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SUBJECT	Science: Paper 1	DATE	10 July 2017
GRADE	12	MARKS	200
EXAMINER	Mr McCoy	MODERATOR	Mrs Visentin Mrs Estehuizen
NAME	Memorandum	DURATION	180 min

QUESTION 1 – MULTIPLE CHOICE

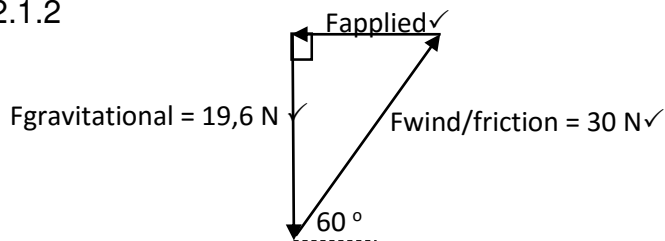
20 MARKS

- 1.1 C ✓✓
- 1.2 B ✓✓
- 1.3 B ✓✓
- 1.4 C ✓✓
- 1.5 C ✓✓
- 1.6 C ✓✓
- 1.7 D ✓✓
- 1.8 C ✓✓
- 1.9 B ✓✓
- 1.10 A ✓✓

QUESTION 2**15 MARKS**

2.1.1 Resultant force is the single force which has the same effect as the original forces acting together. ✓✓ (2)

2.1.2



(3)

2.1.3 ERROR in paper, both answers were marked

$R^2 = y^2 + x^2$ ✓ (✓ showing right angle in the diagram above)

$$30^2 = 19,6^2 + x^2$$

$$x^2 = 515,84$$

$$x = 22,71 \text{ N}$$
 ✓

$$Y = \frac{19,6}{\tan 60} \quad 19,6 \tan 30 = 11,31$$

$$= 11,31 \text{ N}$$

2.2.1 Distance is the path travelled by the umbrella ✓ which is represented by the black line ✓ displacement is the change in position of the umbrella ✓ which is 3 m from the man in direction from his hand to the umbrella. ✓ (4)

2.2.2 $m = Fg / g$

$$m = 19,6 / 9,8$$

$$= 2 \text{ kg}$$
 ✓✓

(2)

QUESTION 3**24 MARKS**

3.1.1 Velocity is the rate of change of position OR rate of change of displacement.

✓✓AON

(2)

$$3.1.2 s = \frac{v^2 - u^2}{2g} \checkmark$$

$$s = \frac{0^2 - 3,66^2}{2(-9,8)} \checkmark$$

$$= 0,68m \checkmark + 7,5 = 8,18 \text{ m above the water} \checkmark (4)$$

$$3.1.3 v^2 = u^2 + 2as$$

$$= 0^2 - 2(9,8)(8,18) \checkmark$$

$$= 147$$

$$v = 12,66m.s^{-1} \checkmark$$

$$s = \frac{(v+u)}{2} xt \checkmark$$

$$-\checkmark 7,5 = \frac{(-12,66 + 3,66)}{2} xt$$

$$t = 1,67 \text{ s} \checkmark (5)$$

3.1.4a) $F_{net} = F_{water} + F_g$

$$= 1098,2 - 588 \checkmark$$

$$= 510,2 \text{ N}$$

$$a = \frac{F_{net}}{m} \checkmark$$

$$= \frac{510,2 \checkmark}{60}$$

$$= 8,5 \text{ m.s}^{-1} \text{ upwards} \checkmark$$

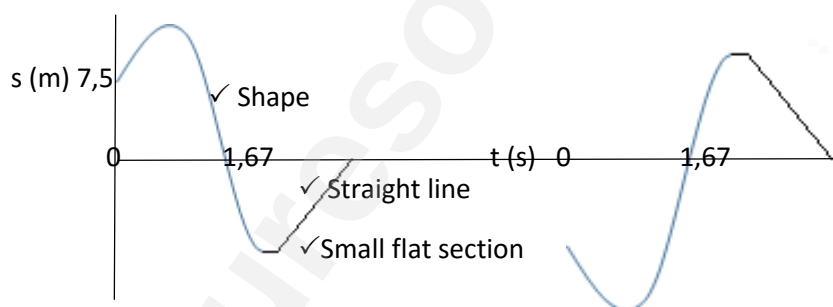
If the boys forget to subtract the weight, max 2.

✓ formula/implied

✓ upwards

(4)

3.1.4b)



✓ Starting at 7,5/ -7,5

✓ values

Minus 1 for no labels (5)

3.2

Jill

$$u = u$$

$$v = 0$$

$$a = g$$

$$t =$$

$$s = h$$

$$v^2 = u^2 - 2gs$$

$$2gh = u^2 \checkmark$$

Jane

$$u = 3u$$

$$v = 0$$

$$a = g$$

$$t =$$

$$s = x$$

$$v^2 = u^2 - 2gs$$

$$\checkmark 2gx = 9u^2$$

$$2gh = \frac{2gx}{9} \checkmark$$

$$x = 9h$$

Jane's height will be 9h ✓

NOTE

The diving board was taken as the reference point. Marks were awarded to pupils who did you the ground as a reference point.

(4)

QUESTION 4**20 MARKS**

4.1 Acceleration is the rate of change of velocity. ✓ ✓ (2)

4.2 Acceleration due to gravity. ✓ (1)

4.3 0,56 s ✓ (1)

4.4

$\text{Gradient} = \frac{\Delta y}{\Delta x} \checkmark$ $= \frac{5,6-0}{0,56-0} \checkmark$ $= 10 \text{ m.s}^{-2} \checkmark \text{ (must have unit)}$	OR	$a = \frac{v-u}{t} \checkmark$ $= \frac{5,6-0}{0,56} \checkmark$ $= 10 \text{ m.s}^{-2} \checkmark$
(3)		

4.5

$\text{accuracy \%} = \frac{ \text{accepted} - \text{experimental} }{\text{accepted}} \times 100 \checkmark$ $= \frac{ 9,8-10 }{9,8} \times 100 \checkmark$ $= 0,02 \%$ $= \text{accurate to within } 0,02\% \checkmark (3)$	$\text{accuracy \%} = \frac{\text{experimental}}{\text{accepted}} \times 100 \checkmark$ $= \frac{10}{9,8} \times 100 \checkmark$ $= 102 \%$ Therefore 98 % accurate ✓(3)
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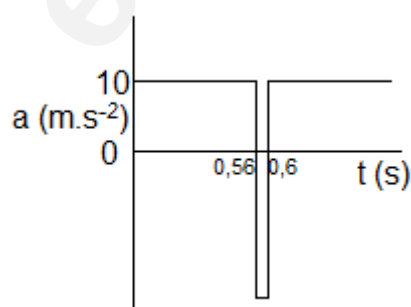
4.6 $\text{height} = \frac{1}{2}bh \checkmark$

$$= \frac{1}{2} 0,56 \times 5,6 \checkmark \text{ NOT } 0,58$$

$$= 1,57 \text{ m high} \checkmark \quad (3)$$

4.7 As the ball has stopped changing position, ✓ as it is stationary on the ground, but the ground is still providing an upward force ✓ and therefore the ball still experiences an acceleration. ✓ (3)

4.8

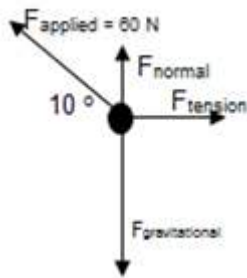


- ✓ positive 10
- ✓ uniform accelerations
- ✓ Large acc for floor
- ✓ time values (4)

QUESTION 5**20 MARKS**

5.1 The normal force is the perpendicular force✓ exerted by a surface on an object in contact with it. ✓ (2)

5.2



✓ of each, with correct length and label. (4)

5.3.1

$F_{60y} = F_{60} \sin \theta$ $F_{60y} = 60 \sin 10^\circ$ ✓ OR $= 10,42 \text{ N}$ ✓ (2)	$F_{60Y} = F_{60} \cos \theta$ $F_{60y} = 60 \cos 80^\circ$
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5.3.2

$F_{60x} = F_{60} \cos \theta$ $F_{60x} = 60 \cos 10^\circ$ ✓ OR $= 59,09 \text{ N}$ ✓ (2)	$F_{60x} = F_{60} \sin \theta$ $F_{60x} = 60 \sin 80^\circ$
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5.4 When a net force, F_{net} , is applied to an object of mass, m , it accelerates in the direction of the net force✓. The acceleration, a , is directly proportional to the net force✓ and inversely proportional to the mass ✓ (3)

5.5.1 $N = mg - F_{60y}$ ✓
 $= 5(9,8) - 10,42$
 $= 38,58 \text{ N}$ ✓ (2)

5.5.2 $F_{net} = F_{hc} + F_g = ma$ ✓ **Using the system**

$$59,09 - (2 \times 9,8) = 7a$$

$$a = 5,64 \text{ m.s}^{-2}$$

$$F_{net} = T + F_g = ma$$

$$T - 19,6 = 2(5,64)$$

$$T = 30,88 \text{ N}$$
 ✓ (5)

QUESTION 6

20 MARKS

6.1 **The Law of Conservation of Momentum** - The total momentum of an isolated system remains constant. ✓✓ aon (2)

6.2 p before collision = p after collision } ✓
 $m_1u_1 + m_2u_2 = (m_1 + m_2)v$
 $(100 \times 80)✓ + (300 \times 0) = (100 + 300)v✓$
 $v = 20 \text{ m.s}^{-1} ✓$ (4)

6.3 $F = \frac{m\Delta v}{\Delta t} ✓$
 $= \frac{300(20 - 0)}{0,8} ✓✓ \text{ OR } = \frac{100(20 - 80)}{0,8} ✓✓$
 $= \underline{7500 \text{ N}} ✓ = -7500 \text{ N}$
 $\therefore$ force exerted by rod on cart is 7500 N towards the cart✓ (to the right forwards). (5)

6.4 The rubber and compressed foam will increase the time ✓ F_{net} inversely proportional to time✓ over which the momentum changes, which will decrease the magnitude of the resultant force acting on the cart and passengers.✓
 $F = \frac{\Delta p}{\Delta t} \leftarrow \text{CONSTANT} ✓ \text{ formula}$
 $\uparrow \Delta t \leftarrow \text{BIGGER}$
 SMALLER (4)

6.5 The external force is applied to the cart✓
 If seat A was used the head would not be supported and the rest of the body would accelerate forwards with the seat✓
 The head would initially remain stationary due to its inertia.✓ (Newton's 1st Law).
 The passengers would suffer from severe whip lash and could break their necks.✓
 Seat B must be used so that the head is supported and therefore accelerates with the cart. ✓ (5)

QUESTION 7

29 MARKS

7.1.1 negative ✓ (1)

7.1.2 $I = V/R$ ✓

$$= 1,36 \checkmark / 6$$

$$= 0,23 \text{ A} \checkmark (3)$$

7.1.3 $I_{3\Omega} = V/R$

$$= 1,36 / 3$$

$$= 0,45 \text{ A}$$

$$I_T = I_2 + I_3$$

$$= 0,23 + 0,45$$

$$= 0,68 \text{ A} \checkmark$$

$$V_{\text{int}} \text{ "lost" } = \varepsilon - V_{\text{ext}}$$

$$= 1,5 - 1,36 \checkmark$$

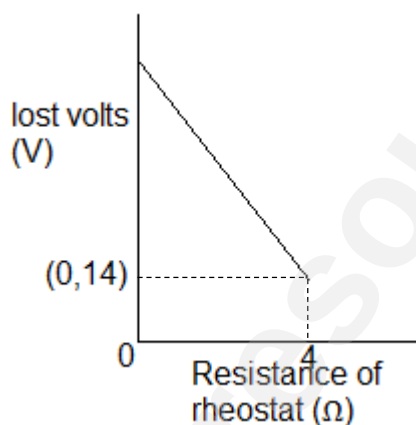
$$= 0,14 \text{ V}$$

$$V_{\text{int}} \text{ "lost" } = Ir \checkmark$$

$$0,14 = (0,68)r \checkmark$$

$$r = 0,21 \Omega \checkmark (5)$$

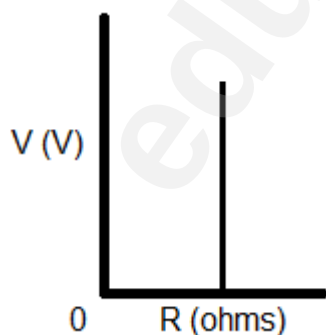
7.1.4



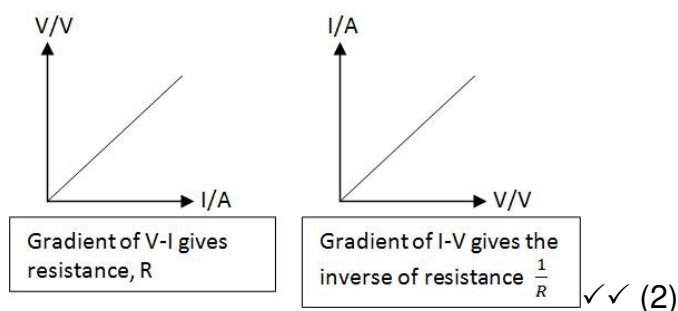
- ✓ variable correct
- ✓ shape
- ✓ line stops at 4 ohms

(3)

7.2.1 The correct answer was



The following graphs were accepted as the question was answered poorly.



7.2.2	OPTION 1 $P = \frac{V^2}{R} \checkmark$ $4 = \frac{V^2}{R} = \frac{(7)^2}{R} \checkmark$ $R = 12,25\Omega \checkmark$	OPTION 2 $P = VI$ $4 = I(7)$ $I = 0,57...A$ $V = IR \checkmark$ $7 = 0,57R \checkmark$ $R = 12,25\Omega \checkmark$	OPTION 3 $P = VI$ $4 = I(7)$ $I = 0,57...A$ $P = I^2 R \checkmark$ $4 = (0,57)^2 R \checkmark$ $R = 12,25\Omega \checkmark$	(3)
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7.2.3a) INCREASES ✓ (1)

7.2.3b) bulb **A** - DECREASES ✓
bulb **B** - INCREASES ✓ (2)

7.2.4c) The current in the main branch will decrease/ The voltage across A will decrease ✓,
P is directly proportional to I^2 / P is directly proportional to V^2 ✓
The current in bulb B branch will be more than before / The voltage across A will decrease ✓,
P is directly proportional to I^2 / P is directly proportional to V^2 ✓
As the resistance of the light bulbs is constant ✓ (5),

7.3 $P = VI$ ✓
= $240 \times 9,5$
= 2280 W
= 2,280 kW ✓
Cost = $2,280 \times \frac{12}{60} \times 1,62$ ✓
= R0,74 or 74 cents ✓ (4)

QUESTION 8**17 MARKS**

8.1.1 work done by a net force on an object is equal to the change in the kinetic energy of the object ✓✓ (AON) (2)

8.1.2 $\Delta E_k = E_{k_f} - E_{k_i}$ ✓
 $= 9 - \frac{1}{2} \times 2 \times 1^2$ ✓
 $= 8 \text{ J}$ ✓ (3)

8.1.3

$\Delta E_k = W_{\text{net}}$ ✓ $F_{\text{net}} = W_{\text{net}}/s$ ✓ $= 8/5$ $= 1,6 \text{ N}$ $F_{\text{net}} = F_{g//} + F_f$ ✓ $1,6 = (2)(9,8) \sin 20^\circ + F_f$ $= 5,1 \text{ N up the slope}$ ✓ (5)	$\Delta E_k = W_{\text{net}}$ ✓ $\Delta E_k = \Delta E_p - F_f$ ✓ $8 = ((2)(9,8) \sin 20^\circ) \times 5 - F_f \times 5$ $= 5,1 \text{ N up the slope}$ ✓ (5)
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8.2.1 The work done on an object is the product of the displacement and the component of the force parallel to the displacement. ✓✓ (AON) (2)

8.2.2 $W_{\text{net}} = W_{\text{applied}} - W_{\text{gravity}} - W_f$ ✓

W_{gravity} is independent of the angle and would be constant ✓.

($W_f = F_f \times s$, F_f depends on $F_n = F_g \cos \beta$) as β increases W_f will decrease ✓.

s is decreasing by the same amount for W_{applied} and W_f ✓, **but overall** W_f would decrease the most ✓

So Harry is correct, as the angle increases the W_{net} on the box will decrease.
 (5)

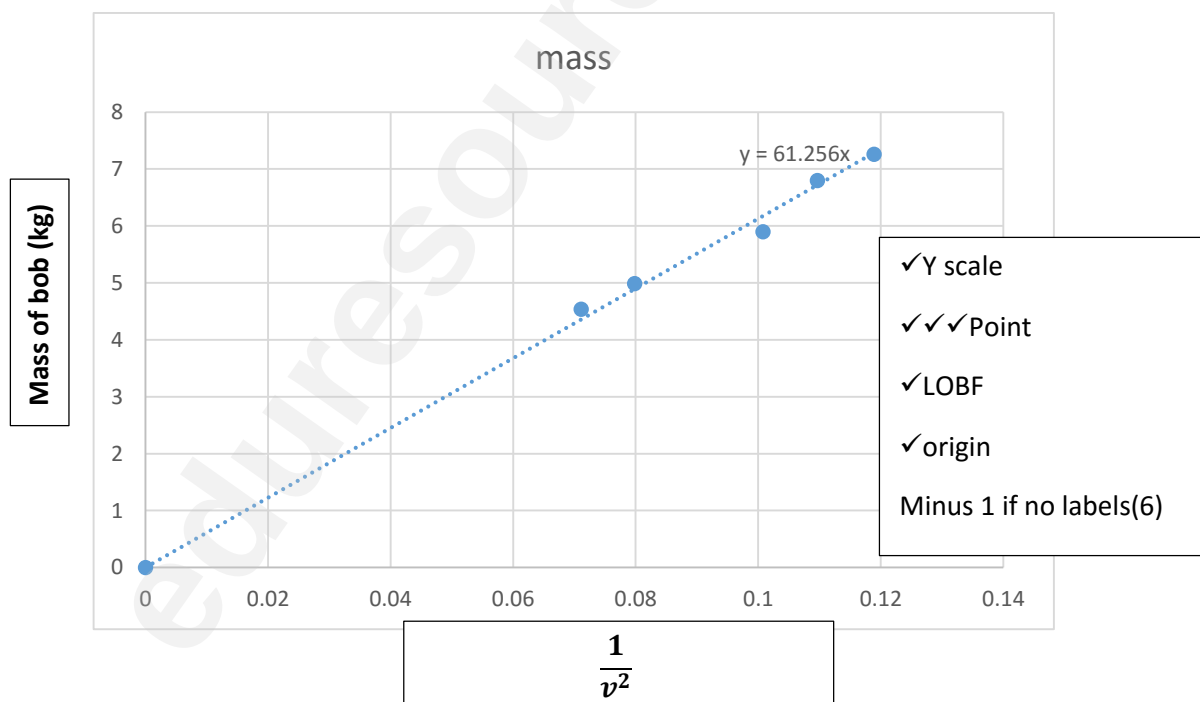
QUESTION 9

35 MARKS

- 9.1 In the absence of air resistance or external force, the mechanical energy of an object remains constant. ✓✓ (2)
- 9.2 B ✓, All of the mechanical energy will be in the form of kinetic energy ✓ as the bob is at its lowest point ($h = 0$) ✓ (3)
- 9.3 Mass of a pendulum bob ✓✓ (2)
- 9.4. The bob will have to be lifted to different height ✓ as E_k is dependent on the velocity at B ✓ and the velocity at B is dependent on the height $v = \sqrt{2gh}$ ✓ (3)
- 9.5.1 (3)

Mass of bob (kg)	Average Maximum Velocity (m.s^{-1})	$\frac{1}{v^2}$ (m^{-2}s^2) ✓
4,54	3,75	0,071
4,99	3,54	0,080 ✓
5,90	3,15	0,101
6,80	3,02	0,110 ✓
7,26	2,90	0,119

9.5.2



- 9.5.3 The square of the velocity of the bob ✓ in inversely proportional ✓ to the mass of the bob. ✓ (3)

$$9.5.4 \text{ Gradient} = \frac{\Delta y}{\Delta x}$$

$$= \frac{5-0}{0.08-0}$$

$$= 62,5 \text{ kg.m}^2.\text{s}^{-2}/\text{J} \quad (4)$$

$$9.5.5 \text{ Gradient} = \frac{m}{v^2}$$

$$E_k = \frac{1}{2} mv^2$$

$$\text{Therefore, gradient} = 2E_k$$

$$62.5 = 10 \times v^2$$

$$v = 2,5 \text{ m.s}^{-1} \quad (4)$$

9.2.1 A collision in which both momentum and kinetic energy are conserved. ✓✓aon (2)

9.2.2 DECREASE ✓, as the kinetic energy would not be conserved ✓, so the ΔE_p would decrease and hence the height. ✓ (3)