



**ALEXANDER ROAD HIGH SCHOOL**

JUNE 2018

2 HOURS

**PHYSICAL SCIENCES PAPER 1**

CO, JA, MH, PE

TOTAL = 100

**GRADE 11**

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**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.
- 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.

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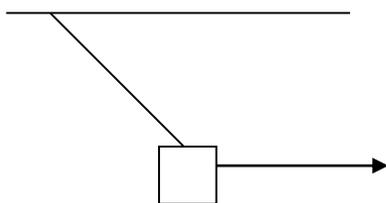
**SECTION A**

- Answer on the answer sheet -

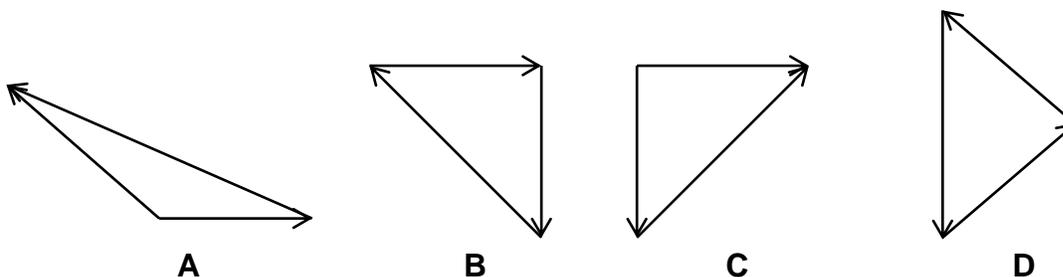
**QUESTION 1: Multiple choice**

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 – 1.12) on the answer sheet.

1.1



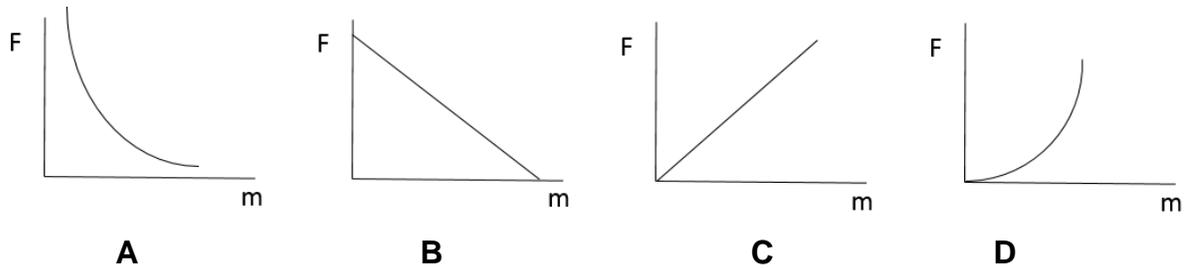
An object is suspended from the ceiling and pulled to the side as shown in the diagram. If the force vectors are added, the correct representation of their addition is:



1.2 Two forces X and Y, acting at a single point, can be replaced by a single force of magnitude 10N. If the magnitude of X is 4N, which one of the following could be the magnitude of Y?

- A** 15N                      **B** 13N                      **C** 5N                      **D** 4N

1.3 Which ONE of the following graphs represents the relationship between force and mass for Newton's law of gravitation?



1.4 The graph of  $F$  vs  $\frac{Q_1 Q_2}{r^2}$  in the Coulomb's law investigation has a gradient of ...

- A** 8,31                      **B**  $6,67 \times 10^{-11}$                       **C** 22,4                      **D**  $9 \times 10^9$

1.5 The force between two masses is  $5 \times 10^{-3}$  N. If the one mass is halved, the other mass is tripled, and the distance between their centres is doubled, what will be the new force between the two masses?

- A**  $3,75 \times 10^{-3}$  N, repelling  
**B**  $1,88 \times 10^{-3}$  N, attracting  
**C**  $3,75 \times 10^{-3}$  N, attracting  
**D**  $1,88 \times 10^{-3}$  N, repelling

1.6 The weight of a man on Earth is 700 N. If he travels to another planet and his weight is also 700N on that planet, and the radius of the planet is half that of the earth's radius, how would the mass of the earth (M) compare to the mass of the planet (m)?

- A**  $M = 2m$                       **B**  $2M = m$                       **C**  $M = 4m$                       **D**  $M = \frac{1}{4} m$

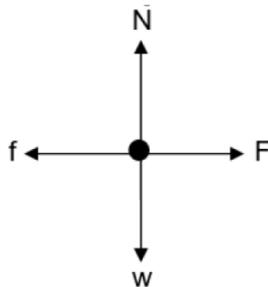
- 1.7 A net force  $\mathbf{F}$  which acts on a body of mass  $m$  causes an acceleration  $\mathbf{a}$ . If the same net force  $\mathbf{F}$  is applied to a body of mass  $2m$ , the acceleration of the body will be ...

A  $\frac{1}{4}a$       B  $\frac{1}{2}a$       C  $2a$       D  $4a$

- 1.8 A **constant** force  $\mathbf{F}$  is applied to a box, causing the box to move at a **constant** velocity over a rough horizontal surface.



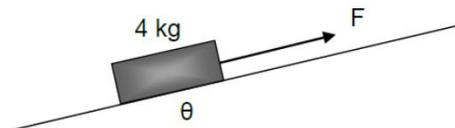
The free-body diagram below shows all forces acting on the box. (Diagram is **NOT** drawn to scale.)



Which **ONE** of the following relationships is correct?

A  $F < f$       B  $F > f$       C  $F = w$       D  $F = f$

- 1.9 A block with a mass of 4 kg is pulled upwards along a frictionless slope, inclined at an angle  $\theta$ , with a force  $\mathbf{F}$ , as shown in the sketch below.



Which **ONE** of the following equations can be used to calculate the magnitude of the normal force (N)?

A  $N = (4)(9,8) \sin\theta$   
B  $N = F - (4)(9,8) \cos\theta$   
C  $N = F + (4)(9,8) \cos\theta$   
D  $N = (4)(9,8) \cos\theta$

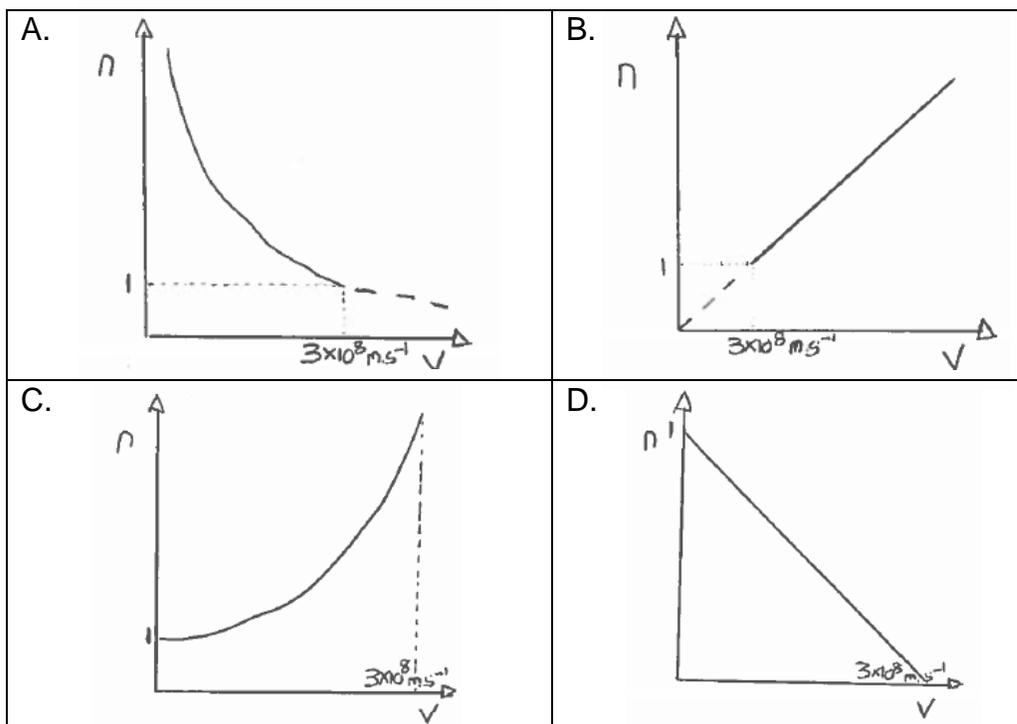
1.10 Which ONE of the following are the conditions required for total internal reflection to take place?

	Condition 1	Condition 2
A.	The angle of incidence must be larger than the critical angle.	Light must be moving to a medium with a higher optical density.
B.	The angle of incidence must be smaller than the critical angle.	Light must be moving to a medium with a lower optical density.
C.	The angle of incidence must be equal to the critical angle.	Light must be moving to a medium with a higher optical density.
D.	The angle of incidence must be larger than the critical angle.	Light must be moving to a medium with a lower optical density.

1.11 Consider a single slit diffraction pattern. If the slit width is decreased, then...

- A. ...the degree of diffraction increases.
- B. ...the degree of diffraction decreases.
- C. ...the degree of diffraction is unaffected.
- D. ...the central band will be narrower.

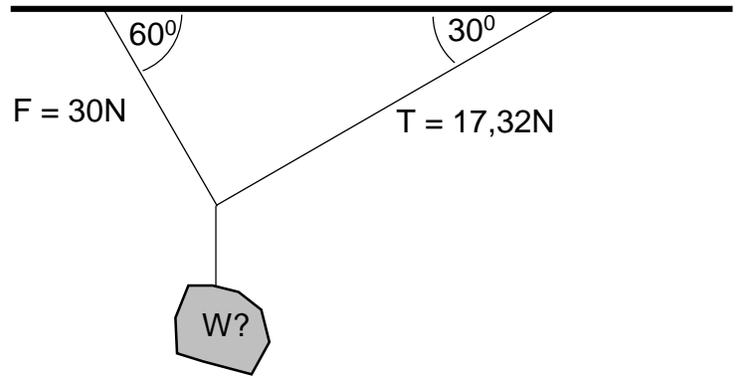
1.12 Which ONE of the following is a graph of the refractive index ( $n$ ) versus speed of light in the medium ( $v$ )?



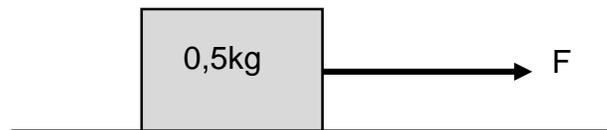
[24]

## QUESTION 2

A rock of unknown weight is hung from a ceiling as shown in the diagram. The tension in the strings are:  
 $F=30\text{N}$  and  $T=17,32\text{N}$



- 2.1 State the rule for adding three forces in equilibrium. (1)
- 2.2 Draw the vector addition diagram for the forces in the three ropes. (3)
- 2.3 Determine the vertical components of the forces in the strings F & T. Each calculation must show a vector diagram of how you calculated it. (3,2)
- 2.4 Determine the WEIGHT of the rock. (3)
- 2.5 If someone pulls down on the rock, which one of string F or T is likely to snap first? Motivate your choice. (2)
- 2.6 In an investigation into friction a pupil measures the force required to start an object sliding across a rough surface, F.



Her measurements for  $F = 2,3\text{N}$ .

- 2.6.1 Use this value to determine the coefficient of static friction for these surfaces. (3)
- 2.6.2 How would the amount of friction between the object and the surface compare if she pulled it at an angle of  $45^\circ$ ? Write only **INCREASES**, **DECREASES** or **STAYS THE SAME**.

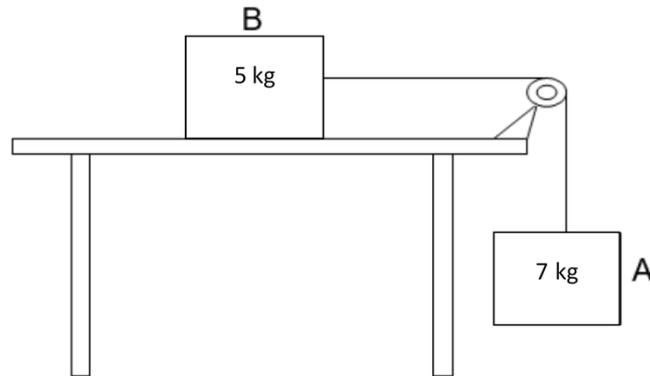


- (1)
- 2.6.3 Motivate your prediction in 2.6.2. (1)

**[19]**

### QUESTION 3

A 5kg block B, resting on a flat, rough, horizontal table is connected by a light inextensible string to a 7kg block A. The string is passed over a light frictionless pulley in such a way that block A hangs vertically downwards as shown in the diagram below.



- 3.1 Write down Newton's second law of motion in words. (2)
- 3.2 Draw a labelled free-body diagram of all the forces acting on block B. (4)
- 3.3 The kinetic frictional force experienced by block B has a magnitude of 35,4 N. Calculate the magnitude of the acceleration. (6)
- 3.4 Calculate the coefficient of kinetic friction between the surface of the table and block B. (3)
- 3.5 One side of the table is now raised causing block B to move down the slope towards A.
- 3.5.1 How will this change affect the frictional force acting on block B?  
Write down only **INCREASE**, **DECREASE** or **REMAINS THE SAME**. (1)
- 3.5.2 Explain your answer in 3.5.1. (3)

**[19]**

#### QUESTION 4

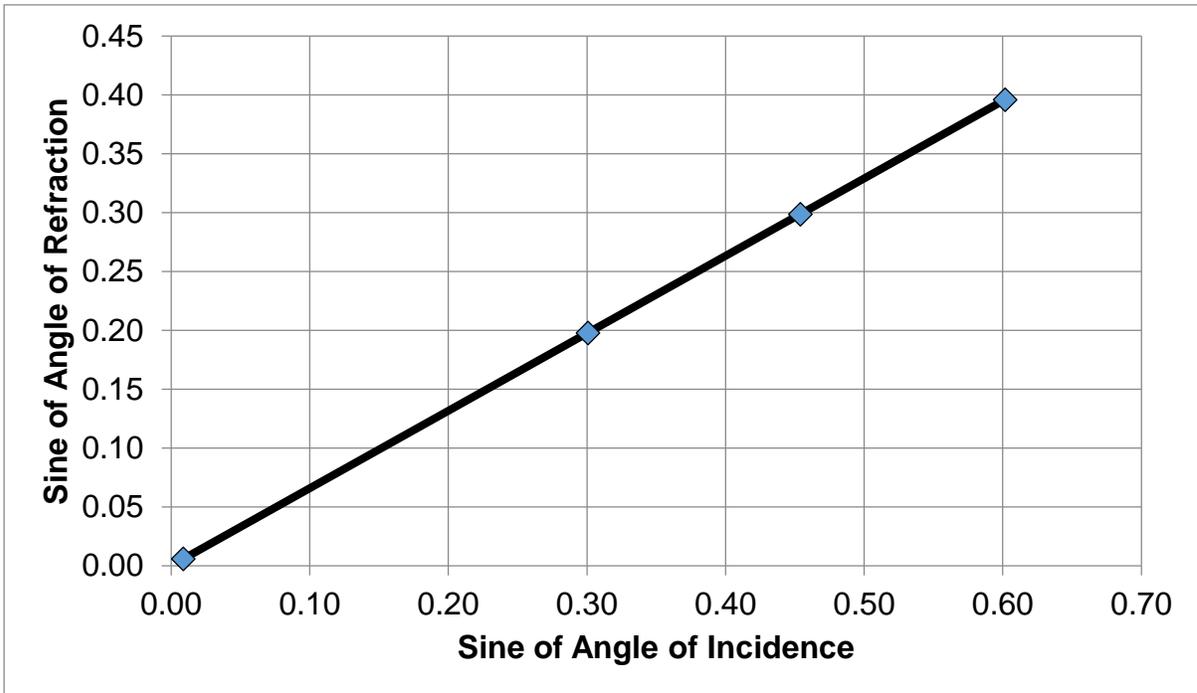
- 4.1 State Newton's law of gravitation. (3)
- 4.2 There is a force between the earth and all objects with mass.
- 4.2.1 Is this force attractive or repulsive? (1)
- 4.2.2 Define *mass* and *weight* to show the difference clearly. (2)
- 4.3 The acceleration due to gravity on Mars is  $3,711 \text{ m}\cdot\text{s}^{-2}$ .
- 4.3.1 Calculate the magnitude of the weight of a 90 kg astronaut on Mars. (3)
- 4.3.2 If the mass of Mars is  $6,39 \times 10^{23} \text{ kg}$ , calculate the radius of Mars. (4)
- 4.3.3 If an object is dropped by the astronaut, will the object fall SLOWER or QUICKER than on the earth? (1)
- 4.3.4 Explain your previous answer. (2)
- 4.4 The mass of an unknown planet is 75% that of the earth's mass. The radius of the planet is double the radius of the earth. Calculate the gravitational acceleration of this planet. (3)
- [19]**

#### QUESTION 5

A group of Grade 11 Alex students have been tasked by Telkom to come up with a design for a new fibre optics project planned in the Port Elizabeth area. Optic fibres are an important tool in the telecommunications industry. An optics fibre has a cylindrical shape and is made up of glass.

As part of their research, the Grade 11s decide they need to determine the refractive index of glass. They shine light from air to glass systematically increasing the angle of incidence ( $\theta_1$ ) whilst measuring the corresponding angle of refraction ( $\theta_2$ ).

After plotting their results, they obtained the following graph:



5.1 The refractive index of air is 1.

5.1.1 Use the graph to calculate the refractive index of glass. (3)

5.1.2 Calculate the speed of light in glass. (3)

5.1.3 Water has a refractive index of 1,33. Between glass and water, which is more optically dense? (1)

5.1.4 **Redraw** the graph above, and on the same set of axes draw the graph that would be obtained if light was shone from air to water instead. Clearly label both graphs. (Please note: only a sketch is required. There is NO NEED to show any values). (2)

5.2 A diamond sparkles because of its high refractive index of 2,42. Calculate the critical angle of a diamond-air surface. (4)

**[13]**

## **QUESTION 6**

6.1 Diffraction of waves is easily explained using Huygen's principle.

6.1.1 State *Huygen's principle* in words. (2)

6.1.2 Redraw the wave front shown below and use Huygen's principle to construct the next wave front. The wave is moving from left to right. (2)



6.2 How will each of the following changes affect the width of the central band in a single slit diffraction pattern? (Write down only **INCREASES**, **DECREASES** or **REMAINS THE SAME**).

6.2.1 Yellow light is replaced with red light. (1)

6.2.2 The screen is moved closer to the aperture. (1)

**[6]**

**TOTAL 100**