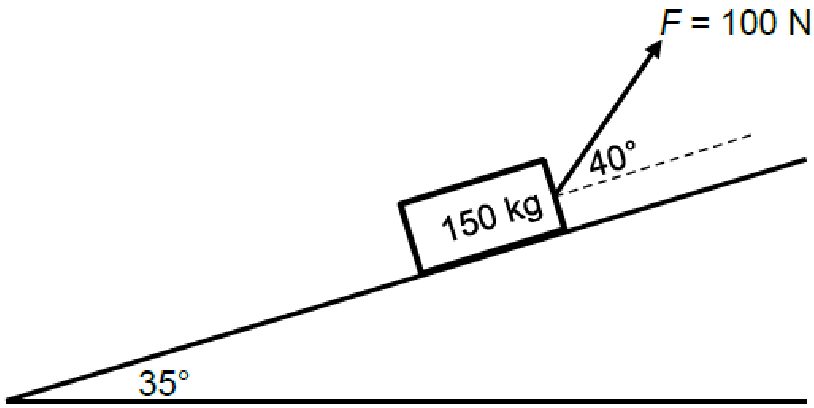
2.3 In which part of the rope is the force greater, in **A** or in **B**? Give a reason for your answer based on your sketch in 2.2. (2)

2.4 The rope will break if the force in the rope exceeds 500N. Determine the maximum weight which the above arrangement can support. (3)

[14]

QUESTION 3

A box of mass 150 kg is prevented from sliding down the slope by a force, *F*, of 100 N acting at 40° to the rough inclined plane as shown. The plane is inclined at 35° to the horizontal and the coefficient of static friction between the box and the surface is 0,7.



3.1 State Newton's first law of motion in words. (2)

3.2 Draw a labelled free-body diagram showing ALL the forces acting on the box. (4)

3.3 Calculate the magnitude of the frictional force that is acting on the box. (5)

The size of force *F* is slowly reduced from 100 N until the box is about to slide.

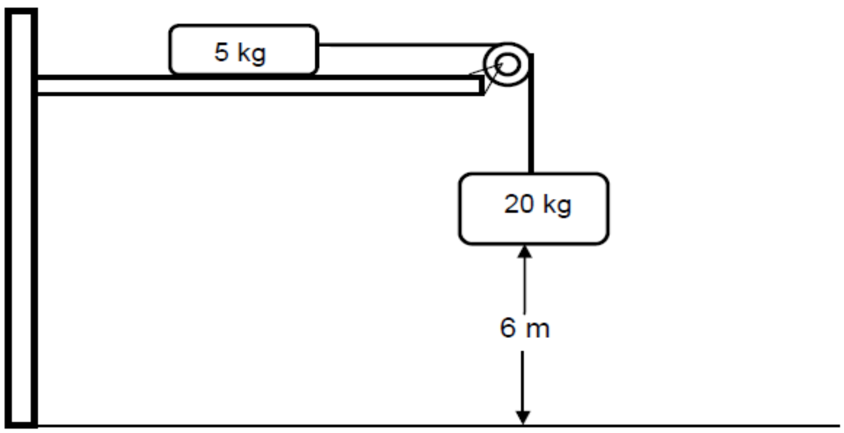
3.4 Calculate the minimum magnitude of force *F* for the box to remain at rest. (7)

[18]

QUESTION 4

A 5 kg mass and a 20 kg mass are connected by a light inextensible string which passes over a light frictionless pulley. Initially, the 5 kg mass is held stationary on a smooth, horizontal surface while the 20 kg mass hangs vertically downwards, 6 m above the ground, as shown in the diagram below.

The diagram is not drawn to scale.



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

4.2 When the 5 kg mass is released, the two masses begin to move. Ignore the effects of air friction.

4.2.1 Draw a free-body diagram, indicating all the forces acting on the 5 kg block. (3)

4.2.2 Calculate the acceleration of the 20 kg mass. (6)

4.2.3 Calculate the magnitude of the tension in the cord between the 5 kg and the 20 kg mass. (2)

[13]

QUESTION 5

Halley's comet, of approximate mass 1×10^{15} kg, was $1,3 \times 10^{8}$ km from Earth at its point of closest approach during its last sighting in 1986.

5.1 State *Newton's Law of universal gravitation* in words. (2)

5.2 Is the magnitude of the gravitational force exerted by Earth on the comet GREATER THAN, EQUAL TO or LESS THAN the gravitational force exerted by the comet on Earth? (1)

5.3 State the Physics Law in words that is applicable to the answer given in 5.2. (2)

5.4 Calculate the magnitude of the gravitational force exerted by Earth on Halley's comet at the point of closest approach. (5)

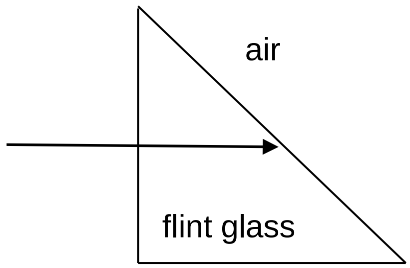
5.5 Determine the factor by which the gravitational force will differ from the gravitational force calculated in 5.4, if the distance between the Earth and Halley's comet doubles. (2)

[12]

QUESTION 6

The prism in the diagram is made of flint glass of refractive index 1,66.

The prism has angles 45°, 90° and 45°.



6.1 Define the term refraction. (2)

6.2 Calculate the critical angle for the flint glass-air boundary. (4)

6.3.1 A ray of light travels into the prism along the normal, as shown in the diagram. At what angle will the ray of light meet the second flint glass-air boundary? (1)

6.3.2 Will *refraction* or *total internal reflection* occur at the second flint glass-air boundary? (1)

6.3.3 Give a reason for your answer in 6.2.2. (1)

6.4 Calculate the speed of light in the flint glass. (3)

[12]

QUESTION 7

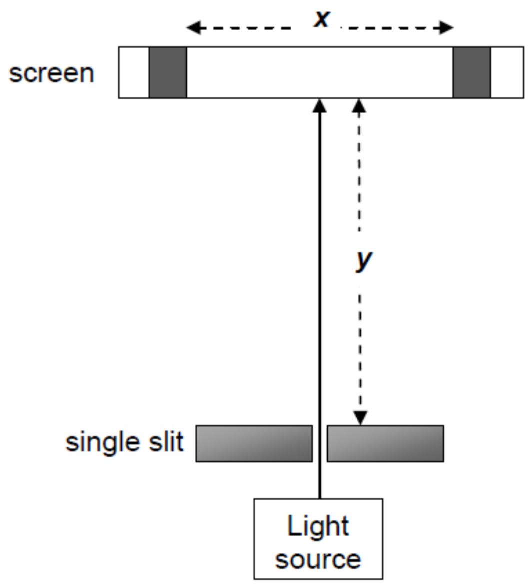
Diffraction illustrates the wave-nature of light and can be explained by using Huygen's principle.

7.1.1 Define diffraction. (2)

7.1.2 State Huygen's Principle in words. (2)

An experiment is set up, as shown below, to investigate the effect of wavelength on the degree of diffraction. Distance ***y*** on the diagram represents the distance between the screen and the single slit. Distance ***x*** on the diagram represents the width of the central bright band.

Red, blue and green light are used in the experiment. ***y*** is kept constant.



7.2 Write down

7.2.1 An investigative question for the experiment. (2)

7.2.2 The independent variable. (1)

7.2.3 The dependant variable. (1)

7.3 State the mathematical relationship between the dependant and independent variable. (1)

7.4 Will red, blue or green light produce the largest value for ***x***? (1)

7.5 If ***y*** is increased, what will happen to the value of ***x***?
Only write INCREASE, DECREASE or REMAINS THE SAME. (1)

[11]

<u>TOTAL 100 MARKS</u>

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^{9}\ N\cdot m^2\cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^{8}\ m\cdot s^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of the earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

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

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$n = \frac{Q}{e}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$R = r_1 + r_2 + r_3 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$