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Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

COMMON TEST

JUNE 2018

TIME: 2 hours

MARKS: 100

This question paper consists of 12 pages a data sheet, and a graph sheet for Question 2.5

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INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK.**
2. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subsections, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Remember to write your name on the graph sheet (Question 2.5), and hand this sheet together with your answer booklet.

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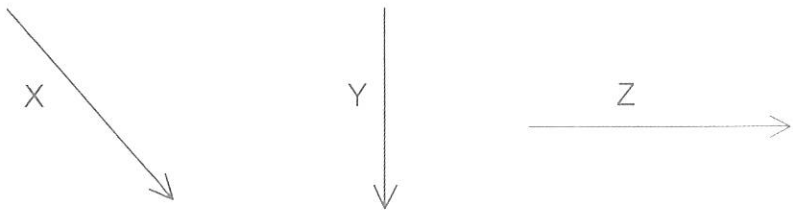
QUESTION 1

Four options are provided as possible answers to the following questions.
Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 — 1.6) in the ANSWER BOOK, for example 1.7 D.

1.1 Three vectors X, Y and Z have magnitudes and directions as shown below.



Which of the following statements is possible?

A $X + Y + Z = 0$

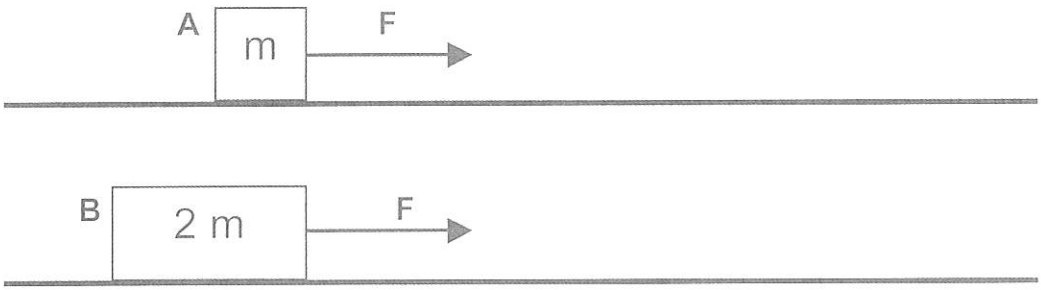
B $X = Y + Z$

C $Y = X + Z$

D $Z = Y + X$

(2)

1.2 Two bodies, A (mass m) and B (mass 2m) are at rest. They are accelerated in a straight line by identical forces F, across the same horizontal, frictionless surface.



After moving a distance ***x***, the velocity of A is ***v***. What will be the velocity of B after it has moved the same distance **x**?

A ***v***

B $2v$

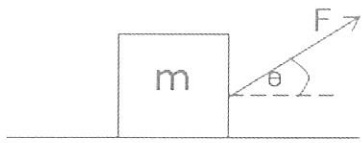
C $4v$

D $\sqrt{½}\,v$

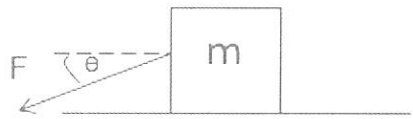
(2)

1.3 The diagrams below show an object of mass *m* moving on the same rough surface under the action of an applied force F. In which diagram will the magnitude of the frictional force ***not depend*** on force F?

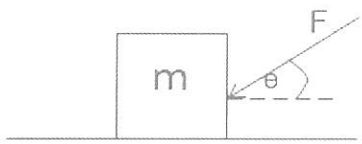
A



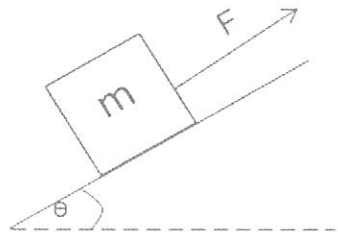
B



C



D



(2)

1.4 The gravitational force that the moon exerts on the earth is

A attractive, and less than the force that the earth exerts on the moon.

B repulsive, and less than the force that the earth exerts on the moon.

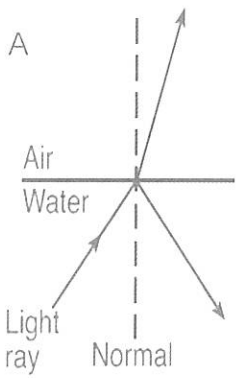
C repulsive, and equal to the force that the earth exerts on the moon.

D attractive, and equal to the force that the earth exerts on the moon.

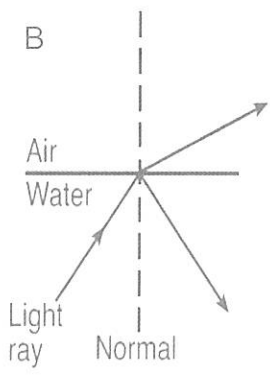
(2)

1.5 When a ray of light traveling in water reaches a boundary with air, part of the light ray is reflected and part is refracted. Which ray diagram best represents the paths of the reflected and refracted light rays?

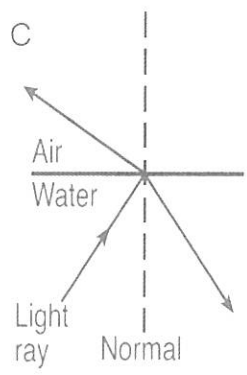
A



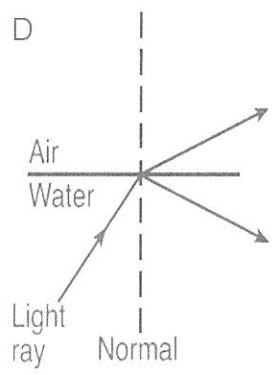
B



C



D



(2)

1.6 The core of an optical fibre has a

A. Lower refractive index than air.

B. Lower refractive index than the cladding.

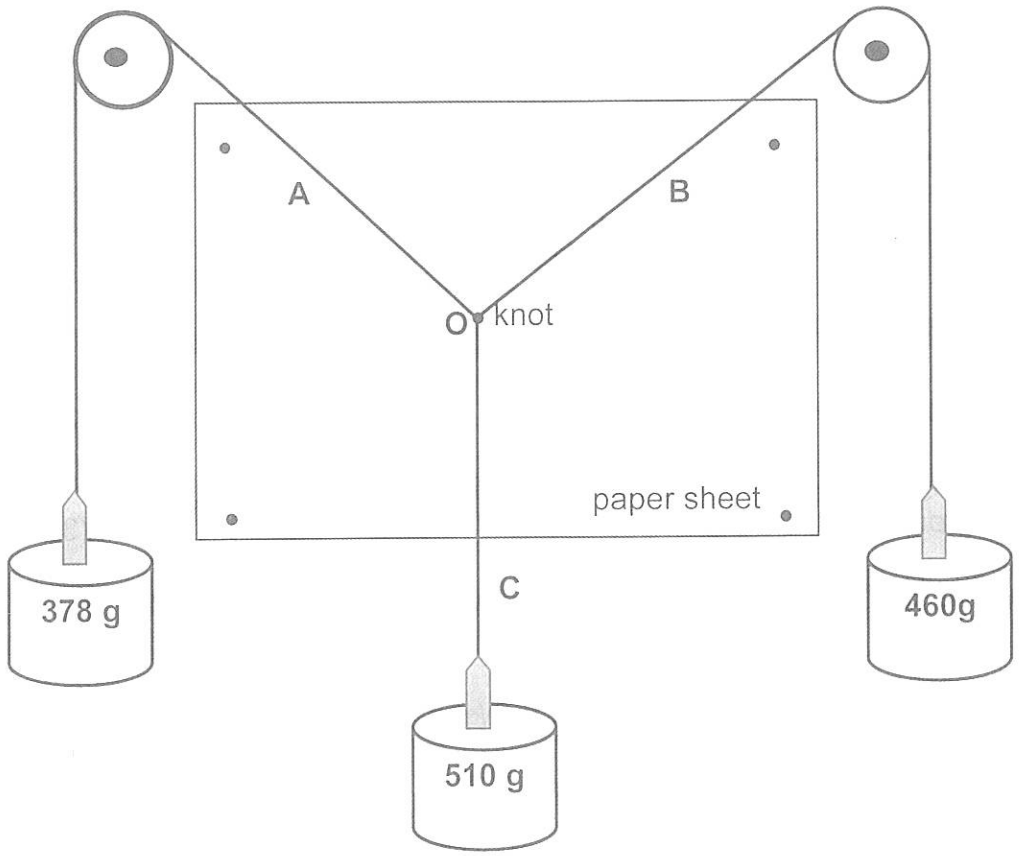
C. Higher refractive index than the cladding.

D. Identical refractive index to that of the cladding. (2)

[12]

QUESTION TWO

The diagram below represents the force board experiment which was used by learners to determine the resultant of two co-planar forces. String C is attached to strings A and B at point O when the system is at rest.



2.1 What is the magnitude of the resultant force of the system? (1)

2.2 State the parallelogram law. (2)

2.3 Calculate the magnitudes of the force in string A. (2)

2.4 State TWO precautions a learner should observe when conducting this experiment. (2)

The data obtained from their experiment was plotted on the attached graph sheet.

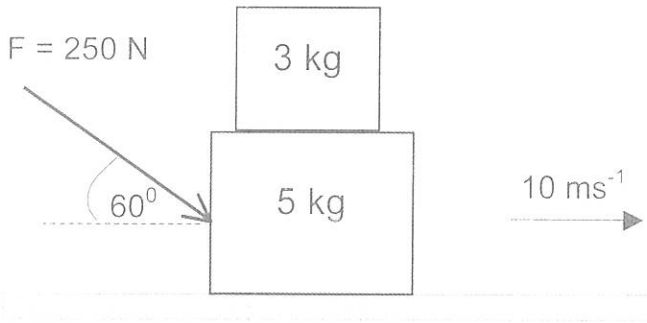
2.5 Determine graphically, using the parallelogram law, the magnitude of the resultant force of the forces acting in strings A and B.
Use the given scale (10 mm represents 1 N). (5)

2.6 What is the relationship between the resultant force and the force in string C? Write down only GREATER THAN, LESS THAN or EQUAL TO. (2)
Explain your answer.

[14]

QUESTION THREE

Two blocks of mass 3 kg and 5 kg respectively are in contact with each other during motion. The 3 kg block is glued onto the 5 kg block.
An applied force F of magnitude 250 N acts on the 5 kg block at an angle of 60^0 with respect to the horizontal. The blocks move at a **constant velocity** of $10\ m{\cdot}s^{-1}$ to the right on a rough horizontal surface.



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

3.2 Calculate the magnitude of the frictional force acting between the 5 kg block and the ground. (3)

3.3 Calculate μ_K, the coefficient of kinetic friction between the 5 kg block and the surface. (5)

A retarding force of 50 N is applied horizontally to the 5 kg block

3.4 Calculate the acceleration of the 5 kg block. (3)

[13]

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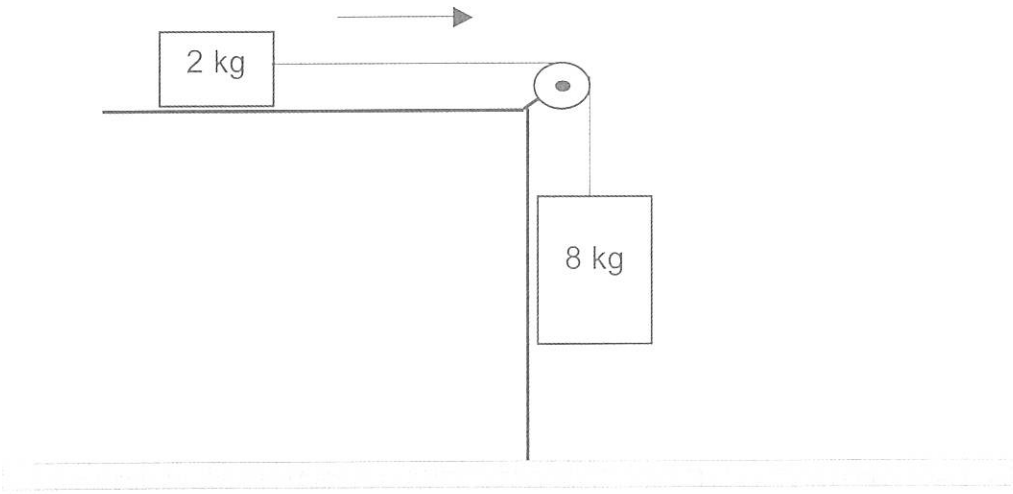
QUESTION FOUR

The sketch shows a block of mass 2 kg placed on a rough horizontal surface. This block is attached to an 8 kg mass by an inextensible cord that passes over a frictionless pulley. The frictional force between the surface and the 2 kg block is 10 N when the block is in motion.



4.1 Draw a labelled free body diagram showing all the forces acting on the 2 kg mass piece. (4)

4.2 **Calculate**:

4.2.1 the acceleration of the 8 kg mass. (5)

4.2.2 the tension in the cord. (2)

4.2.3 The distance the 2 kg mass would travel in 1,2 s if it starts from rest. Assume that the 2 kg block does not strike the pulley in 1,2s. (3)

The cord attached to the masses breaks.

4.3 What is the magnitude of the acceleration of the 8 kg mass? (1)

[15]

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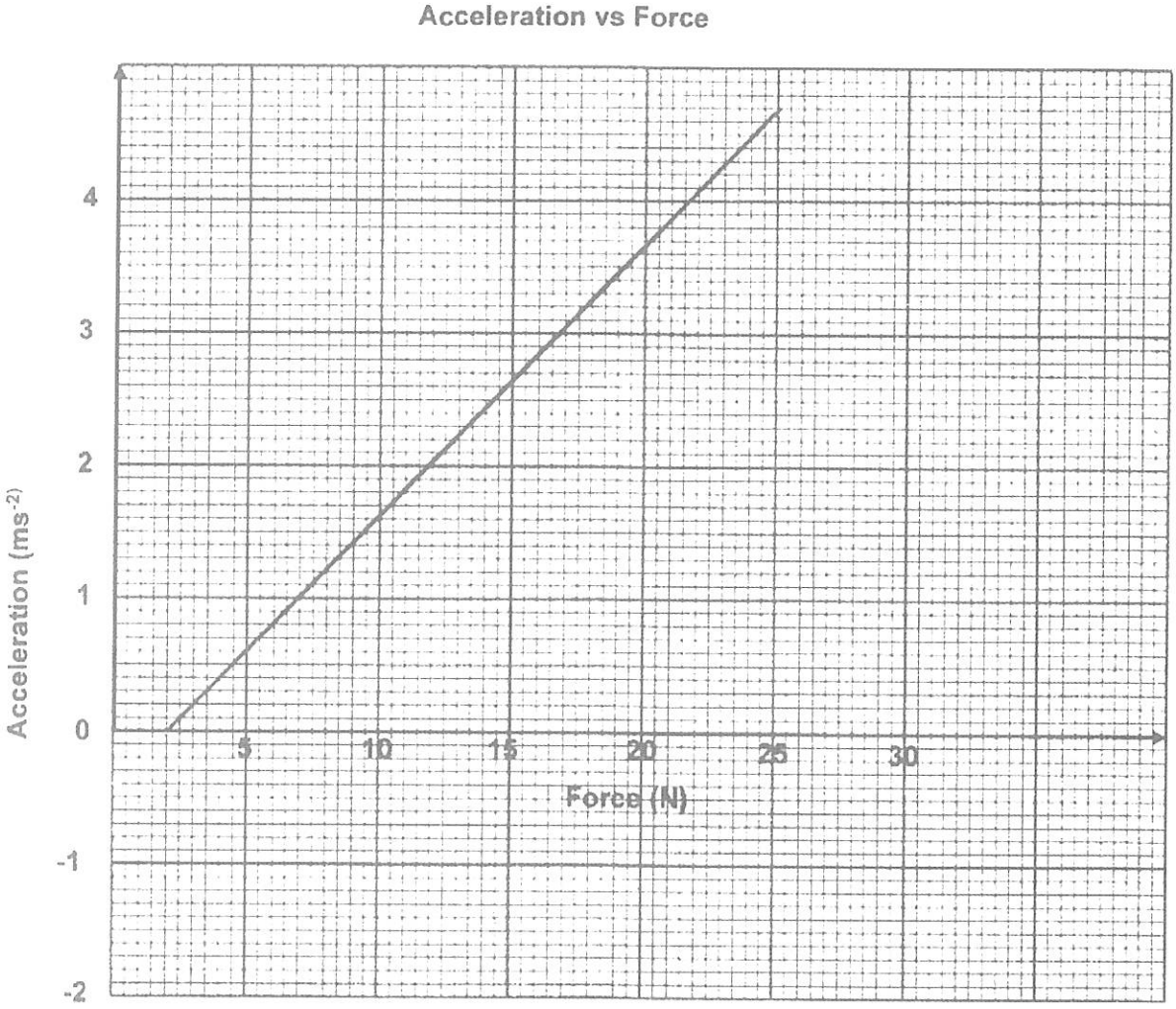
QUESTION FIVE

The graph below was obtained from an experiment to determine the relationship between the acceleration and a horizontal applied force on a dynamics trolley on a flat runaway.



5.1 Name and state the law that is being investigated above. (3)

5.2 Use the graph to determine

5.2.1 the mass of the trolley. (3)

5.2.2 the acceleration of the trolley when the applied force is zero. (4)
[10]

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QUESTION SIX

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

6.2 An astronaut on the surface of the moon weighs an object of mass **m**. What would be the approximate weight of the same object on the surface of the earth if its weight on the moon is $\mathbf{W_m}$? Write down your final answer in terms of $\mathbf{W_m}$

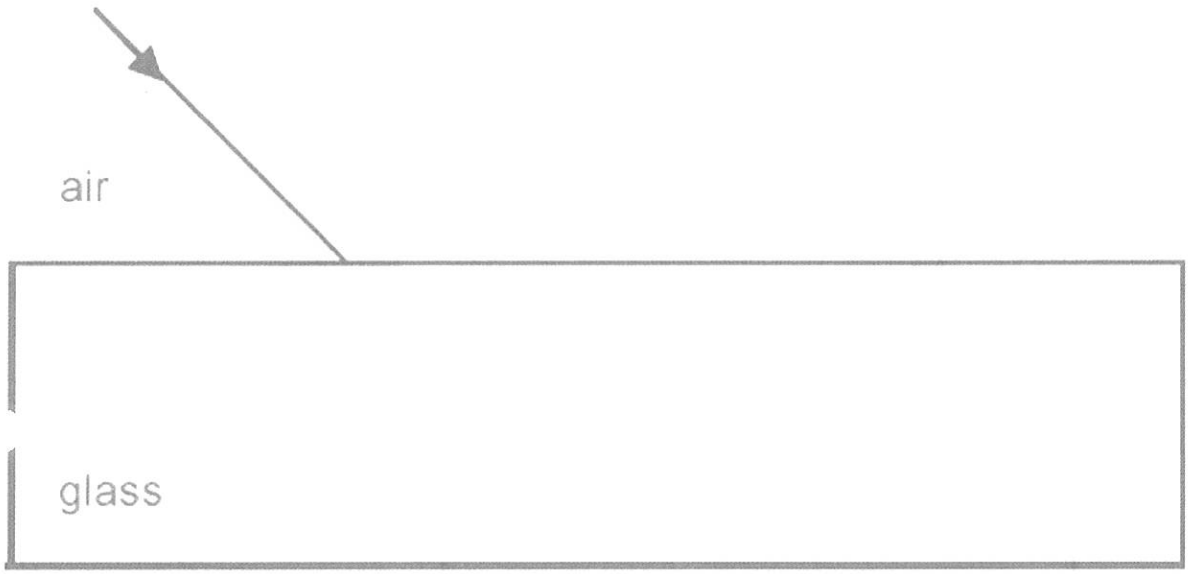
Given: $\frac{\text{Mass of Earth}}{\text{Mass of Moon}} = 81$ $\frac{\text{Radius of Earth}}{\text{Radius of Moon}} = \frac{11}{3}$

(5)

[7]

QUESTION SEVEN

7.1 The diagram below shows light entering a glass block which is placed above a block of diamond. Use the table of refractive indices to answer the questions below.



Material	air	glass	diamond
Refractive Index	1,00	1,58	2,42

7.1.1 Define "refraction of light ". (2)

7.1.2 Copy the diagram in your answer booklet. Complete the diagram by showing the path taken by the light ray as it passes from air to glass and then to diamond. Label the angle of incidence as the light passes from air to glass and draw the normal at each surface. (4)

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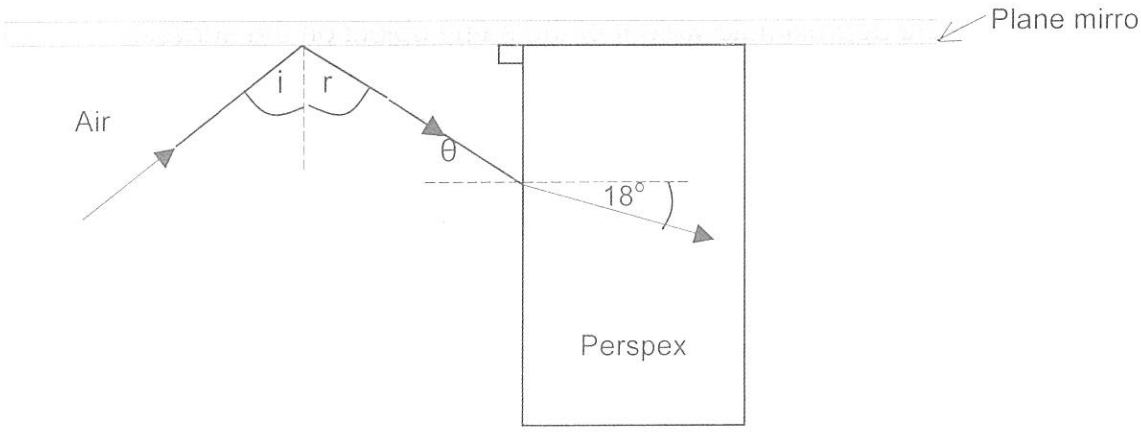
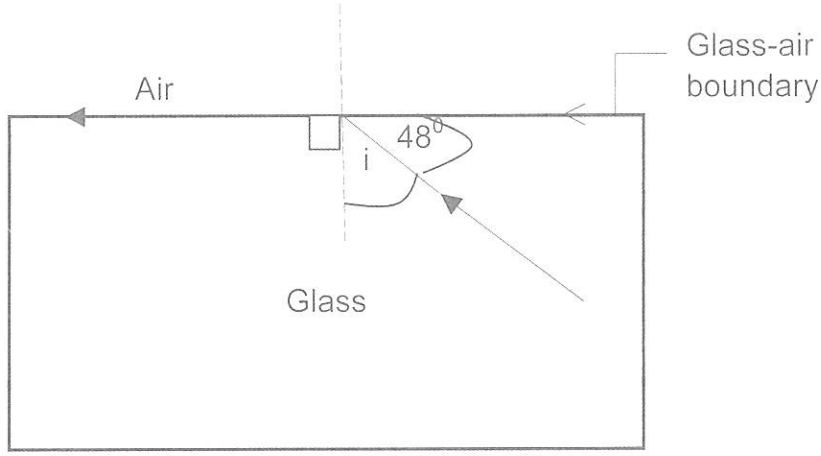
7.2 The surfaces of a plane mirror and a rectangular block of Perspex are at right angles to each other as shown in the diagram below.
The refractive index of Perspex is 1,42 and the refractive index of air is 1,0.



7.2.1 State Snell's law. (2)

7.2.2 The angle of refraction of a light ray is 18° in the Perspex. Calculate the angle of incidence of the light ray, i, at the surface of the mirror. (5)

7.3 A ray of light strikes a glass-air interface and travels as shown in the diagram below. The refractive index of air (n_{air}) is equal to 1.



7.3.1 Determine the critical angle of glass. (1)

7.3.2 Calculate the refractive index of glass. (3)

7.3.3 Name the phenomenon that occurs when angle *i* exceeds the critical angle. (1)

7.3.4 State two conditions that are required for this phenomenon to occur. (2)

[20]

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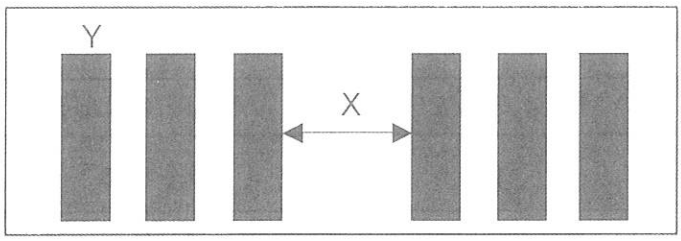
QUESTION EIGHT

Monochromatic red light is shone through a narrow slit and a diffraction pattern is observed on a screen as shown below.



8.1 Define *monochromatic light.* (1)

8.2 State Huygens principle. (2)

8.3 Describe the diffraction pattern which is observed on the screen. (2)

8.4 Explain the formation of Y. (2)

8.5 How will the broadness of X differ if the following changes take place. Write down only BROADER, NARROWER or REMAINS THE SAME.

8.5.1 Monochromatic blue light is used. (1)

8.5.2 A narrower slit is used (1)

[9]

TOTAL : 100

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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	$6{,}38 \times 10^{6}\ m$

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

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

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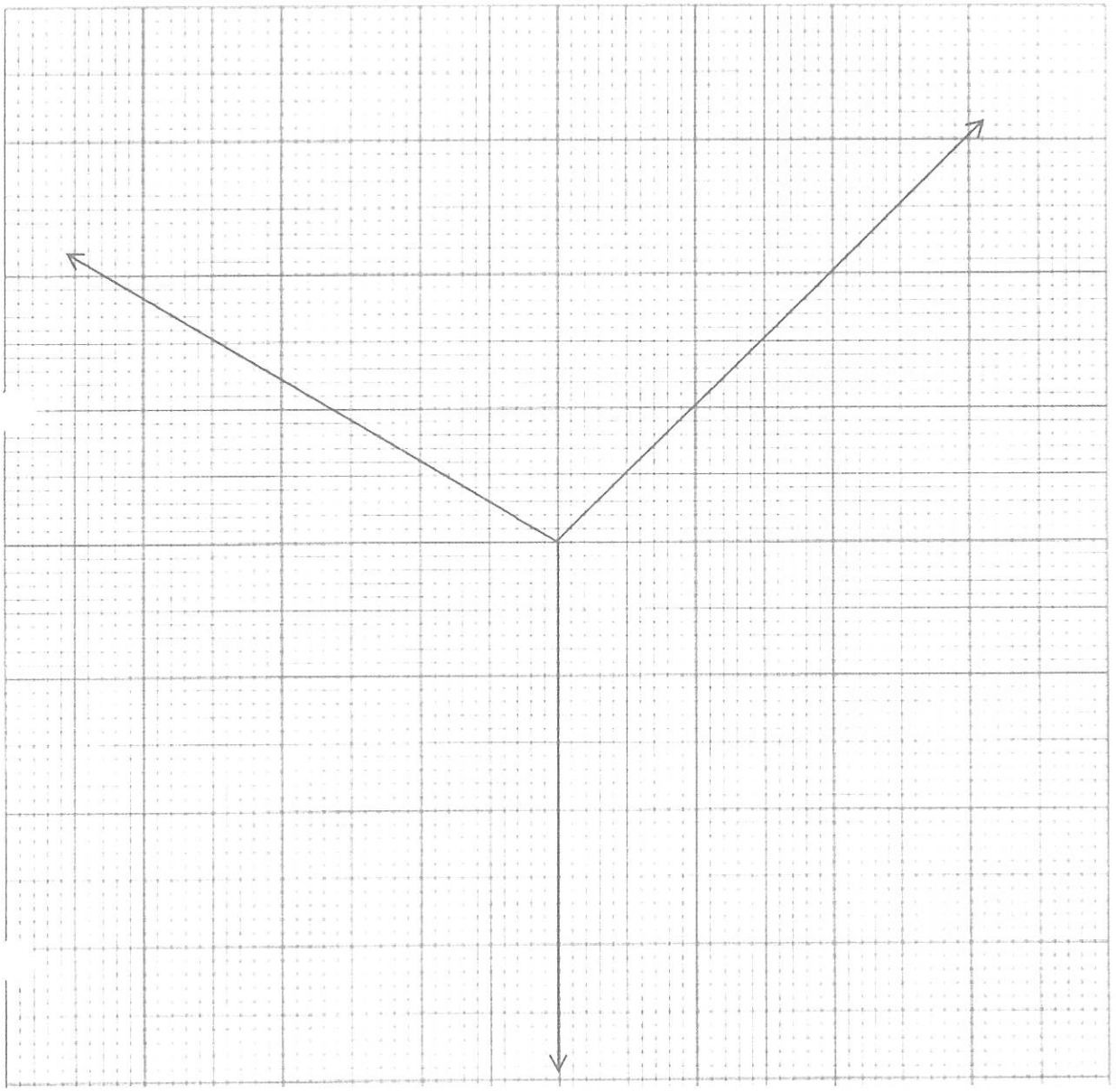
Question 2.5 **ANSWER SHEET** **GRADE 11**

NAME OF LEARNER : _____

NAME OF SCHOOL : _____



SCALE : 10 mm represents 1 N

TEAR-OFF SHEET

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Department:
Education
PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P1
MARKING GUIDELINE
COMMON TEST
JUNE 2018

NATIONAL SENIOR CERTIFICATE

GRADE 11

This marking guideline consists of 9 pages.

QUESTION ONE

1.1 B ✓✓

1.2 D ✓✓

1.3 D ✓✓

1.4 D ✓✓

1.5 B ✓✓

1.6 C ✓✓

[12]

QUESTION TWO

2.1 0 N ✓ / ZERO ✓ (1)

2.2 The resultant of two vectors drawn from a common point is the diagonal of the parallelogram of which the two vectors form adjacent sides. ✓✓(2 or 0) (2)

2.3 $F_A = m \cdot g$

$= 0,378 \times 9,8$ ✓

$= 3,704$ N✓ (2)

2.4 - Avoid the error of parallax. ✓ (the perceived shift in an object's position as it is viewed from different angles).
- Ensure that the pulleys are acting in the same plane. ✓
- Ensure that the pulleys are running freely. ✓
- the weights/weight hangers should not touch the board. ✓
(Any TWO) (2)

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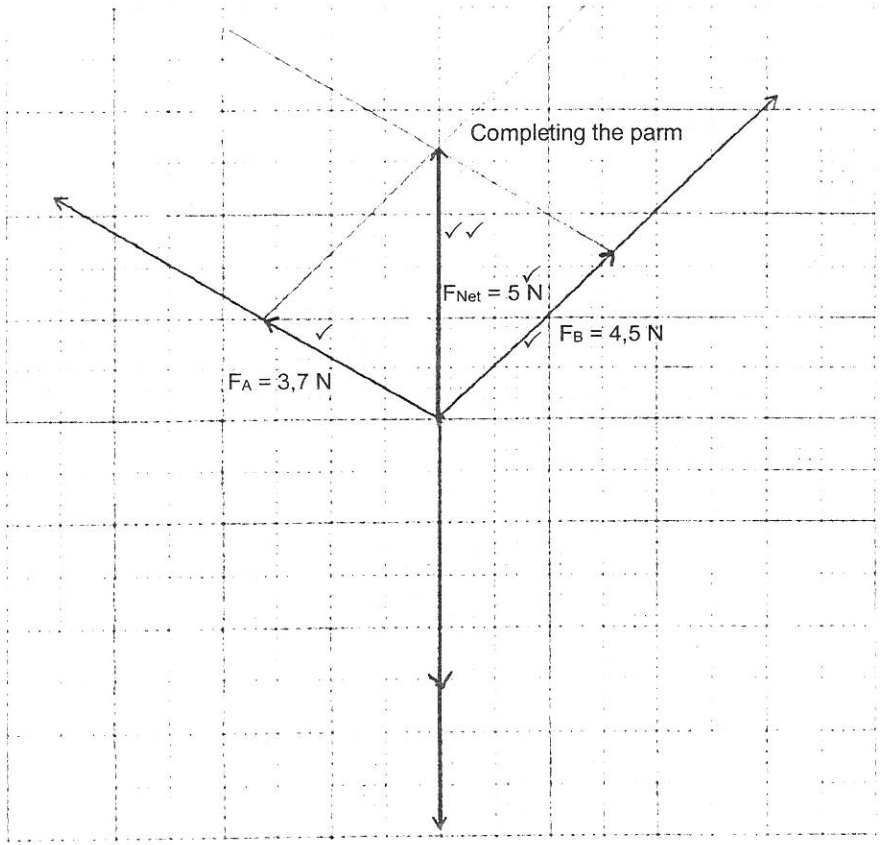
2.5



SCALE : 10 mm represents 1 N

Marking Rubric : Scale Diagram	
Criteria	Mark allocation
Forces A and B correctly plotted using the given scale	2 x 1 = 2
Resultant force is correctly drawn by completing the parallelogram accurately.	2 x 1 = 2
Answer is correct (F_{NET} = 5 N)	1

(5)

2.6 Equal to✓. The net force acting on the system is zero.✓ (2)

[14]

QUESTION THREE

3.1 The force that opposes the motion of a moving object✓ acting parallel to a surface.✓ (2)

3.2

$F_X = F\cdot\cos\theta$

$= 250\cdot\cos 60^0$

$= 125$ N

$F_{NET} = m\cdot a$ ✓ Any one

$F_X + (-f_K) = m\cdot a$ ✓

$125 - f_K = 8\cdot(0)$ ✓

$f_K = 125$ N✓

OR

$f_K = F\cdot\cos\theta$✓

$= 250\cdot\cos 60^0$✓

$= 125$N✓

(3)

3.3 **Positive marking from Q 3.2**

$F_N = W + F_y$

$F_N = m\cdot g + F\cdot\sin e$ ✓ Any one

$= 8(9,8)$ ✓$+ 250\sin 60^0$✓

$= 294,906$ N

$f_K = \mu_K\cdot F_N$

$125 = \underline{\mu_K\cdot 294,906}$✓

$\mu_K = 0,42$ ✓ (5)

3.4 $F_{NET} = m\cdot a$✓

$\underline{-50 = 8\cdot a}$✓

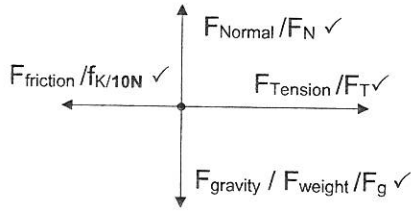
$a = -6,25\ m\cdot s^{-2}$

$a = \underline{6,25\ m\cdot s^{-2}\text{ opposite to the motion of the blocks}}$.✓ (3)

[13]

QUESTION FOUR

4.1



If one or more incorrect forces is drawn, max 3/4

(4)

4.2.1 2kg mass

$F_{NET} = m \cdot a$
$F_T + (-f_K) = 2 \cdot a$ } Any one✓

$F_T - 10 = 2 \cdot a$
$F_T = 2a + 10$ ✓ (Any one)..... (1)

8kg mass

$F_{NET} = m \cdot a$
$F_g + (-F_T) = 8a$ ✓ (Any one)
$8(9,8) - F_T = 8a$
$F_T = 78,4 - 8a$ .....(2)

- If masses are added , then maximum 3/5.

Equating (1) and (2)

$2a + 10 = 78,4 - 8a$

$a = 6,84\ m \cdot s^{-2}$✓,downward.✓

(5)

Positive marking from Q 4.2.1

4.2.2 $F_T = 2a + 10$
$= 2(6,84) + 10$✓
$= 23,68$ N✓

OR

$F_T = 78,4 - 8a$
$= 78,4 - 8(6,84)$✓
$= 23,68$ N✓

(2)

Positive marking from Q 4.2.1

4.2.3 $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓
$= 0 + \frac{1}{2}(6,84)(1,2)^2$✓
$= 4,92$ m✓

(3)

4.3 $a = 9,8\ m \cdot s^{-2}$✓ (1)

[15]

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QUESTION FIVE

5.1 Newton's Second law of motion✓

If a non-zero net force acts on an object, then the object accelerates in the direction of the net force. The acceleration of the object is directly proportional to the net force✓ and inversely proportional to the mass of the object. ✓

(3)

5.2.1 (Gradient) : $\frac{1}{m} = \frac{\Delta a}{\Delta F}$✓

$= \frac{2.65 - 0}{15 - 2}$ } ✓

$= 0.2038$

$m = 4.91$ kg✓ [acceptance range: 4.80 to 5.00 kg]

(3)

5.2.2 Extrapolation of the graph to the y-intercept

(must be shown on the graph) ✓✓ $a = -0,4\ m \cdot s^{-2}$ ✓✓

OR

Positive marking from Q 5.2.1

$y = mx + c$

$a = 0,2F + c$ ✓

0✓ $= 0.2(2)$ ✓+ c (or the substitution of any ordered pair from graph)

$c = -0,4$

When F= 0, $a = -0,4 m \cdot s^{-2}$✓

(4)

[10]

QUESTION SIX

6.1 Everybody in the universe attracts every other body with a gravitational force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

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6.2 $F_{Moon} = \frac{Gm.m_{Moon}}{r^2_{Moon}} = W_m$

$F_{Moon} = \frac{Gm_1.m_2}{r^2} = W_m$ ✓ (any one)

$F_{Earth} = \frac{Gm.m_{Earth}}{r^2_{Earth}}$

$= \frac{Gm\cdot(81m_{Moon})}{(\frac{11}{3}r_{Moon})^2}$ ✓ ✓

$= 6.024\frac{Gm\cdot m_{Moon}}{r^2_{Moon}}$ ✓

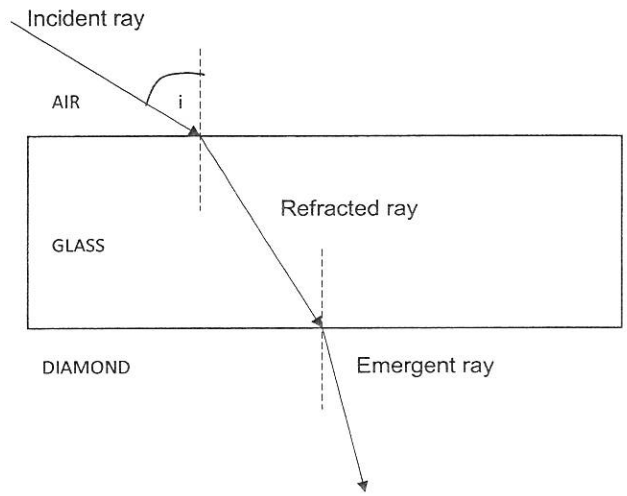
$= 6.02\ \mathbf{W_m}$ ✓ (5)

[7]

QUESTION SEVEN

7.1.1 It is the bending of light/change in direction of light ✓ as it passes from one medium to another of different optical density.✓ (2)

7.1.2



Marking Rubric : Ray diagram	
Criteria	Mark allocation
Both normal lines drawn	1 mark
Angle of Incidence drawn and labelled	1 mark
Ray bends towards the normal at surface 1	1 mark
Ray bends towards the normal at surface 2	1 mark

(4)

7.2.1 The ratio of the sine of the angle of incidence in one medium to the sine of the angle of refraction in the other medium is a constant. ✓✓ (2 or 0) (2)

7.2.2 $n_1\sin\theta_1 = n_2\sin\theta_2$ ✓

$1.\sin\theta = 1{,}42\cdot\sin(18^0)$ ✓

$\theta = 26{,}03^0$

$\angle r = 90^0 - 26{,}03^0 = 63{,}97^0$ ✓

$\angle i = \angle r\ (law\ of\ reflection\ of\ light)$ ✓

Angle of incidence: $\angle i = 63{,}97^0$ ✓ (5)

7.3.1 Critical angle = $90^o - 48^o = 42^0$✓ (1)

7.3.2 $n_1 \sin \theta_1 = n_2 \sin \theta_2$

$n_1 \sin 42^o$ ✓ $= 1 \cdot \sin 90^o$✓

$n_1 = 1,49$✓ (3)

7.3.3 Total internal reflection ✓ (1)

7.3.4 The angle of incidence must exceed the critical angle of that substance.✓ Light must travel from a more optically dense medium to a less optically dense medium.✓ (2)

[20]

QUESTION EIGHT

8.1 Light made up of a single frequency/single wavelength✓ (1)

8.2 Every point on a wave front acts as a source of a secondary wavelet that spreads out in all directions✓✓(at the same speed as the original wave) (2 or 0 marks) (2)

8.3 A broad central red band is observed✓ flanked on either side by alternating narrower dark and red bands.✓ (2)

8.4 The dark bands(Y) are due to wavelets/crests and troughs meeting out of phase /interference of wavelets✓resulting in destructive interference.✓ (2)

8.5.1 Narrower✓ (1)

8.5.2 Broader ✓ (1)

[9]

TOTAL : 100

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