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ST BENEDICT'S

SUBJECT	PHYSICS – PRELIM - MG
GRADE	12
EXAMINER	Mr Hilder
MODERATOR	Mr McCoy
DATE	12 July 2024
MARKS	200
DURATION	180 minutes

%

MARKING GUIDELINES**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

1. This question paper consists of 19 pages and a Data Sheet. Please check that your question paper is complete.
2. Read the questions carefully.
3. Answer **ALL** the questions on the question paper and hand it in at the end of the assessment. Remember to write your name and surname in the space provided above.
4. Use the data and formulae sheet whenever necessary.
5. Show your working in all calculations.
6. Units need not be included in the working of calculations, but appropriate units should be shown in the answer.
7. Answers must be expressed in decimal format, not left as proper fractions.
8. Where appropriate, express answers to TWO decimal places.
9. It is in your own interest to write legibly and to present your work neatly.
10. Blank pages and black graphs are included at the end of the paper. If you run out of space for a question, use this space. Clearly indicate the question number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKER TO ENTER MARKS

Question	1	2	3	4	5	6	7	8	9	10	11	Total
Mark												
Moderated Mark												
Question Total	20	24	30	19	18	17	10	13	16	18	15	200

Comment:

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	~~C~~	D
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Here the option C has been marked as an example.

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

1.1 Which one of the following units represents a vector quantity?

A $\text{kg.m}^2.\text{s}^{-2}$ ($\frac{m.x^2}{t^2} = m.a.x = F.x$ [N.m so Joule] scalar)

B kg.m.s^{-1} ($\frac{m.x}{t} = mv = p$ [momentum] vector)

C kg.m.s^2 ($m.x.t = \text{no quantity}$)

D $\text{kg.m}^2.\text{s}$ ($m.x^2.t = \text{no quantity}$)

1.2 You have two identical marbles. You drop the first marble and throw the second marble down from the same height. Air resistance is negligible. While the marbles are in the air, which statement is NOT correct?

A The second marble will spend less time in the air

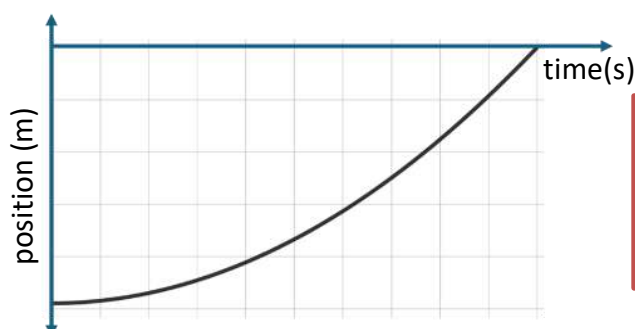
B The first marble will have a smaller velocity when it reaches the ground

C The second marble will experience a larger force

(both only experience acceleration due to gravity, and $F = ma$, $F \propto m$,)

D Both marbles will have the same acceleration

- 1.3 A sketch of the position-time graph for a moving object is shown below.

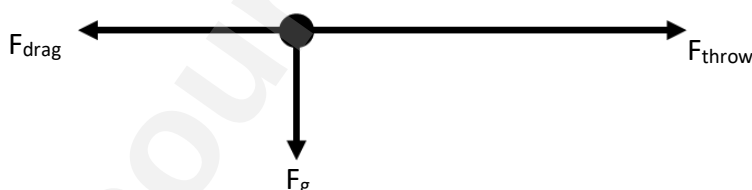


Gradient increasing in the and getting more positive in direction.

Which answer best describes the magnitude of the object's velocity and the sign of the acceleration?

	$v \text{ (m.s}^{-1}\text{)}$	$a \text{ (m.s}^{-2}\text{)}$
A	increasing	+
B	decreasing	—
C	decreasing	+
D	increasing	—

- 1.4 A student draws a force diagram for a ball in mid-flight, moving horizontally to the right after being thrown



Which force, if any, is **INCORRECT**?

- A F_{drag} , the force due to air resistance
B F_{throw} , the force due to the throw
 C F_g , the force due to gravity
 D None of the forces are incorrect

As the Freebody is drawn for after the ball was thrown. There is no force acting to the right anymore.

- 1.5 A moving ball has a kinetic energy of E_k . If the ball slows down to half its original velocity, what will its kinetic energy be?

- A E_k
 B $2E_k$
 C $\frac{1}{2}E_k$
D $\frac{1}{4}E_k$

Find equation, and substitute the change made to the variable,

$$E_{kA} = \frac{1}{2}mv_A^2 \quad \& \quad E_{kB} = \frac{1}{2}m\left(\frac{v_A}{2}\right)^2$$

Simplify the changing equation by removing the constants ($\frac{1}{2}m$) and don't forget the square

$$E_{kB} = \frac{1}{2}m\left(\frac{v_f^2}{2^2}\right) \rightarrow E_{kB} \propto v_f^2 \cdot \frac{1}{4}$$

So if E_{kB} is directly proportional to v_f^2 , if the side of the equation with v_f^2 decreases by $\frac{1}{4}$ the other variable will decrease by the same amount so $\frac{E_{kB}}{4} \dots$

$$\text{if } (E_{kA} = 1) \quad \text{and} \quad \left(\frac{E_{kB}}{4} \propto \frac{v_f^2}{4}\right) \quad \text{then} \quad E_{kB} = \frac{1}{4}$$

This means the kinetic energy after the ball hit the wall will be one quarter the kinetic energy of the ball before it slowed down to half its original velocity.

$$E_{kA} = \frac{1}{4}E_{kA} \quad \text{or} \quad E_{kA} = 4E_{kB}$$

$$(v_B = \frac{v_A}{2})$$

$$E_{kA} = \frac{1}{2}mv_A^2 \quad E_{kB} = \frac{1}{2}m(v_B)^2$$

$$\frac{2E_{kA}}{m} = v_A^2 \quad \frac{2E_{kB}}{m} = \left(\frac{v_A}{2}\right)^2$$

$$\frac{2E_{kB}}{m} = \left(\frac{v_A^2}{4}\right)$$

so ...

$$v_A^2 = \frac{2E_{kA}}{m} \quad \& \quad \frac{8E_{kB}}{m} = v_A^2$$

$$v_A^2 = \frac{2E_{kA}}{m}$$

$$\therefore \frac{2E_{kA}}{m} = \frac{8E_{kB}}{m}$$

$$\text{either (i) } E_{kA} = 4E_{kB} \quad \text{or} \quad \text{(ii) } E_{kB} = \frac{E_{kA}}{4}$$

- 1.6 A lightbulb uses energy at a rate of 500 W while in use. It is 75% efficient. How much energy being dissipated is wasted?

- A 875 W
B 500 W
C 375 W
D 125 W

$$500 \text{ W} \times 75\% = 375 \text{ W used}$$

$$\therefore 500 - 375 = 125 \text{ W wasted.}$$

OR

$$500 \text{ W} \times (100\% - 75\%)$$

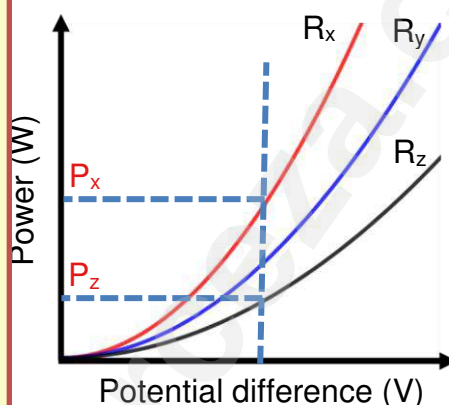
$$500 \times 25\% = 125 \text{ W}$$

- 1.7 The graph below shows the relationship between power dissipated (W) and potential difference (V) for three different resistors, R_x , R_y and R_z , at constant temperature.

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

$$P \propto \frac{1}{R} \text{ when } V \text{ is constant.}$$

- So comparing the power of two options at the same voltage,
→ P_x is greater than P_z ,
→ and $P \propto \frac{1}{R}$,
→ so an increasing resistance will lead to Power decreasing
→ as $P_z > P_x$, then the inverse is true for resistance, so...
→ $R_z > R_x$



g conclusions regarding the resistances of the

resistors is **CORRECT?**

- A $R_z > R_y > R_x$
B $R_x = R_y = R_z$
C $R_x > R_y > R_z$
D $R_x > R_y$ and $R_y < R_z$

- 1.8 The wavelength of a light source P is twice that of a light source Q.
The energy of a photon from source P will be ... of a photon from source Q.

- A a quarter of the energy
B half the energy
C equal to the energy
D twice the energy

$$\lambda_P = 2\lambda_Q \text{ and } E_P = \frac{hc}{\lambda_P}$$

$$\therefore E_P \propto \frac{1}{(2\lambda_Q)} \text{ as } hc \text{ is const } \left(\frac{E_P}{2}\right).$$

$$\therefore \frac{E_P}{2} = E_Q$$

(or P possesses half the energy Q does)

1.9 Two circuits are shown in the diagram

$$R_A \uparrow$$

$$R \propto \frac{1}{I}$$

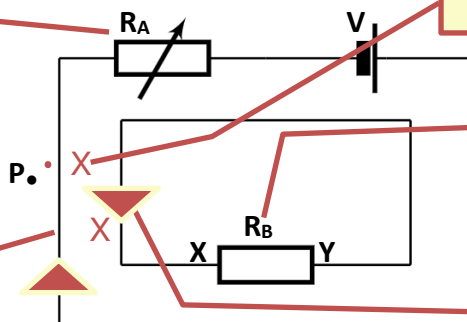
$$\therefore I \downarrow$$

$$I \downarrow$$

$$emf = IR$$

$$so IR = -N \frac{\Delta \Phi}{\Delta t} \text{ \& } I \propto \Delta \Phi$$

So decreasing current will lead to a decreasing change in magnetic flux



→ right hand rule
@ P out of page.
& on the other side of
the wire into page.

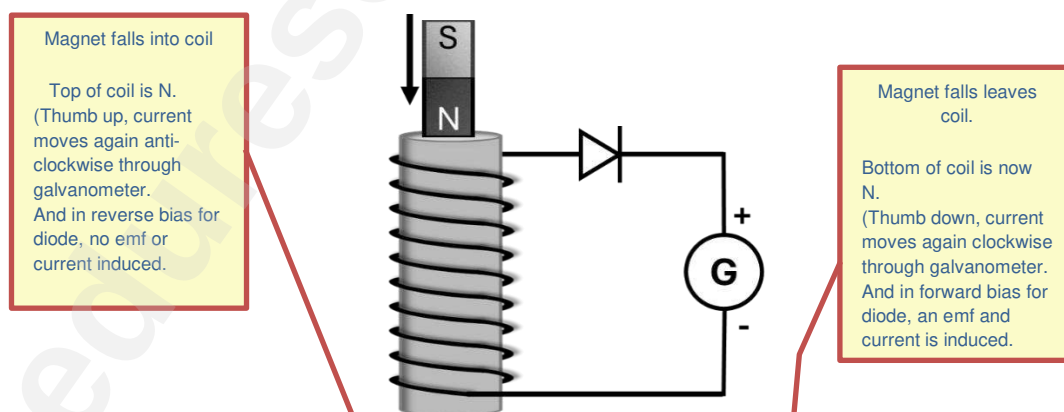
So the current through R_B is due the changing magnetic flux in the outside circuit.

The current will flow in a direction to reinforce the change in flux, thus as the field into the page is decreasing the current will flow to create a field that also goes into page with the original field, so x- y (right hand)

The resistance in the outside circuit, R_A is **increasing** at a constant rate. In which direction is the magnetic field at point P pointing and in which direction is the conventional current through the resistor, R_B in the smaller inside circuit?

	Magnetic field at P	Current through R_B
A	Into the page	From X to Y
B	Into the page	From Y to X
C	Out of the page	From X to Y
D	Out of the page	From Y to X

1.10 A magnet is dropped through a coil connected to a circuit containing a diode as shown below.



Magnet falls into coil

Top of coil is N.
(Thumb up, current moves again anti-clockwise through galvanometer.
And in reverse bias for diode, no emf or current induced.

Magnet falls leaves coil.

Bottom of coil is now N.
(Thumb down, current moves again clockwise through galvanometer.
And in forward bias for diode, an emf and current is induced.

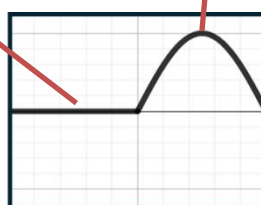
Which graph of emf vs. time would be produced though the galvanometer?



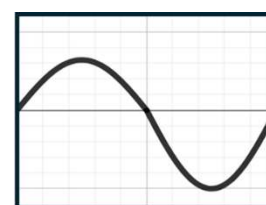
A



B



C



D

QUESTION 2 KH**24 MARKS**

2.1 Car movement.

2.1.1 A change in position ✓✓ (2)

2.1.2 0m ✓ (returned to initial positions) (1)

2.1.3 D-E ✓ (when line is horizontal on x/t) (1)

2.1.4 Speed B-C (3)

$\text{speed} = \frac{\text{displacement}}{\text{time}} \checkmark$ $\text{speed} = \frac{25 - 5}{6 - 2} = \frac{20}{4} \checkmark$ $\text{speed} = 5 \text{ m.s}^{-1} \checkmark$	OR	$m = \frac{y_C - y_B}{x_C - x_B} \checkmark$ $m = \frac{25 - 5}{6 - 2} = \frac{20}{4} \checkmark$ $m = 5 \text{ m.s}^{-1} \checkmark$
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2.1.5 determine t_F . (4)

$t_F = t_f \checkmark + \frac{x}{v} \checkmark$ $t_F = 18 + \frac{25}{6}$ $t_F = 18 + 4,167 \checkmark$ $t_F = 22,17 \text{ s} \checkmark$	OR	$m = \frac{y_f - y_g}{x_f - x_g} \checkmark$ $-6 \checkmark = \frac{0 - 25}{x_f - 18} \checkmark$ $x_f = 22,17 \text{ s} \checkmark$	OR	$v_{FG} = \frac{x_{FG}}{t_{FG}} \checkmark$ $-6 = \frac{25}{t_{FG}}$ $t_{FG} = 4,167 \checkmark$ $t_G = t_F + t_{FG} \checkmark$ $t_G = 18 + 4,167$ $t_F = 22,17 \text{ s} \checkmark$
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2.1.6 acceleration AB. (3)

$$v_{BC} = u_A + a_{AB} t_{AB} \checkmark$$

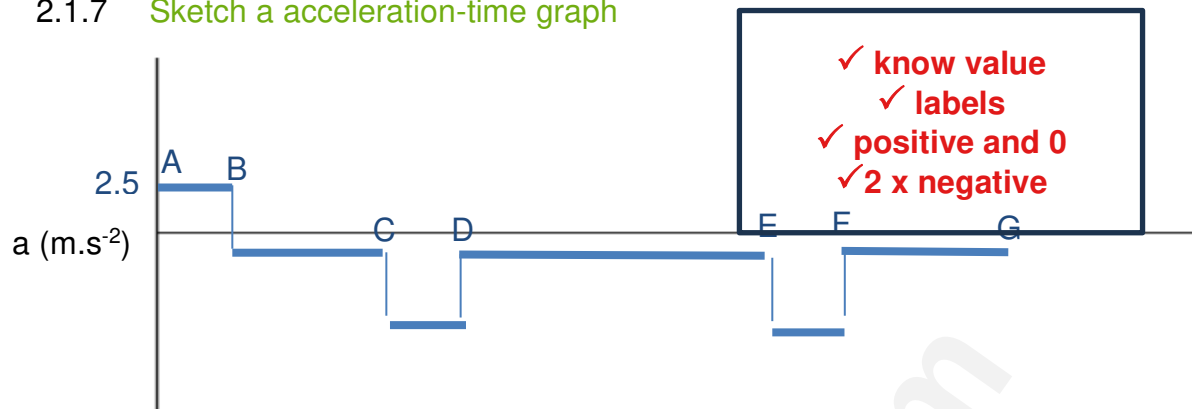
$$5 \checkmark = 0 + a(2) \text{ [c.o.e} \rightarrow \text{2.1.4]}$$

$$\frac{5}{2} = a$$

$$a_{AB} = 2,5 \text{ m.s}^{-2} \checkmark$$

2.1.7 Sketch an acceleration-time graph

(4)

2.2 thrown upward 20 m.s⁻¹, 40 m directly above. what height above the ground

(6)

$(i) \quad s_{fA} = u_A t + \frac{1}{2} g t^2$ $s_{fA} = 20t + \frac{1}{2} (-9,8) t^2 \checkmark$ $s_{fA} = 20t - 4,9t^2 \checkmark$	$(ii) \quad s_{fB} - s_{iB} = u_B t + \frac{1}{2} g t^2$ $s_{fB} - 40 = 0 + \frac{1}{2} (-9,8) t^2$ $s_{fB} = 40 - 4,9t^2 \checkmark$
$s_{fA} = s_{fB} \checkmark$ $20t - 4,9t^2 = 40 - 4,9t^2$ $20t = 40$ $t = 2 \text{ s} \checkmark$	
$s_{fB} = 40 - 4,9(2^2)$ $s_{fB} = 40 - 19,6$ $s_{fB} = \boxed{20,4 \text{ m}} \checkmark$	

QUESTION 3 FMC**30 MARKS**3.1 **DOWNWARD** ✓ (weight) (1)

3.2 maximum height (4)

$v_{\max h}^2 = u^2 + 2gh_{\text{thrown}}$ $0 = 14^2 + 2(-9,8)h \text{ ✓ } (\pm \text{signs})$ $\frac{-196}{-19,6} = h$ $h_{\text{thrown}} = 10 \text{ m } \text{ ✓ }$ $\therefore h_{\max (v=0)} = h_{\text{thrown}} + h \text{ ✓ }$ $h_m = 10 + 9 = \boxed{19 \text{ m } \text{ ✓ }}$	OR	$v^2 = u^2 + 2a\Delta s$ $0 = 14^2 + 2(-9,8)(s_f - s_i) \text{ ✓ } (\pm \text{signs})$ $-196 = -19,6(s_f - 9) \text{ ✓ }$ $\frac{-196}{-19,6} = s_f - 9$ $10 \text{ ✓ } = s_f - 9$ $s_f = \boxed{19 \text{ m } \text{ ✓ }}$
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3.3 velocity ball strikes grandstand (v_{gs}). (3)

$$v_{gs} = u_{\text{throw}} + gt_{\text{given}}$$

$$v_{gs} = 14 + (-9,8)(3,32) \text{ ✓ }$$

$$v_{gs} = 14 - 32,536$$

$$v_{gs} = -18,536$$

$$\therefore v_{gs} = \boxed{18,54 \text{ m} \cdot \text{s}^{-1} \text{ ✓ down } \text{ ✓ }}$$

3.4 height, h , of grandstand (gs). (4)

$s_{gs} = ut + \frac{1}{2}gt^2$ $s_{gs} = 14(3,32) + \frac{1}{2}(-9,8)(3,32^2) \text{ ✓ }$ $s_{gs} = 46,48 - 54,01$ $\underline{s_{gs} = -7,53 \text{ m } \text{ ✓ }}$	OR	$s_{gs} = \frac{(v_{gs} + u)}{2}t$ $s_{gs} = \left(\frac{-18,54 + 14}{2}\right)3,32 \text{ ✓ }$ $s_{gs} = (-2,27)(3,32)$ $\underline{s_{gs} = -7,54 \text{ m } \text{ ✓ }}$
METHOD 2:	THEN	
$v_{gs}^2 = u^2 + 2gs$ $18,54^2 = 0^2 + 2(9,8)s$ $18,54^2 = 19,6s$ $s = 17,54 \text{ m}$ $s_{gh} = h_{\max} - s_s$ $s_{gh} = 19 - 17,54 \text{ m}$	$\Delta s = s_{gs} - \Delta h \text{ ✓ }$ $\Delta s = -7,53 - (-9)$ $\Delta s = 1,47 \text{ m } \text{ ✓ }$	

3.5 Distance travelled in 3,32 s.

(3)

$distance = h_{thrown} + h_{return} + s_{gs} \checkmark$ $distance = 10 + 10 + 7,54 \checkmark$ $distance = \boxed{27,53 \text{ m} \checkmark}$	OR [c. o. e - 3.4 s_{gs}]	$distance = s_{up} + s_{down} \checkmark$ $distance = 10 + 17,54 \checkmark$ $distance = \boxed{27,53 \text{ m} \checkmark}$
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3.8 average velocity.

(3)

$$v_{avg} = \frac{\Delta s}{\Delta t} \checkmark$$

$$v_{avg} = \frac{-7,32 \checkmark}{3,32}$$

$$v_{avg} = -2,27 \text{ m.s}^{-1}$$

$$\therefore 2,27 \text{ m.s}^{-1} \text{ down} \checkmark$$

3.9 time elapsed bouncing - ground?

(3)

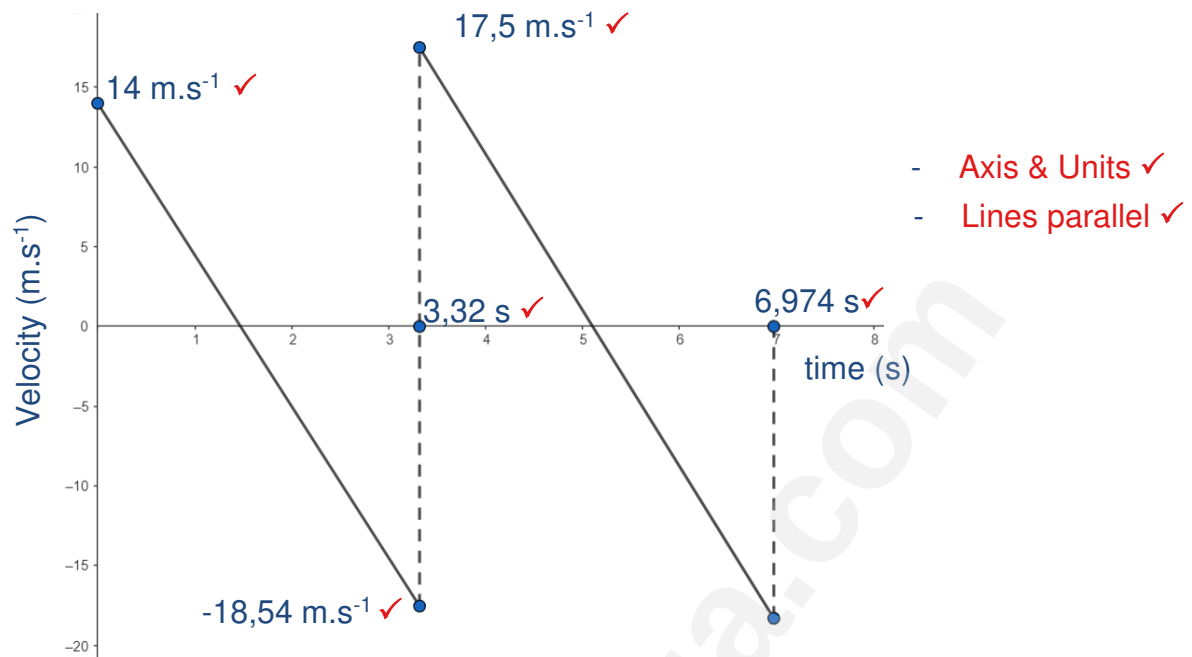
Use quadratic formula: $s = ut_b + \frac{1}{2}at_b^2$ $-1,47 \checkmark = 17,5t_b + \frac{1}{2}(-9,8)t_b^2 \checkmark$ $0 = 1,47 + 17,5t_b - 4,9t_b^2$ $t = \frac{-17,5 - \sqrt{17,5^2 - 4(-4,9)(1,47)}}{2(-4,9)}$ $t = \frac{-17,5 - \sqrt{335,062}}{-9,8}$ $t = \boxed{3,654 \text{ s} \checkmark}$	OR Calculate velocity before bouncing on grandstand. $v^2 = u^2 + 2gs$ $v^2 = 17,5^2 + 2(-9,8)(-1,47)$ $v = \sqrt{306,25 + 28,812}$ $v = 18,305 \text{ m.s}^{-1} \text{ down} \checkmark$ Then calculate the time in freefall between the two bounces. $v = u + gt_b$ $-18,305 = 17,5 + (-9,8)t_b \checkmark$ $\frac{-35,805}{-9,8} = t_b$ $t_b = \boxed{3,654 \text{ s} \checkmark}$
IF: The following is used only one mark: $v = u + at$ $0 = 17,5 + (-9,8)t$ $t = 0,79 \text{ s} \checkmark$	

3.10 time thrown - ground.

(2)

$$t_t = t_a + t_b \checkmark [\text{c. o. e} - 3.7]$$

3.11



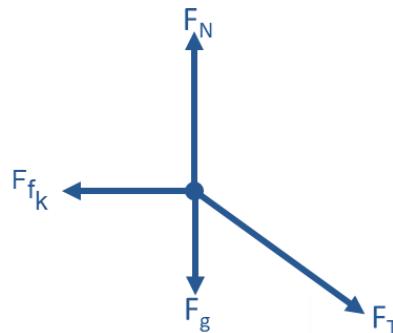
QUESTION 4 KH

19 MARKS

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

- 4.2 F_T is 655T at Y

4.2.1



- F_N greater than F_g ✓
- F_{fk} shorter than F_{Tx} ✓
- Correct labels used ✓
- F_T correct angle. ✓

(4)

- 4.2.2 $F_N = (F_g + 655 \sin(12^\circ))$ |OR| $F_N = mg + F_T \sin \theta$ |OR| $F_N = mg + F_{Ty}$ ✓✓ (2)

- 4.2.3 Magnitude of friction. (3)

$$F_{fk} = \mu_k F_N \quad \checkmark$$

$$F_{fk} = (0,56) ((70)(9,8) + 655 \sin(12^\circ)) \quad \checkmark$$

$$F_{fk} = 0,56(686 + 136,182)$$

$$F_{fk} = 0,56(822,182)$$

$$F_{fk} = \boxed{460,42 \text{ N}} \quad \checkmark$$

- 4.2.4 acceleration (4)

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

$$F_{Tx} + F_{fk} = ma$$

$$F_T \cos \theta + F_{fk} = ma$$

$$655 \cos(12^\circ) \checkmark - 460,42 = 70 \checkmark a$$

$$640,687 - 460,42 = 70 a$$

$$180,267 = 70 a$$

$$a = \boxed{2,58 \text{ m} \cdot \text{s}^{-2}} \quad \checkmark$$

- 4.3 acc between x-z

- 4.3.1 DECREASING ✓ (1)

4.3.2 - The angle (θ) will increase as the person approaches the pulley.✓

- This will cause F_{Ty} to increase thus increasing the Normal Force.✓
- Friction will increase as it is directly proportional to normal force
- $F_{fk} \propto F_N$ ✓

OR

- The horizontal component of Tension will decrease as the angle increases✓
- This will cause a decrease in F_{net} .
- $F_{net} \propto F_{Tx}$ ✓

(3)

QUESTION 5

FMC

18 MARKS

5.1 gradient

$$m = \frac{\Delta y}{\Delta x} = \frac{\Delta p}{\Delta t} \checkmark$$

$$\Delta p = F_{net} \Delta t \checkmark \therefore F_{net} = \frac{p}{t} \checkmark \text{ so physical quantity is } F_{net} (N) \checkmark$$

Mark not awarded if units used.

(4)

5.2 kinetic energy $\checkmark$ is not conserved $\checkmark$ ($\sum E_{k_i} \neq \sum E_{k_f}$)only $\checkmark$ momentum conserved.

(2)

5.3 impulse

$$J = \Delta p$$

$$J = 3 - (-1) \checkmark$$

$$J = 4 \text{ N.s } \checkmark \text{ forward } \checkmark$$

(3)

5.4 v of red cart

$$p = mv$$

$$8 = 4v \checkmark$$

$$v = 2 \text{ m.s}^{-1} \text{ forward } \checkmark$$

(2)

5.5 displacement.

$W_{net} = \Delta E_k$ $F_{net} \Delta x = \frac{1}{2} m v^2 - \frac{1}{2} m u^2 \checkmark$ $\frac{\Delta p}{t} \checkmark \Delta x = \frac{1}{2} m \left(\frac{p_f}{m} \right)^2 - \frac{1}{2} m u^2$ $\left(\frac{-4}{1} \right) \Delta x = \frac{1}{2} (4) \left(\frac{4}{4} \right)^2 - \frac{1}{2} (4) (2^2) \checkmark$ $-4 \Delta x = 2 - 8$ $-4 \Delta x = -6$ $\Delta x = 1,5 \text{ m } \checkmark$	$F_{net} = \frac{\Delta p}{\Delta t} = \frac{4 - 8}{1} = -4 \text{ N } \checkmark$ $v_f = \frac{p_f}{m} = \frac{4}{4} = 1 \text{ m.s}^{-1} (\checkmark)$ $W_{net} = \Delta E_k$ $F_{net} \Delta x = \frac{1}{2} m v^2 - \frac{1}{2} m u^2 \checkmark (\text{inferred})$ $-4 \Delta x = \frac{1}{2} (4) (1^2 (\checkmark)) - \frac{1}{2} (4) (2^2) \checkmark$ $-4 \Delta x = 2 - 8$ $\Delta x = 1,5 \text{ m } \checkmark$
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5.6

5.6.1 SAME AS $\checkmark$

(1)

5.6.2 LESS THAN $\checkmark$

(1)

QUESTION 6 ZN**17 MARKS**

6.1 determine the height, h

(3)

$E_{m_i} = E_{m_f} \checkmark$ $E_{p_i} + 0 = E_{k_f} + 0$ $mgh = \frac{1}{2}mv^2$ $(4)(9,8)h = \frac{1}{2}(4)(11,2^2 \checkmark)$ $39,2h = 250,88$ $h = \boxed{6,4 \text{ m} \checkmark}$	$E_{m_i} = E_{m_f} \checkmark$ $v = \sqrt{2gh}$ $v^2 = 2gh$ $11,2^2 = 2(9,8)h \checkmark$ $\frac{125,44}{18} = h$ $h = \boxed{6,4 \text{ m} \checkmark}$
---	---

6.2 Principle of conservation of mechanical energy, $\checkmark$ no external forces so no energy is lost. $\checkmark$ **(2)**6.3 Normal Force (F_N) |OR| Weight (F_g) $\checkmark$ **(1)**6.4 The normal force acts perpendicular $\checkmark$ to the motion $\checkmark$. [$W = F\Delta x \cos 90^\circ = 0$]**(2)**

6.5 Work done by friction

(4)

$$W_{net} = \Delta E_k \checkmark$$

$$\Delta E_p + W_f = \Delta E_k$$

$$(4)(-9,8)(3,4) \checkmark + W_f = 0 - \frac{1}{2}(4)(11,2^2) \checkmark$$

$$-133,28 + W_f = -250,88$$

$$W_f = \boxed{-117,6 \text{ J} \checkmark}$$

6.6 Angle of slope

Work done by friction over distance of slope.

(5)

$$W_f = F_f \Delta x \checkmark$$

$$-117,6 = -21 \Delta x \text{ [c.o.e - 6.5]}$$

$$\Delta x = 5,6 \text{ m} \checkmark$$

it slid 5,6 m up the slope (hypotenuse) to a height of 3,4 m (opposite) so...

$$\sin \theta = \frac{y}{r} = \frac{o}{h} = \frac{\text{height}}{\text{slope length}} \checkmark$$

$$\sin \theta = \frac{3,4 \checkmark}{5,6}$$

$$\theta = \boxed{37,38^\circ \checkmark}$$

QUESTION 7 ZN**10 MARK**

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

7.2 New velocity

(if the mass m_{ab} is 1 (5)

$$p_i = p_f$$

$$m_{ab}u_{ab} = m_a v_a + m_b v_b$$

$$(m_t + m_{ICBM})v_i = m_t v_f + m_{ICBM} v_{ICMB} ✓$$

$$30(4m) ✓ = 3m v_f + 1m(210) ✓$$

$$120m - 210m = 3m v_f$$

$$120m - 210m = 3m v_f$$

$$-90m = 3m v_f$$

$$-30 = v_f$$

$$\therefore 30 \text{ m.s}^{-1} ✓ \text{ backwards } ✓$$

7.3 The rocket experiences a forward force ✓, the transporter therefore simultaneously ✓ experiences a force of equal magnitude back onto it. ✓ (3)

OR

The transporter experiences a net force, $\therefore$ change in velocity (only one ✓)

QUESTION 8 KM**13 MARKS**

8.1

8.1.1 The current through a conductor is directly proportional to the potential difference across the conductor at constant temperature✓✓ (2)

8.1.2 Voltmeter (2)

$$P_{fan} = V_{fan} I_{fan}$$

$$P_{fan} = V(I_A \times 2) \checkmark$$

$$50 = V(2,5 \times 2)$$

$$V = 10 \text{ V} \checkmark$$

8.1.3 energy (2)

$$W = Pt$$

$$W = (50)(90) \checkmark$$

$$W = \boxed{4\,500 \text{ J}} \checkmark$$

8.1.4 INCREASE✓ (1)

8.1.5 Total resistance will increase.✓
Current will decrease in circuit, but current through lamp will increase.✓
 $P = I^2 R$ $P \propto I^2$ as the resistance of lamp remains constant.✓
So the brightness or power of lamp increases. (3)

8.2 Cost (3)

$$\text{cost} = kW \times h \times \text{unit cost} \checkmark$$

$$80 = 0,4 \checkmark \times h \times 3,48$$

$$h = \frac{80}{(0,4)(3,48)}$$

$$h = \boxed{57,47 \text{ hours}} \checkmark$$

QUESTION 9 KM**16 MARKS**

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

9.2 r (2)

$$emf = V_{ext} + Ir$$

$$12 = 10 + 2r \checkmark$$

$$2 = 2r$$

$$r = 1 \Omega$$

9.3 current

(2)

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

$$I = \frac{10}{20}$$

$$I = 0,5 A$$

9.4 R_2

(3)

$$P = I^2 R$$

$$5,85 = (2 - 0,5)^2 R$$

$$5,85 = (1,5)^2 R$$

$$R = \frac{5,85}{2,25}$$

$$R = 2,6 \Omega$$

9.5 R_3

(3)

$$R_s = \frac{V}{I_s}$$

$$R_s = \frac{10}{1,5}$$

$$R_s = 6,67 \Omega$$

$$R_s = R_2 + R_3$$

$$6,67 = 2,6 + R_3$$

$$R_3 = 4,07 \Omega$$

9.6 INCREASE

(1)

The total current will decrease

The lost voltage will decrease as $emf = V_{ext} + V_{lost}$

as $V_{lost} = I r \therefore V_{lost} \propto I$ as r is constant

so if lost voltage will decrease causing V_{ext} to increase.

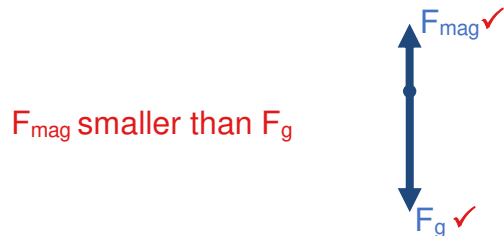
(3)

QUESTION 10 SG**18 MARKS**

10.1 The induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux.✓✓ (2)

10.2 SOUTH✓✓ (2)

10.3



10.4 B to A✓ (1)

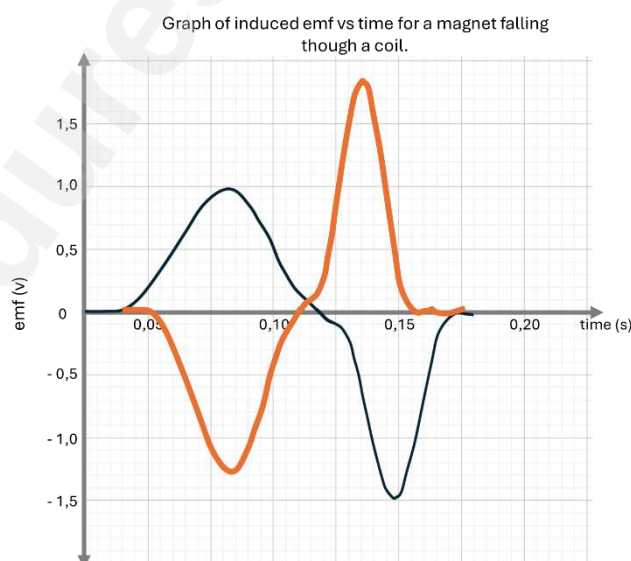
10.5 - As the north pole leaves the coil |OR| The permanent magnetic field is upwards.✓
 - Magnetic Flux is decreasing in the coil.✓
 - A south pole is induced on the bottom of the coil to oppose the change in magnetic flux. |OR| The induced magnetic field is upwards to oppose the change in magnetic flux
 → causes an emf to be induced in the coil.✓ (3)

10.6 The magnet is moving faster as it exits the coil as it has fallen further.

$v \propto \frac{1}{t}$ & $emf \propto \frac{1}{t}$ ✓ So as velocity increases time decreases, and then as time decreases emf increases.✓ (2)

10.7

10.7.1



- mirrored over x-axis✓
 - Maximums greater and time shorter.✓

10.8 The alternating current✓ in the primary coil a induced a magnetic field in the core,✓
 more coils are on the secondary✓, increased the induced emf✓ (4)

QUESTION 11 SG**15 MARKS**

11.1

11.1.1



(2)

11.1.1 The resultant magnetic field is zero at P.

Thus current must be flowing to induce a magnetic field out of the page✓
to oppose the permanent magnetic field into the page.✓

(2)

11.1.2 TOWARDS.✓

(1)

11.1.3 When the conductor is parallel to the magnetic field lines✓.

OR angle between current and flux✓ must be zero✓

(2)

11.2

11.2.1 Kinetic (mechanical) energy to electrical energy.✓

(1)

11.2.2 Yes,✓ slip ring commutator present.✓

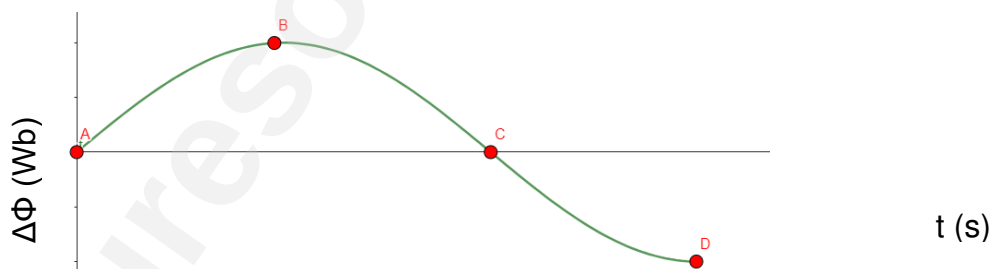
OR A force is applied✓

(2)

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

(2)

11.2.4



(3)

11.2.5 0V✓

(1)