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WOODRIDGE COLLEGE

SEPTEMBER 2021

3 HOURS

GRADE 12 PHYSICAL SCIENCES: PAPER 1

EXAMINER: Mr P. Maartens TOTAL = 200 marks

MODERATOR: Dr C. Logie

MEMORANDUM

Question 1

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

[2 X 10 = 20]

Question 2

2.1. Speed is a scalar – only magnitude ✓
and velocity a vector ✓ – magnitude
and direction ✓ (3)

2.2. **Graph: Only one mark in total to be
subtracted for time conversion done
wrong in 2.2.1 thereafter coe.**

$$\begin{aligned}
 2.2.1. s &= \text{area} = \frac{1}{2}(b \times h) + (l \times b) + \frac{1}{2}(b \times h) \\
 &= \frac{1}{2}([2 \times 60]0,93) + ([13 \times 60] \times 0,93) + \\
 &\quad \frac{1}{2}([13 \times 60] \times 0,22) \checkmark \checkmark \quad (-1 \text{ for each} \\
 &\quad \text{mistake}) \\
 &= 55,8 + 725,4 + 85,8 \\
 &= \mathbf{867 \text{ m}} \checkmark \quad (3)
 \end{aligned}$$

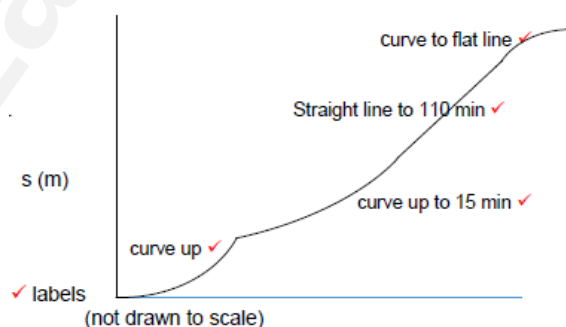
$$\begin{aligned}
 2.2.2. v_{\text{average}} &= \frac{\text{Total displacement total}}{\text{time}} \checkmark \\
 &= 867 / (15 \times 60) \checkmark \text{ coe} \\
 &= 0,96 \text{ m.s}^{-1} \checkmark \quad (3)
 \end{aligned}$$

2.2.3. The rate of change of velocity ✓✓ (2)

$$\begin{aligned}
 2.2.4. a &= \text{gradient} = \Delta y / \Delta x \checkmark \\
 &= 0,93 / 2 \times 60 \checkmark \\
 &= 0,008 \\
 &= 0,01 \text{ m.s}^{-2} \checkmark \quad (3)
 \end{aligned}$$

2.2.5. Gradient is steeper from 0-2 than from
2-15 minutes. ✓
This shows the acceleration is higher
curve to flat line ✓ (2)

2.2.6. (5)



[21]

Question 3

3.1. Rate of change of displacement. ✓✓ (2)

$$3.2. \quad 0 \text{ m.s}^{-1} \checkmark \quad 9,8 \text{ m.s}^{-2} \checkmark \quad (2)$$

$$\begin{aligned}
 3.3. \quad v^2 &= u^2 + 2as \checkmark \\
 v^2 &= 9^2 + 2(-9,8)(-6) \checkmark \checkmark \\
 v &= 14,09 \text{ m.s}^{-1} \checkmark \quad (4)
 \end{aligned}$$

$$\begin{aligned}
 3.4. \quad v &= u + at \checkmark \\
 (-14,09) &= (9) + (-9,8)t \checkmark \\
 -23,09 &= -9,8t \\
 t &= 2,36 \text{ s} \quad (2)
 \end{aligned}$$

$$\begin{aligned}
 3.5. \quad \text{Time from lower deck to sea} \\
 &= 5,64 - 2,36 \\
 &= 3,28 \text{ s} \checkmark \\
 s &= ut + \frac{1}{2}at^2 \checkmark \\
 -10 &= u(3,28) + \frac{1}{2}(-9,8)(3,28)^2 \checkmark \\
 u &= 13,02 \text{ m.s}^{-1} \checkmark \text{ upwards} \checkmark \quad (5)
 \end{aligned}$$

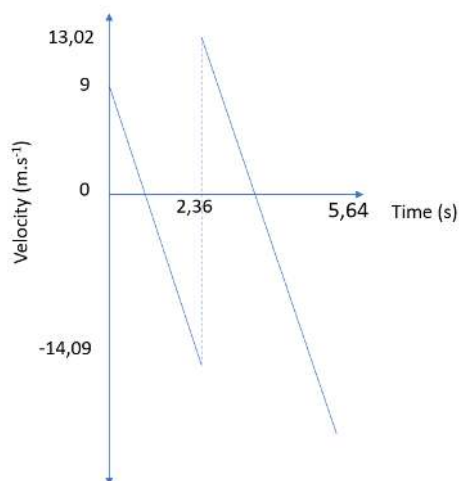
Shape (Decreasing velocity) ✓

Both lines parallel ✓

Velocity values given ✓✓

Time values given ✓✓

(7)



Question 4

4.1 $(E_k + E_p)_{\text{before}} = (E_k + E_p)_{\text{after}}$ ✓

$$\frac{1}{2}(55)V^2 + 0 = \frac{1}{2}(55)(0,9)^2 + (55)(9,8)(1,2) \quad \checkmark$$

$$V = 4,93 \text{ m.s}^{-1} \quad \checkmark \quad (4)$$

4.2 An object continues in a state of rest or uniform motion unless it is acted upon by a net force. ✓✓ (2)

4.3.1 Constant velocity ✓

AB is frictionless and therefore

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

(2)

4.3.2 uniform acceleration down the slope. ✓ Block experiences a net force down the slope. ✓ Horizontal component of weight ✓ (3)

5.1.2

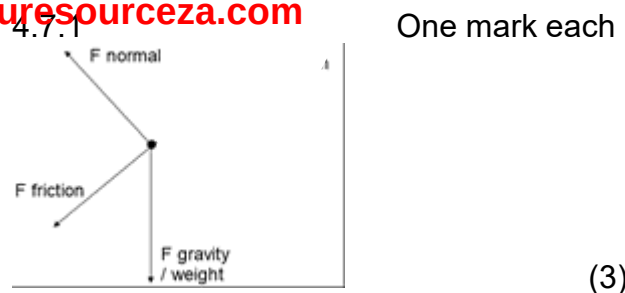
4.4 The product of the net force ✓ and the contact time. ✓ (2)

$$F_{\text{net}} = m(v_f - v_i) / t \quad \checkmark$$

$$= 55(4,93 - 0) \quad \checkmark / 0,42 \text{ c.o.e}$$

$$= 645,60 \text{ N} \quad \checkmark \quad (3)$$

4.6 The force that opposes the motion of an object. Acts parallel to the surface. (2)



(3)

$$4.7.2 \quad W_{\text{nc}} = \Delta E_p + \Delta E_k \quad \text{or}$$

$$F_{\text{friction}} \Delta x \cos \beta = \Delta E_p + \Delta E_k \quad \checkmark \quad \text{or}$$

$$(\mu \cdot mg \cdot \cos \theta) \Delta x \cos \beta = \Delta E_p + \Delta E_k$$

$$[(0,03)(55 \times 9,8 \times \cos 14) \Delta x \cos 180]$$

$$= [(55)(9,8)h - 0] + [\frac{1}{2}(55)(0)^2 - \frac{1}{2}(55)(4,93)^2] \quad \checkmark$$

$$-15,69(h / \sin 14) \quad \checkmark = 539h + (-668,88)$$

$$-64,85h - 539h = -668,88$$

$$-603,86h = -668,88$$

$$h = 1,11 \text{ m} \quad \checkmark$$

No ✓

(6)

OR

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

$$F_{\text{friction}} + F_{\text{gll}} = ma \quad \checkmark$$

$$\mu \cdot mg \cdot \cos \theta + mg \cdot \sin \theta = ma$$

$$(0,03)(55)(9,8)(\cos 14) \quad \checkmark + (55)(9,8)(\sin 14) = 55a \quad \checkmark$$

$$a = -2,66 \text{ m.s}^{-2}$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$0^2 = 4,93^2 + 2(-2,66)\Delta x$$

$$\Delta x = 4,57 \text{ m} \quad \checkmark$$

$$\Delta x \text{ of slope: } \sin 14 = 1,2 / \Delta x$$

$$\Delta x = 4,96 \text{ m} \quad \checkmark$$

No. ✓

[27]

Question 5

5.1.1 The work done by a net force is equal to the change in kinetic energy. ✓✓ (2)

$$5.1.2 \quad \text{slope} = \Delta y / \Delta x = \Delta E_k / \Delta x \quad \checkmark$$

$$\text{But } \Delta E_k = W_{\text{net}}$$

$$\Delta E_k / \Delta x = W_{\text{net}} / \Delta x \quad \checkmark$$

$$\text{but } W_{\text{net}} / \Delta x = F_{\text{net}} \quad \checkmark \quad (3)$$

$$5.1.3 \quad C: = 180 - 88 \quad \checkmark / 15 - 10 \quad \checkmark$$

$$= 18,4 \text{ N} \quad \checkmark \quad \text{method gradient} \quad (3)$$

$$5.1.4 \quad W_{\text{net}} = F_{\text{net}} \Delta x \cos \theta \quad \checkmark$$

$$= (18,4)(5) \cos 0 \quad \checkmark$$

$$= 92 \text{ J} \quad \checkmark \quad (3)$$

5.1.5 B ✓

5.1.6 The net force (gradient) will be smallest ✓ when force of friction is the largest. B has smallest gradient ✓ (2)

5.1.7 region A

Option 1: $v_f^2 = v_i^2 + 2a\Delta x$ ✓

$= 0 + 2(1)(5) = 10$ ✓

$\Delta E_k = \frac{1}{2} m v_f^2$

$60 = \frac{1}{2} m (10)$ ✓

$m = 12 \text{ kg}$ ✓ (4)

Option 2:

Slope of the graph = $60/5$
 $= 12 \text{ N}$ ✓

$F_{\text{net}} = \text{slope of the graph} = 12 \text{ N}$

$F_{\text{net}} = ma$ ✓

$12 = m \times 1$ ✓

$m = 12 \text{ kg}$ ✓ (4)

5.2.1 The rate of doing work ✓✓ (2)

5.2.2 $v = 60 \times 1000/3600$
 $= 16,67 \text{ m.s}^{-1}$ ✓ (1)

5.2.3 $P = Fv$ ✓
 $60\,000 = F(16,67)$ ✓
 $F = 3600 \text{ N}$ ✓ (3)

5.3 $v = 19,44 \text{ m.s}^{-1}$
 $m_c v_{ic} + 0 = (m_c + m_v) v_f$ ✓
 $1500 (19,44) = 7(1500) + m_v$ ✓
 $m_v = 2666,67 \text{ kg}$ ✓ (4)

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Question 6

6.1.1. a) Every particle with mass in the universe attracts every other particle with a force that is directly proportional to the **product** of the masses ✓ and inversely proportional to the **square** of the distance between their centres. ✓ (2)

b) $F = Gm_1m_2 / r^2$ ✓
 $= \frac{(6,7 \times 10^{-11})(5375)(6,0 \times 10^{24})}{\{(953+6371) \times 10^3\}^2}$ ✓
 conversion ✓
 $= 40281,71 \text{ N}$ ✓ (4)

6.1.2. a) Earth: $g = GM / r^2$

Moon: $(1/81) / (1/16) g = G^{1/81}M / (1/4 r)^2$ ✓

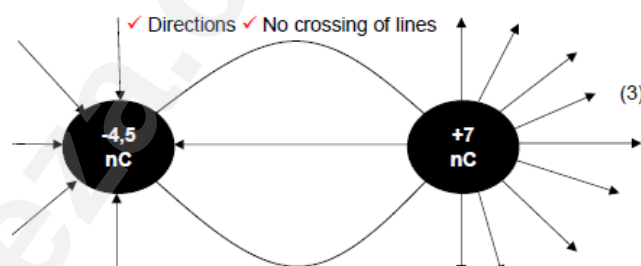
$g \text{ on the moon} = (1/81)/(1/16) (9,8)$ ✓
 $= 1,94 \text{ N.kg}^{-1}$ ✓ (3)

(could be done by substituting values)

b) Mass = $340 - 5\% \text{ of } 340 = 323 \text{ g}$ ✓ (1)

6.2.1. The force per unit charge. ✓✓ (2)

6.2.2. (2)



6.2.3a) $E_{4,5nC} = kQ/r^2$ ✓

$= (9 \times 10^9)(4,5 \times 10^{-9}) / (18 \times 10^{-3})^2$ ✓✓
 conversion

$= 125\,000 \text{ N.C}^{-1} \text{ to the left}$

$E_{\text{net}} = 255165,29 - 125\,000$ for subtracting the two fields ✓

$= 130165,29 \text{ N.C}^{-1} \text{ to the left}$ ✓

$E_{7nC} = kQ/r^2$

$130165,29 = (9 \times 10^9)(7 \times 10^{-9}) / r^2$ ✓
 $r = 22 \times 10^{-3} \text{ m}$

$x = 22 + 18 = 40 \text{ mm}$ ✓ (7)

[21]

Question 7

7.1.1 Total energy supplied per coulomb of charge by the cell. ✓✓ (2)

7.1.2 $1/R_p = 1/R_1 + 1/R_2$
 $1/R_p = 1/20 + 1/30$ ✓
 $R_p = 12 \Omega$ ✓

$R_T = 12 + 33 = 45 \Omega$ ✓ (3)

7.1.3 $\text{emf} = I(R + r)$ ✓ **Downloaded from eduresourceza.com**

$28 = I(45 + 7)$ ✓ c.o.e

$I = 0,54\text{A}$ ✓

(3)

Or $V = IR$

7.1.4 $V = \text{emf} - Ir$ ✓

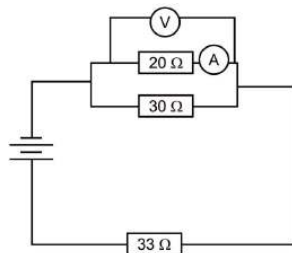
$= 28 - (0,54)(7)$ ✓ c.o.e

$= 24,23\text{ V}$ ✓

(3)

7.1.5 Ammeter in series with 20Ω ✓

Voltmeter in parallel with 20Ω ✓



(2)

7.2.1 Work done per unit positive charge ✓✓

(2)

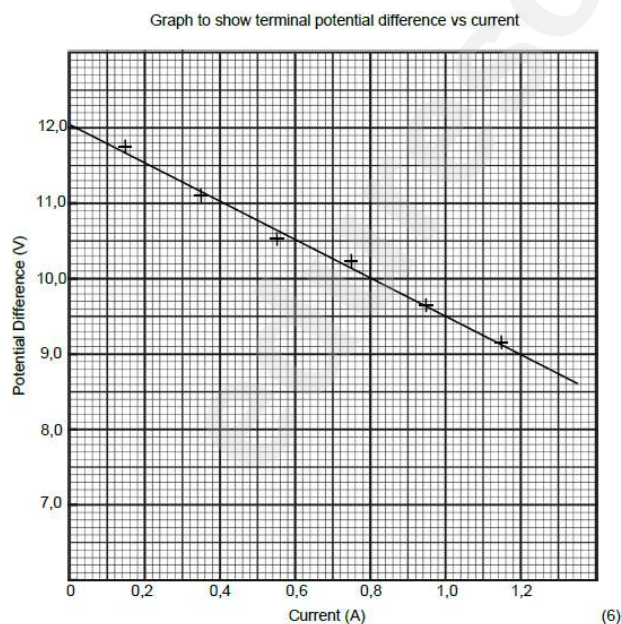
7.2.2 Heading ✓

y-axis title and unit ✓

y-axis scale $> \frac{1}{2}$ the graph paper ✓

plotted points ✓

line of best fit ✓✓



(6)

7.2.3 $V = \text{emf} - IR$

$V = (-r)I + \text{emf}$

Slope $= -r$ ✓

$-r = -2,52\Omega$

$r = 2,52\Omega$ ✓

(2)

7.2.4 the emf ✓

(1)

[24]

Question 8

8.1.1 anti-clockwise ✓

(1)

8.1.2 It changes the direction of the current

✓ in the coil every half rotation. ✓

(2)

8.1.3 $F = BIl \sin \theta$

Increase the magnetic field strength B ✓

Increase the current I ✓

Increase the number of turns of wire in the

coil, l ✓

(3)

8.2.1 $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ ✓

$\frac{6}{240} = \frac{N_s}{8000}$ ✓

$N_s = 200$ ✓

(3)

8.2.2 $P = VI$ ✓

$= (240)(0,05)$ ✓

$= 12\text{W}$ ✓

(3)

8.3.1 The emf induced is directly

proportional ✓ to the rate of change of

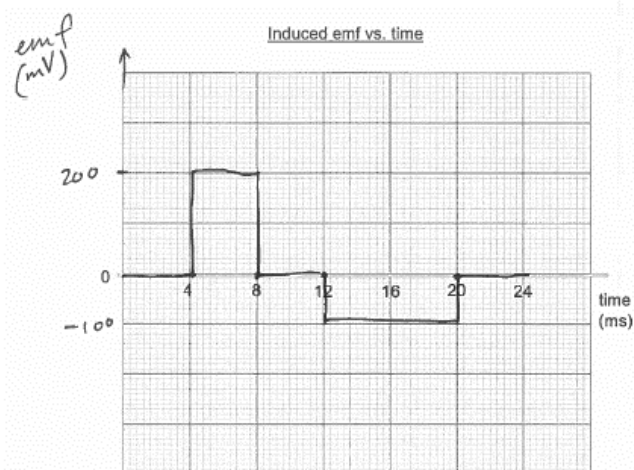
magnetic flux. ✓

(2)

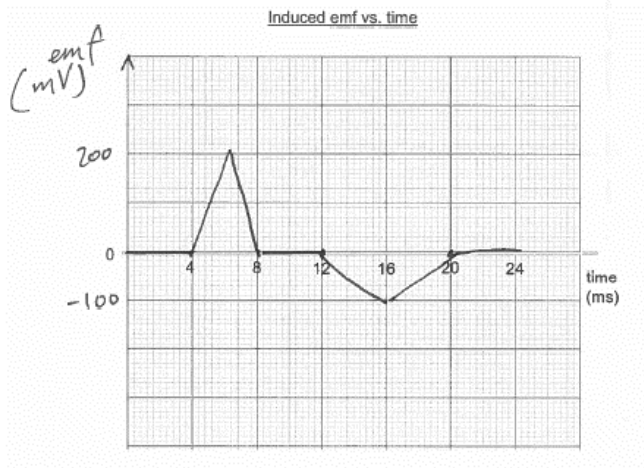
8.3.2 The current in the primary coil cause a magnetic field around the coil. ✓ There is magnetic flux through the secondary coil.

When the current in P changes it causes a change in the magnetic flux through S ✓ which induces an emf in S ✓ according to Faraday's Law. (3)

8.3.3



Or



(4)
[21]

Question 9

9.1.1 $E = hf$ ✓
 $= (6,63 \times 10^{-34}) \times (9,1 \times 10^{14})$ ✓
 $= 6,01 \times 10^{-19} \text{ J}$ ✓ (3)

9.1.2 Minimum amount of energy needed to emit an electron (from surface of metal) ✓✓ (2)

9.1.3 $E = W + \frac{1}{2} mv^2$ ✓
 $6,01 \times 10^{-19} \text{ J} = 3,5 \times 10^{-19} \text{ J} + \frac{1}{2} (9,1 \times 10^{-31}) v^2$ ✓
 (c.o.e 9.1.1)
 $v = 7,43 \times 10^5 \text{ m.s}^{-1}$ ✓ (4)

9.2.1 particle of light ✓ or
 A packet/quantum of energy ✓ (1)

9.2.2 $E = hc / \lambda$ ✓
 $= \frac{(6,63 \times 10^{-34}) \times (3 \times 10^8)}{524 \times 10^{-9}}$ ✓
 $= 3,78 \times 10^{-19} \text{ J}$ ✓ (3)

9.2.3 $3,78 \times 10^{-19} = 2,36 \text{ eV}$ ✓
 $E_5 - E_2 = 2,36$
 $E_5 = -2,81 + 2,36$ ✓
 $= -0,45 \text{ eV}$ ✓ (3)
 [16]

TOTAL: 200 MARKS