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ST. MARY'S DSG KLOOF



PHYSICAL SCIENCES
TRIALS PAPER 1: PHYSICS

GRADE 12

MODEL ANSWER

TIME: 3 hours

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MARKS: 200

Examiner: Mrs K. Bolton

Moderator: Mrs T. Kirsten and Mrs G. Main

QUESTION 1

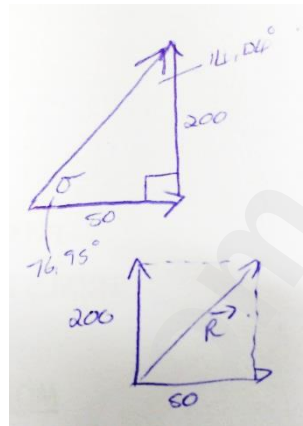
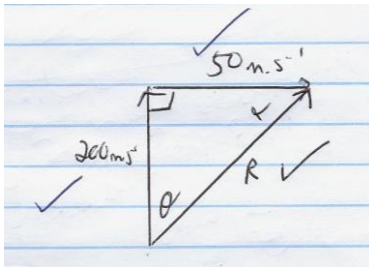
- 1.1 D
- 1.2 B
- 1.3 C
- 1.4 A
- 1.5 D
- 1.6 C
- 1.7 A
- 1.8 B
- 1.9 C
- 1.10 C

[2x10=20]

QUESTION 2 - KINEMATICS (VECTORS)

2.1 Single vector has same effect ✓ as original vectors acting together. ✓ (2)

2.2.1



(3)

$$2.2.2 \quad R = \sqrt{200^2 + 50^2}$$

$$= 206,16 \text{ m.s}^{-1} \checkmark$$

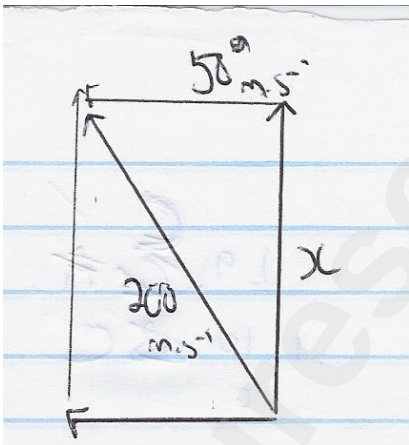
$$\tan \theta = \frac{50}{200} \checkmark$$

$$\text{or} \quad \tan \theta = \frac{200}{50}$$

$$\theta = 14,04^\circ \checkmark / \text{on a bearing of } 14,04^\circ / \text{E of N}$$

$$\theta = 76,96^\circ \text{ N of E} \quad (3)$$

2.3



$$X = \sqrt{200^2 \checkmark - 50^2 \checkmark}$$

$$= 193,65 \text{ m.s}^{-1} \checkmark$$

(3)

QUESTION 3 - KINEMATICS (MOTION)

3.1 $9,8 \text{ m.s}^{-2} \checkmark$ down ✓ (2)

3.2 Yes ✓
Only F_g acting on the ball ✓ (2)

3.3 $\Delta x = 1,8 \text{ m}$

$$V_i = 8 \text{ m.s}^{-1}$$

$$g = 9,8 \text{ m.s}^{-2}$$

$$vf^2 = v_i^2 + 2ax \checkmark$$

$$= (8)^2 + 2 (9,8)(1,8) \checkmark$$

$$V_f = 9,96 \text{ m.s}^{-1} \checkmark \quad (3)$$

3.4 $\Delta x = v_i t + \frac{1}{2} a t^2 \checkmark$

$$1,8 = 8(t) + \frac{1}{2} (9,8)t^2 \checkmark$$

$$t = 0,2 \text{ s} \checkmark \quad (3)$$

OR

$$v_f = v_i + at \checkmark$$

$$9,96 = 8 + 9,8t \checkmark$$

$$t = 0,2 \text{ s} \checkmark$$

OR

$$\Delta x = \frac{V_f + V_i}{2} t \checkmark$$

$$1,8 = \frac{9,86 + 8}{2} t \checkmark$$

$$t = 0,2 \text{ s} \quad (3)$$

3.5 $80 \% \text{ of } 9,96 = 7,97$

$$v_f^2 = v_i^2 + 2 ax$$

$$0^2 \checkmark = (7,97)^2 \checkmark + 2(-9,8) \checkmark \Delta x$$

$$\Delta x = 3,24 \text{ m} \checkmark$$

Ball will not reach the ceiling. $\checkmark \quad (5)$

OR $v_f = v_i + at$

$$0 \checkmark = 7,97 \checkmark + (-9,8) t$$

$$t = 0,81 \text{ s}$$

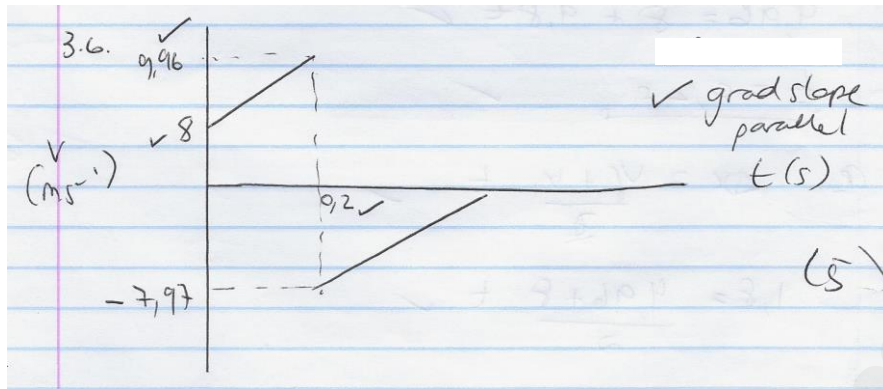
$$\Delta x = v_i t + \frac{1}{2} a t^2$$

$$= (7,97) (0,81) \checkmark + \frac{1}{2} (-9,8)(0,81)^2$$

$$= 3,24 \text{ m} \checkmark$$

No $\checkmark$

3.6

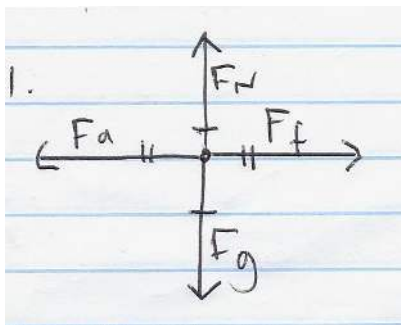


(4)

[19]

QUESTION 4 - NEWTON'S LAWS

4.1



Correct direction of $F_N + F_g$ ✓

Equal length $F_N + F_g$ ✓

Correct direction of $F_a + F_f$ ✓

Equal length $F_a + F_f$ ✓

(4)

4.2 When a net force is applied to an object of mass, m it accelerates ✓ in the direction of net force. The accelerator is directly proportionate to force ✓ and inversely proportional to the mass ✓.

(3)

4.3.1 $F_t = ma$

$$2800 = (6200) a$$

$$a = 4,52 \text{ m.s}^{-2} \checkmark$$

$$v_f^2 = v^2 + 2ax \checkmark$$

$$(56)^2 \checkmark = (0)^2 \checkmark + 2 (4,52)x$$

$$x = 346,9 \text{ m} \checkmark$$

(6)

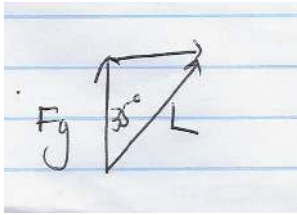
4.4.1 An object continues in a state of rest or uniform motion ✓ unless it is acted upon by a net or resultant force. ✓

(2)

4.4.2 $F_{\text{net}} \checkmark = 0 \checkmark$

(2)

4.4.3



$$L = \frac{F_g}{\cos 35^\circ} = \frac{6200 \times 9,81 \checkmark}{\cos 35^\circ \checkmark}$$

$$= 74174,26\text{N} \checkmark$$

(3)

[20]

QUESTION 5 - MOMENTUM, ENERGY AND POWER

5.1 $m_A = 0,2 \text{ kg}$

$F = 3 \text{ N}$

$t = 0,15 \text{ s}$

$v_i = 0$

$F_{\text{NET}} = ma$

$a = \frac{3}{0,2}$

$= 15 \text{ m.s}^{-2} \checkmark$

$v_f = v_i + at$

$= 0 \checkmark + (15)(0,15)$

$v_f = 2,25 \text{ m.s}^{-1} \checkmark \text{right} \checkmark$

(4)

5.2 Product $\checkmark$ of mass and velocity $\checkmark$ of an object.

(2)

5.3 $v_A = 2,25 \text{ m.s}^{-1} \text{ right}$

$v_{A+B} = 1,2 \text{ m.s}^{-1}$

$v_B = 0$

$p_b = p_a \checkmark$

$m v_A + m v_B = (m_{A+B})(v_{A+B})$

$(0,2)(2,25) + 0 \checkmark = (0,2 + m_B)(1,2) \checkmark$

$0,45 = 0,24 + 1,2 m_B$

$m_B = \frac{0,21}{1,2}$

$= 0,18 \text{ kg} \checkmark$

(4)

5.4 $E_k \text{ before} = \frac{1}{2} m v_A^2 + \frac{1}{2} m v_B^2 \checkmark$

Must show two bodies!

$= \frac{1}{2} (0,2)(2,25)^2 + \frac{1}{2} (0,18)(0)^2$

$= 0,51 \text{ J} \checkmark$

$E_k \text{ after} = \frac{1}{2} m_{A+B} v_{A+B}^2$

$= \frac{1}{2} (0,2 + 0,18)(1,2)^2$

$= \frac{1}{2} (0,38)(1,2)^2$

$= 0,27 \text{ J} \checkmark$

$E_k \text{ before} > E_k \text{ after} \checkmark$

$\therefore \text{inelastic} \checkmark$

(5)

5.5.1 Impulse = area under graph ✓

$$= \frac{1}{2} (2)(10) \checkmark + \frac{1}{2} (-10)(2) + (-10)(6) \checkmark$$

$$= -60 \text{ N.s} \checkmark$$

$$= 60 \text{ N.s West} \checkmark \quad (5)$$

5.5.2 Greater than ✓ *Must have a formula!*
 $Ft = \text{impulse}$
 Same time ✓ therefore Impulse is proportional to F
 but force P > force Q ✓ therefore Impulse P > Impulse Q. (3)

5.5.3 Impulse = Δp

$$= (10) (V_f - V_i)$$

$$-60 \checkmark = (10)(V_f) - (10) \checkmark (5,5)$$

$$V_f = 0,5 \text{ m.s}^{-1} \checkmark \text{ west} \checkmark \quad (4)$$

5.6.1 In the absence of air resistance or external forces, ✓ the mechanical energy of an object is constant ✓. (2)

5.6.2 Emech top = Emech P

$$\frac{1}{2}mv^2 + mgh = \frac{1}{2}mv^2 + mgh \checkmark \quad \text{Must show two bodies!}$$

$$0 + (5)(9,8)(5) \checkmark = \frac{1}{2} (5)V_f^2 + 0 \checkmark$$

$$V_f = \sqrt{(5)(9,8)(5)}$$

$$= 9,9 \text{ m.s}^{-1} \checkmark \quad (4)$$

5.6.3 Friction less ✓ P → Q ∴ mech E conserved ✓. (2)

5.6.4 $E_p = mgh \checkmark$

$$= (5)(9,8)(3) \checkmark$$

$$= 147 \text{ J} \checkmark \quad (3)$$

OR

$$W_g = F_{//} \times \Delta x$$

$$= mg \sin \theta \times \Delta x$$

$$= (5)(9,8)\left(\frac{3}{5}\right) \times \Delta x \quad = 147 \text{ J}$$

$$\begin{aligned}
 5.6.5 \quad W_{nc} &= F_f = \Delta E_p + \Delta E_k \checkmark \\
 &= 147 \text{ J} + (0 - \frac{1}{2} (5)(9,9)^2) \checkmark \\
 &= -98 \text{ J} \checkmark
 \end{aligned} \tag{3}$$

5.6.6 Work done by a net force $\checkmark$ is equal to the change in kinetic energy $\checkmark$. (2)

$$\begin{aligned}
 5.6.7 \quad W_{F_f} &= F \cdot \cos 180^\circ \Delta x \\
 -98 &= 18 \checkmark \Delta x (-1) \\
 \Delta x &= 5,45 \text{ m} \checkmark \\
 * \sin \theta &= \frac{3}{5,45} \checkmark \\
 \theta &= 33,40^\circ \checkmark
 \end{aligned} \tag{5}$$

Or

$$\begin{aligned}
 W_{net} &= W_f + W_g \\
 &= f \Delta x \cos \theta + m g \sin \theta \times \Delta x \cos \theta \\
 &= (18)(\Delta x)(-1) \checkmark + (5)(9,8) \left(\frac{3}{5,45} \right) (\Delta x) \cos 180^\circ \\
 &= -18 \Delta x - 147 \checkmark \\
 W_{net} &= \Delta E_k \checkmark \\
 -18 \Delta x - 147 &= \frac{1}{2} (5) (0 - 9,9^2) \\
 \Delta x &= 5,45 \text{ m} \checkmark *
 \end{aligned}$$

$$\begin{aligned}
 5.7.1 \quad P &= \frac{w}{t} \checkmark \\
 w &= mgh & \text{or } W &= F \Delta x \cos \theta \\
 h &= \sqrt{75^2 - 45^2} \checkmark & &= 5200 \times 9,8 \times 75 \times \cos 36,87^\circ \\
 &= 60 \text{ m} \checkmark & &= 3\,057\,595,9 \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 W &= (5200)(9,8)(60) \\
 &= 3\,057\,600 \text{ J} \checkmark \\
 P &= \frac{3057600}{(1,5)(60)} \checkmark \\
 &= 33\,973,33 \text{ W} \checkmark
 \end{aligned} \tag{6}$$

$$5.7.2 \quad \% \text{ eff} = \frac{p_{out} \times 100}{p_{in}} = \frac{33973,33 \times 100}{50000} \checkmark$$

$$= 67,95 \% \checkmark \quad (3)$$

[57]

QUESTION 6 - FIELDS

$$6.1 \quad g = \frac{GM_J}{r^2} \checkmark$$

$$7,5 = \frac{(6,67 \times 10^{-4})(M_J)}{(1,3 \times 10^8)^2} \checkmark$$

$$M_J = \frac{1,2675 \times 10^{17}}{6,67 \times 10^{-11}}$$

$$= 1,9 \times 10^{27} \text{ kg} \checkmark \quad (3)$$

$$6.2 \quad g_A = \frac{GM_J}{r_A^2} \quad \frac{GM_J}{r_m^2} \quad \text{Or } g_A \propto \frac{1}{r^2}$$

$$g_A r_m^2 = g_m r_m^2 \checkmark \quad 304090 g_m \propto \frac{1}{r^2}$$

$$r_m^2 = \frac{g_A}{g_m} r_A^2 \quad \text{therefore } r_m = \sqrt{304090} \times r_A^2$$

$$\sqrt{(304090,1)(1,3 \times 10^8)^2} \checkmark$$

$$= 2,4 \times 10^{10} \text{ m} \checkmark \quad (3)$$

6.3.1 The force between 2 charges is directly proportional to the product of the charges and inversely proportional to the distance between the charges squared. (3)

$$6.3.2.1 \quad F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$1,44 \times 10^{-1} = \frac{(9 \times 10^9) Q^2}{(0,5)^2} \checkmark \checkmark$$

$$\underline{Q = 2 \times 10^{-6} \text{ C}} \checkmark \quad (4)$$

$$6.3.2.2 \quad Q = ne$$

$$2 \times 10^6 = n(1,6 \times 10^{-19}) \checkmark$$

$$N = 1,25 \checkmark \times 10^{13} \text{ } \bar{e} \text{ s} \quad (2)$$

6.3.3 Left/towards B (1)

6.3.4 $E_{\text{net}} = E_A + E_B$ ✓

Right $\oplus E_{\text{net}} = \frac{KQ_A}{r^2} + \frac{KQ_B}{r^2}$

$3 \times 10^4 = -\sqrt{\frac{(9 \times 10^9)(2 \times 10^{-6})}{45^2} + \frac{(9 \times 10^9)Q_B}{(1)^2}}$ ✓

$Q_B = 4,22 \times 10^{-6} \text{ C}$ ✓ (4)

[20]

QUESTION 7 - ELECTRIC CIRCUITS

7.1.1 $V_{\text{ext}} = I R$ ✓

$= (0,2)(4 + 8)$ ✓

$= 2,4 \text{ V}$ ✓ (3)

7.1.2 $I_{2\Omega} = \frac{V}{R}$

$= (0,2)(4 + 8)/2$ or $2,4/2$

$= 1,2 \text{ A}$ ✓

$I_T = 1,2 + 0,2$ ✓

$= 1,4 \text{ A}$ ✓ (4)

OR $I : 0,2 \text{ X}_{2\Omega}$

$R : 1 : 6$ ✓

$X = 6 \times 0,2$ ✓

$= 1,2 \text{ A}$ ✓

7.1.3 Lost volts $= Ir$ ✓

$= (7,4)(0,5)$

$= 0,7 \text{ V}$ ✓

EMF $= \text{PD} + \text{lost volts}$ ✓

$= 2,4 + 0,7$ ✓

$= 3,1 \text{ V}$ ✓ (5)

OR

$R_p = \frac{\text{prod}}{\text{sum}}$ ✓

$= \frac{(12)(2)}{12+2}$

$= 1,71\Omega$ ✓

EMF $= I(R + r)$ - ✓

$= 1,4(1,71 + 0,5)$ ✓

$= 3,09 \text{ V}$ ✓

7.2 Increases ✓

Removing $2\ \Omega \uparrow R_T \therefore I_T \downarrow$

$\downarrow$ lost volts ✓ EMF constant $\therefore PD \uparrow$

$$EMF = PD + \text{lost volts} \quad (3)$$

7.3.1 Current through a conductor is directly proportional to the PD across the conductor at constant temp.

(2)

7.3.2 Same length wires ✓

Same thickness / diameter ✓

(2)

$$7.3.3 \quad R_A = \text{grad} \quad \checkmark \quad R_B = \frac{2,2}{0,4} \quad \checkmark$$

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

$$= 5,5\ \Omega \quad \checkmark$$

$$= \frac{4,4}{0,4} \quad \checkmark$$

$$= 11\ \Omega \quad \checkmark$$

Various values accepted here

(5)

$$7.3.4 \quad P = I^2 R \quad \checkmark \quad \text{Or } W = I^2 R t$$

Same current $R_A > R_B \quad \checkmark \therefore P_A > P_B$

$\therefore A \quad \checkmark$

OR

$$W = I^2 R t \quad \text{same } t + I \quad R_A > R_B \therefore W_A > W_B$$

(3)

[27]

QUESTION 8 - ELECTRODYNAMICS

8.1 Motor effect ✓ (1)

8.2 Electrical ✓ $\rightarrow$ Kinetic ✓ / Mechanical (2)

8.3 The current is flowing parallel ✓ to magnetic field $\therefore$ no interacting ✓ magnetic fields to create a force. (2)

8.4 Carbon brush ✓ (1)

8.5 Split ring commutator ✓
To reverse current ✓ in coil to keep coil turning in same direction. (2)

8.6 Anti-clockwise ✓ (1)

8.7.1 Half-wave ✓ (1)

8.7.2 A diode which only allows current to flow in one direction is used ✓ (2)

$$\begin{aligned}
 8.8 \quad E &= P \times t \\
 &= \frac{2750}{1000} \checkmark \times 6 \\
 &= 16,5 \checkmark \text{ kwh} \times R1,75 \\
 &= R 28,88 \checkmark
 \end{aligned}
 \tag{3}$$

8.9.1 Step up $\checkmark$ (1)

$$\begin{aligned}
 8.9.2 \quad \frac{N_s}{N_p} &= \frac{V_s}{V_p} \\
 N_s &= \frac{V_s N_p}{V_p} \\
 &= \frac{(220)(4800) \checkmark}{(110) \checkmark} \\
 &= 1 \checkmark
 \end{aligned}
 \tag{2}$$

8.10.1 The EMF induced $\checkmark$ is already directly proportional to the rate of change of magnetic flux (flux linkage) (2)

- 8.10.2 - Torch is shaken to and fro
- Magnet moves $\checkmark$ in and out of coil
 - The field lines cut through $\checkmark$ the coil or changing magnetic flux
 - Inducing a PD / EMF across the coil
 - A current is induced $\checkmark$ in the circuit. (4)

8.10.3 Stronger magnet.
Coil with more turns
smaller gap between coil and magnet. (2)

Cannot accept shake any faster, must be design.

[26]