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2024 Physical Science Trials Paper 1 MEMO

QUESTION 1

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

[10x2=20]

QUESTION 2

2.1.1 the rate of change of position ✓✓ or the rate of displacement or the rate of change of displacement (2)

$$2.1.2 \quad v = \frac{350}{2(60)} \checkmark \text{ conv} \\ = 2,92 \text{ m.s}^{-1} \checkmark \text{ W } \checkmark \quad (3)$$

$$2.1.3 \quad 3,75 \checkmark = \frac{2X+350 \checkmark}{120} \\ 450 = 2X + 350 \\ X = 50 \text{ m} \checkmark \text{ E of X} \checkmark \quad (4)$$

2.2.1 the rate of change of velocity ✓ ✓ (2)

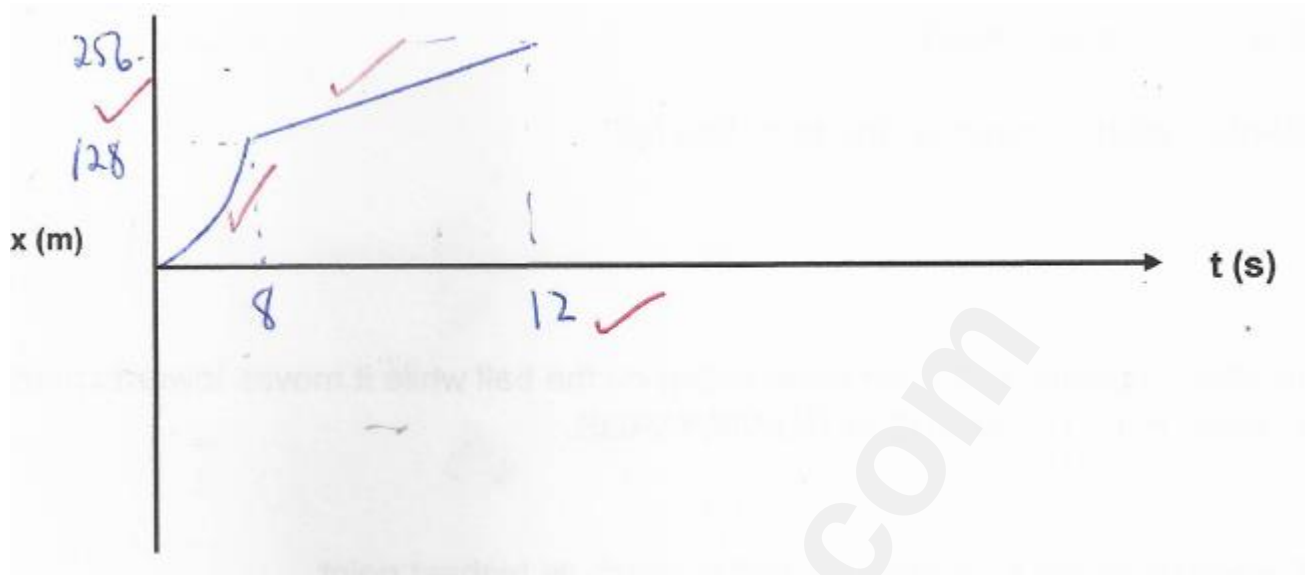
$$2.2.2 \quad v_f = v_i + at \\ 0 = 25 + a(5) \checkmark \\ a = -5 \text{ m.s}^{-2} \\ = 5 \text{ m.s}^{-2} \text{ W} \checkmark \checkmark \quad (3)$$

$$2.2.3 \quad x = 25(5) \checkmark \\ = 125 \text{ m} \checkmark \quad (2)$$

$$2.2.4 \quad \text{Van} \\ x = v_i t + \frac{1}{2} at^2 \\ = 25(5) + \frac{1}{2}(-5)(5)^2 \checkmark \\ = 125 - 62,5 \\ = 62,5 \text{ m} \checkmark \\ 125 - 62,5 - 5 \checkmark (\text{method}) = 57,5 \text{ m} \quad (3)$$

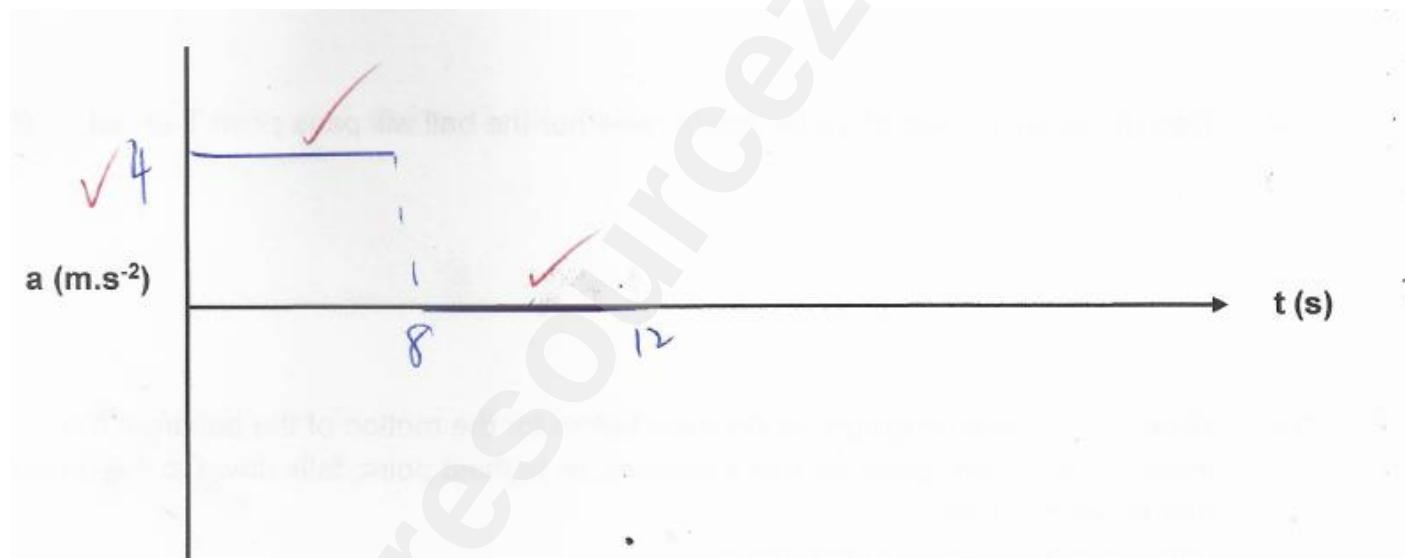
$$2.2.5 \quad \text{gradient} = a \\ 4 \checkmark = \frac{X-0}{8-0} \checkmark \\ X = 32 \text{ m.s}^{-1} \checkmark \quad (3)$$

2.2.6



(4)

2.2.7



(3)

[29]

QUESTION 3

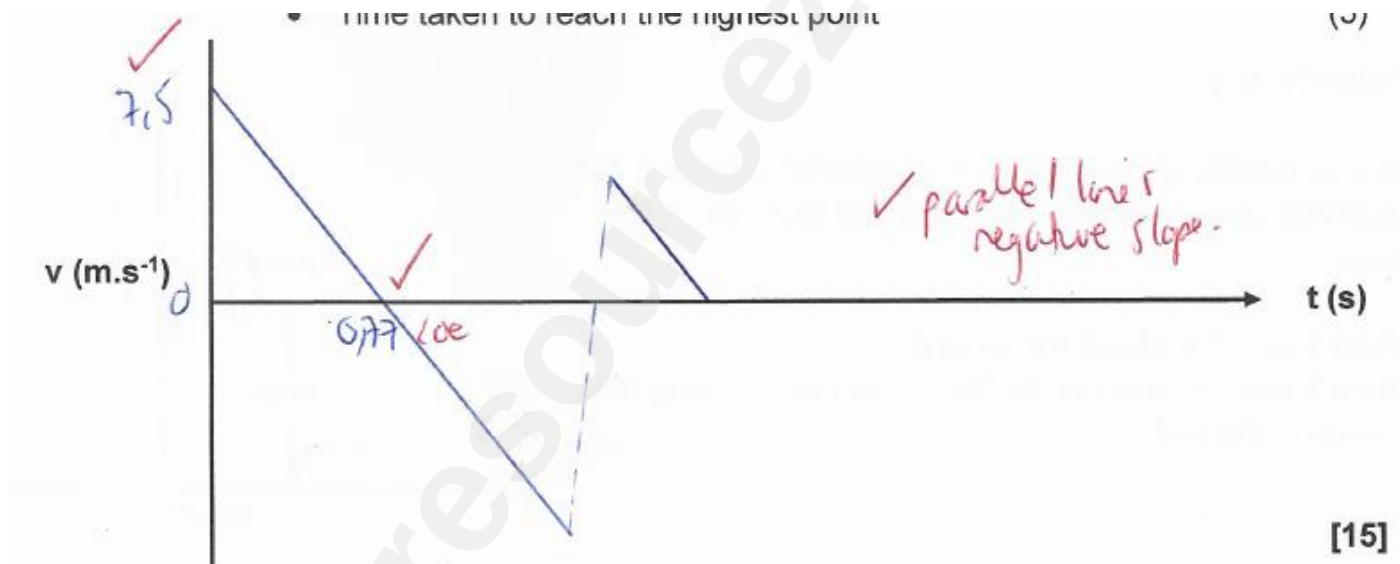
3.1 The only force acting on the object is the force of gravity. ✓ (1)

3.2 DOWNWARDS ✓ ✓ (2)

3.3 $v_f = v_i + at$
 $0 = 7,5 + (-9,8)t$ ✓
 $t = 0,77s$ ✓ (3)

3.4 $v_f^2 = v_i^2 + 2ax$
 $0 = (7,5)^2 + 2(-9,8)x$ ✓
 $x = 2,87 m$ ✓
 $T = 3,7 - 1,6 = 2,1 m$ ✓ therefore will reach T. ✓
 OR $2,87 m + 1,6 m = 4,4,7$ which is greater than 3,7 therefore will reach T. (6)

3.5 (3)

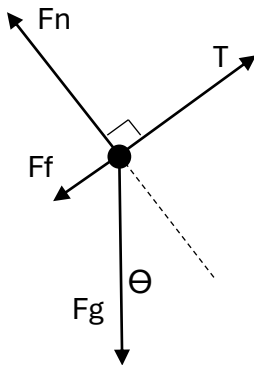


QUESTION 4

4.1 The box is moving at the same velocity as the Land Rover. When the Land Rover is stopped by the rock, the force of the rock acts only on the Land Rover ✓ and not on the box. The box continues ✓ moving at the velocity ✓ it was going so fell in front of the Land Rover. (3)

4.2.1 When a net force is applied to an object of mass, it accelerates in the direction of the net force. ✓ The acceleration is directly proportional to the net force and inversely proportional to the mass. ✓ (2)

4.2.2

 F_n = normal ✓ F_f = friction ✓ F_g = weight ✓ T = tension ✓ $\Theta = 30^\circ$

-1 no angles

(4)

4.2.3 $F_g \parallel \text{slope} = mg \sin \theta$

$$= 3 \times 9,8 \times \sin 30^\circ \checkmark$$

$$= 14,7 \text{ N} \checkmark$$

(2)

4.2.4 VC of $60 \text{ N} = 60 \sin 20^\circ = 20,52 \text{ N} \checkmark$

$$F_g = mg = 5 \times 9,8 = 49 \text{ N} \checkmark$$

$$F_n = 20,52 + 49 = 69,52 \text{ N} \checkmark$$

(3)

4.2.5 $F_f = \mu F_n = 0,15 \times 69,52 \checkmark \text{ coe} = 10,43 \text{ N} \checkmark \text{ coe}$

(2)

4.2.6 **3 kg block**

$$F_{\text{net}} = ma$$

$$T - F_f - F_g \parallel \text{slope} = ma \quad \checkmark \text{ HC of } 5 \text{ kg} - T - F_f = ma$$

$$T - 3,82 - 14,7 = 3a \checkmark \quad 60 \cos 20^\circ - T - 10,43 (\text{coe}) = 5a \checkmark \text{ (whole expression)}$$

$$T - 18,52 = 3a$$

$$56,38 - T - 10,43 = 5a$$

$$T = 3a + 18,52$$

$$T = 45,95 - 5a$$

$$3a + 18,52 = 45,95 - 5a \checkmark \text{ (equate)}$$

$$8a = 27,43$$

$$a = 3,43 \text{ m.s}^{-2} \checkmark$$

$$T = 3(3,43) + 18,52 = 28,81 \text{ N} \quad \checkmark$$

(6)

[22]

QUESTION 5

5.1 The total linear momentum of an isolated system remains constant. ✓✓ (2)

5.2 $p_{before} = p_{after}$ ✓

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v$$

$$(1100)(20) + m(-30) ✓ = (1100 + m)(-10) ✓$$

$$22000 - 30m = -11000 - 10m$$

$$33000 = 20m$$

$$m = 1650 \text{ kg} ✓$$

This is less than 3500 kg therefore not overloaded ✓ (5)

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

$$5.4 \quad W_{net} = F_{net} \cdot \Delta x = \Delta E_k = E_{kfinal} - E_{kinitial}$$

$$-2500 \times x ✓ = \frac{1}{2} (1100 + 1650) ✓ (0 - (10)^2) ✓$$

$$-2500x = 1375(-100)$$

$$-2500x = -137500$$

$$x = 55 \text{ m} \quad ✓$$

OR

$$F_{net} = ma$$

$$-2500 = 2750a$$

$$a = -0,9 \text{ m.s}^{-2}$$

$$v_f^2 = v_i^2 + 2ax$$

$$(0)^2 = (10)^2 + 2(-0,9)x$$

$$X = 55,56 \text{ m}$$

(4)

[13]

QUESTION 6

6.1.1 The product of the displacement and the component of the force parallel to the displacement. ✓✓ (2)

6.1.2 $T = F_g$ as velocity is constant

$$W = F \cdot \Delta x = mg \cdot \Delta x$$

$$W = 55 \checkmark \times 9,8 \times 1,8 \checkmark$$

$$W = 970,2 \text{ J } \checkmark \quad (3)$$

$$6.1.3 \quad P = \frac{W}{t} \checkmark = \frac{970,2}{4 \checkmark} = 242,55 \text{ W } \checkmark \quad (3)$$

6.1.4 The same as. ✓

Pulley doesn't affect the magnitude of the tension✓, it only changes the direction✓.

F stays the same, x stays the same, therefore W stays the same. (3)

6.2.1 In the absence of air resistance or any external forces, the mechanical energy of an object is constant. ✓✓ (2)

$$6.2.2 \quad E_K = \frac{1}{2}mv^2 = \frac{1}{2}m(2,5)^2 \checkmark = 3,125m \text{ J } \checkmark \quad (-1 \text{ if not unit}) \quad (2)$$

$$6.2.3 \quad E_{p \text{ bottom}} + E_{K \text{ bottom}} = E_{p \text{ top}} + E_{K \text{ top}} \checkmark$$

$$0 + 3,125m \checkmark = (m \times 9,8 \times 0,3) \checkmark + \frac{1}{2}mv^2$$

$$3,125m = 2,94m + \frac{1}{2}mv^2$$

$$\frac{3,125m - 2,94m}{\frac{1}{2}m} = v^2$$

$$v = 0,61 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad (4)$$

$$6.2.4 \quad E_{mech \text{ bottom}} = E_{mech \text{ top}} + W_f = mgh + \frac{1}{2}mv^2 + W_f$$

$$3,125m \checkmark = (m \times 9,8 \times 0,14) + 0 + 0,7 \checkmark$$

$$3,125m - 1,372m = 0,7$$

$$m(1,753) = 0,7$$

$$m = 0,4 \text{ kg} \quad \checkmark \quad (3)$$

Or $W_{nc} = \Delta E_k + \Delta E_p$

$$-0,7 = \frac{1}{2}m(0) - \frac{1}{2}m(2,5)^2 + m(9,8)(0,14) - 0$$

$$-0,7 = -3,125m + 1,372m$$

$$-0,7 = -1,753m$$

$$m = 0,4 \text{ kg} \quad [22]$$

QUESTION 7

7.1.1 The force acting per unit mass $\checkmark\checkmark$ (2)

$$7.1.2 \quad g = \frac{GM}{r^2} = \frac{6,7 \times 10^{-11} \times \checkmark 6,4 \times 10^{23}}{(3400 \times 1000)^2 \checkmark}$$

$$= 3,71 \text{ m} \cdot \text{s}^{-2} \checkmark / \text{N} \cdot \text{kg}^{-1} \quad (3)$$

$$7.1.3 \quad F = \frac{Gm_1m_2}{r^2} = \frac{6,7 \times 10^{-11} \times 6,4 \times 10^{23} \checkmark \times 3000}{(1,26 \times 10^6 + 3,4 \times 10^6 \checkmark \text{conv})^2 \checkmark \text{adding}}$$

$$= 5923,85 \text{ N} \checkmark \quad (4)$$

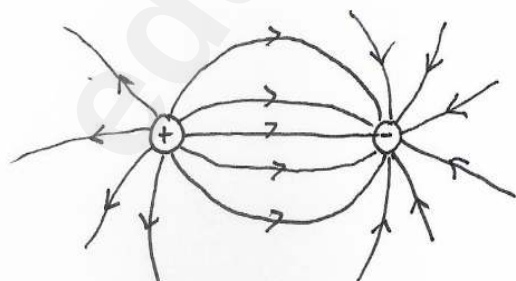
$$7.2 \quad F = E \cdot q \checkmark$$

$$= 4,5 \times 10^3 \times 1,6 \times 10^{-19} \checkmark$$

$$= 7,2 \times 10^{-16} \text{ N} \checkmark \quad (3)$$

7.3.1 Two point charges exert forces on each other. The force is directly proportional to the product of the charges and inversely proportional to the square of the distance between the charges $\checkmark\checkmark$. (2)

7.3.2



Pattern $\checkmark$
 Arrows away from +,
 towards - $\checkmark$
 Few more lines around - $\checkmark$

(3)

$$7.3.3 \quad F_{net} = F_{yz} - F_{yx}$$

$$-1,8 \times 10^{-6} \checkmark = [9 \times 10^9 \cdot 2 \times 10^{-9} \cdot Q_z \checkmark / (0,2)^2] \checkmark - [9 \times 10^9 \cdot 2 \times 10^{-9} \cdot 1,5 \times 10^{-9} \checkmark / (0,1)^2 \checkmark]$$

$$-1,8 \times 10^{-6} = 450 Q_z - 2,7 \times 10^{-6}$$

$$Q_z = 2 \times 10^{-9} \text{ C} \checkmark \quad (5)$$

[22]

QUESTION 8

8.1 The current through a conductor is directly proportional to the potential difference across the conductor at constant temperature $\checkmark\checkmark$. (2)

$$\begin{aligned} 8.2 \quad V_2 &= I \times R \checkmark \\ &= 0,6 \text{ A} \times 7 \Omega \checkmark \\ &= 4,2 \text{ V} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 8.3 \quad R_{//} &= \frac{\text{product}}{\text{sum}} \\ &= \frac{7 \times 3}{7+3} \checkmark \\ &= 2,1 \Omega \checkmark \end{aligned} \quad (2)$$

8.4 The rate of flow of charge $\checkmark\checkmark$ (2)

$$\begin{aligned} 8.5 \quad I_{3\Omega} &= \frac{4,2}{3} \checkmark = 1,4 \text{ A} \\ A_1 &= 1,4 \text{ A} + 0,6 \text{ A} \checkmark = 2 \text{ A} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 8.6.1 \quad P &= I^2 R \checkmark \\ &= 2^2 \cdot 12 \checkmark \text{ (coe)} \\ &= 48 \text{ W} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 8.6.2 \quad \frac{48}{1000} \checkmark \text{ (coe)} &\times 0,75 \checkmark \times R_{3,62} \\ &= R_{0,13} \text{ or } 13 \text{ c} \checkmark \end{aligned} \quad (3)$$

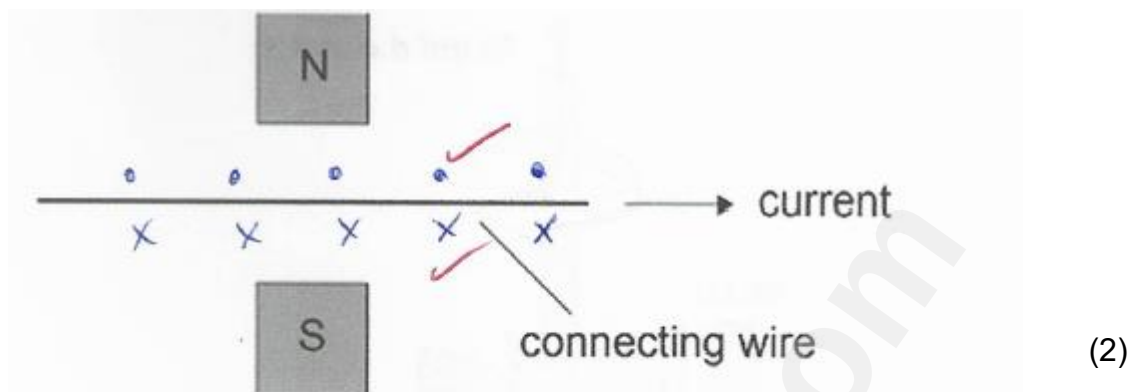
$$\begin{aligned} 8.7 \quad \text{EMF} &= I (R + r) \\ \checkmark 30 &= 2 (14,1 + r) \checkmark \\ 30 &= 28,2 + 2r \\ \frac{30-28,2}{2} &= r \\ &= 0,9 \Omega \checkmark \end{aligned} \quad (3)$$

8.8 $W = VIt$ ✓
 $= 4,2 \times 1,4$ ✓ $\times 180$ ✓ OR $W = I^2Rt$
 $= 1058,4 \text{ J}$ ✓ $= (1,4)^2 \cdot 3 \cdot 180$
 $= 1058,4 \text{ J}$ (4)
[25]

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QUESTION 9

9.1.1 anticlockwise and circular



9.1.2 Two interacting magnetic fields ✓ – cancel out on one side and reinforce on the other/moves into weaker magnetic field. ✓

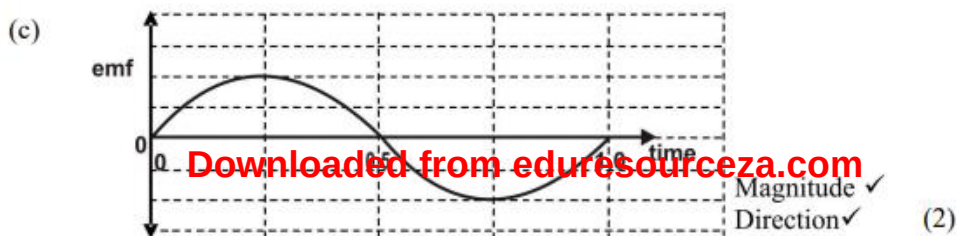
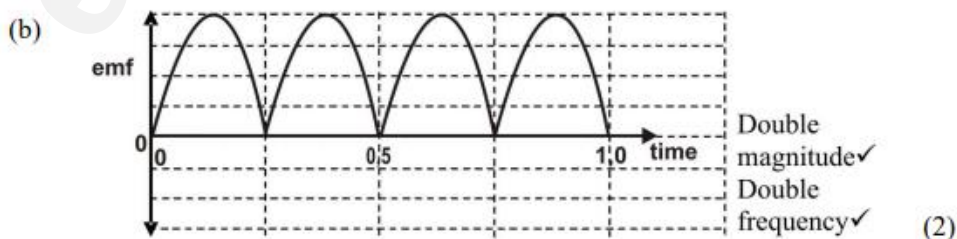
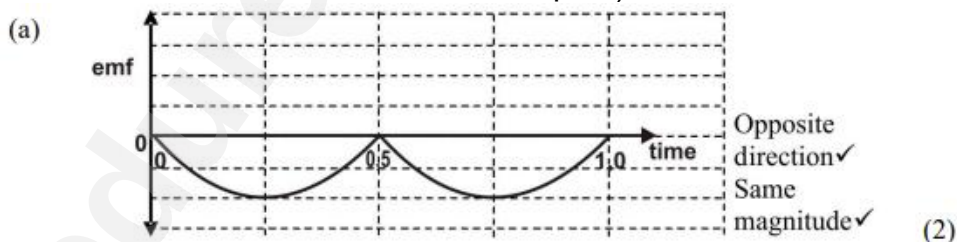
9.1.3 INTO THE PAGE ✓ ✓

9.2.1 NEGATIVE ✓

9.2.2 Any TWO of the following

- The surface area of the blades.
- Add gears.
- Change shape of blades.
- Adjust the angle of the blades.
- Increase the number of blades. / Put blades closer
- Use lighter blades (e.g. plastic vs metal)
- Reduce friction of shaft mechanism.
- Increase the force/pressure/speed at which the water flows over the blades. (This is NOT a modification to the turbine, but will be accepted)

9.2.3



9.3.1 Number of windings in a coil. ✓ (1)

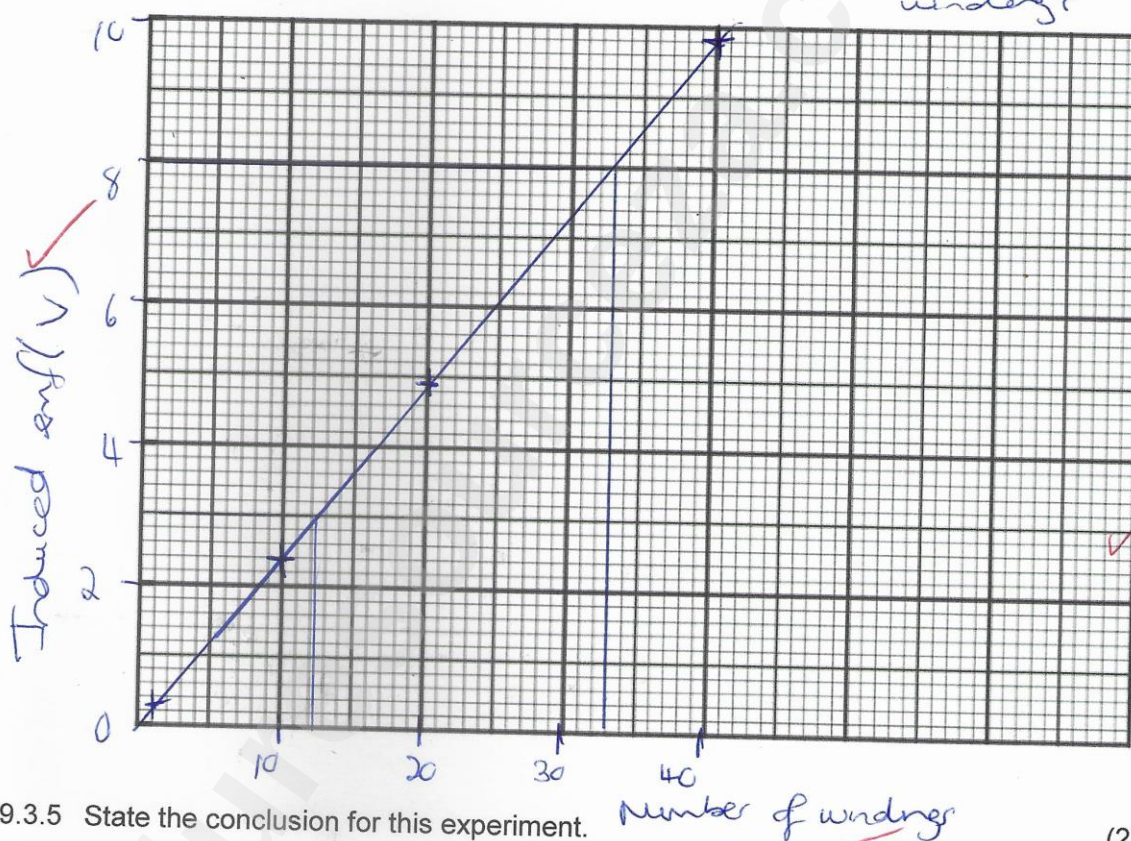
9.3.2 Induced emf ✓ (1)

9.3.3 Same magnetic field, speed of rotation ✓ (1)

9.3.4

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Graph to show relationship between emf + number of windings



9.3.5 State the conclusion for this experiment.

Number of windings

(2)

9.3.5 Induced emf is directly proportional ✓ to the number of windings ✓

(7)

(2)

9.3.6 gradient = $\frac{8-3}{33-12,25} = 0,24$ ✓

-1 if points not shown on graph

(3)

9.3.7 $EMF = -N \frac{\Delta \Phi}{t}$

$\frac{EMF}{N} = -\frac{\Delta \Phi}{t}$ i.e. rate of change in magnetic flux linkage ✓

(2)

[32]