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(1)

MEMO GRI 2 PI PRELIM JULY 2019

Question 1

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

Question 2

2.1. Time = 5h 31min 33s
 $= 5 + \frac{31 \times 60 + 33}{3600}$ (method) ✓

Average speed = $\frac{87}{5.53}$ (method) ✓
 $= 15.73 \text{ km h}^{-1}$ (accuracy) (3)

2.1.2. Distance: length of path travelled. ✓
 Displacement: change in position ✓
 Distance (scalar) Displ. (vector) ✓ (3)

2.1.3. Displacement = $120 \times \frac{1}{2}$ (method) ✓
 $= 60 \text{ km}$ (accuracy) (2)

(2)

2.1.3. Displacement = $120 \times \frac{1}{2}$ (method) ✓
 $= 60 \text{ km}$ (accuracy) (2) ✓
 (SI units)

~~2.1.4.~~

2.2.1. $V_f = v_i + a \Delta t$ (method) ✓
 $V_f = V_f - a \Delta t$ (subs) ✓
 $= 0 - (-9.8)(9.4)$ ✓
 $= 3.92 \text{ ms}^{-1}$ up ✓
 (accuracy) (units) (direction) (2)

2.2.2. $V_f = v_i + a \Delta t$ (sub) ✓
 $= 3.92 + (-9.8)(1.6)$ (accuracy) ✓
 $= -11.76$ ✓
 $= 11.76 \text{ ms}^{-1}$ down ✓
 (SI units direction) (2)

2.3. John: $\Delta x = v_i t + \frac{1}{2} a t^2$ ✓
 $= 0 + \frac{1}{2} \left(\frac{1}{2}\right) t^2$ ✓
 $= \frac{1}{4} t^2$ ✓

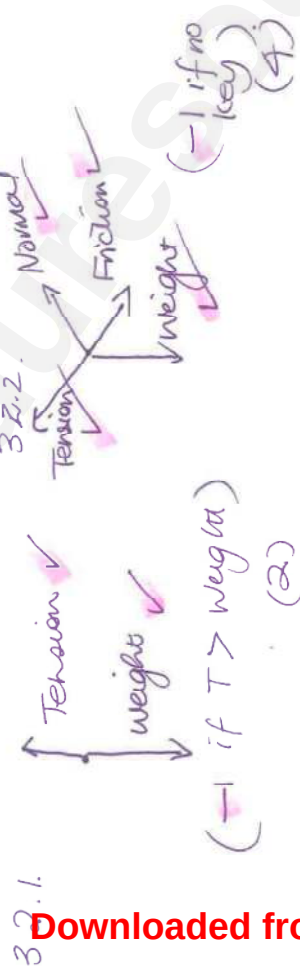
Paul: $\Delta x = \frac{1}{2} (1) (t-5)^2$ ✓
 $= \frac{1}{2} (t^2 - 10t + 25)$ ✓
 $\Delta x = \Delta x$ ✓
 $\frac{1}{4} t^2 = \frac{1}{2} (t^2 - 10t + 25)$ ✓
 $t^2 = 2t^2 - 20t + 50$ ✓
 $t^2 - 20t + 50 = 0$ ✓
 $t = \frac{20 \pm \sqrt{400 - 200}}{2}$ ✓
 $= (2.92 \text{ s})$ or (17.07 s) ✓

Paul catches John 17.07s after John started. (8)

③

Question 3.

3.1. When a net force is applied to an object of mass, the mass accelerates in the direction of the net force. The acceleration $\propto$ F_{net} and $\frac{1}{x}$ mass (2)



3.3. $F_{net} = ma = -T + mg$ (method)

$2a = -T + 2g$

$2 \times 0,25 = -T + 2 \times 9,8$ (sub)

$T = -0,5 + 19,6 = 19,1 N$ (accuracy) (3)

3.4. $F_{net} = Tension - Fg_{||} - f_f$ (method)

$= T - (mg \sin \theta) - (mg \cos \theta \mu_k)$

$\therefore F_f = T - F_{net} = Fg_{||}$

$= 19,1 - (3 \times 0,25) - mg \sin \theta$

$= 19,1 - 0,75 - 14,7 = 3,65 N$ (6)

④

3.5. The value of the kinetic friction force to the normal. (2)

3.6 $\mu_k = \frac{F_f}{F_N} = \frac{3,65}{mg \cos 30} = \frac{3,65}{25,46} = 0,14$ (3)

3.7. For the 2kg block:

$F_{net} = 0$

$\therefore 0 = mg - T$

$T = 19,6 N$

OR For the 5kg block:

$F_{net} = 0$

$\therefore F_{net} = T - Fg_{||} - f_f$

$\therefore T = Fg_{||} + f_f$

$= mg \sin 30 + 0,2 mg \cos 30$

$= 19,79 N$

3.8 For the 1kg block:

$0 = T - mg \sin 30$

$19,6 = 4,9 m + 0,2 m$

$19,6 = 5,1 m$

$m = 3,84 kg$

(4)

Question 4.

Question 4.
4.1.1 Work done by a net force on an object is equal to the change in kinetic energy of the object.

4.1.2. $W_{\text{net}} = \Delta E_K$ ✓ Accepted ✓
 $= 40 - 0$ ✓
 $42 - 0 = 42 \text{ J}$ ✓

4.1.3. $W_{\text{net}} = F_{\text{net}} \cdot \Delta x = \Delta E_k = 40$

$$\Delta x = v_1 \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \left(\frac{0 + v_f}{2} \right) \cdot \Delta t$$

$$F_{\text{net}} = \frac{40}{18,97} = 2,11 \text{ N}$$

$$\left(\frac{42}{19,44} = 2,16 \text{ N} \right)$$

4.1.4. Surface C. ✓
The charge in kinetic energy is smallest over surface C.
∴ the net force is smallest and the frictional force is greatest
∴ $\mu_k = \frac{F_f}{F_N}$ is largest ✓ (4)
(F_N remains constant)

4.1.5. For surface B

$$\Delta E_k = 100 - 40 = 60 \text{ J}$$

$$\frac{v_1}{v_2} = \frac{\sqrt{40}}{\sqrt{100}}$$

$$a = \frac{\sqrt{100} - \sqrt{40}}{10 - 6} = 0,92 \text{ ms}^{-2} \quad \checkmark$$

$$4.1 \cdot b \cdot F_{\text{net}} = m \cdot a = 2 \times 0.92 = 1.84 \text{ N}$$

$$\begin{aligned} F - F_f &= F_{\text{net}} \\ \therefore F &= F_{\text{net}} + F_f \\ &= 1,84 + 179 \\ &= 1,84 + 0,25 \\ &= 6,74 \text{ N.} \end{aligned}$$

⑦

4.2.1. Impulse is the product of net force and time of contact; ✓
(Its direction is that of net force) (2)

$$4.2.2 \quad 144 \text{ km h}^{-1} = \frac{144 \times 1000}{60 \times 60} =$$

$$= 144 \div 36$$

$$= 40 \text{ ms}^{-1} \quad \checkmark \quad (1)$$

$$4.2.3. \text{ Impulse} = \Delta p = m v_f - m v_i$$

$$= (0,58)(40) - 0$$

$$= 6,32 \text{ kg ms}^{-1} \quad (3)$$

$$4.2.4. \quad F_{\text{net}} \cdot \Delta t = 6,32 \quad \checkmark$$

$$F_{\text{net}} = \frac{6,32}{0,08}$$

$$= 79 \text{ N.} \quad \checkmark \quad (2)$$

4.2.5 "Sweep" the ball (stay in contact with the ball for longer. ✓

$$F_{\text{net}} = \frac{\Delta p}{\Delta t} \quad \checkmark$$

Δp stays constant $\therefore$ if Δt increases the F_{net} decreases ✓ (3)

⑧

Question 5

5.1.1. force per unit mass ✓ (2)

$$5.1.2. \quad g = \frac{GM}{r^2} \quad \checkmark$$

$$= \frac{6,7 \times 10^{-11} \times 6,4 \times 10^{23}}{(3400 \times 10^3)^2} \quad \checkmark$$

$$= 3,71 \text{ ms}^{-2} \quad \checkmark \quad (4)$$

5.1.3. Weight: force due to gravity ✓ (2)

$$5.1.4 \quad \text{Alt 1:} \quad m = \frac{500}{9,8} = 51,02 \quad \checkmark$$

$$\text{Weight}_{\text{mars}} = \frac{500}{9,8} \times 3,71 \quad \checkmark$$

$$= 189,29 \text{ N} \quad \checkmark \quad (3)$$

$$\text{Alt 2:} \quad \frac{g_{\text{mars}}}{g_{\text{earth}}} = \frac{3,71}{9,8} \quad \checkmark$$

$$\text{Weight}_{\text{(mars)}} = \frac{3,71}{9,8} \times 500 \quad \checkmark$$

$$= 189,29 \text{ N.} \quad \checkmark \quad (3)$$

5.2.1. Force between two charged objects is proportional to the product of the charges and inversely proportional to the distance between the charges squared ✓ (2)

9

$$5.22. \quad F_A = \frac{k Q_1 Q_2}{r^2}$$

$$= \frac{9 \times 10^9 \times 12 \times 10^{-6} \times 20 \times 10^{-6}}{(12 \times 10^{-2})^2}$$

$$= 150 \text{ N attraction.}$$

$$5.23 \quad F_{\text{net}} = 0$$

$$\therefore F_A = F_B$$

$$F_B = \frac{k Q_3 Q_2}{x^2}$$

$$x^2 = \frac{k Q_3 Q_2}{F_B}$$

$$= \frac{9 \times 10^9 \times 20 \times 10^{-6} \times 36 \times 10^{-6}}{150}$$

$$x^2 = 0.0432$$

$$x = 0.208 \text{ m}$$

Question 6

6.1. Total energy supplied per coulomb of charge by the cell.

6.2. Alternative I

$$R_{\text{eq}} = \frac{4 \times 5}{4 + 5}$$

$$= 2.22 \Omega$$

Alt II

$$R_{\text{eq}} = \frac{1}{\frac{1}{4} + \frac{1}{5}} = \frac{9}{20}$$

$$\therefore R_{\text{eq}} = 2.22 \Omega$$

$$E_{\text{mf}} = \frac{I(R+r)}{I}$$

$$6 = \frac{I(2.22 + r)}{I}$$

$$6 = 2.22 + r$$

$$r = 3.78 \Omega$$

$$E_{\text{mf}} = \frac{I(R+r)}{I}$$

$$6 = \frac{I(2.22 + r)}{I}$$

$$6 = 2.22 + r$$

$$r = 3.78 \Omega$$

$$= 0.78 \Omega$$

6.3. $V = IR$

$$= 2 \times 2.22$$

$$= 4.44 \text{ V}$$

6.4. Alt 1

$$\frac{V}{I_2} = \frac{R}{I_2}$$

$$I_2 = \frac{V}{R}$$

$$= \frac{4.44}{5}$$

$$= 0.888 \text{ A}$$

Alt 2

$$I_2 = \frac{4}{5} \times 2$$

$$= 0.89 \text{ A}$$

6.5.1 decreases

6.5.2 increases

(2)

(1)

⑪

6.6 The resistance of the external circuit increases when the branch of the parallel circuit is removed. ✓

∴ the current decreases & the $V_{\text{ext}} (I_r)$ decreases ✓

∴ $V_T = \text{emf} - I_r$ increases ✓ (3)

$P = \text{emf} \times I$ ✓ (Battery!)

S. closed : $P = 6 \times 2 = 12 \text{ W}$ ✓

S open : $P = \frac{\text{emf}^2}{(R+r)}$

$$= \frac{6^2}{(9.78+4)} \checkmark$$

$$= 7.53 \text{ W} \checkmark$$

⑫

less Power when switch is open (R) than when switch is closed (R₁)

	Closed	Open
R	0.78 + 2.22	0.78 + 4
I	2	1.255 A.

⑫

Question 7

7.1.1 The changing magnetic flux as the magnet falls through the coil ✓ includes an emf in the coil ✓ as predicted by Faraday law $\text{emf} = -N \frac{\Delta \Phi}{\Delta t}$ ✓ (3)

7.2 The rate of change of magnetic flux increases as the magnet moves closer & then into the coil (2)

7.1.3 The magnet travels at a greater velocity (speed) ✓ as it falls. The rate of change of magnetic flux increases as the magnet leaves the coil. (2)

7.14 The rate of change of flux changes direction as the magnet enters then leaves the coil (2)

7.1.5.1 The magnetic flux linkage - (1)

$$7.1.5.2 \text{ emf} = -N \frac{\Delta \Phi}{\Delta t} \checkmark$$

$$\text{emf} \cdot \Delta t = -N \cdot \Delta \Phi \checkmark$$

Since N and $\Delta \Phi$ are constant ✓
∴ $\text{emf} \cdot \Delta t$ is constant ✓
ie area under the graph for each is the same. (2)

7.2.1. slip rings (1)
 7.2.2. (carbon) brushes connect the generator to the external circuit (2)
 7.2.3. clockwise (1)
 7.2.4. see attachment.
 7.2.5. } half the emf } allow cōt from 7.2.3. (2)
 } twice the period
 7.2.1. step down (1)

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$V_s = V_p \times \frac{N_s}{N_p}$$

$$= 15000 \times \frac{3333}{10000}$$

$$= 5000 \text{ V}$$

$$\frac{V_s I_s}{I_s} = \frac{V_p I_p}{15000 \times 0.005}$$

$$= \frac{5000}{0.015 \text{ A}}$$

QUESTION 2.

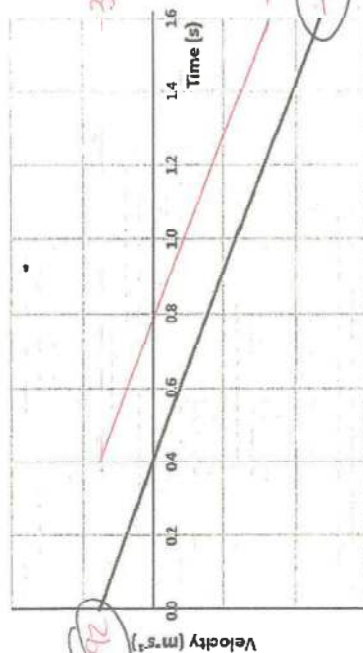
2.2.5 Fill in the following values on the velocity-time graph on the Answer Sheet:

2.2.5.1 The initial velocity of Ball A on the graph. (1)

2.2.5.2 The final velocity of Ball A on the graph. (1)

2.2.6 On the same set of axes, draw the velocity-time graph for Ball B. (3)

Velocity-Time Graph of Objects in Free-fall.



2.2.7 Use the velocity-time graph to calculate the maximum height of Ball A above the ground. (3)

Area under graph = $\frac{1}{2} (0.4) (3.92)$ method

$$= 0.78 \text{ m}$$

Height above ground = $6.27 + 0.78$ (coe method)

$$= 7.05 \text{ m}$$

2.2.8 The axes of a displacement-time graph are drawn below. Values have been provided for the time axis.

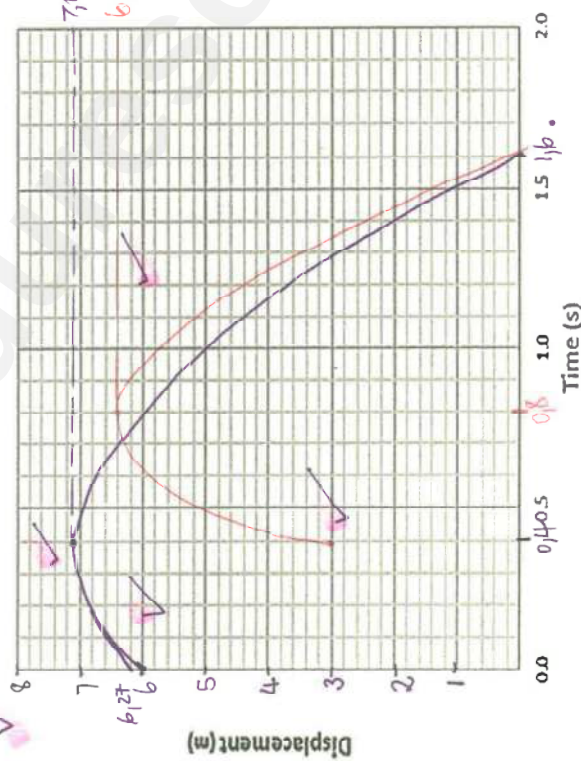
2.2.8.1 Fill in the relevant values of displacement for Ball A on the y-axis. (1)

Draw the graph of displacement against time for

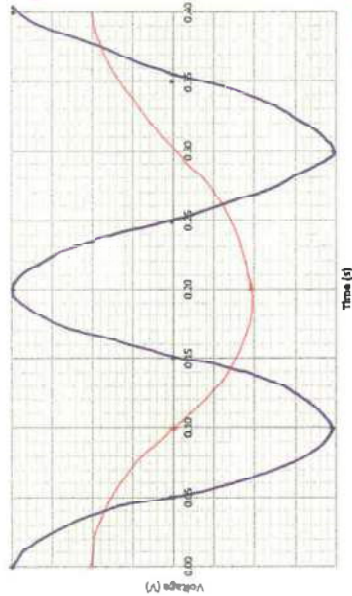
2.2.8.1 Ball A.

2.2.8.2 Ball B.

Displacement-Time Graph



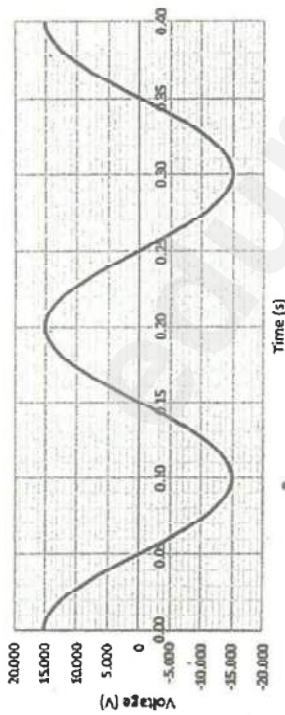
Questions 7.2.4 and 7.2.5: Graphs of Voltage against Time for an AC generator



7.2.4.4
 ✓ shape
 ✓ starting at max emf
 ✓ period correct
 ✓ emf axis

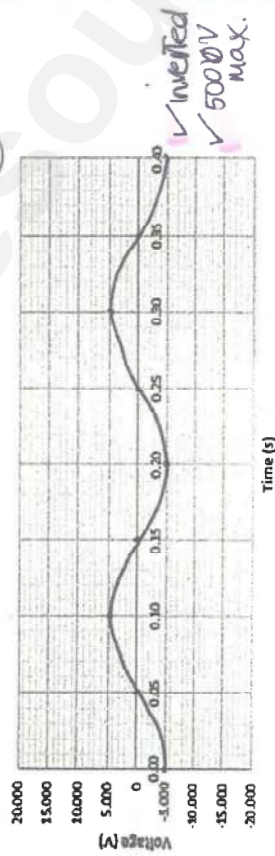
7.2.5
 ✓ have the emf
 ✓ twice the period
 allow cos from 7.4.

Question 7.3.5: Graph of Voltage against Time for a Transformer



7.3.5.1 Voltage against time for the secondary coil

(2)



7.3.5.2 Flux in the transformer core against time.

(2)

