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Grade 12 Physics Prelim memorandumQuestion 1

1.1 C

1.2 A

1.3 C

1.4 D

1.5 C

1.6 D

1.7 D $P_{3\Omega} = V^2/R \quad 36/3 = 12 \text{ W} \quad P_{6\Omega} = V^2/R \quad 36/6 = 6 \text{ W}$

1.8 A

1.9 C

1.10 C

10x 2 = [20]

Question 2

2.1 Free fall is the motion of an object when the only force acting on it is a gravitational force. ✓ ✓ [2]

2.2.1 Up positive

$$v_f = v_i + a \Delta t \quad \checkmark$$

$$0 = 12 \checkmark + (-9,8 \checkmark) \Delta t$$

$$\Delta t = 1,22 \text{ s} \checkmark \quad [4]$$

2.2.2 $v_f = v_i + a \Delta t$

$$0 \checkmark = v_i + (-9,8 \checkmark) (1,22 - 0,72 \checkmark)$$

$$v_i = 4,9 \text{ m.s}^{-1} \checkmark \quad [4]$$

2.2.3 Ball **A** height above the ground: Ball **B** height above the ground:

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

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

$$0 = (12)^2 + 2 (-9,8 \checkmark) \Delta y$$

$$0 = (4,9)^2 + 2 (-9,8) \Delta y$$

$$\Delta y = 7,351 \text{ m} \checkmark$$

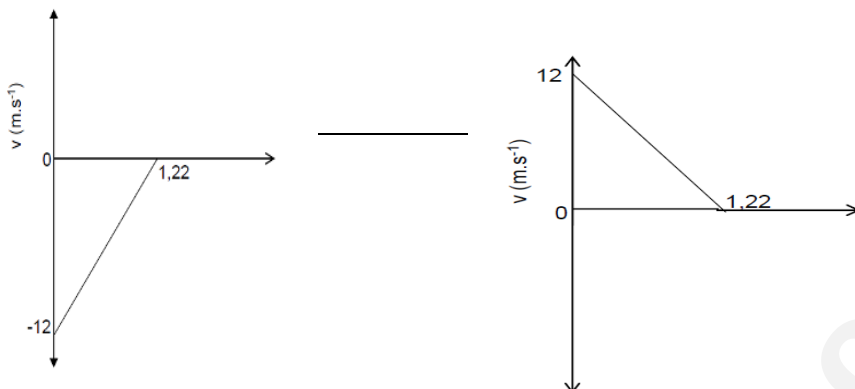
$$\Delta y = 1,225 \text{ m} \checkmark$$

$$\text{Height of building} = 7,351 - 1,225 \checkmark = 6,125 \text{ m} \checkmark \quad [5]$$

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

2.3 Down positive**Up positive**

✓ ✓ axes labelled ✓ values of time and initial velocity ✓ ✓ Shape of graph ✓ Heading ✓ [6]

**Question 3**

3.1 The rate ✓ of change of velocity ✓ [2]

3.2 acceleration = gradient ✓ = 0,5 ✓ m.s⁻² forwards. [2]3.3 $v_f = v_i + at$

$$0 = 1 + a(0,25) \quad \checkmark$$

$$a = -4 \text{ m.s}^{-2} \quad \checkmark$$

$$a = 4 \text{ m.s}^{-2} \text{ backwards} \quad \checkmark [3]$$

3.4 A change in position ✓ [1]

3.5 $s = \text{area under graph} = \frac{1}{2}(2)(1) \quad \checkmark + (2)(1) \quad \checkmark = 3 \text{ m} \quad \checkmark$ forwards. [3]**Question 4**4.1 $F_N = mg \cos \theta$

$$= 2(9,8) \cos 35^\circ \quad \checkmark$$

$$= 16,06 \text{ N} \quad \checkmark$$

$$F_k = \mu_k F_N$$

$$= 0,12(16,06) \quad \checkmark$$

$$= 1,93 \text{ N} \quad \checkmark \text{ up the hill} \quad \checkmark [5]$$

$$4.2 \quad F_{//} = mg \sin \theta$$

$$= 2(9,8) \sin 35^\circ \checkmark$$

$$= 11,24 \checkmark$$

$$F_{\text{net}} = F_{//} - f$$

$$= 11,24 - 1,93 \checkmark$$

$$= 9,31 \text{ N downhill. } \checkmark$$

[4]

$$4.3 \quad a = F_{\text{net}} / m$$

$$= 9,31 / 2 \checkmark$$

$$= 4,66 \text{ m.s}^{-2} \text{ downhill } \checkmark$$

$$v_f^2 = v_i^2 + 2 a \Delta x \quad 6 \text{ km.h}^{-1} = 1.667 \checkmark \text{ m.s}^{-1}$$

$$= (1.667 \checkmark)^2 + 2 (4,66)(45) \checkmark$$

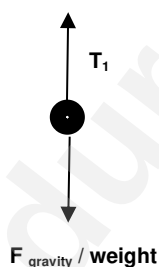
$$= 0,278 + 353,7$$

$$v_f = 20,55 \text{ m.s}^{-1} \checkmark$$

[6]

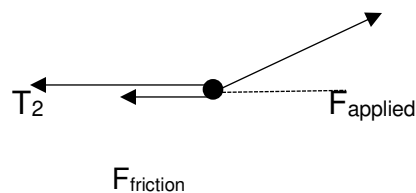
Question 5

5.1.1



[2]

5.1.2



[3]

5.2 When a net force is applied to an object of mass, it accelerates in the direction of the net force. ✓ The acceleration is directly proportional to the net force ✓ and inversely proportional to the mass ✓ OR The net force is equal to the rate of change of momentum.

[3]

5.3 Up is positive

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

$$T1 + (-w) \checkmark = 0$$

$$T1 + (-mg) = 0$$

$$T1 + (3)(-9,8) \checkmark = 0$$

$$T1 = 29,40 \text{ N upwards} \checkmark \quad [4]$$

5.4 29,40N ✓✓ c.o.e 5.3

[2]

5.5 Right is positive

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

$$f + (-T2) + (FA \cos 30^\circ) \checkmark = 0$$

$$f - 29,40 \checkmark + 36 \cos 30^\circ \checkmark = 0$$

$$f = -1,78 \text{ N}$$

$$f = 1,78 \text{ N left} \checkmark \quad [5]$$

Question 6

6.1 The total linear momentum of an isolated system ✓ remains constant ✓ [2]

6.2 Horizontal component of boulder = $1,2 \cos 30^\circ \checkmark \checkmark$

$$= 1,039 \text{ m.s}^{-1} \checkmark \quad [3]$$

6.3 P_{tot} before = P_{tot} after ✓

$$(300)(0,6) \checkmark + (100)1,039 \checkmark + (400)(-0,3) \checkmark = (300+100+400) v_f \checkmark$$

$$V_f = 0,205 \text{ m.s}^{-1} \checkmark \text{ Right} \checkmark \quad [7]$$

Question 7

7.1 $F_N = mg \cos \Phi$

$$= 20(9,8) \cos 30^\circ \checkmark$$

$$F_N = 169,74 \text{ N} \checkmark \quad [2]$$

7.2 $W_{\text{net}} = \Delta E_K \checkmark$

$$\text{or } W_{\text{net}} = W_g + W_{\text{force applied}}$$

$$W_{F \text{ applied}} + W_g // = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(F_A \cdot \Delta x \cdot \cos \phi) + (m \cdot g \sin 30^\circ \cdot \Delta x \cos \phi) \checkmark = \frac{1}{2} (20) (10,8^2 - 12^2) \checkmark$$

$$F_A (4) (1) \checkmark + 20 (9,8) \cdot \sin 30^\circ (4) \cdot -1 \checkmark = -273,6$$

$$4 F_A - 392 = -273,6$$

$$F_{\text{applied}} = 29,6 \text{ N} \checkmark \quad [6]$$

Question 8

8.1 In the absence of air resistance or any external forces✓, the mechanical energy of an object is constant✓ [2]

$$\begin{aligned} 8.2 \quad (E_p + E_k)_{\text{at A}} &= (E_p + E_k)_{\text{at B}} \checkmark \\ (1,5 \times 9,8 \times 0,6) \checkmark + 0 &= (1,5 \times 9,8 \times 0,32) + E_k \checkmark \\ E_k &= 4,12 \text{ J} \checkmark \end{aligned} \quad [4]$$

$$\begin{aligned} 8.3 \quad E_P(A) &= mgh \checkmark \\ &= 1,5 \times 9,8 \checkmark \times (0,60 - 0,12) \checkmark \\ &= 1,5 \times 9,8 \times 0,48 \\ &= 7,06 \text{ J} \checkmark \end{aligned}$$

This is the energy lost between A and D [4]

Or

$$\begin{aligned} E_{\text{mech at A}} &= E_{\text{mech at B}} \checkmark \\ (1,5 \times 9,8 \times 0,6) &= (1,5 \times 9,8 \times 0,32) + -(0,5 \times 1,5 \times 4,12^2) \\ E_{\text{mech at B}} &= E_k + E_p \\ &= 4,12 + (1,5 \times 9,8 \times 0,32) \\ &= 8,82 \text{ J} \checkmark \\ E_{\text{mech at D}} &= E_k + E_p \\ &= (1,5 \times 9,8 \times 0,12) + E_k \\ &= 1,764 + 0 \checkmark \\ \text{From B to D} &= 8,82 - 1,764 \\ &= 7,06 \text{ J} \checkmark \end{aligned}$$

Question 9

- 9.1 The horizontal force is directly proportional ✓ to the product of the two charges. ✓ [2]
- 9.2 $F_g \tan \theta \quad 0,49 \tan 23,5 = 21,3 \times 10^{-2} \text{ N} \checkmark \checkmark$ [2] or 0
- 9.3 charge on fixed ball ✓ (A) [1]
- 9.4 mass of ball B, distance between balls, charge on ball B [2]
- 9.5 axis headings with units and main heading ✓✓✓ plotted points ✓✓ line ✓ [6]
- 9.6 directly proportional ✓ [1]

Question 10

$$\begin{aligned}
 10.1.1 \quad V &= I R \\
 &= 0,2 \checkmark (4+8) \checkmark \\
 &= 2,4 \text{ V} \checkmark
 \end{aligned}
 \quad [3]$$

$$\begin{aligned}
 10.1.2 \quad V &= I R & \text{or} \quad I_2 &= 0,6 \times 2 \\
 2,4 \checkmark &= I_2 \times 2 \checkmark & I_2 &= 1,2 \text{ A} \\
 I_{2\Omega} &= 1,2 \text{ A} & I_{\text{tot}} &= 1,2 + 0,2 \\
 I_{\text{tot}} &= 1,2 + 0,2 \checkmark & &= 1,4 \text{ A} \\
 &= 1,4 \text{ A} \checkmark
 \end{aligned}
 \quad [4]$$

$$\begin{aligned}
 10.1.3 \quad 1/R_{//} &= 1/12 + 1/2 \\
 &= 1/12 + 6/12 \checkmark \\
 R_{//} &= 1,71 \Omega \checkmark \\
 \text{Emf} &= I (R + r) \checkmark \\
 &= 1,4 \checkmark (1,71 + 0,5) \checkmark \\
 &= 3,09 \text{ V} \checkmark
 \end{aligned}
 \quad [6]$$

$$\begin{aligned}
 10.1.4 \quad W &= I^2 R t \\
 &= (0,2 \checkmark)^2 \times 8 (120 \checkmark) \\
 &= 38,4 \text{ J} \checkmark
 \end{aligned}
 \quad [3]$$

$$\begin{aligned}
 10.1.5 \quad Q &= I \times t \\
 &= (1,4 - 0,2) \checkmark \times 1 \\
 &= 1,2 \text{ C} \checkmark
 \end{aligned}
 \quad [2]$$

10.2 Increase. $\checkmark$

Removing the 2Ω resistor **increases the total resistance**. $\checkmark$ $R_{\text{tot}} = 12 \text{ ohm}$

Total **current decreases**. Thus decreasing the V_{int} V_{lost} . $\checkmark$ $V_{\text{lost}} = I \times r$

$\downarrow \quad \downarrow$
 $0,5$

[3]

- 10.3.1 When the kettle is connected to a voltage (potential difference) of 240 V, its power (consumption) is 1 800 W (or J.s^{-1}). must make the connection between the power consumption. ✓✓ [2]

1mark assigned if :

interprets 1 800 W as 1 800 J.s^{-1}

Or refers to rate of energy transfer as 1 800 W (J.s^{-1})

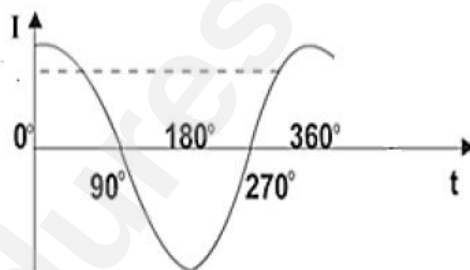
Or states that electrical energy is transferred to heat.

- 10.3.2 $P = V I$
 $1800 \checkmark = 240 I \checkmark$
 $I = 7,5 \text{ A} \checkmark$ [3]

- 10.3.3 1 kWh cost 140c
 1,8KWh cost $1,8 \times 140 = 252\text{c} \checkmark$
 1,8KWh for $\frac{1}{4}$ hour = $252/4 \checkmark$
 $= 63 \text{ c} \checkmark$ [3]

Question 11

- 11.1.1 1: magnet ✓ 2 : conducting wire/coil✓ [2]
 11.1.2 Anti clock wise ✓ [1]
 11.1.3 Right hand dynamo rule✓ [1]
 11.1.4 shape, ✓✓ axes labelled ✓
 ✓ at least 1 angle [4]



- 11.1.5 In phase ✓
 When emf is maximum, ✓ it produces a current which is also maximum✓ [3]
 11.1.6 3: slip rings remain in contact with the rotating coil and conduct the AC induced in the armature✓ to the external circuit via the 4: brushes ✓ [2]
 11.1.7 Replace slip ring with split ring commutator✓ [1]

11.1.8 $P = W/t$

$$6000 = W/(20 \times 60) \checkmark \text{ (conv. min to seconds)}$$

$$W = 6000 \times 1200 \checkmark$$

$$= 7\,200\,000 \text{ J (7200 kJ)} \checkmark \quad [3]$$

11.2.1 The emf induced $\checkmark$ is directly proportional to the rate of change of magnetic flux (flux linkage). $\checkmark$ [2]

11.2.2 When the magnet moves towards the coil the needle will swing in one direction $\checkmark$ indicating an emf generated $\checkmark$ and when it moves backwards the needle will swing in the opposite direction to show an emf of opposite sign $\checkmark$ [3]

11.2.3 Lenz's law $\checkmark$ which states that the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux. $\checkmark$ [2]

Question 12

12.1 The minimum amount of energy needed to emit an electron $\checkmark$ from the surface of a metal $\checkmark$ [2]

$$12.2 \quad E = W_0 + E_{k(\max)} \quad \checkmark$$

$$h c / \lambda \quad \checkmark = 3,36 \times 10^{-19} + 2,32 \times 10^{-19} \quad \checkmark$$

$$(6,6 \times 10^{-34})(3 \times 10^8) / \lambda \quad \checkmark = 3,36 \times 10^{-19} + 2,32 \times 10^{-19}$$

$$\lambda = 3,49 \times 10^{-7} \text{ m} \quad \checkmark \quad [5]$$

$$12.3 \quad = W_0 + E_{k(\max)}$$

$$(6,6 \times 10^{-34})(3 \times 10^8) / 3,49 \times 10^{-7} \quad \checkmark = 3,65 \times 10^{-19} + E_k \quad \checkmark$$

$$E_k = 2,03 \times 10^{-19} \text{ J} \quad \checkmark$$

$$= 1,27 \text{ eV} \quad \checkmark \checkmark \text{ [conversion]} \quad [5]$$

12.4.1 Increasing the intensity does not change the energy / frequency / wavelength of the incident photons. Energy of the photons remains unchanged. $\checkmark \checkmark$ [2]

12.4.2 Increases $\checkmark$ [1]

12.4.3 More photons are ejected per unit time $\checkmark$ and therefore the current increases. $\checkmark$ [2]