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REDHILL HIGH SCHOOL

GRADE 12

PHYSICAL SCIENCE

PRELIMINARY EXAMINATION

PAPER I

ANSWER BOOKLET

Date: Thursday 12 September 2019

Student Name: MEMO **Option:** _____

Teacher's Name: _____

QUESTION	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	
%	

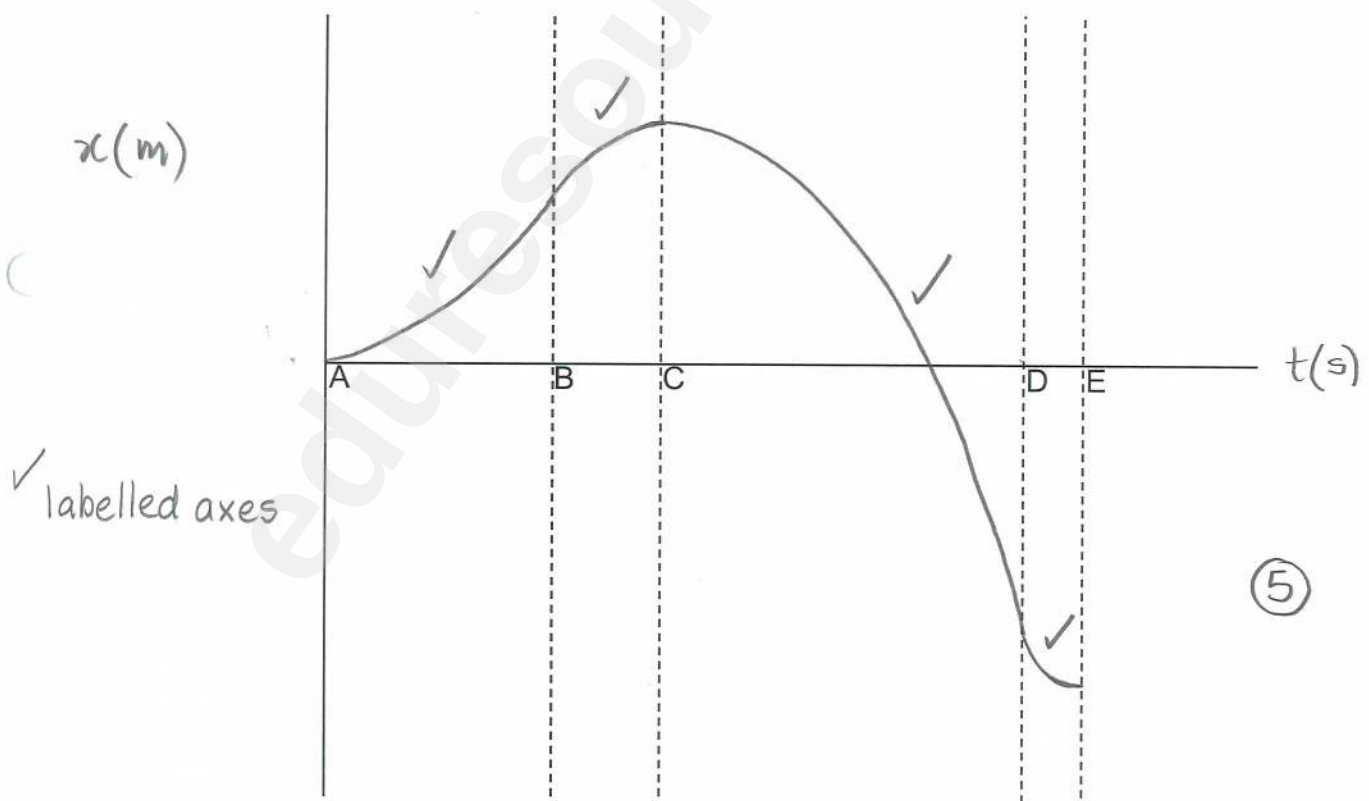
QUESTION 1

MULTIPLE CHOICE ANSWER SHEET

1.1	A	B	~~C~~	D	C ✓
1.2	A	~~B~~	C	D	B
1.3	~~A~~	B	C	D	<u>A</u>
1.4	A	~~B~~	C	D	B
1.5	A	~~B~~	C	D	B
1.6	A	~~B~~	C	D	<u>B</u>
1.7	A	B	~~C~~	D	C
1.8	A	B	~~C~~	D	C ✓
1.9	A	B	C	~~D~~	<u>D</u>
1.10	A	~~B~~	C	D	B

[20]

QUESTION 3.7

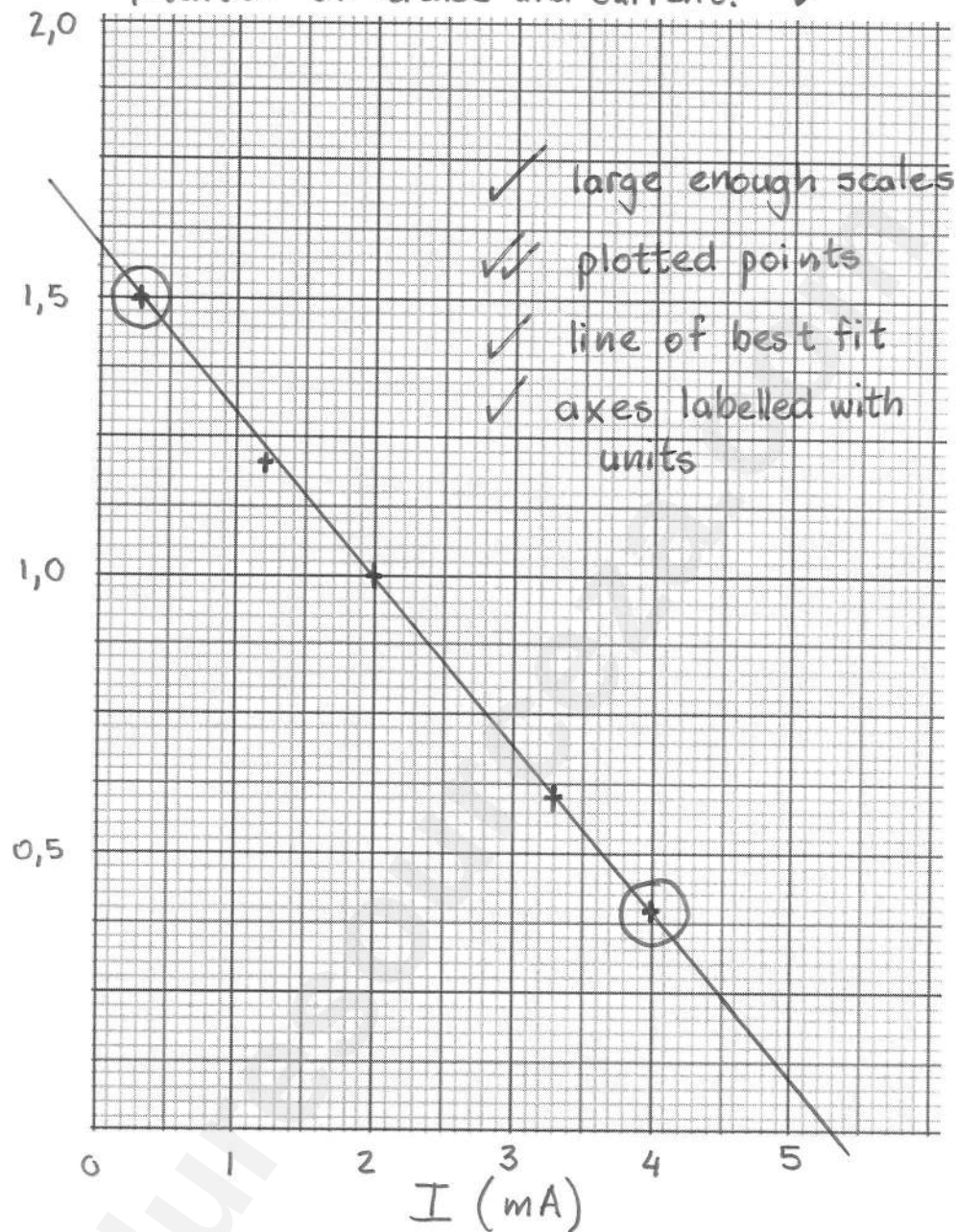


(5)

(5)

QUESTION 7.1.2

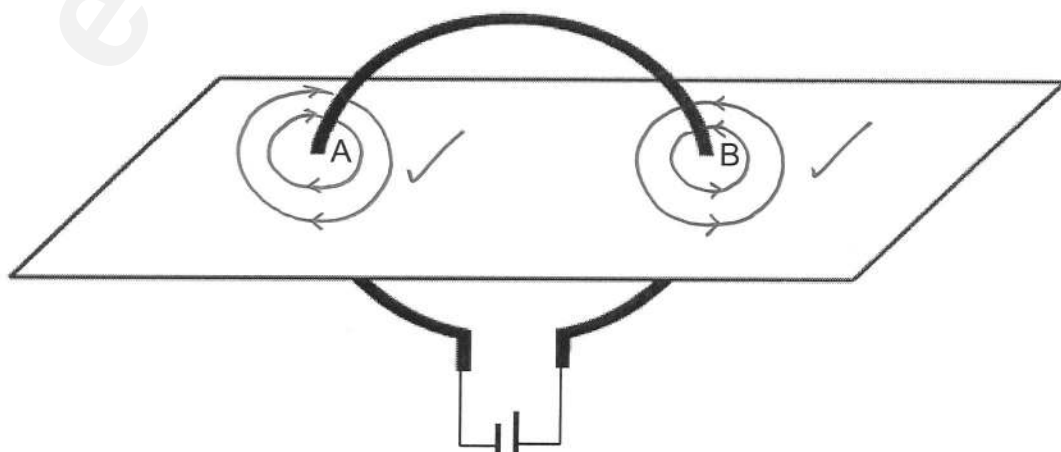
Line graph to show the relationship between terminal potential difference and current.



(6)

(6)

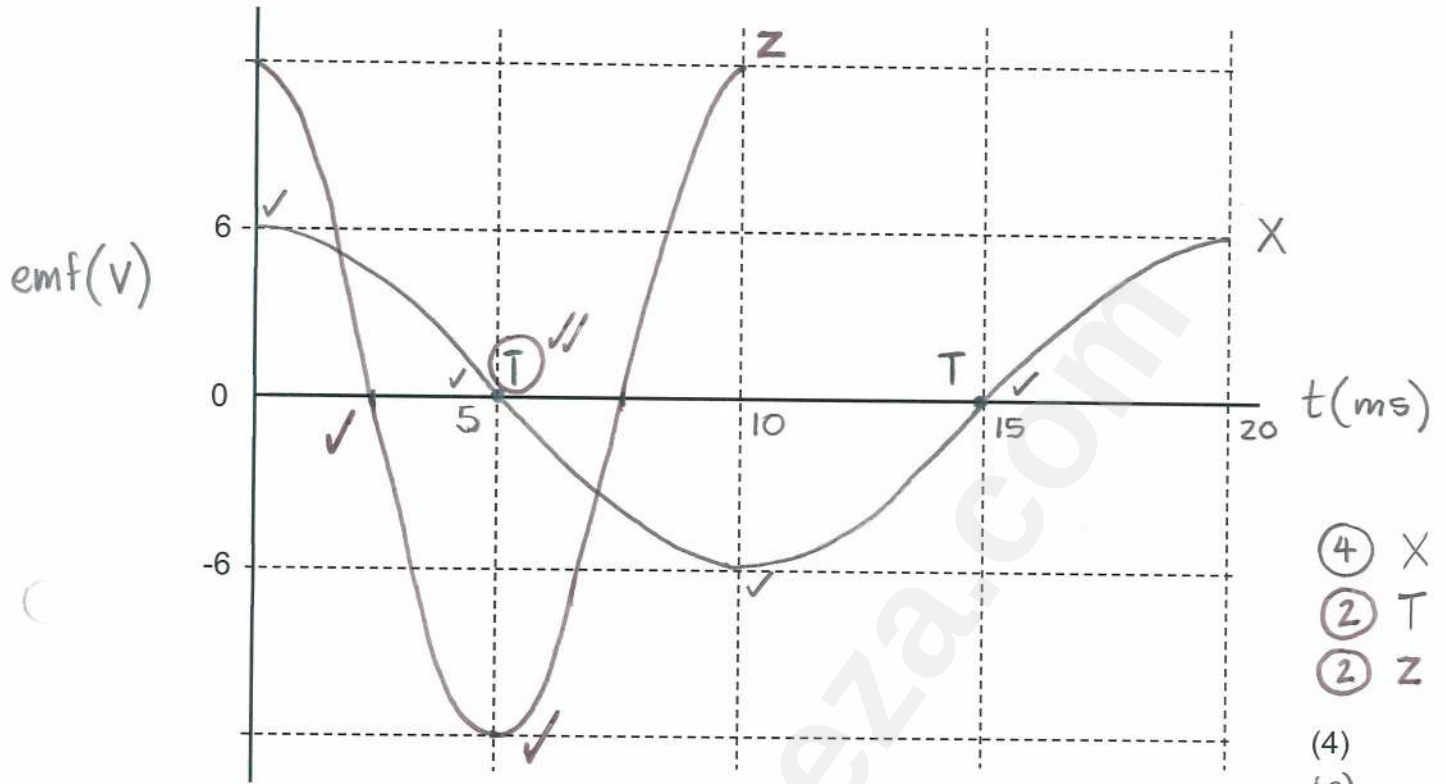
QUESTION 8.2



(2)

(2)

QUESTIONS 8.4.1 and 8.4.3



graph X

amplitude 6V ✓ (anywhere)

1 complete wave in 20ms ✓

max at $t = 0$ and 10ms ✓

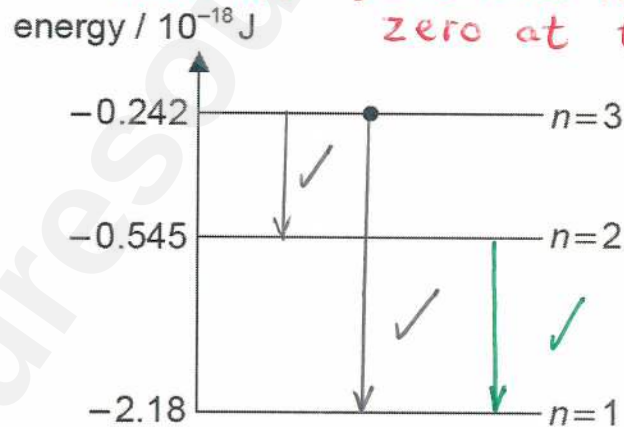
zero at $t = 5$ ms and 15ms ✓

QUESTION 9.4.1

graph Y

max = 12V ✓

complete cycle in 10ms ✓



~~(2)~~

(3)

(2)

(3)

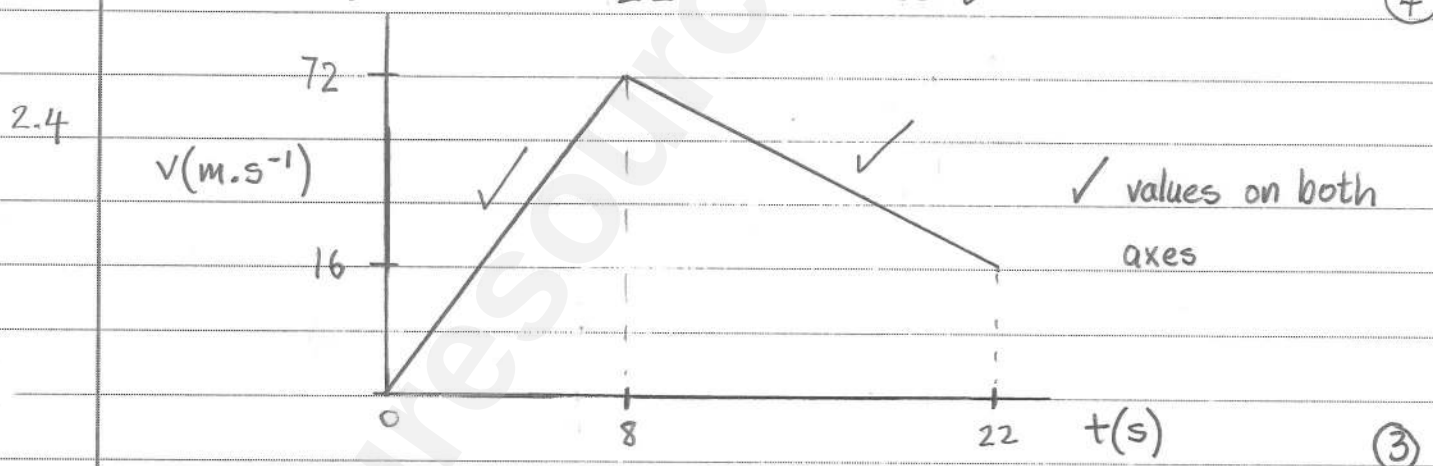
2.1 The rate of change of distance ✓✓ (2)

2.2 $V_f = V_i + a\Delta t$
 $16 = 72 + a(14)$ ✓
 $a = \frac{-56}{14} = -4 = 4 \text{ m.s}^{-2} \text{ south}$ ✓ (4)

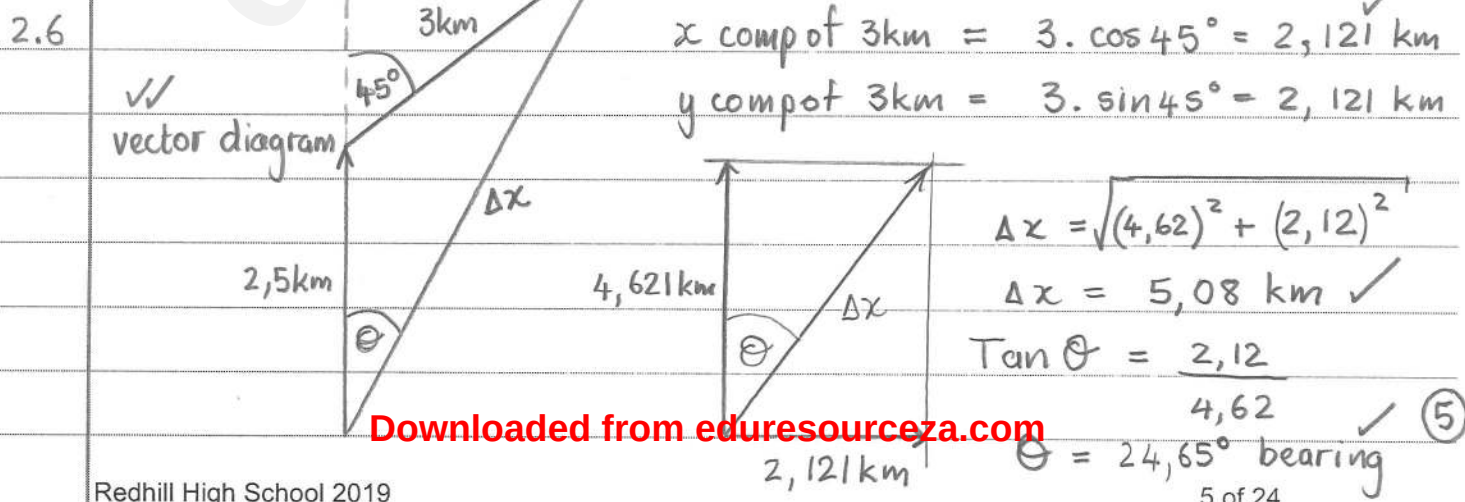
2.3 Stage 1: $\Delta x = \left(\frac{V_f + V_i}{2} \right) \Delta t = \left(\frac{72 + 0}{2} \right) 8 = 288 \text{ m}$ ✓

Stage 2: $\Delta x = \left(\frac{16 + 72}{2} \right) 14 = 616 \text{ m}$ ✓

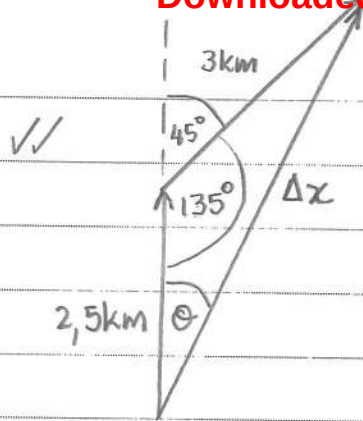
$v = \frac{d}{t} = \frac{288 + 616}{22} = \frac{904}{22} = 41.09 \text{ m.s}^{-1}$ ✓ (4)



2.5 The single vector which has the same effect as the original vectors acting together. ✓✓ (2)



2.6



Cosine Rule:

$$\Delta x^2 = (3)^2 + (2.5)^2 - 2(3)(2.5)\cos 135^\circ$$

$$\Delta x^2 = 25.857$$

$$\Delta x = 5.09 \text{ km} \quad \checkmark$$

Sine Rule:

$$\frac{3}{\sin \theta} = \frac{5.09}{\sin 135^\circ}$$

$$\sin \theta = \frac{3 \times \sin 135^\circ}{5.09}$$

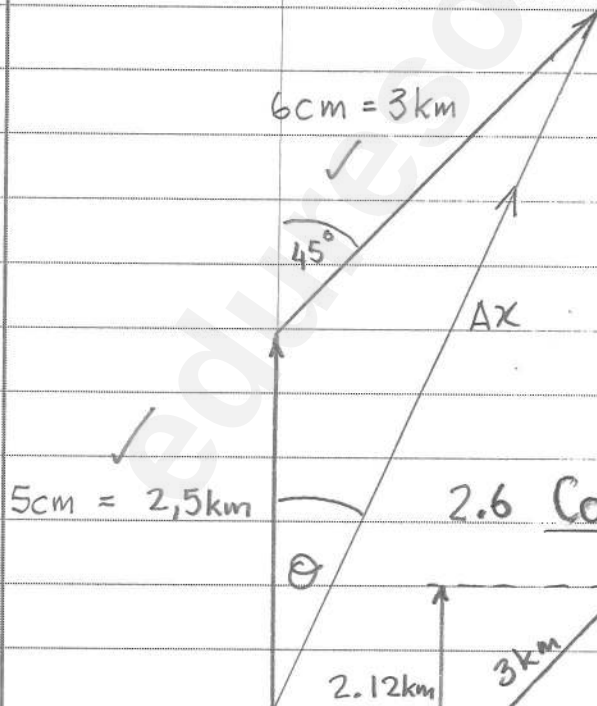
$$\theta = 24.63^\circ \text{ bearing} \quad \checkmark \quad (5)$$

[20]

Scale diagram:

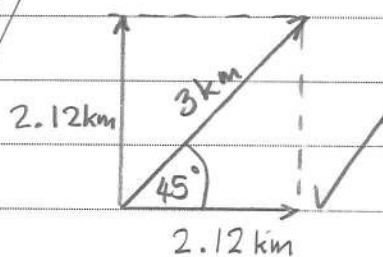
scale

$$1 \text{ cm} = 0.5 \text{ km} \quad \checkmark$$

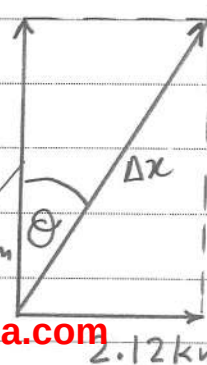


$$\Delta x = 10.2 \text{ cm} \\ = 5.1 \text{ km} \quad \checkmark$$

$$\text{bearing } 24^\circ \quad \checkmark$$

2.6 Components

$$\begin{aligned} &2.12 + \\ &2.5 \\ &= 4.62 \text{ km} \end{aligned}$$



$$\Delta x = \sqrt{(4.62)^2 + (2.12)^2}$$

$$\Delta x = 5.08 \text{ km} \quad \checkmark$$

$$\tan \theta = \frac{2.12}{4.62} \quad \checkmark$$

$$\theta = 24.65^\circ$$

will this be +ve marking.

3.1 upwards ✓ + ①

3.2 The upward force of the hand is greater than the weight of the sensor ✓, resulting in a net force upwards ③

3.3 B D
0,32 - 0,99 s ✓ ✓ ①

3.4 Area = Δx
 $\Delta x = \frac{1}{2}(0,32)(1,372)$ ✓
 $\Delta x = 0,22 \text{ m}$ ✓ ③

3.5 $v_f = v_i + a\Delta t$
 $0 = 1,372 + (-9,8)\Delta t$
 $\Delta t = 0,14 \text{ s}$
 $t_{\text{up}} = 0,32 + 0,14 = 0,46 \text{ s}$ ✓ ③

3.6 $v_f = v_i + a\Delta t$ $v_f^2 = v_i^2 + 2a\Delta x$
 $v_f = 1,372 + (-9,8)(0,67)$ $(-5,19)^2 = (1,372)^2 + 2(-9,8)\Delta x$
 $v_f = -5,19 \text{ m.s}^{-1}$ ✓ $\Delta x = -1,278 \text{ m}$ ✓

COE Q3.4

height = $+0,22 - 1,278 = -1,06 \text{ m} = 1,06 \text{ m}$ ✓

no direction required

OR $\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

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

$$= 1,372(0,67) + \frac{1}{2}(-9,8)(0,67)^2$$

$$= -1,280 \text{ m}$$

$$\Delta x_{AB} = 0,22 \text{ m} \checkmark$$

$$\Delta x_{BC} = \frac{1}{2}(0,14)(1,372)$$

$$= 0,096 \text{ m}$$

$$\Delta x_{CD} = \frac{1}{2}(0,53)(-5,19)$$

$$= -1,375 \text{ m}$$

$$\Delta x = \left(\frac{-5,19 + 1,372}{2}\right)0,67$$

$$\Delta x = -1,279 \text{ m}$$

$$\Delta x_{\text{up}} = \frac{1}{2}(0,46)(1,372) = 0,316 \text{ m}$$

$$\Delta x_{\text{down}} = \frac{1}{2}(0,53)(-5,19) = -1,375 \text{ m}$$

D: $v_f = v_i + a\Delta t$

$$v_f = 0 - 9,8(0,99 - 0,46) = -5,19 \text{ m.s}^{-1}$$

3.7 On page 2 ⑤ $= +0,316 - 1,375$

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

$$= 0 + \frac{1}{2}(-9,8)(0,53)^2 = -1,376 \text{ m}$$

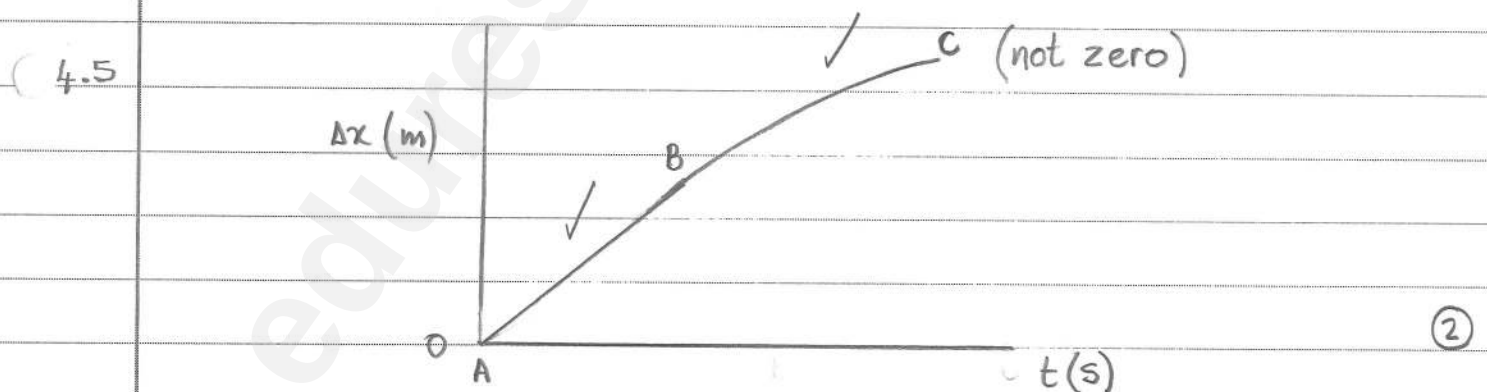
4.1 Kinetic ✓ to gravitational potential energy ✓ (2)

$$\begin{aligned}
 4.2 \quad E_{\text{mech at A}} &= E_{\text{mech at C}} \\
 \frac{1}{2}(55)v^2 &= \frac{1}{2}(55)(0,9)^2 + (55)(9,8)(1,2) \\
 27,5 v^2 &= 22,275 + 646,8 \\
 27,5 v^2 &= 669,075 \\
 v^2 &= 24,33 \\
 v &= 4,93 \text{ m.s}^{-1} \quad (4)
 \end{aligned}$$

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

4.4.1 constant velocity ✓
AB is frictionless and therefore $F_{\text{net}} = 0$ ✓ (2)

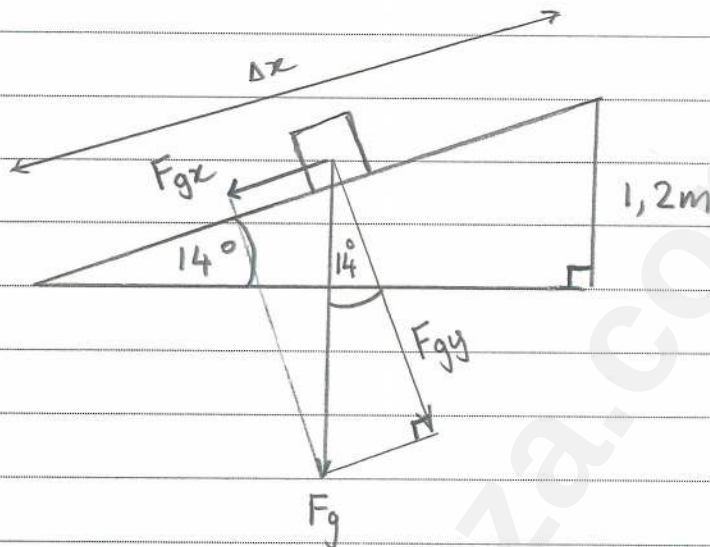
4.4.2 uniform acceleration down the slope ✓
Block experiences a net force (horizontal component of weight) down the slope ✓ (3)



$$\begin{aligned}
 4.6 \quad F_{\text{net}} &= \frac{\Delta p}{\Delta t} = \frac{m \Delta v}{\Delta t} = \frac{55(4,93 - 0)}{0,42} \\
 F_{\text{net}} &= \frac{271,15}{0,42} = 645,60 \text{ N} \quad (3)
 \end{aligned}$$

4.7 The force that opposes the motion of an object and acts parallel to the surface with which the object is in contact. ✓✓ (2)

4.8



$$F_N = F_{gy} = F_g \times \cos 14^\circ = 55 \times 9,8 \times \cos 14^\circ = 539 \times \cos 14^\circ$$

$$F_N = 522,99 \text{ N} \quad \checkmark$$

$$F_{fk} = \mu_k F_N = 0,03 \times 522,99 = \underline{15,69 \text{ N}} \quad \checkmark$$

$$F_{gx} = F_g \times \sin 14^\circ = 539 \times \sin 14^\circ = \underline{130,40 \text{ N}} \quad \checkmark$$

$$F_{\text{net}} = F_{fk} + F_{gx} = 15,69 + 130,40 = 146,09 \text{ N}$$

$$a = \frac{F_{\text{net}}}{m} = \frac{-146,09}{55} = -2,66 \text{ m} \cdot \text{s}^{-2}$$

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

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

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

$$\Delta x \text{ of slope:} \quad \sin 14^\circ = \frac{1,2}{\Delta x}$$

$$\Delta x = \frac{1,2}{\sin 14^\circ} = 4,96 \text{ m} \quad \checkmark$$

No ✓

4.8

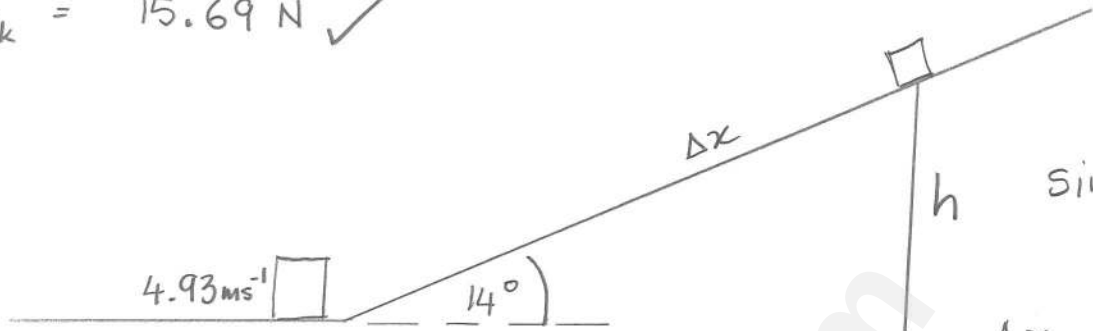
Alternative solution

Downloaded from eduresourceza.com

$$F_{fk} = 0.03 \times 522.99$$

$$F_{fk} = 15.69 \text{ N} \checkmark$$

$$F_N = F_{gy} = F_g \cos 14^\circ = 522.99 \text{ N} \checkmark$$



$$\sin 14^\circ = \frac{h}{\Delta x}$$

$$\Delta x = \frac{h}{\sin 14^\circ}$$

$$E_{\text{mech at B}} - W_{F_f} = E_{\text{mech at top}}$$

$$\frac{1}{2}(55)(4.93)^2 \checkmark - F_{fk} \Delta x = 55(9.8)h$$

$$668.385 - 15.69 \Delta x = 539h$$

$$668.385 - 15.69 \left(\frac{h}{\sin 14^\circ} \right) = 539h$$

$$668.385 - 64.856h = 539h$$

$$668.385 = 603.856h$$

$$h = 1.11 \text{ m} \checkmark$$

No ✓

(6)

5.1 The product of the mass and velocity of an object ✓ (2)

5.2 The net force acting on an object is equal to the rate of change of momentum. ✓ (2)

$$\begin{aligned}
 5.3 \quad F_{\text{net}} \cdot \Delta t &= \Delta p \\
 &= m \Delta v \\
 &= m(v_f - v_i) \\
 &= 2200(4,3 - 0) \\
 J &= 9460 \text{ N.s } \checkmark (\text{kg.m.s}^{-1}) \text{ right } (4)
 \end{aligned}$$

$$\begin{aligned}
 5.4 \quad \text{Area of } F \text{ vs } \Delta t \text{ graph} &= J \\
 \frac{1}{2}(0,54) F_{\text{max}} &= 9460 \checkmark \\
 F_{\text{max}} &= 35\,037,04 \text{ N } \checkmark \\
 &= (3,50 \times 10^4) (3)
 \end{aligned}$$

$$\begin{aligned}
 5.5 \quad F_{\text{net}} \cdot \Delta x &= \Delta E_k \checkmark \\
 F_f \cdot \Delta x &= \frac{1}{2}(2200)(2,8)^2 - \frac{1}{2}(2200)(4,3)^2 \\
 &= 8624 - 20\,339 \\
 &= -11\,715 \text{ J } \checkmark (4)
 \end{aligned}$$

$$\begin{aligned}
 5.6 \quad P_{\text{before}} &= P_{\text{after}} \checkmark \\
 2200(+2,8) + 3000(-0,8) &= 5200 \text{ V } \checkmark \\
 6160 - 2400 &= 5200 \text{ V } \\
 3760 &= 5200 \text{ V } \\
 v &= 0,72 \text{ m.s}^{-1} \checkmark (4)
 \end{aligned}$$

$$\begin{aligned}
 5.7 \quad E_{k \text{ before}} &= \frac{1}{2}(2200)(2,8)^2 + \frac{1}{2}(3000)(0,8)^2 = 8625 + 960 \\
 &= 9585 \text{ J } \checkmark \\
 E_{k \text{ after}} &= \frac{1}{2}(5200)(0,72)^2 = 1347,84 \text{ J } \checkmark (3) \\
 &\text{inelastic } \checkmark
 \end{aligned}$$

6.1.1 The force acting per unit mass. ✓✓ (2)

$$g = \frac{GM}{r^2}$$

$$2,2 \checkmark = \frac{6,7 \times 10^{-11} \times M}{(3,1 \times 10^6 + 2,4 \times 10^7)^2 \checkmark}$$

$$M = \frac{2,2 \times (2,71 \times 10^7)^2}{6,7 \times 10^{-11}}$$

$$M = 2,41 \times 10^{25} \text{ kg} \checkmark (3)$$

6.1.3

$$F = \frac{G m_1 m_2}{r^2}$$

$$= \frac{6,7 \times 10^{-11} \times 2,41 \times 10^{25} \times 6,2 \times 10^{12} \checkmark}{(2,71 \times 10^7)^2 \checkmark}$$

c/e

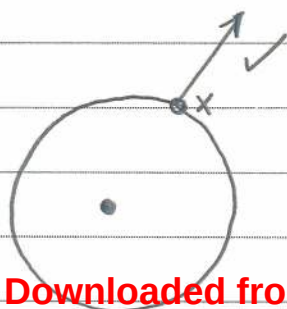
$$= 1,36 \times 10^{13} \text{ N} \checkmark \text{ towards asteroid. (attraction)} (4)$$

6.2.1

$$q = 74 \times 1,6 \times 10^{-19} = 1,18 \times 10^{-17} \text{ C} \checkmark (2)$$

6.2.2 A region of space in which an electric charge experiences a force. ✓ The direction of the electric field at a point is the direction that a positive test charge would move if placed at that point. ✓ (2)

6.2.3



(1)

6.2.4

$$E = \frac{kQ}{r^2}$$

$$= \frac{9 \times 10^9 \times 1,18 \times 10^{-17}}{(140 \times 10^{-12})^2} \checkmark$$

c/e

$$E = 5,42 \times 10^{12} \text{ N.C}^{-1} \checkmark$$

(3)

6.2.5

$$F = Eq$$

$$= 5,42 \times 10^{12} \times 1,6 \times 10^{-19} \checkmark$$

$$= 8,67 \times 10^{-7} \text{ N} \checkmark$$

c/e

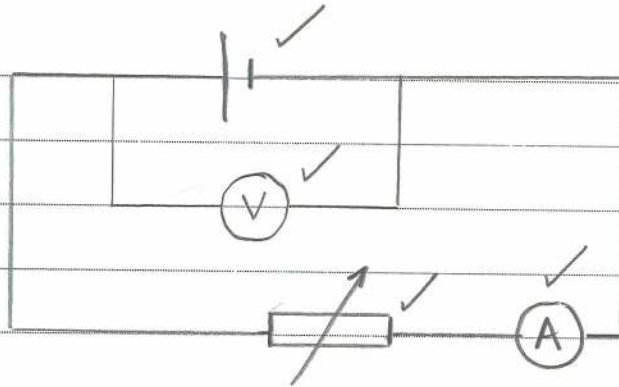
(3)

OR

$$F = \frac{kq_1q_2}{r^2} = \frac{9 \times 10^9 \times (1,18 \times 10^{-17}) (1,6 \times 10^{-19})}{(140 \times 10^{-12})^2} \checkmark$$

$$= 8,67 \times 10^{-7} \text{ N} \checkmark$$

7.1.1



(4)

7.1.2

On page 3 (6)

7.1.3

→ Definition of

The total energy supplied per coulomb of charge by the cell (2)

7.1.4

i)

$$\text{emf} = V + Ir$$

$$V = -rI + \text{emf}$$

$$y = mx + c$$

$$\text{emf} = y\text{-intercept} = 1,6 \text{ V} \checkmark \checkmark$$

(accept -) (2)

ii)

$$\text{gradient} = -r$$

$$\text{gradient} = \frac{\Delta y}{\Delta x} = \frac{y_f - y_i}{x_f - x_i}$$

$$= \frac{0,4 - 1,5}{(4 - 0,3) \times 10^{-3}} \frac{\text{V}}{\text{A}} \checkmark \checkmark$$

$$= \frac{-1,1}{3,7 \times 10^{-3}}$$

$$-r = -297,30$$

$$r = 297,30 \, \Omega \checkmark$$

(3)

iii)

$$I_{\text{max}} = x\text{-intercept}$$

$$= 5,3 \text{ mA} \checkmark = 0,0053 \text{ A} \checkmark$$

(accept -) (2)

7.1.5

$$q = I \times t \quad \checkmark$$

$$= 6 \times 10^{-6} \times (16 \times 60 \times 60) \quad \checkmark$$

$$= 0,35 \text{ C} \quad \checkmark$$

57600s

(3)

7.2.1

The product of the potential difference across the device and the current flowing through it. $\checkmark \checkmark$

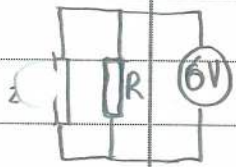
(2)

7.2.2

$$\frac{1}{R_{\text{ext}}} = \frac{1}{24} + \frac{1}{R}$$

OR

$$R_{\text{ext}} = \frac{24 \times R}{24 + R} \quad \checkmark$$



$$\frac{1}{11} \quad \checkmark = \frac{1}{24} + \frac{1}{R} \quad \checkmark$$

$$\frac{1}{R} = \frac{1}{11} - \frac{1}{24} = \frac{13}{264}$$

$$\therefore R = \frac{264}{13} = 20,31 \Omega \quad \checkmark$$

$$24R = 11(24 + R)$$

$$24R = 264 + 11R$$

$$13R = 264 \quad \checkmark$$

$$R = 20,31 \Omega \quad (3)$$

7.2.3

$$V_{\text{ext}} = \frac{12V}{2} = 6V \quad \checkmark \checkmark \quad (2)$$

$$\text{OR } I = \frac{\text{emf}}{R_T} = \frac{12}{22} = 0,545A \quad \checkmark$$

$$\text{OR } V_{\text{ext}} = 0,25 \times 24 = 6V \quad \checkmark = 0,545 \times 11$$

$$= 0,295 \times 20,3 = 6V \quad \checkmark = 6V$$

$$I_{24\Omega} = \frac{V}{R} = \frac{6}{24} = 0,25A \quad \checkmark$$

$$I_R = 0,545 - 0,25 = 0,295A$$

$$R = \frac{V}{I} = \frac{6}{0,295} = 20,34 \Omega \quad \checkmark$$

7.2.4

$$\text{emf} = I(R_{\text{ext}} + r)$$

$$12 = I(11 + 11) \quad \checkmark$$

$$I = \frac{12}{22} = 0,55A \quad \checkmark$$

$$P = VI = 12 \times 0,55 = 6,6 \text{ W} \quad \checkmark$$

(3)

$$\text{OR } P = \frac{V^2}{R} = \frac{(12)^2}{22} = 6,55 \text{ W} \quad \checkmark$$

$$\text{OR } P = I^2 R = (0,55)^2 \times 22 = 6,66 \text{ W} \quad \checkmark$$

8.1 A representation of the magnitude and direction of the magnetic field. ✓✓ (2)

8.2 On page 3 (2)

8.3.1 The emf induced is directly proportional to the rate of change of magnetic flux ✓✓ (2)

8.3.2 There is a magnetic field around the wire carrying a current. ✓
As the loop moves left, the magnetic flux passing through the area of the loop is increasing (changing) ✓
The change in magnetic flux induces an emf in the loop. (3)

8.3.3 DCBA ✓✓ anticlockwise (2)

8.4.1 } (4)
8.4.2 } On page 4 (2)
8.4.3 } (2)

8.5.1 B ✓ (1)

8.5.2 As the south pole moves down, a changing magnetic flux passing through the coil induces an emf in the coil. ✓
An induced current flows in the coil to oppose this change in magnetic flux creating a south pole at the top of the coil. ✓
Current flows from X to Y through the circuit (4)
Diode B is forward biased allowing current through it. ✓

9.1 The process that occurs when light shines on a metal and electrons are ejected ✓✓ (2)

$$\begin{aligned} 9.2.1 \quad W_0 &= 2 \text{ eV} \\ &= 2 \times 1,6 \times 10^{-19} \\ hf_0 &= 3,2 \times 10^{-19} \text{ J} \quad \checkmark \end{aligned}$$

$$f_0 = \frac{3,2 \times 10^{-19}}{6,6 \times 10^{-34}} = 4,85 \times 10^{14} \text{ Hz} \quad \checkmark \quad (3)$$

$$\begin{aligned} 9.2.2 \quad E &= W_0 + E_{k(\max)} \\ E_{k(\max)} &= E - W_0 \\ &= hf - W_0 \\ &= \frac{hc}{\lambda} - W_0 \\ &= \left(\frac{6,6 \times 10^{-34} \times 3 \times 10^8}{420 \times 10^{-9}} \right) - 3,2 \times 10^{-19} \\ &= 4,714 \times 10^{-19} - 3,2 \times 10^{-19} \\ E_{k(\max)} &= 1,51 \times 10^{-19} \text{ J} \quad \checkmark \quad (4) \end{aligned}$$

9.3.1 On page 4 (2)

$$9.3.2 \quad E = \frac{hc}{\lambda} = \frac{6,6 \times 10^{-34} \times 3 \times 10^8}{656 \times 10^{-9}} = 3,0 \times 10^{-19} \text{ J} \quad \checkmark$$

$$\begin{aligned} E &= E_3 - E_2 \\ &= [-0,242 - (-0,545)] \times 10^{-18} \\ &= 0,303 \times 10^{-18} \\ &= 3,03 \times 10^{-19} \\ &= 3,0 \times 10^{-19} \text{ J} \quad \checkmark \end{aligned}$$