education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES P1

COMMON TEST

JUNE 2019

TIME: 2 hours

MARKS: 100

This question paper consists of 15 pages (including a graph sheet for Q 4.3 and an answer sheet for Q 7.2.1). A data sheet is also provided.

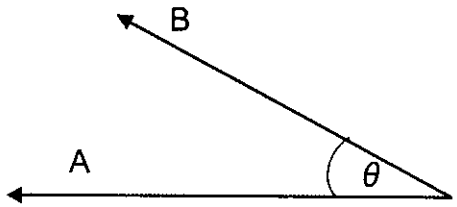
INSTRUCTIONS AND INFORMATION TO CANDIDATES

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.

QUESTION 1 : MULTIPLE CHOICE QUESTIONS

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 — 1.5) in the ANSWER BOOK, for example 1.6 D.

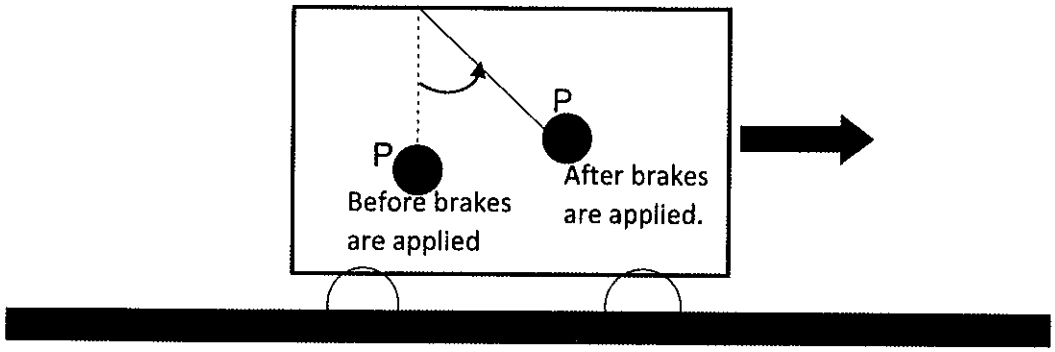
1.1 Two forces A and B of constant magnitude act at the same point as shown below.



If the angle θ increases from 0^0 to 90^0, the magnitude of the resultant force will .....

A Increase
B Remain the same
C Decrease
D Increase initially and then decrease (2)

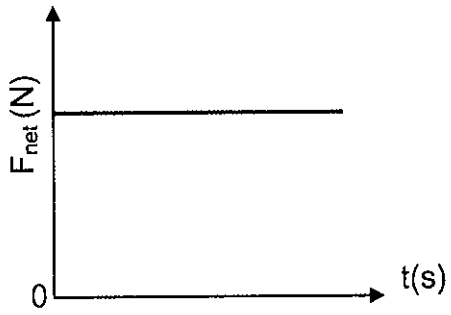
1.2 The diagram below shows the motion of an object P attached to the ceiling of a railway car.



When the brakes are applied it is observed that object P moves as shown above. This motion can best be explained by.....

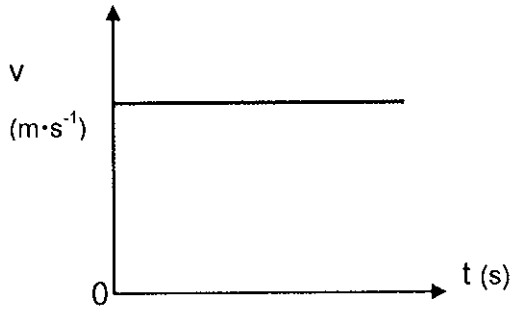
A Newton's Second Law
B Inertia
C Newton's Third Law
D Newton's Law of Universal Gravitation (2)

1.3 The net force versus time graph represents the motion of a car starting from rest on a horizontal surface.

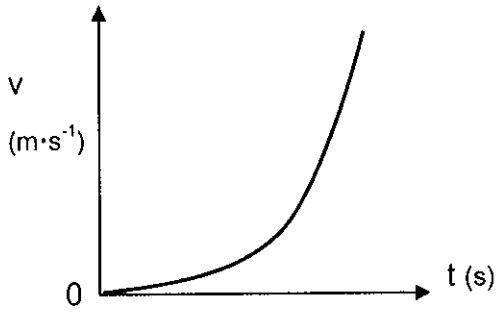


Which one of the velocity-time graphs shown below represents the motion of the car during this period? (2)

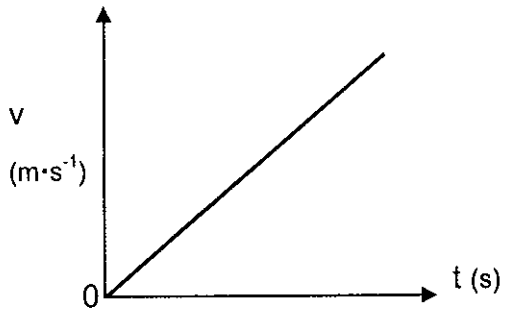
A



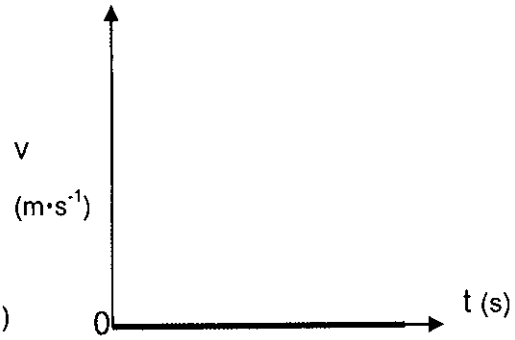
B



C



D



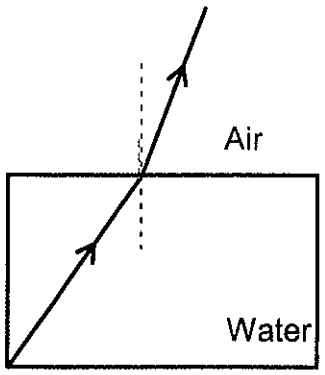
(2)

1.4 A space rocket of mass M has a weight W on the surface of the Earth. The rocket is launched and reaches a height above the surface of the Earth equal to TWICE the Earth's radius. At this height its mass is reduced to a quarter of its original mass (M) because it had used up some of its fuel. The gravitational force of attraction between the rocket and the Earth at this height is ....

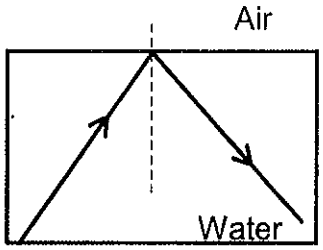
A 12 W
B 36 W
C 1/36 W
D 1/12 W (2)

1.5 Which ray diagram is the correct representation of the phenomenon of refraction?

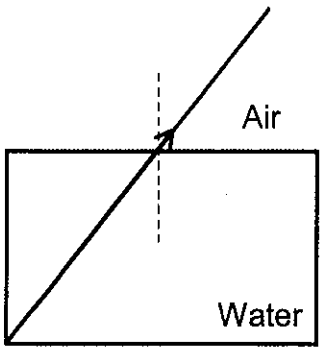
A



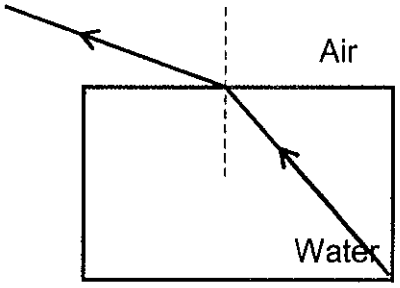
B



C



D

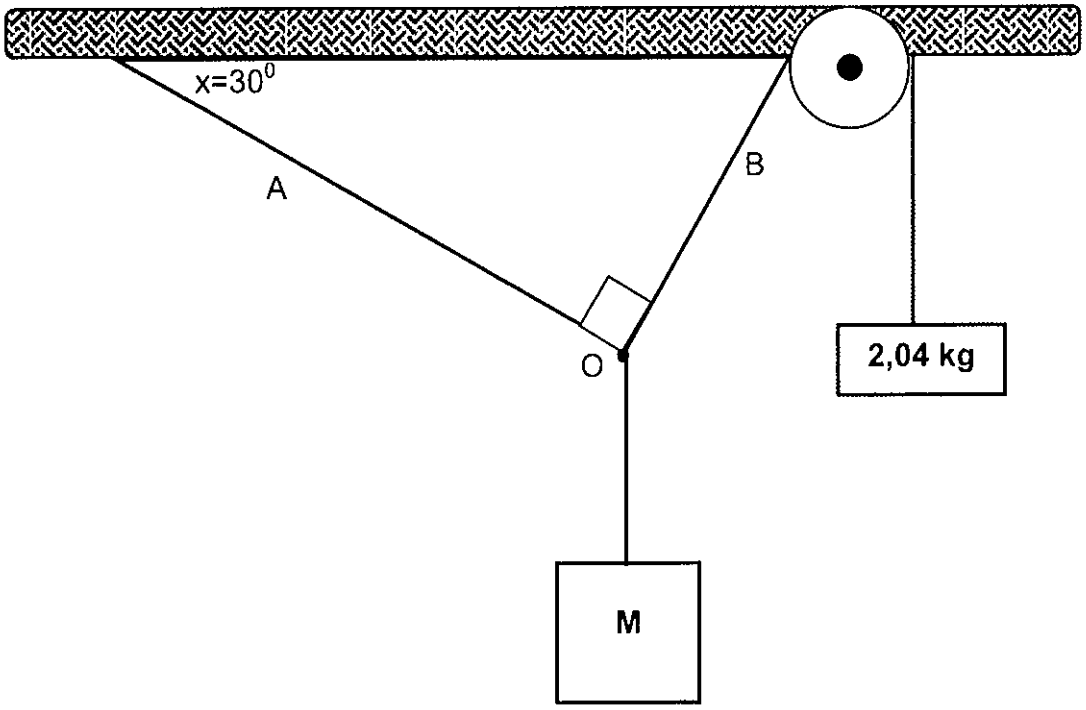


(2)

[10]

QUESTION TWO

The diagram below shows a body M suspended from a ceiling by string A that is attached to a 2,04 kg mass by string B which runs freely over a pulley.
The strings have negligible mass. It is observed that when the system comes TO REST, the angle between strings A and B is 90^0 and the size of angle x is 30^0.



2.1 What can be said about the forces acting at point O when the system comes to rest? (2)

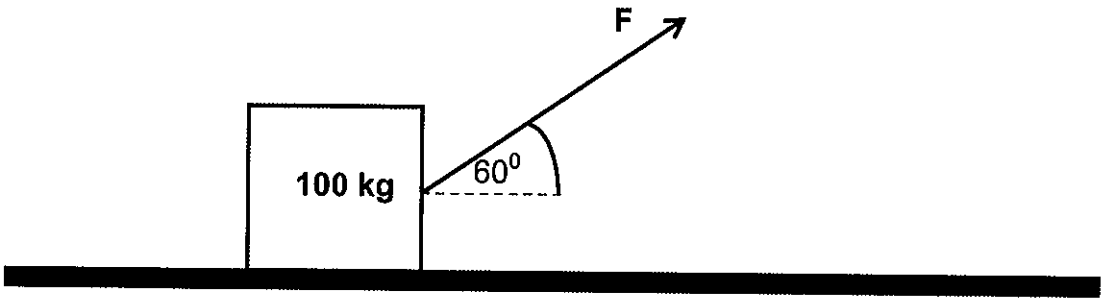
2.2 Draw a closed vector diagram to show all the forces acting at point O. Indicate two angles in your diagram. (4)

2.3 Calculate the mass of body M. (4)

[10]

QUESTION THREE

A force of magnitude F is applied to a 100 kg box at an angle of 60^0 to the horizontal. The box is initially at rest on a rough horizontal surface.



There is a constant kinetic frictional force of magnitude 6,5 N that acts on the box as it moves along the surface. The box moves to the right with a constant acceleration of 5 $m \cdot s^{-2}$.

3.1 State the definition of *kinetic frictional force.* (2)

3.2 Calculate the magnitude of force F. (4)

3.3 Draw a force diagram showing all the VERTICAL FORCES acting on the box. (2)

3.4 Calculate u_K, the co-efficient of kinetic friction for the box and the surface. (5)

3.5 How will the co-efficient of kinetic friction be affected if the angle of the force F is increased to 80°.
(Choose from INCREASES, DECREASES or REMAINS THE SAME). (1)

[14]

QUESTION FOUR

The table below was obtained from an experiment conducted by grade 11 learners. The aim of the experiment was to verify the mass-acceleration relationship of Newton's Second Law.

Mass of trolley(kg)	$\frac{1}{\text{Mass}}$ (kg^{-1}) X 10^{-1}	Acceleration($m \cdot s^{-2}$)
2	5	4
3	3,3	2.7
4	(a)	1.9
5	(b)	1.6
6	1,7	1.33

4.1 Write down the values for (a) and (b) located in the table. (1)

4.2 Which variable was kept constant in this experiment? (1)

4.3 USE THE GRAPH SHEET PROVIDED to draw a graph of acceleration versus $\frac{1}{\text{mass}}$. Draw the line of best fit. (5)

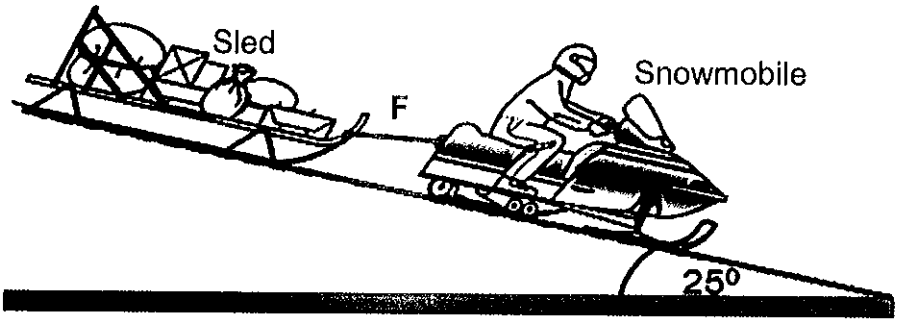
4.4 What is the relationship between acceleration and $\frac{1}{\text{mass}}$? (1)

4.5 Use your graph to calculate the magnitude of the net force acting on the trolley . (3)

[11]

QUESTION FIVE

5.1 A snowmobile pulls a 50 kg sled down a snowy hill that has a constant incline of 25^0. The snowmobile exerts a force F on the sled.



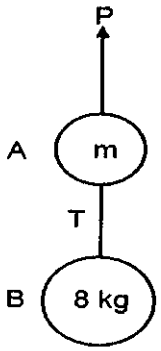
The kinetic frictional force acting on the sled is 17,76 N.

5.1.1 State Newton's Second Law of motion in words. (2)

5.1.2 Draw a labelled free body diagram to show all the forces acting on the sled. (4)

5.1.3 Calculate F (the force exerted by the snowmobile on the sled) if the sled accelerates at 5 $m{\cdot}s^{-2}$ down the hill. (4)

5.2 Two spheres A and B having masses of m and 8 kg respectively, are connected by a piece of light, inextensible string. They are pulled vertically upwards by a constant applied force P of magnitude 200 N. The tension in the string connecting A and B is T.
Ignore the effects of air-resistance.



The net force acting on the 8 kg sphere is 40 N.
Calculate the mass m of sphere A. (6)

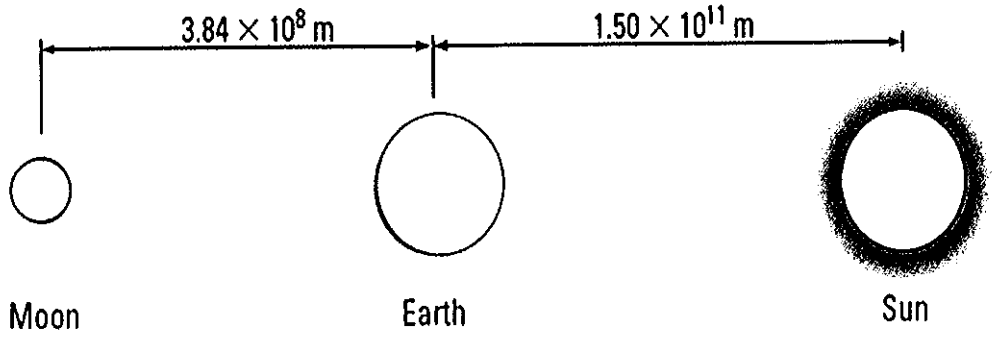
[16]

QUESTION SIX

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

6.2 Distinguish between the *mass* and the *weight* of an object . (2)

6.3 During a lunar eclipse, the Earth, the Moon, and the Sun are aligned on the same plane as shown below



Data Table

Celestial Body	Mass (kg)	Mean Separation Distance from Earth (m)
Earth	5.97×10^{24}	—
Earth's Moon	7.35×10^{22}	3.84×10^{8}
Sun	1.99×10^{30}	1.50×10^{11}

6.3.1 Using the data table given above, calculate the magnitude of the force exerted by the Moon on the Earth. (4)

The force exerted by the Sun on the Earth is 3.522×10^{22} N.

6.3.2 Write down the magnitude of the force exerted by the Earth on the Sun. (1)

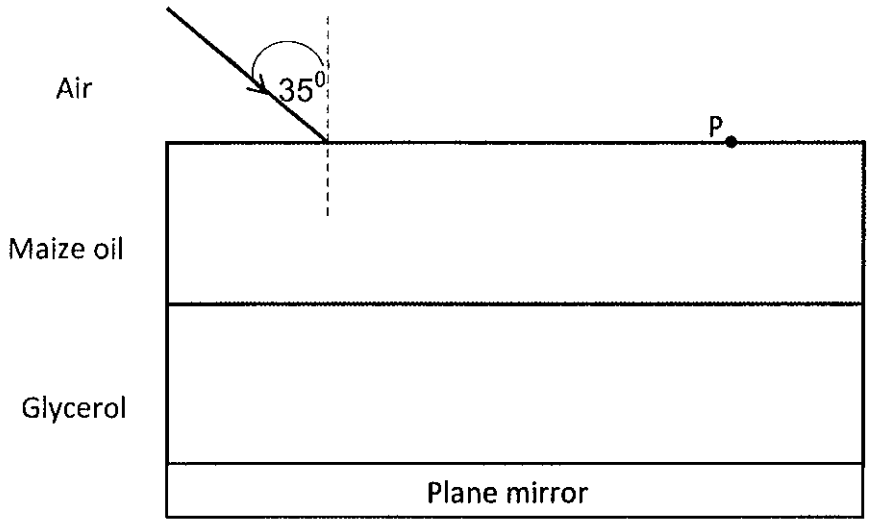
6.3.3 Calculate the net force experienced by the Earth due to the Moon and the Sun. (3)

[12]

QUESTION SEVEN

7.1 State the definition of *"refraction of light"*. (2)

7.2 A ray of monochromatic light having a frequency of 5.09×10^{14} Hz is incident from air to Maize oil to glycerol and strikes a plane mirror. The angle of incidence from air to maize oil is 35° as shown.



Material	Air	Maize oil	Glycerol
Refractive Index	1,00	1,47	1,47

7.2.1 ***This question must be answered using the answer sheet provided on page 15.***
Draw the path taken by the light ray as it passes :

- From air into the maize oil,
- From maize oil into glycerol
- To strike the mirror and then
- To return to point P.

Draw the normal at each surface. (5)

7.2.2 State Snell's Law in words. (2)

7.2.3 Calculate the angle of the refraction as the ray passes from air to maize oil. (4)

(3)

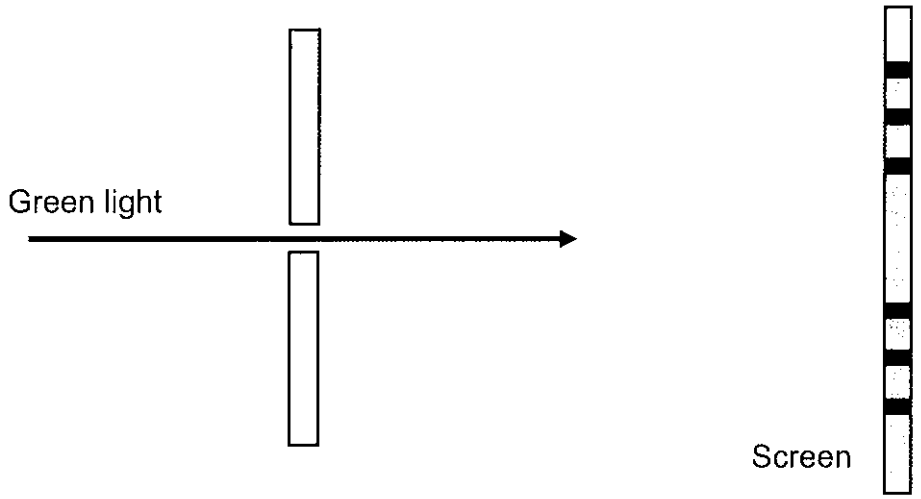
7.2.4 Calculate the speed of the light ray as it passes through glycerol. The speed of light in a vacuum is 3×10^8 m·s^{-1}.

7.2.5 What will be the magnitude of the speed of light as it passes through the maize oil? Give a reason. (2)

[18]

QUESTION EIGHT

The sketch below shows a beam of monochromatic green light passing through a single slit. A pattern is observed on the screen.



8.1 What do the dark bands represent? Give a reason. (2)

8.2 What is this phenomenon called? (1)

8.3 The pattern observed on the screen is explained by Huygen's principle. State Huygen's principle in words. (2)

8.4 State TWO changes that could be made to the above set up that will affect the appearance of the pattern formed on the screen if green light is used. (2)

8.5 The green light is now replaced by RED LIGHT. State TWO differences in the pattern that will now be observed on the screen. (2)

[9]

[100]

Make sure you hand in your answer pages for Questions 4.3 and 7.2.1 with your answer book.

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*

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

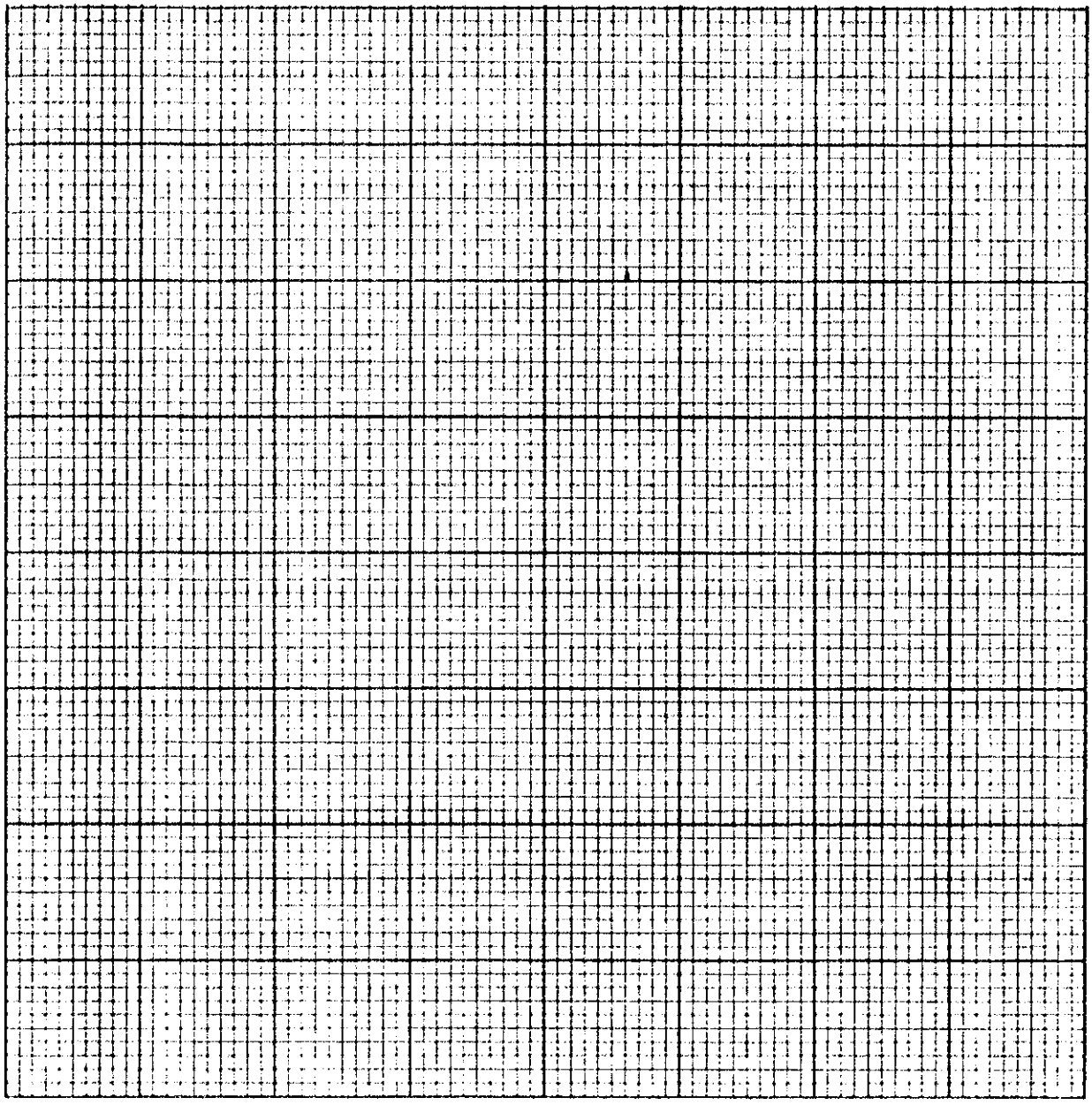
WAVES ,SOUND AND LIGHT/GOLWE, KLANK EN LIG

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

NAME OF SCHOOL : _____

NAME OF LEARNER :_____ **GRADE 11** ____

Question 4.3 Answer sheet

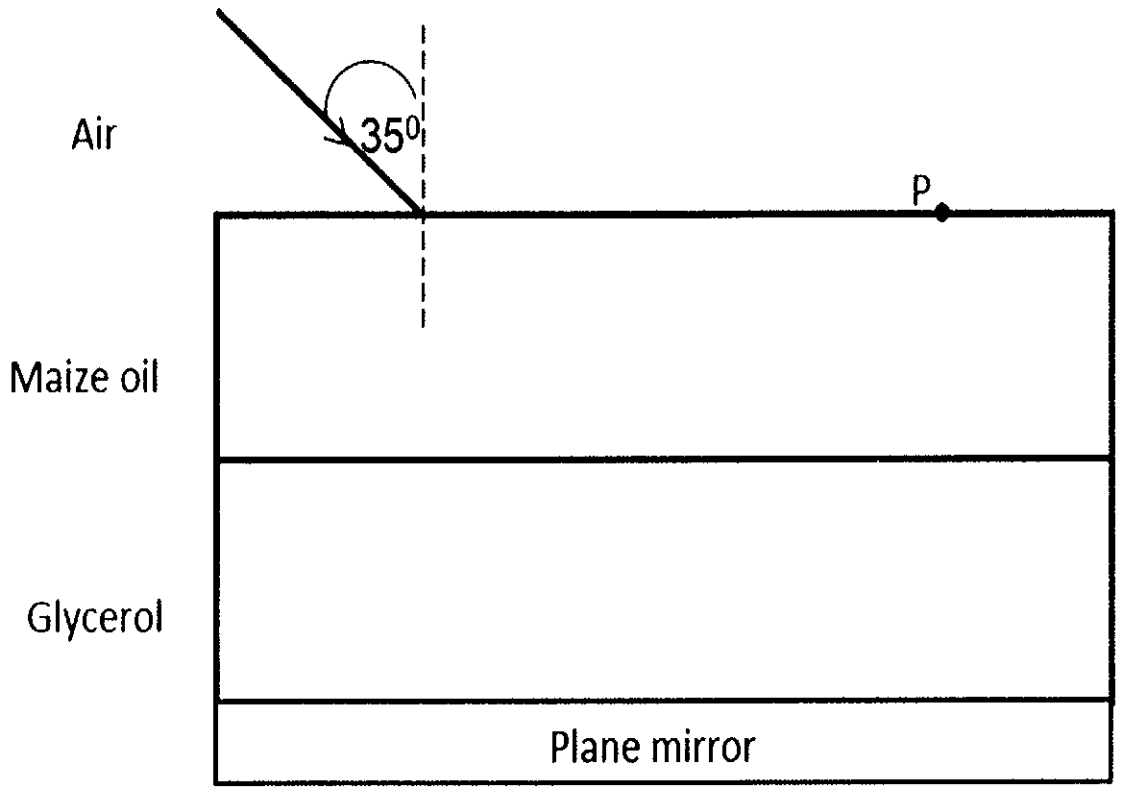


TEAR-OFF SHEET

NAME OF SCHOOL : _____

NAME OF LEARNER :_____ GRADE 11 ____

QUESTION 7.2.1 ANSWER SHEET



TEAR-OFF SHEET

education

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PHYSICAL SCIENCES P1

COMMON TEST

JUNE 2019

MARKING GUIDELINE

NATIONAL SENIOR CERTIFICATE

GRADE 11

NB: This marking guideline consists of 9 pages.

QUESTION ONE

1.1 C ✓✓

1.2 B ✓✓

1.3 C ✓✓

1.4 C ✓✓

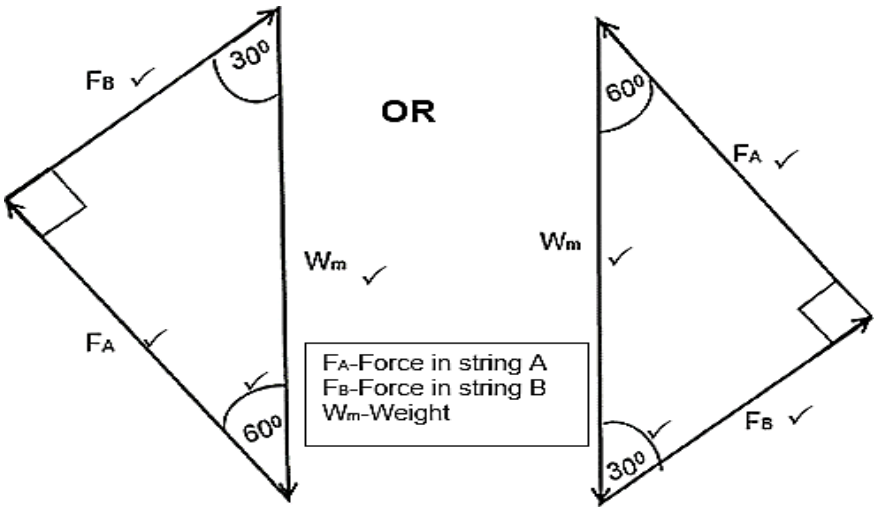
1.5 D ✓✓

[10]

QUESTION TWO

2.1 The forces are balanced. ✓✓ OR $F_{net} = 0$ ✓✓ (2)

2.2



Marking Rubric : Diagram	
Criteria	Mark allocation
Forces A , B and W correctly drawn and labelled in a closed triangle.	3 x 1 = 3
Any two angles shown correctly	1
If no arrows shown penalise once (max ¾)	

(4)

2.3 $F_B = m \cdot g$

$= 2,04 \times 9,8$

$= 19,99\ N$ } Any one ✓

$\sin 60^0 = \frac{O}{H}$

$\sin 60^0 = \frac{19.99}{W_m}$ ✓

$W_m = 23,082 N$

$W_m = m \cdot g$

$23,082 = m \times 9,8$ ✓

$m = 2,36\ kg$ ✓

OR

$\cos 30^0 = \frac{A}{H}$

$\cos 30^0 = \frac{19.99}{W_m}$ ✓

$Wm = 23,082\ N$

(4)

[10]

QUESTION THREE

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

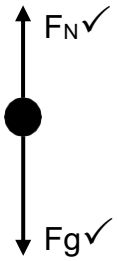
3.2 $F_{NET} = m \cdot a$

$F_X + (-f_K) = m \cdot a$ } Any one ✓

$F \bullet \cos 60^0 + (-6,5)$ ✓ $= 100 \bullet (5)$ ✓

$F = 1013\ N$ ✓ (4)

3.3



(2)

3.4 **Positive marking from Q 3.2**

$F_N = W - F_y$
$F_N = m \cdot g - F \bullet \sin\theta$ } Any one ✓

$= (100)(9,8) - 1013 \sin(60^0)$ ✓
$= 102,716$ N

$f_K = \mu_K \bullet F_N$ ✓ ⊕

$\underline{6,5 = \mu_K \bullet 102,716}$ ✓

$\mu_K = 0.063$ ✓ (5)

3.5 Remains the same ✓ (1)

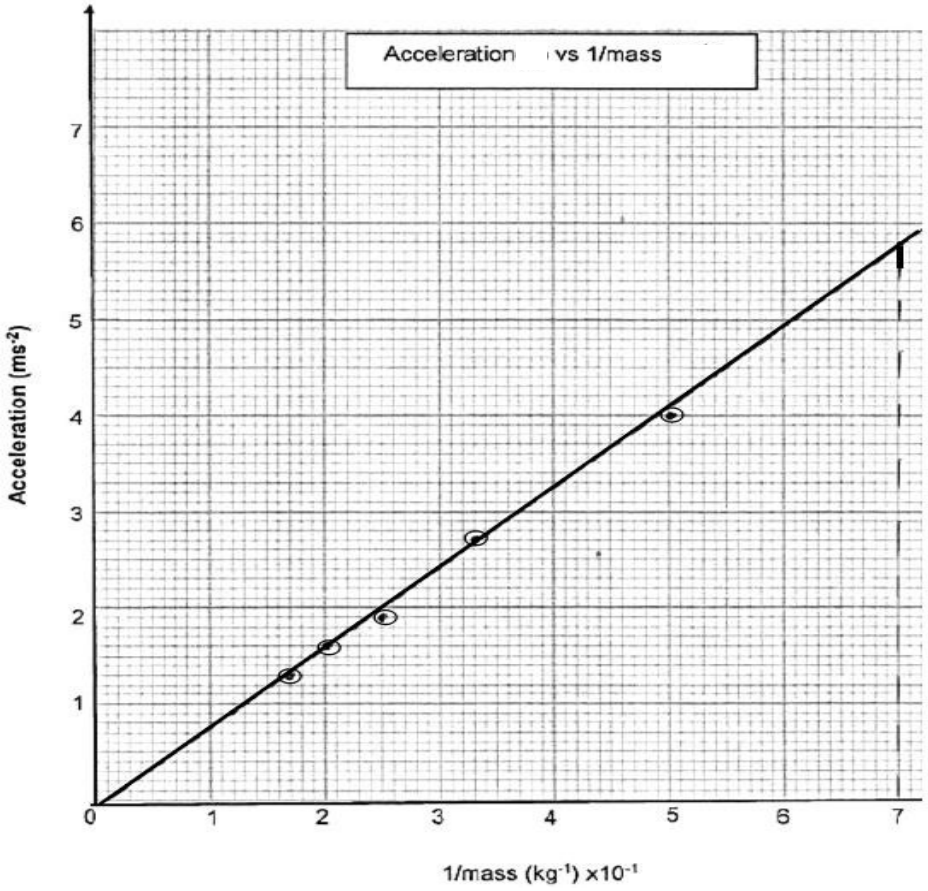
[14]

QUESTION FOUR

4.1 (a) = 0,25
(b) = 0,20 } ✓ (1)

4.2 Force exerted on the trolley ✓ (1)

4.3



Marking Rubric : Diagram	
Criteria	Mark allocation
• Appropriate scale used on x and y axis	1
• All points correctly plotted • 3 out of 5 points correctly plotted	2 1
• Best fit line showing direct proportion(graph passing through the origin)	1
• Correct choice of axes	1

(5)

4.4 Directly proportional✓ (1)

4.5 Gradient : $F = \frac{\Delta a}{1/\Delta m}$

$= \frac{5,8 - 0}{0,7 - 0.01}$ ✓✓

$= 8,41$

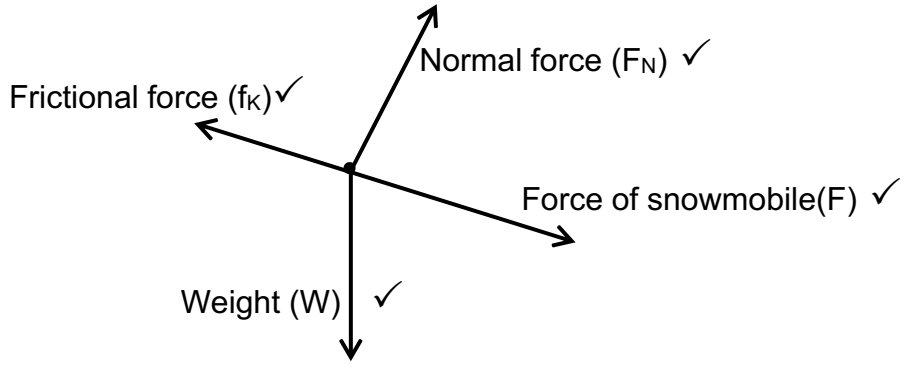
$F = 8,41$ N✓ (accept range 8,21 N – 8,61 N) (3)

[11]

QUESTION FIVE

5.1.1 If a non zero NET force acts on an object, then the object accelerates in the direction of the NET force where the acceleration of the object is directly proportional to the NET force ✓ and inversely proportional to the mass of the object. ✓ (2)

5.1.2



(Accept the parallel and perpendicular components of weight.) (4)

5.1.3 $F_{g//} = m \bullet g \sin\theta$
$= 50(9,8) \sin 25^0$
$= 207,083$ N ✓

Take the motion of the sled down the incline as being positive.

$F_{NET} = m \cdot a$
$F + F_{g//} + (-f) = m \bullet a$ Any one ✓
$F + 207,083 + (-17,76) = 50(5)$ ✓
$F = 60.677$ N ✓ (4)

5.2 **Sphere B**
$F_{NET} = m \bullet a$
$40 = 8 \cdot a$ ✓
$a = 5\ ms^{-2}$

$F_{NET} = m \cdot a$
$T + (-W) = m \bullet a$
$T - 8(9,8) = 8(5)$ ✓
$T = 118,4$ N ✓

Sphere A
$F_{NET} = m \bullet a$
An
$m = 5,51$ kg ✓ (6)

[16]

QUESTION SIX

6.1 Every body 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)

6.2 The mass of an object is the amount of matter found in an object. ✓The weight of an object is the force with which the centre of a planet attracts✓an object/an object is attracted to a large mass . (2)

6.3.1 $F_{Moon \rightarrow Earth} = \frac{Gm_1m_2}{r^2}$ ✓

$= \frac{6,67x10^{-11} \cdot (7,35x10^{22}) \cdot (5,97x10^{24})}{(3,84x10^{8})^2}$ ✓ ✓

$= 1,985x10^{20}$ N✓ (4)

6.3.2 $3,522 \times 10^{22}$ N✓ (1)

6.3.3 Take the direction to the right as being positive.

Positive marking from Q6.3.1

$F_{NET\ on\ Sun} = F_{Sun \rightarrow Earth} + (- F_{Moon \rightarrow Earth})$

$= 3{,}522 \times 10^{22} - 1{,}985 \times 10^{20}$ ✓

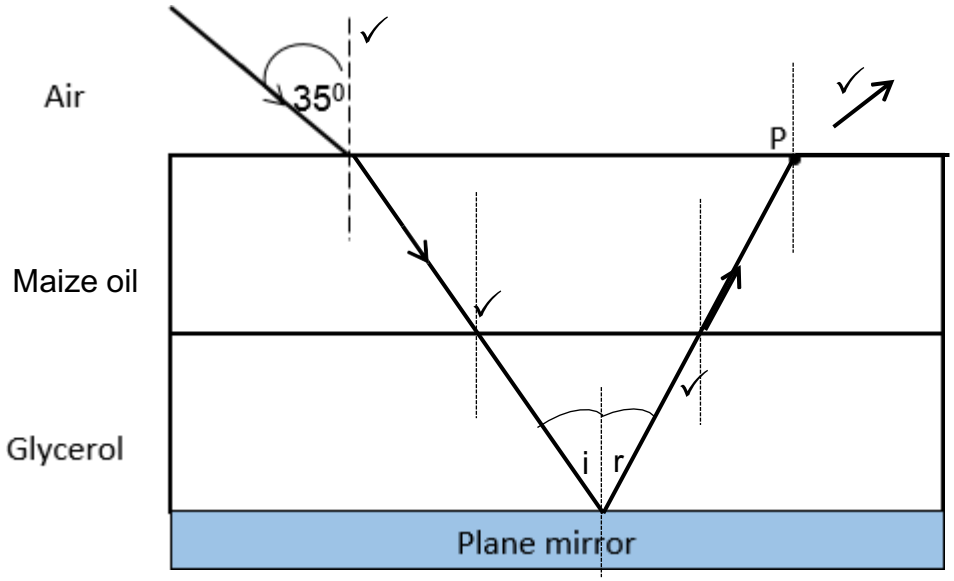
$= 3{,}50 \times 10^{22}$ N ✓,towards the Sun ✓ (3)

[12]

QUESTION SEVEN

7.1 It is the bending of light as it passes from one medium to another of different optical density. ✓✓ (2 or 0) (2)

7.2.1



Marking Rubric : Diagram	
Criteria	Mark allocation
• Refracted ray bending towards normal (Air - maize oil)	1
• Straight line from maize oil to glycerol.	1
• Straight line from glycerol to maize oil.	1
• Ray bending away from the Normal when going from maize oil to air.	1
• All Normal lines are drawn correctly	1

(5)

7.2.2 The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant. ✓✓ (2)

7.2.3 $n_1 \sin \theta_1 = n_2 \sin \theta_2$ ✓
$1 \cdot \sin 35^0$ ✓ = $1,47 \cdot \sin(\theta_2)$ ✓
$\theta_2 = 22,97^0$ ✓ (4)

7.2.4 $n = \frac{C}{v}$ ✓
$1,47 = \frac{3 \times 10^8}{v}$ ✓
$v = 2,04 \times 10^8 \text{ m·s}^{-1}$ ✓ (3)

7.2.5 $2,04 \times 10^8 \text{ m·s}^{-1}$ ✓
Maize oil has the same refractive index as glycerol. ✓ (2)

[18]

QUESTION EIGHT

8.1 Destructive interference ✓ takes place at those points on the screen , this is due to a crest and a trough overlapping at those points out of phase. ✓ (2)

8.2 Diffraction ✓ (1)

8.3 Every point on a wave-front is a source of a secondary wavelet which spreads out in all directions ✓✓ (2)

8.4
- Change the width of the slit ✓
- Move the screen towards or away from the slit ✓ (2)

8.5 A broader central red band ✓ is observed alternating with broader red and dark bands. ✓ (2)

[9]

TOTAL: [100]