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GRADE 12 Physics Exam MEMO July 2022

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

[20]

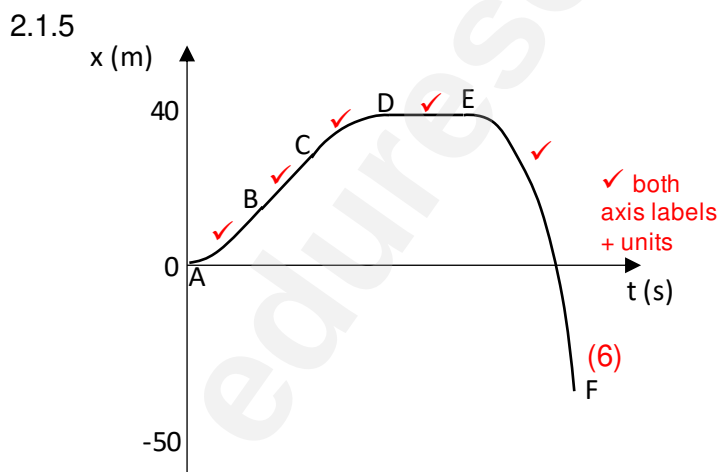
Question 2:

2.1.1 $a = \frac{\Delta v}{\Delta t} = \frac{-3}{30} = 0,1 \text{ m/s}^2$ West (4)

2.1.2 $s = \frac{1}{2}(10)(2) + (10)(2) + \frac{1}{2}(10)(2) + \frac{1}{2}(3)(30) = 10 + 20 + 10 + 45 = 85 \text{ m}$ (4)

2.1.3 west ; west (2)

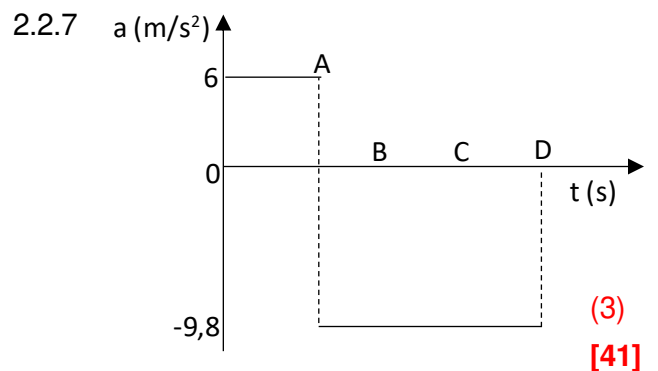
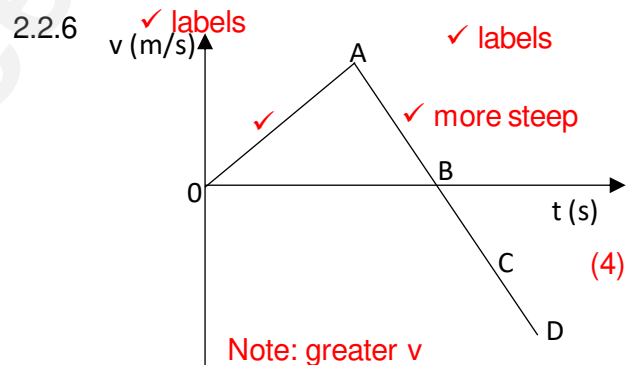
2.1.4 change in position (2)



2.2.3 $s = ut + \frac{1}{2}at^2$ ✓
 $5 = 0 + \frac{1}{2}(6)t^2$ ✓
 $5 = 3t^2$ ✓
 $t = 1,29 \text{ s}$ ✓ (3)

2.2.4 $v^2 = u^2 + 2as$ ✓
 $0^2 = (7,75)^2 + 2(-9,8)s$ ✓
 $s = 3 \text{ m}$ ✓
 $\text{height} = 3 + 5 = 8 \text{ m}$ ✓ (5)

2.2.5 $v^2 = u^2 + 2as$ ✓ OR $v^2 = u^2 + 2as$ ✓
 $v^2 = (8)^2 + 2(-9,8)(-5)$ ✓ ✓ $v^2 = 0^2 + 2(-9,8)(8)$ ✓
 $v^2 = 162$ ✓
 $v = 12,73 \text{ m/s}$ ✓ (3)



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2.2.1 rate of change of velocity (2)

2.2.2 $v^2 = u^2 + 2as$ ✓
 $v^2 = 0^2 + 2(6)(5)$ ✓
 $v = 7,75 \text{ m/s}$ ✓ (3)

Question 3:

3.1 The net force acting on an object is equal to the rate of change of momentum. ✓ ✓

OR

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)

$$3.2 \quad F_{NET} = \frac{mv - mu}{\Delta t} \quad \checkmark$$

$$6000 = \frac{2000v - 2000(10)}{2,5} \quad \checkmark \checkmark$$

$$v = 17,5 \text{ m/s} \quad \checkmark \text{ upwards} \quad \checkmark \quad (5)$$

OR $a = \frac{F_{NET}}{m} = \frac{6000}{2000} = 3 \text{ m/s}^2$

$$v = u + at = 10 + (3)(2,5)$$

$$3.3 \quad v = \frac{s}{t} \quad \checkmark = \frac{15}{30} \quad \checkmark = 0,5 \text{ m/s} \quad \checkmark \quad (3)$$

3.4 The total linear momentum of an isolated system is conserved. ✓✓ (2)

$$3.5 \quad m_1 u_1 + m_2 u_2 = (m_1 + m_2) v_2 \quad \checkmark$$

$$(0) = (75)(0,5) + 25v \quad \checkmark \checkmark$$

$$v = 1,5 \text{ m/s} \quad \checkmark \text{ away from the shuttle} \quad \checkmark \quad (5)$$

3.6 Kinetic energy is not conserved. ✓✓ (2)

$$3.7 \quad E_K \text{ before} = 0 \quad \checkmark$$

$$E_K \text{ after} = \frac{1}{2}(75)(0,5)^2 + \frac{1}{2}(25)(1,5)^2 \quad \checkmark$$

$$= 9,375 + 28,13$$

$$= 37,5 \text{ J} \quad \checkmark$$

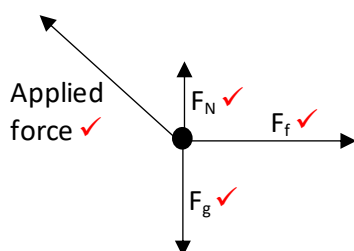
∴ E_K not equal / collision is inelastic ✓

(4)

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Question 4:

4.1



(4)

4.2

$$F_N + F_g + F_v = F_{NET} \quad \checkmark$$

$$F_N + (50)(-9,8) \quad \checkmark + 30 \sin 30^\circ \quad \checkmark = 0$$

$$F_N = 490 - 15$$

$$F_N = 475 \text{ N} \quad \checkmark \quad (4)$$

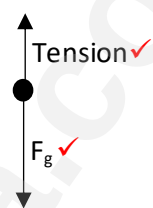
4.3

$$F_f = \mu F_N \quad \checkmark$$

$$5 = \mu(475) \quad \checkmark$$

$$\mu = 0,01 \quad \checkmark \quad (3)$$

4.4



(2)

4.5

$$\vec{F}_g + \vec{T} = m\vec{a}$$

$$110(9,8) - T = 110a \quad \checkmark$$

$$T = 1078 - 110a$$

$$\vec{F}_g + \vec{T} = m\vec{a}$$

$$50(-9,8) + T = 50a \quad \checkmark$$

$$-490 + (1078 - 110a) = 50a \quad \checkmark$$

$$588 = 160a$$

$$a = 3,675 \text{ m/s}^2 \quad \checkmark \quad (4)$$

4.6

$$T = 1078 - 110(3,675) \quad \checkmark$$

$$= 673,75 \text{ N} \quad \checkmark \quad (2)$$

4.7

$$F_f = \mu F_N$$

$$= (0,2) \quad \checkmark (10)$$

$$= 2 \text{ N} \quad \checkmark \quad (3)$$

4.8

$$F_{NET} = ma$$

$$= 50(1,2) \quad \checkmark$$

$$= 60 \text{ N} \quad \checkmark \quad (2)$$

4.9

$$\vec{T} + \vec{F}_g + \vec{F}_f = m\vec{a}$$

$$T + (-490) + (-2) = 60 \quad \checkmark \checkmark$$

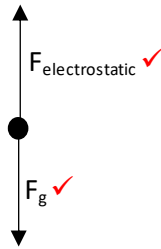
$$T = 552 \text{ N} \quad \checkmark \quad (3)$$

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Question 5:

- 5.1 $E_P = mgh$
 $= (100)(9,8)(28) \checkmark$
 $= 27\,440 \text{ J} \checkmark$ (3)
- 5.2 $27\,440 \text{ J} \checkmark$ (1)
- 5.3 *In the absence of air resistance or any external forces, the mechanical energy of an object is constant. $\checkmark\checkmark$* (2)
- 5.4 $(E_P + E_K)_{28\text{m}} = (E_P + E_K)_{8\text{m}} \checkmark$
 $27\,440 + 0 = (100)(9,8)(8) + E_K \checkmark\checkmark$
 $E_K = 19\,600 \text{ J} \checkmark$ (4)
- 5.5 *The work done by a net force on an object is equal to the change in the kinetic energy of the object. $\checkmark\checkmark$* (2)
- 5.6 $F_{\text{NET},S} = \Delta E_K \checkmark$
 $F_{\text{NET},40} = 27\,440 \checkmark\checkmark$
 $F_{\text{NET}} = 686 \text{ N} \checkmark$ (4)
- 5.7 $\checkmark$ heading (both variables)
 $\checkmark$ both axis labels (with complete units)
 $\checkmark$ scales (even, start at 0, no "break")
 $\checkmark\checkmark$ correct plotting
 $\checkmark$ best fit straight line (extended beyond first and last points, same number of points above and below line) (6)
- 5.8 $\frac{\Delta t}{\Delta v}$ to calculate $\checkmark\checkmark$
 Accept range $0,25 - 0,28 \checkmark$
 Shown on graph $\checkmark$ (4)
- 5.9 $v = u + at$
 But $v = 0 \text{ m/s}$: $u = -at \checkmark$
 $t = -\frac{u}{a}$ or $t = -\frac{1}{a} u$
 gradient $= -\frac{1}{a} \checkmark$
 $0,27 = -\frac{1}{a} \checkmark$
 $a = -3,76 \text{ m/s}^2 \checkmark$
 (Accept range: $3,57 - 4,00$) (4)

Question 6:

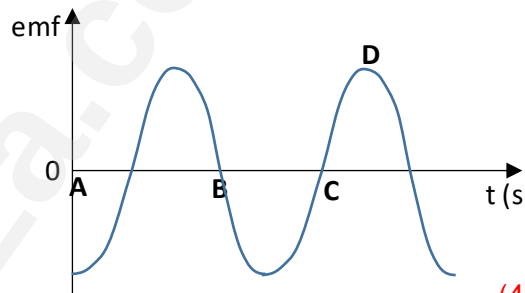
- 6.1.1 $F = \frac{G M_M M_S}{r^2}$
 $= \frac{(6,7 \times 10^{-11})(6,4 \times 10^{23})(4250)}{(6300 \times 10^3)^2} \checkmark\checkmark$
 $= 4\,592 \text{ N} \checkmark$ (4)
- 6.1.2 $g = \frac{G M_M}{r^2} \checkmark$
 $3,7 = \frac{(6,7 \times 10^{-11})(6,4 \times 10^{23})(4250)}{r^2} \checkmark$
 $r = 3\,400 \text{ km (or } 3,4 \times 10^6 \text{ m)} \checkmark$ (3)
- 6.1.3 mass halved $\therefore \frac{g}{2} \checkmark$
 Radius $\frac{1}{3} \therefore g \times 9 \checkmark$
 $g_{\text{Mercury}} = \frac{9}{2}g = \frac{9}{2}(3,7) = 16,65 \frac{\text{m}}{\text{s}^2} \checkmark$ (3)
- 6.2.1 *Two point charges in free space or air exert forces on each other. The force is directly proportional to the product of the charges and inversely proportional to the square of the distance between the charges. $\checkmark\checkmark$* (2)
- 6.2.2 negative $\checkmark$ (1)
- 6.2.3  (2)
- 6.2.4 $F = \frac{k Q_1 Q_2}{r^2} \checkmark$
 $(0,02)(9,8) \checkmark = \frac{(9 \times 10^9)(10 \times 10^{-9}) \cdot Q}{(0,2)^2} \checkmark$
 $Q = 8,7 \times 10^{-5} \text{ C} \checkmark$ or $87 \mu\text{C}$ (4)

Question 7:

- 7.1 The current through a conductor is directly proportional to the potential difference across it, provided the temperature remains constant. ✓✓ (2)
- 7.2 $W = \frac{V^2 t}{R}$ ✓
 $15\,000 = \frac{V^2 (50)}{40}$ ✓
 $V = 109,54\text{ V}$ ✓ (4)
- 7.3 $V = IR$
 $109,54 = I(60)$ ✓
 $I = 1,83\text{ A}$ ✓ (3)
- 7.4 $\frac{1}{R_P} = \frac{1}{40} + \frac{1}{60} \therefore R_P = 24\ \Omega$ ✓
 $I_{TOTAL} = \frac{V_{TOTAL}}{R_{TOTAL}} = \frac{109,54}{24} = 4,56\text{ A}$ ✓
 OR
 $I_{40\Omega} = \frac{V_{40\Omega}}{R_{40\Omega}} = \frac{109,54}{40} = 2,74\text{ A}$
 $I_{TOTAL} = 2,74\text{ A} + 1,83\text{ A} = 4,56\text{ A}$ ✓ (3)
- 7.5 $emf = I(R_{EXT} + r)$ ✓
 $200 = 4,56 (R_{EXT} + 6)$ ✓
 $R_{EXT} = 37,82\text{ V}$ ✓ (37,86 V - depends on rounding)
 $R = 37,82 - 24$ ✓✓
 $= 13,82\ \Omega$ ✓ (5)
- 7.6 $P = \frac{W}{t} = \frac{15\,000}{50} = 300\text{ W} = 0,3\text{ kW}$ ✓
 $W = Pt = 0,3(2) = 0,6\text{ kWh}$ ✓
 $\text{Cost} = 0,6 \times R2,43 = R1,46$ ✓ (4)
- 7.7 Resistor removed from parallel, so R_{TOTAL} increases ✓ $\therefore I_{TOTAL}$ decreases. ✓ so reading on ammeter decreases. ✓ (3)

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Question 8:

- 8.1 towards ✓✓ (2)
- 8.2 A – slip ring(s) ✓
 B – Contact brush(es) ✓
 C – armature / coil / loop of wire ✓
 D – permanent magnet ✓ (4)
- 8.3 the total energy supplied per coulomb of charge by the cell ✓✓ (2)
- 8.4  (4)
- 8.5 $\frac{N_S}{N_P} = \frac{V_S}{V_P}$
 $\frac{N_S}{1000} = \frac{14\text{ V}}{200\text{ V}}$ ✓
 $N_S = 70\text{ turns}$ ✓ (3)
- 8.6 a diode
 A bridge rectifier (1)
- [Needs to be connected AFTER the transformer as a transformer cannot change the voltage of DC.]

[16]

200 MARKS