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ST BENEDICT'S

SUBJECT	Physics Prelim
GRADE	12
EXAMINER	Mr McCoy
MODERATOR	Mrs Govender
DATE	11 July 2022
MARKS	200 marks
DURATION	180 minutes

MARK
TOTAL

LEARNER NAME: Marking Guidelines

QUESTION 1 - GR

20 MARKS

Answer these questions on the multiple-choice answer sheet below. Make a cross (X) in the box corresponding to the letter that you consider to be correct.

A	B	☒	D
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Here the option C has been marked as an example

1.1	A	B	☒	D	
1.2	A	☒	C	D	$v^2 = \frac{2E_k}{m} \therefore v = \sqrt{\frac{2E_k}{m}} \therefore v' = \sqrt{\frac{22E_k}{m}} \therefore v' = \sqrt{2} \sqrt{\frac{2E_k}{m}} s \propto v$
1.3	A	☒	C	D	
1.4	A	B	☒	D	
1.5	A	B	☒	D	
1.6	☒	B	C	D	
1.7	☒	B	C	D	
1.8	A	B	☒	D	
1.9	☒	B	C	D	
1.10	☒	B	C	D	

QUESTION 2 - ZN

15 MARKS

- 2.1 Vector - physical quantity ✓ that has both magnitude and direction ✓ (2)
- 2.2 2 m ✓ east ✓ (2)
- 2.3 Rate of change of displacement ✓✓. or Rate of change of position/Rate of displacement. (2)
- 2.4 $average\ velocity = \frac{s}{t} = \frac{2\text{ coe} \checkmark}{2 \checkmark} = 1\text{ m} \cdot \text{s}^{-1} \checkmark\text{ east}$ (3)
- 2.5 $average\ speed = \frac{total\ distance \checkmark}{t} = \frac{\pi(1) \checkmark}{2 \checkmark} = 1,57\text{ m} \cdot \text{s}^{-1} \checkmark$ (4)
- 2.6 $1,57\text{ m} \cdot \text{s}^{-1} \checkmark\text{ south} \checkmark$ (2)

QUESTION 3 - ZN

17 MARKS

3.1 $s = ut + \frac{1}{2}gt^2 \checkmark$

$-18 = u(2,8) + \frac{1}{2}(-\checkmark\text{ same sign})9,8)(2,8 \checkmark)^2$

$20,42 = 2,8u$

$u = 7,29\text{ m} \cdot \text{s}^{-1} \checkmark$ (4)

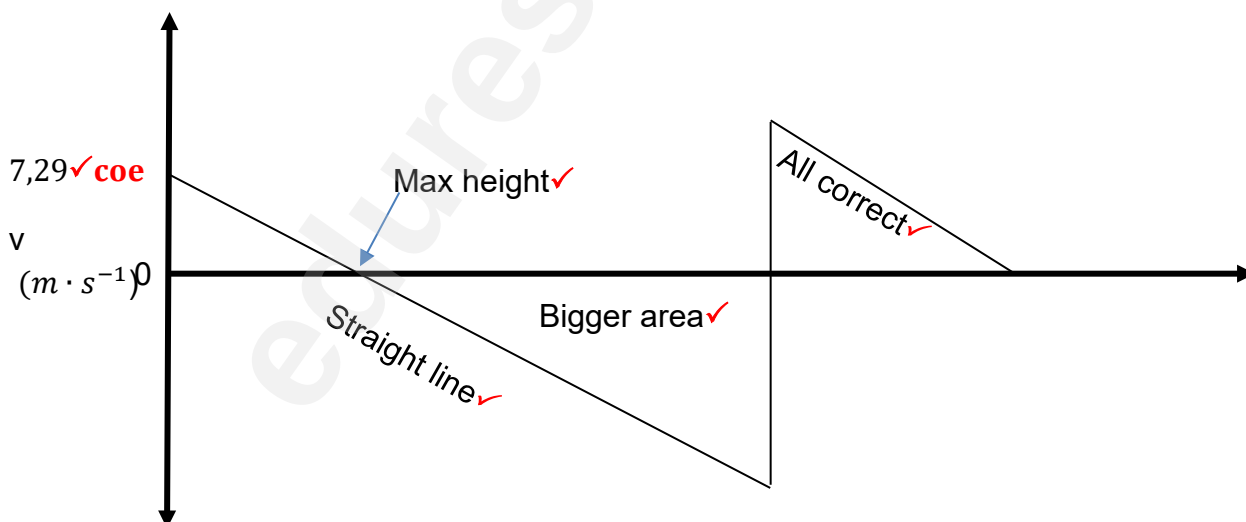
3.2 $v^2 = u^2 + 2as \checkmark$

$0^2 = 7,29\text{ coe}^2 + 2(-9,8)s \checkmark$

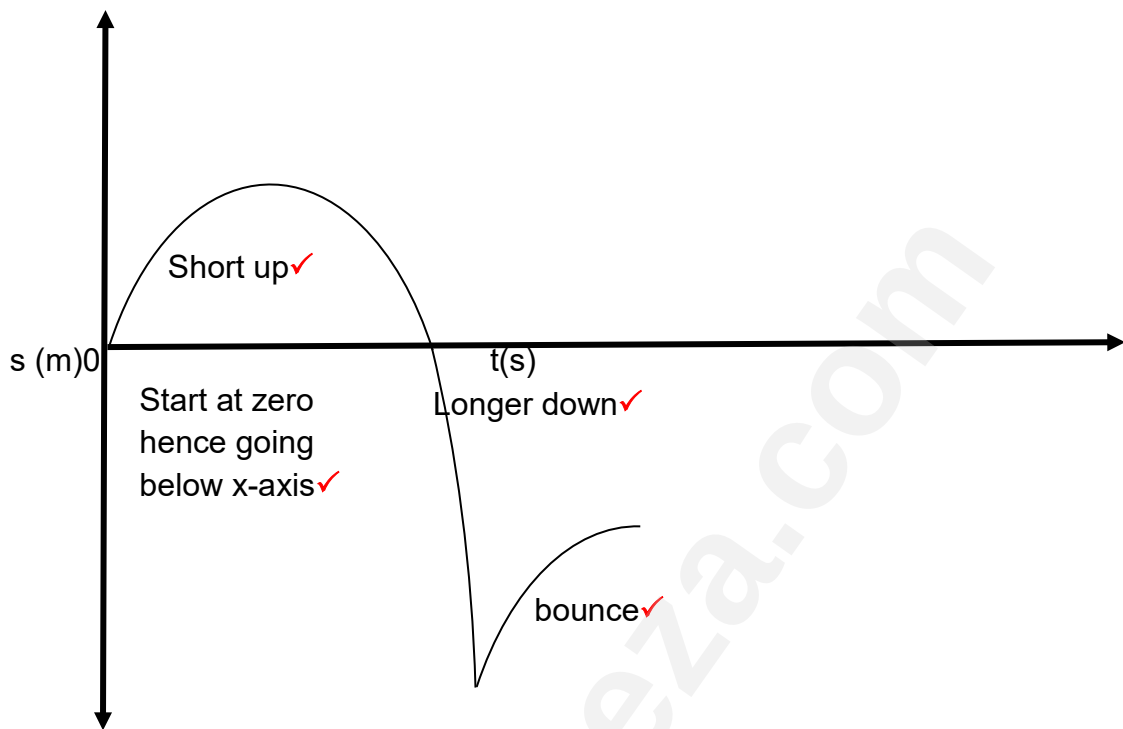
$s = 2,71\text{ m} \checkmark$

$height\ above\ water = 18 + 2,27 = 20,71\text{ m} \checkmark$ (4)

3.3 (5)



- 3.4 Sketch the corresponding displacement-time graph. Consider the top of the building as the position where the displacement is zero. (4)



QUESTION 4 - ZN

14 MARKS

4.1 D-E or 8 – 10 s ✓

(1)

4.2 acceleration - the rate of change of velocity ✓✓

(2)

4.3 AB – (uniform) acceleration north ✓

BC greater ✓ (uniform) acceleration south ✓

(3)

4.4 Twice ✓✓

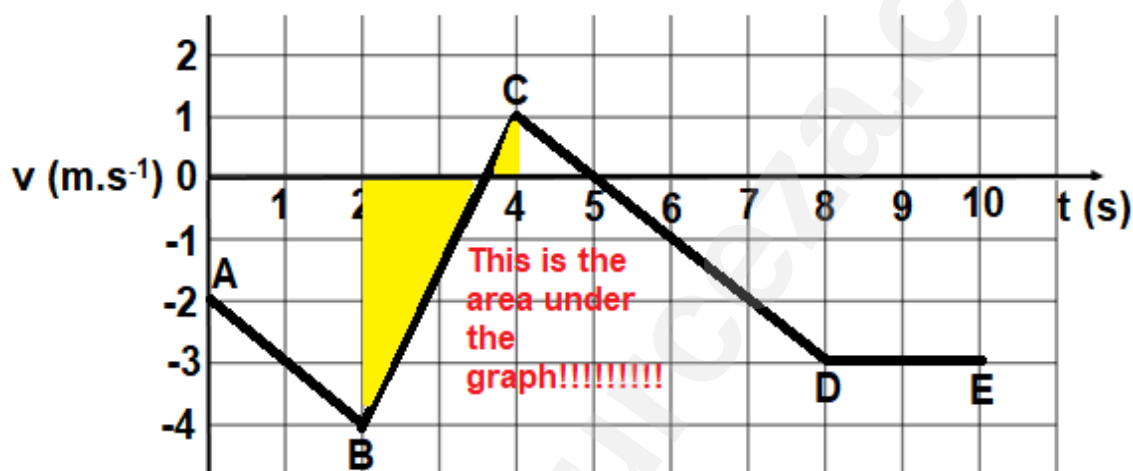
(2)

4.5 **Distance** = Area = $(\frac{1}{2}b \times h)$ + $(\frac{1}{2}b \times h)$ ✓

$$Area = \left(\frac{1}{2}(\pm 3.6 - 2) \times 4\right) + \left(\frac{1}{2}(4 - \pm 3.6) \times 1\right) \checkmark$$

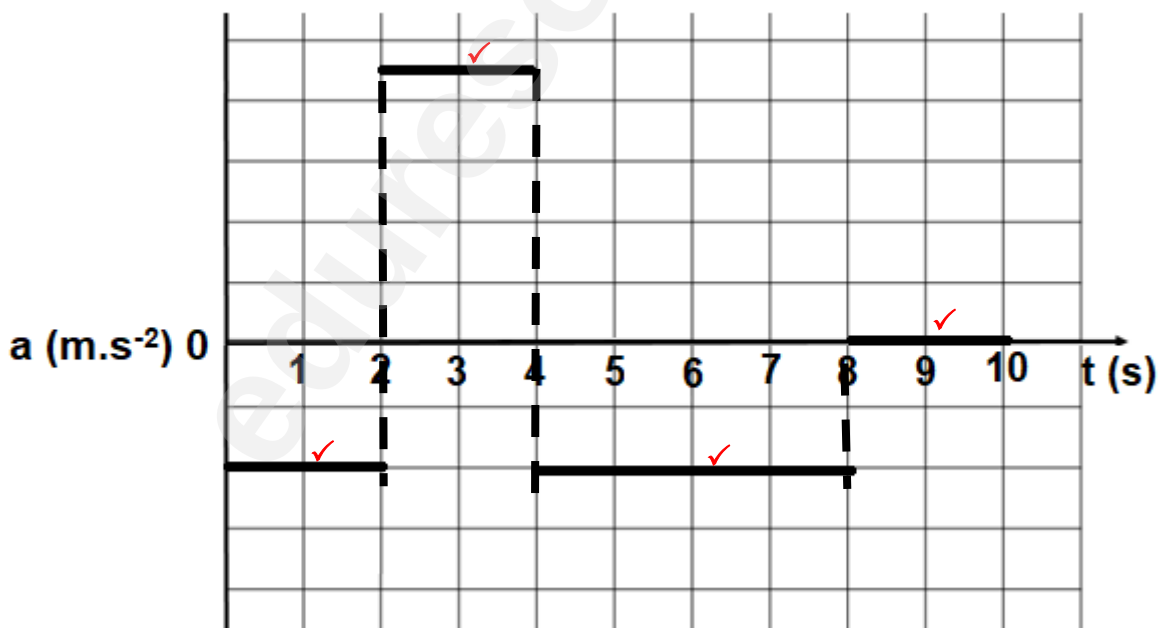
$$Area = \pm 3,4 \text{ m} \checkmark$$

(3)



4.6

(4)



QUESTION 5 - KH

27 MARKS

5.1.1

(3)

The friction force that the surface exerts parallel to the object increases as the applied force increases ✓

Just before/as the object starts to move. ✓

The friction force is at maximum force, this is the maximum static friction. ✓

5.1.2 LESS THAN ✓

(1)

5.1.3 How would it be possible to increase the maximum static friction on the box, without changing the materials?

Use a suitable equation to help you explain.

(3)

By pushing down on the box OR adding mass to the box to ✓

increase the normal force on the box. ✓

$F_f = \mu F_N$, hence $F_N \propto F_f$ ✓

5.1.4 Name and describe the reaction force to the frictional force on the box.

(2)

Frictional force

The friction of the box on the table ✓ to the RIGHT ✓

5.2 A car has an ornament hanging from the inside mirror by a string. The car accelerates from a stop street to 20 m.s^{-1} , in 5 seconds.

5.2.1 State Newton's first law.

(2)

An object continues in a state of rest or uniform (moving with constant) velocity ✓ unless it is acted upon by a net or resultant force ✓

5.2.2 Explain why the ornament moves backwards while the car is accelerating.

(3)

The net force is on the car and not the object. ✓

The inertia ✓ of the object prevent the object from accelerating with the car ✓

5.2.3 What angle θ does the string make with the vertical? (5)

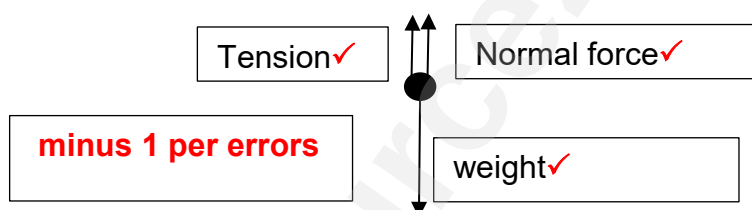
$v = u + at$ $20 = 0 + a5$ $a = 4 \text{ m} \cdot \text{s}^{-2}$ ✓	$F_{car} = ma$ $F_{car} = m4$ ✓ $F_g = m9.8$ ✓	$\tan\theta = \frac{F_{car}}{F_g}$ ✓ $\tan\theta = \frac{m4}{m9.8}$ $\theta = 22,2^\circ$ ✓
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5.3 A box weighing 80 N rests on a table. A rope tied to the box runs vertically upward over the pulley and a weight is hung from the other end.

5.3.1 Define *normal force*. (2)

the perpendicular force exerted by a surface ✓ on an object in contact with it ✓
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5.3.2 Draw a free-body diagram of all the forces acting on the box. (3)



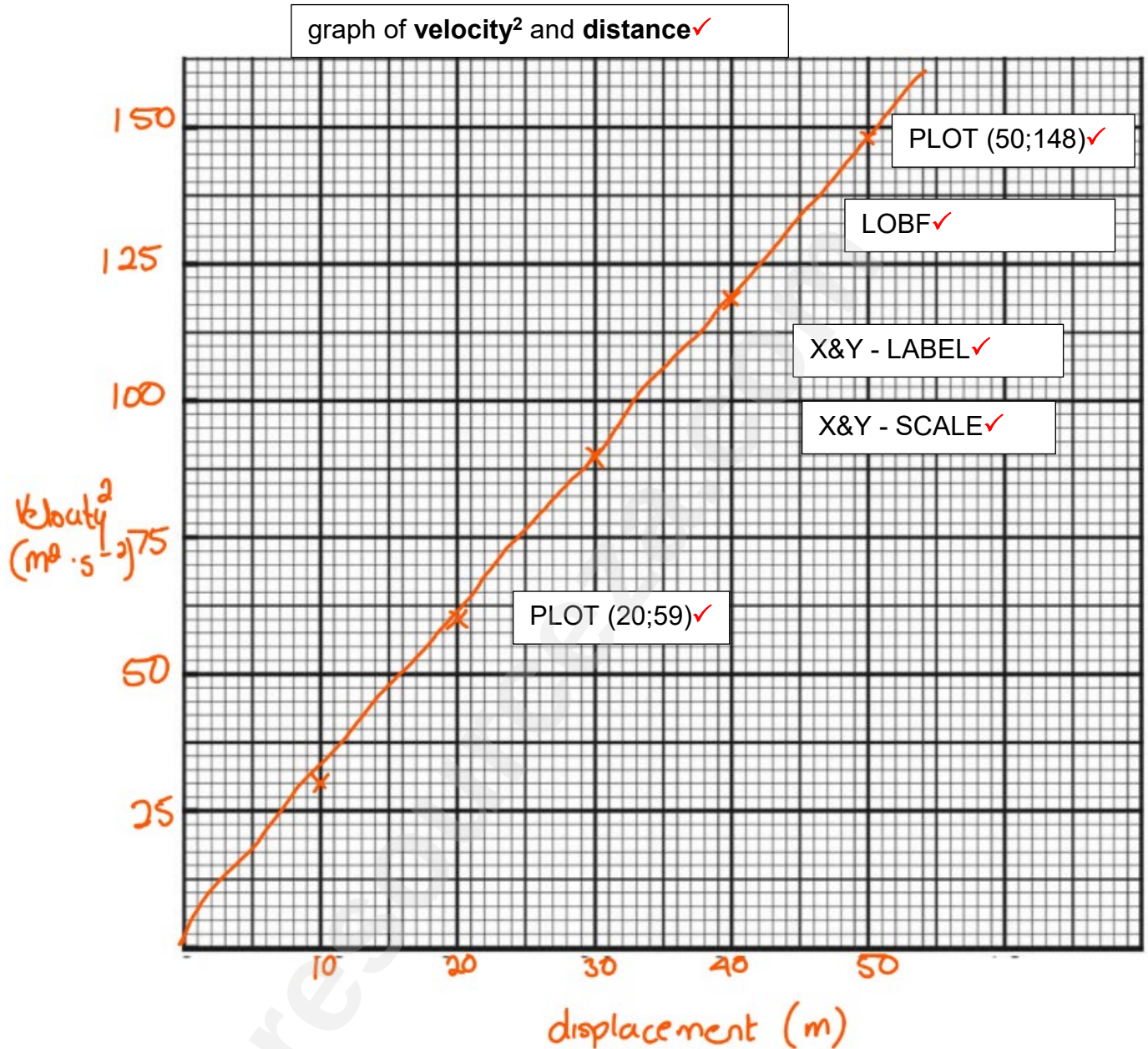
5.3.3 Determine the normal force if the mass of the weight is 3 kg. (3)

$F_g = m9.8$ $F_g = 3 \times 9.8$ $F_g = 29,4 \text{ N} = T$	$N = \text{weight} - T$ ✓ $N = 80 - 29,4$ ✓ $N = 50,6 \text{ N up}$ ✓
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QUESTION 6 - SG

14 MARKS

6.1



6.2 To obtain a straight line graph. ✓ (1)

6.3 $Gradient = \frac{\Delta y}{\Delta x}$

Substitution of two points✓✓

Answer in the range of 2,9 – 3,1✓

(Unit: m.s⁻²)

(3)

6.4 $v^2 = u^2 + 2as$

$v^2 = 2as$ ✓ **v not u!**

$Gradient = \frac{\Delta v^2}{s}$

$Gradient = 2a$

2,9 coe✓ = $2a$ ✓

$a = 1,48 \text{ m} \cdot \text{s}^{-2}$ ✓

(4)

QUESTION 7 - SG

35 MARKS

7.1.1 Between 1,8 - 1,925 seconds ✓✓ only 1 mark if a single time is given (2)

7.1.2 $p_{\text{final}} = p_1 + p_2$ ✓
 $= (0,306)(0,423) \checkmark + (0,250)(0,085) \checkmark$
 $= 0,151 \text{ kg.m.s}^{-1} \checkmark$ (4)

7.1.3 A collision in which both momentum ✓ and kinetic energy are conserved ✓ (2)

7.1.4 $E_{\text{initial}} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$ $E_{\text{final}} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$
 $= (0) + (0,5)(0,25)(0,477)^2 \checkmark$ $= (0,5)(0,306)(0,423)^2 + (0,5)(0,25)(0,085)^2 \checkmark$
 $= 0,028 \text{ J} \checkmark$ $= 0,028 \text{ J} \checkmark$

(minus 1 if not 3 decimal points)

The collision was elastic as the kinetic energy of the system was conserved. ✓ (5)

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

7.1.6 $F_{\text{net}}\Delta t = \Delta p$

$F(0,125) = (0,306 \checkmark)(0,423 - 0 \checkmark)$

$= 1,04 \text{ N} \checkmark$ OR

$a = m = \frac{\Delta y}{\Delta x} = \frac{0,423 - 0}{1,925 - 1,8} = 3,38$ (3)

$F_{\text{net}} = ma = 0,306 \times 3,38 = 1,04 \text{ N}$

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

$$\begin{aligned}
 7.2.2 \quad E_{kx} &= \frac{1}{2}mv^2 & E_{kwater} &= \frac{1}{2}mv^2 \text{ OR } v^2 = u^2 + 2as \\
 &= 12(300)(2)^2 & &= 12(300)(5)^2 & a &= 0,875 \text{ m/s} \\
 &= 600 \text{ J } \checkmark & &= 3750 \text{ J } \checkmark & F_{net} &= ma = 300 \times 0,875 \\
 \Delta E_k &= 3750 - 600 & & & &= 262,5 \text{ N} \\
 &= 3150 \text{ J } \checkmark
 \end{aligned}$$

$$W_{net} = F_{net} \cdot \Delta x = \Delta E_k$$

$$F_{net} \times 12 \checkmark = 3150$$

$$F_{net} = 262,5 \text{ N } \checkmark$$

$$\begin{aligned}
 7.2.3 \quad F_{net} &= F_{g//slope} - F_f \\
 262,5 \checkmark \text{coe} &= 300 (9,8) (\sin 20^\circ) \checkmark - F_f \\
 262,5 &= 1005,54 - F_f \\
 F_f &= 1005,54 - 262,5 \\
 &= 743,04 \text{ N } \checkmark
 \end{aligned}$$

(5)

$$\begin{aligned}
 7.2.4a \quad \Delta E_p &= mgh \\
 &= 300 \times 9,8 \times 5 \checkmark \\
 &= 14700 \text{ J} \\
 \text{Total } W &= 14700 + 15000 \\
 &= 29700 \text{ J } \checkmark
 \end{aligned}$$

$$P = \frac{W}{t}$$

$$P = \frac{29700}{20 \checkmark}$$

$$= 1485 \text{ W } \checkmark$$

(4)

$$7.2.4b \quad \% \text{efficiency} = \frac{P_{out}}{P_{in}} \times 100$$

$$93 \checkmark = \frac{1485 \checkmark \text{coe}}{P_{in}} \times 100$$

$$P_{in} = 1596,77 \text{ W } \checkmark$$

(3)

QUESTION 8.1 - KH

15 MARKS

8.1.1

(4)

$P = V \times I$ ✓ $P = 7,4 \times 2$ $P = 14,8 \text{ W}$	$W = P \times t$ ✓ $W = 14,8 \times (240 \times 60)$ ✓ $W = 213120 \text{ J}$ ✓	
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8.1.2

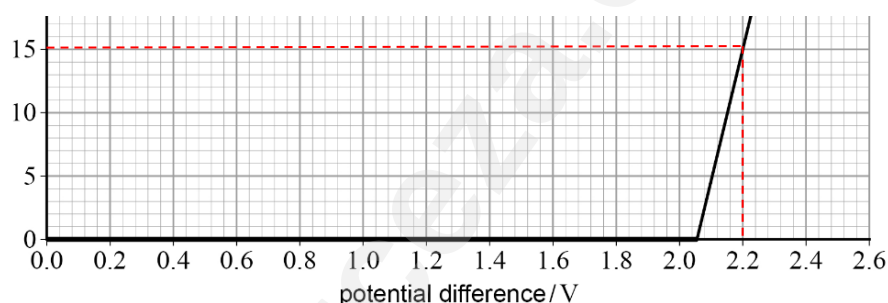
(3)

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

$$R = \frac{7,4}{2}$$

$$R = 3,7 \Omega$$

Graph of Current vs. Potential difference for an LED.



8.1.3

(3)

No, as the temperature current through the LED is NOT directly proportional to the potential difference across the LED.

8.1.4

(2)

0,015 (A) only 1 mark if 15 mA

8.1.5

(3)

pd across resistor = $7,4 - 2,2 = 5,2 \text{ V}$ $R = \frac{V}{I}$ $R = \frac{5,2}{0,015}$ $R = 346,67 \Omega$	$P = \frac{V^2}{R}$ $P = \frac{1,3^2}{2,11}$ $P = 0,8 \text{ W}$
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QUESTION 8.2 - FMC

15 MARKS

8.2.1

(2)

$$\frac{1}{R_p} = \frac{1}{r} + \frac{1}{r}$$

$$\frac{1}{R_p} = \frac{1}{0,65} + \frac{1}{0,65} \checkmark$$

$$\therefore R_p = 0,325 \, \Omega$$

8.2.2

(3)

$$R = \frac{V^2}{P} \checkmark$$

$$R = \frac{1,3^2}{0,8}$$

$$R = 2,11 \, \Omega \checkmark$$

$$R_T = R_{load} + r$$

$$R_T = 2,11 \, \Omega + 0,325 \, \Omega$$

$$R_T = 2,44 \, \Omega \checkmark$$

8.2.3

(3)

$I = \frac{P}{V}$ $I = \frac{0,8}{1,3}$ $I = 0,62 \, A \checkmark$	$V_{internal} = I \times R$ $V_{internal} = 0,62 \times 0,325$ $V_{internal} = 0,2 \, V \checkmark$
Conclusion: Yes, $V_{load} = \varepsilon - V_{internal}$ $V_{load} = 1,5 - 0,2 \checkmark = 1,3 \, V$	

8.2.4

(3)

(Cells must be added) in parallel $\checkmark$

Because:

more energy stored in the bank of cells / less power from each cell $\checkmark$ without increasing the voltage across the bulb $\checkmark$

8.3

(4)

$$Cost = kWh \times unit \, price \checkmark$$

$$Cost = 2,2 \times 10 \checkmark \times \frac{269}{100} \checkmark$$

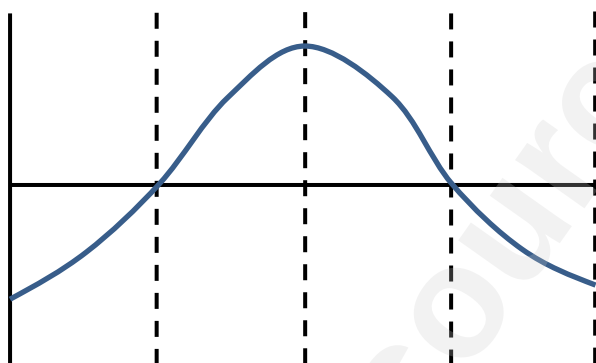
$$Cost = R \, 59,18 \checkmark$$

QUESTION 9 - FMC

28 MARKS

- 9.1.1 Dots equally spaced on the top✓
Crosses equally spaced on the bottom✓ (2)
- 9.1.2 2 arrows, parallel✓ and N to S✓
Force pointing down✓✓ (can be anywhere) (4)
- 9.1.3 The wire would need to parallel to the magnetic field✓,
so that the angle was zero✓, $F = IlB\sin\theta$. ✓ (3)
- 9.2.1 Clockwise✓✓ (2)
- 9.2.2 Brushes✓, conducts current to and from the split ring commutator while allowing the commutator to turn✓. (2)
- 9.3.1 The induced current flows in a direction so as to set up a magnetic field✓ to oppose the change in magnetic flux. ✓ (2)
- 9.3.2a Clockwise✓✓ (2)
- 9.3.2b The external magnetic field is into the page✓,
and decreasing✓ (inside the loop)
Therefore the induced current need to produce a magnetic field into the page✓ (to oppose the change in magnetic flux.) (3)

9.4



ϕ starts negative✓
zero at 90✓
max positive at 180✓

- 9.5.1 $\frac{V_p}{N_p} = \frac{V_s}{N_s}$ ✓
 $\frac{15}{1200} = \frac{V_s}{3000}$ ✓
 $V_s = 37,5 \text{ V}$ ✓ (3)
- 9.5.2 $V_p I_p = V_s I_s$ ✓
 $I_s = 0,4 \text{ mA}$ ✓ (2)