Province of the
EASTERN CAPE
EDUCATION

OR TAMBO INLAND DISTRICT

GRADE 11

PHYSICAL SCIENCES
CONTROLLED TEST
MARCH 2024

MARKS: 100

TIME: 2 HOURS

This question paper consists of 12 pages, including 1 data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your FULL NAME and SURNAME on the ANSWER SCRIPT.
2. The question paper consists of 6 questions. Answer ALL the questions in the ANSWER SCRIPT.
3. Start EACH question on a new page in the ANSWER SCRIPT.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE-line open between two sub-questions 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 SHEETS.
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 explanations, motivations, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.8) in the ANSWER BOOK, for example 1.9 E

1.1 Which one of the following physical quantities is not an example of a vector quantity?

A. Acceleration
B. Weight
C. Electrostatic force
D. Time (2)

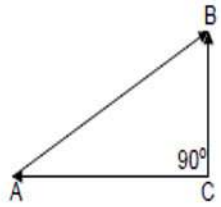
1.2 Two forces, F_1 and F_2, act on a point. If F_1 and F_2 act in the same direction, the maximum resultant has a magnitude of 15 N. If forces F_1 and F_2 act in opposite directions, the magnitude of the minimum resultant is 3 N. The magnitude of the two forces, in Newton, is:

A. 8 and 7
B. 9 and 6
C. 12 and 3
D. 11 and 4 (2)

1.3 The mass of an astronaut on EARTH is M. At a height above the Earth equal to twice the radius of the Earth, the mass of the astronaut will be …

A. M
B. ¼ M
C. 2 M
D. $\frac{1}{9}M$ (2)

1.4 Consider the following vector diagram:



The vector which represents the resultant of the other two, is …..

A. AC

B. AB

C. BA

D. CB (2)

1.5 A car moving forward collides with a tree and comes to rest very quickly. The passenger who was not wearing a seat belt continued moving forward and collided with a car's windscreen. Which law explains this scenario?

A. Newton's second law of motion

B. Newton's law on universal gravitation

C. Newton's first law of motion

D. Newton's third law of motion (2)

1.6 Which ONE of the statements concerning the inertia of a body is true?

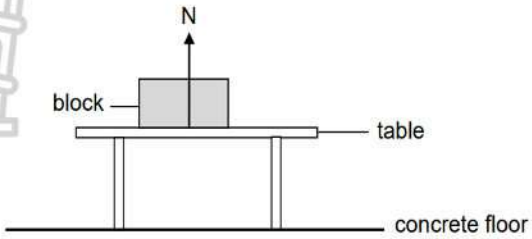
A. Inertia is inversely proportional to the mass of the body.

B. Inertia is only a property of bodies, which have no forces acting on them.

C. Inertia is that force acting on a body, which resists any change in its state of motion.

D. Inertia is that property of a body, which resists any change in its state of motion. (2)

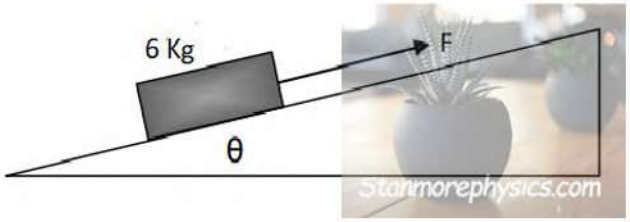
1.7 A block rests on a table. The table stands on a concrete floor. The normal force is represented by N, as shown in the diagram below.



Which ONE of the following forces will form an action-reaction pair with the normal force (N)?

A. Force of the block on the Earth
B. Force of the block on the table
C. Force of the table surface on the block
D. Force of the block on the concrete floor (2)

1.8 A block with a mass of 6 kg is pulled upwards along a frictionless slope, inclined at an angle θ, with a force F, as shown in the sketch below.



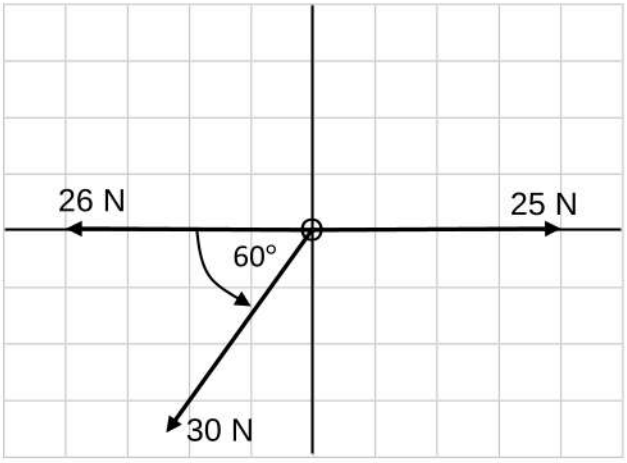
Which ONE of the following equations can be used to calculate the magnitude of the normal force (N)?

A. $N = (6)(9,8)\cos\theta$
B. $N = F + (6)(9,8)\cos\theta$
C. $N = (6)(9,8)\sin\theta$
D. $N = F - (6)(9,8)\cos\theta$ (2)

[16]

QUESTION 2

2.1 The diagram below represents three force vectors acting on a point O.

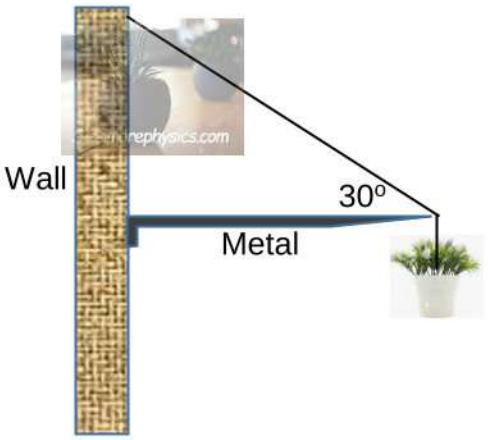


2.1.1 Define the term *resultant vector*. (2)

2.1.2 Calculate the magnitude of the vertical component for 30 N. (2)

2.1.3 Determine the magnitude and direction of the (net) resultant vector acting on point O. (6)

2.2 The garden boy wants to expose a flower to the sun. He decided to mount a string from the flower bucket to the wall, which is then supported by the metal attached to the wall, such that the flower bucket is stationary. The combined mass of the bucket and the flower is 2.5 kg. The metal is mounted such that it is perpendicular to the wall and the angle between the string and the metal is 30°.



2.2.1 Calculate the weight of the bucket system (3)

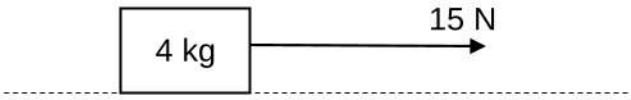
2.2.2 Draw a closed vector diagram, including at least TWO angles. (4)

2.2.3 Explain the meaning of a closed vector diagram. (2)

[19]

QUESTION 3

The box of mass 4 kg is pulled with a force of 15 N on a horizontal, *rough* surface to the right. The box is moving at a CONSTANT VELOCITY.



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

3.2 Write down the magnitude of the net force acting on the box. (2)

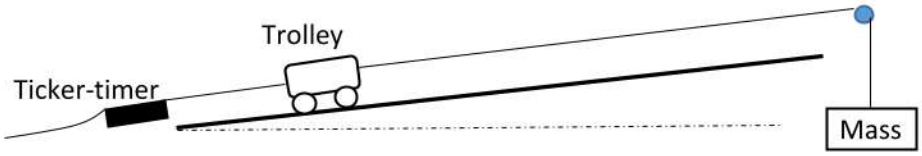
3.3 Calculate the magnitude of the normal force (3)

3.4 Calculate the coefficient of the kinetic friction. (5)

[12]

QUESTION 4

Grade 11 learners investigate the relationship between the net force and acceleration by pulling a trolley across a surface, which is slightly inclined. The trolley is connected to different masses by a string of negligible mass. The string passes over a frictionless pulley. Refer to the diagram below



Ticker tape attached to the trolley passes the ticker-timer. The acceleration of the trolley is determined by analysing the ticker tape. The results of the net force produced by different masses and the acceleration of the trolley were recorded in the table below.

Net Force (N)	Acceleration ($m.s^{-2}$)
0.2	0.41
0.4	0.81
0.6	1.22
0.8	1.64

4.1 Write down the investigative question (2)

4.2 From the above investigation write down the:

4.2.1 Independent variable (1)

4.2.2 Dependent variable (1)

4.3 Write down the name of the law that is investigated above. (1)

4.4 Use the graph paper provided on the ANSWER SHEET and draw a graph of acceleration versus net force. (4)

4.5 Use the graph to calculate the mass of the trolley (5)

4.6 Using the graph, write down the conclusion for the experiment. (2)

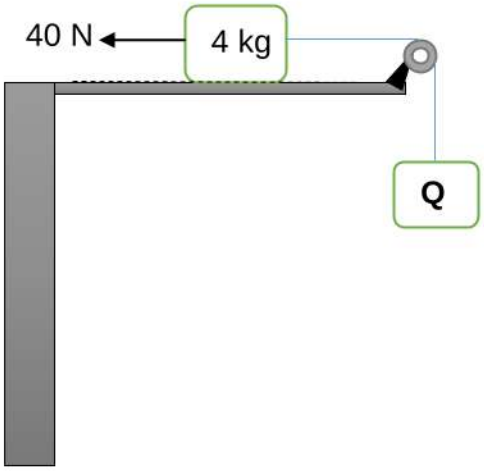
4.7 Write down ONE possible error that can occur in this experiment (1)

4.8 How can the error mention be eliminated? (1)

[18]

QUESTION 5

A 4 kg block is placed on a rough horizontal surface. It is connected to a second block, **Q** of an *unknown* mass, by a light inextensible string passing over a light, frictionless pulley, as shown below. A force of 40 N is applied to a 4 kg block so that the sysytem moves to the left at an acceleration of 2 $m.s^{-2}$.



The coefficient of the kinetic friction between the surface and the 4 kg block is 0.2.

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

5.2 Calculate the kinetic frictional force between the surface and a 4 kg block (3)

5.3 Draw a free-body diagram, showing all the forces acting on the 4 kg block. (5)

5.4 Calculate the:

5.4.1 Tension of the system (4)

5.4.2 Mass of block **Q**. (3)

The force applied, 40 N now acts at an angle of 25° to the system above, to the same direction.

5.5 What effect will it have to the kinetic friction? Write down INCREASES, DECREASES or REMAINS THE SAME. (1)

5.6 Support your answer to QUESTION 5.5. (2)

[20]

QUESTION 6

Two satellites orbiting the Earth are situated on opposite sides of the Earth. Satellite X has a mass of 4 600 kg and satellite Y has a mass of ***m*** kg. Satellite X is at 32 000 km above the Earth surface.

Satellite X

Earth

Satellite Y

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

6.2 Calculate the force exerted by Satellite **X** on Earth. (4)

6.3 How does the force exerted by Earth on Satellite **X** compared to that of Satellite **X** on Earth? Write, GREATER THAN, SMALLER THAN or EQUAL TO. (1)

6.4 State the law relevant to your answer in 6.3. (2)

6.5 Explain the difference between the weight and mass. (2)

The distance between Satellite **Y** and Earth surface is same as the distance between Satellite **X** and the Earth surface.

6.6 Calculate the mass of Satellite **Y**, if the force between Earth and Satellite **Y** is half that of Earth on Satellite **X**. (4)

[15]

GRAND TOTAL = [100]

DATA FOR PHYSICAL SCIENCES GRADE 11

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

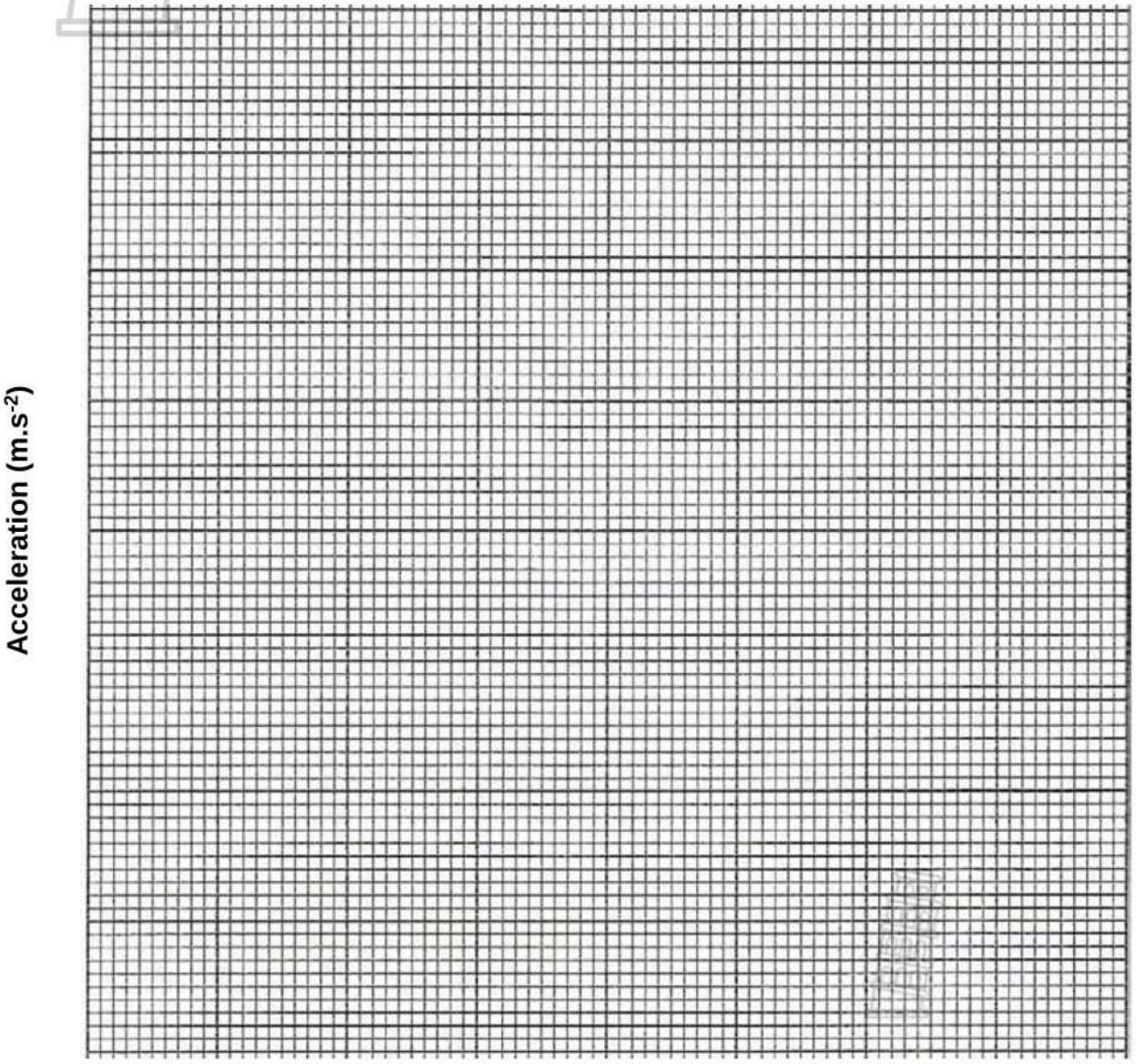
NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6,67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Radius van die Aarde*	R_E	$6,38 \times 10^{6}\ m$
Coulomb's constant *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 Earth *Massa van die Aarde*	M	$5,98 \times 10^{24}\ kg$

FORCE

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

NAME: _____

4.3



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MEMORANDUM

MARKS: 100

THIS MEMORANDUM CONSISTS OF FIVE PAGES

QUESTION 1

1.1 D✓✓ (2)

1.2 B✓✓ (2)

1.3 A✓✓ (2)

1.4 D✓✓ (2)

1.5 C✓✓ (2)

1.6 D✓✓ (2)

1.7 B✓✓ (2)

1.8 A✓✓ (2)

[16]

QUESTION 2

2.1.1 Single vector having the same effect as two or more vectors together.✓✓ (2)

OR

Resultant is the vector sum of two or more vectors.

2.1.2

Option 1	**Option 2**	**Option 3**
$F_y = 30\sin 60°$ ✓ $F_y = 25.98\ N$ ✓	$F_y = 30\cos 30°$ ✓ $F_y = 25.98\ N$ ✓	$F_y = 30\sin 120°$ ✓ $F_y = 25.98\ N$ ✓

(2)

2.1.3 $R_y = 25.98\ N$, downwards

$F_x = 30\cos 60°$ $F_x = 15\ N$✓, $left$	$F_x = 30\sin 30°$ $F_x = 15\ N$✓, $left$

$R_x = 25\ N - 15\ N - 26\ N$

$R_x = -16\ N$

$R_x = 16\ N$✓, $left$

$R^2 = {R_x}^2 + {R_y}^2$

$R^2 = (16)^2 + (25.98)^2$ ✓

$R = 30.51\ N$ ✓

$\tan\theta = \frac{16}{25.98}$ ✓

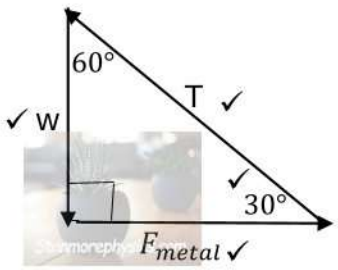
$\theta = 31.63°$ ✓ (6)

2.2.1 $w = mg$ ✓

$w = (2.5)(9.8)$ ✓

$w = 24.50\ N$ ✓ (3)

2.2.2



(4)

2.2.3 A closed vector diagram is set of vectors drawn on the Cartesian using tail to head method✓ and that has a resultant with a magnitude of zero✓. (2)

[19]

QUESTION 3

3.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it.✓✓ (2)

3.2 $F_{net} = 0$ (N)✓✓ (2)

3.3
$N = mg$ ✓
$N = (4)(9.8)$ ✓
$N = 39.2\ N$ ✓ (3)

3.4
$F_{net} = 0$
$F + (-f) = 0$ ✓
$15 - f = 0$ ✓
$f = 15\ N$
$f_k = \mu_k N$ ✓
$15 = \mu_k(39.2)$ ✓
$\mu = 0.38$ ✓ (5)

[12]

QUESTION 4

4.1 What is the relationship between the acceleration and net force when the mass of the trolley is kept constant? ✓✓ (2)

OR

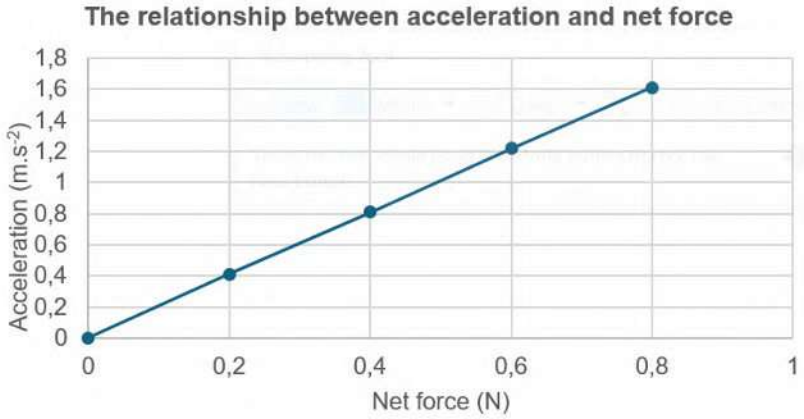
How will the net force affects the acceleration (of the trolley) when the mass of the trolley is kept constant?

4.2.1 Net force✓ (1)

4.2.2 Acceleration✓ (1)

4.3 Newton's Second Law✓ (1)

4.4



Marking criteria for the graph	
Axes with correct/ appropriate scale	✓
3 or more coordinates correctly plotted	✓✓
Drawing a line of best fit	✓

(4)

4.5

Option 1	Option 2
$Gradient = \frac{1.64-0}{0.8-0}$ ✓✓ $Gradient = 2.05$ $mass = \frac{1}{2.05}$ ✓✓ $= 0.49\ kg$ ✓	$Gradient = \frac{1.64-0.41}{0.8-0.2}$ $Gradient = 2.05$ $mass = \frac{1}{2.05} = 0.49\ kg$

(5)

4.6 The acceleration is directly proportional to net force if the mass of the trolley is kept constant.✓✓ (2)

4.7 Presence of friction force.✓ (1)

4.8 To compensate the friction, increase the angle until the velocity is constant.✓ (1)

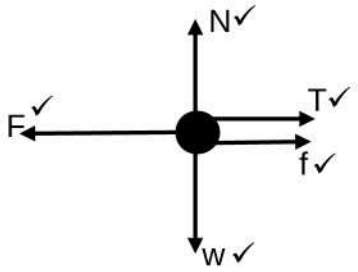
[18]

QUESTION 5

5.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an *acceleration directly proportional to the force*✓ and *inversely proportional to the mass of the object*.✓ (2)

5.2 $f_k = \mu_k N$ ✓
$f_k = (0.2)(4 \times 9.8)$ ✓
$f_k = 7.84\ N$ ✓ (3)

5.3



(5)

5.4.1 $F_{net} = ma$ ✓
$F - f - T = ma$
$40 - 7.84 - T$ ✓$= 4 \times 2$ ✓
$T = 24.16\ N$ ✓ (4)

5.4.2 $F_{net} = ma$
$T - w = ma$
$24.16 - m(9.8)$ ✓$= m(2)$ ✓
$m = 2.05\ kg$ ✓ (3)

5.5 DECREASES✓ (1)

5.6 As the angle increases, the normal decreases✓ and the friction will also decrease✓. (2)

Frictional force is directly proportional to the normal force✓,
OR $f_k \propto N$.

[20]

QUESTION 6

6.1 Each particle in the universe attracts every other particle 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 $F = \frac{Gm_1m_2}{r^2}$ ✓
$F = \frac{(6.67 \times 10^{-11})(4600)(5.98 \times 10^{24})}{(32000 \times 1000 + 6.38 \times 10^6)^2}$ ✓✓
$F = 1245.59\ N$ ✓ (4)

6.3 EQUAL TO✓ (1)

6.4 When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A.✓✓ (2)

6.5 *weight is the gravitational force exerted by the Earth on an object*✓, whilst *mass is the amount of matter in a body.*✓ (2)

6.6 $F = \frac{Gm_1m_2}{r^2}$
622.795✓ $= \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})m_Y}{(32000 \times 1000 + 6.38 \times 10^6)^2}$ ✓✓
$m_Y = 2300\ kg$ ✓ (4)

[15]

TOTAL: 100