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Area under the v/t graph = Δx ✓
 Area of a triangle = $\frac{1}{2} b.h$
 $= \frac{1}{2} \times 1.53 \times 15$ ✓
 $= 11,48 \text{ m}$
 $\Delta x = 11,48 \text{ m}$ ✓ (3)

WOODRIDGE COLLEGE

SEPTEMBER 2020

3 HOURS

GRADE 12 PHYSICAL SCIENCES: PAPER 1

EXAMINER: Mr P. Maartens TOTAL = 200 marks

MODERATOR: Dr C. Logie

MEMORANDUM

Question 1

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

[2 X 10 = 20]

Question 2

2.1 acceleration is rate of change of velocity. ✓✓ (2)

2.2 $9,8 \text{ m.s}^{-2}$ ✓ down ✓ (2)

2.3 $v_f = v_i + g\Delta t$ ✓
 $0 = 15 + (-9,8) \cdot \Delta t$ ✓ (subst)
 $\Delta t = 1,53 \text{ s}$ (3)

2.4 $\Delta x = v_i \Delta t + \frac{1}{2} g \Delta t^2$ ✓
 $= 15(1,53) + \frac{1}{2} (-9,8)(1,53)^2$ ✓
 up is +
 $= 11,47 \text{ m}$ ✓

2.5 $v_f^2 = v_i^2 + 2g\Delta x$ ✓
 $(-34)^2 = 15^2 + 2(-9,8)\Delta x$ ✓
 (signs correctly substituted)
 $\Delta x = -47,5 \text{ m}$ (magnitude) ✓ or
 Therefore height = $47,5 \text{ m}$ ✓ (4)

2.6 line continues below x-axis stop at 5 s ✓;
 time scale on x-axis correct ✓
 line continues with same gradient; ✓ (3)

2.7 (plotting) line ✓
 Straight line down ✓
 Start at origin ✓ (3)

2.8 $t = 2,2 \text{ s}$ ✓✓ (2)

2.9 A is above B ✓ (1)

2.10 displacement is given by area under graph. ✓
 Area UNDER AXIS
 (displacement down for B) > area under X-axis for A ✓ (2)

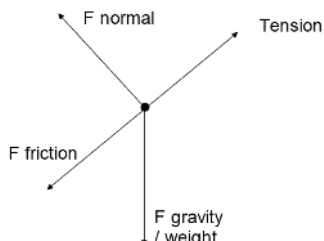
2.11 Take down as +
 Ball A: $\Delta x = v_i \Delta t + \frac{1}{2} g \Delta t^2$ ✓
 $\Delta x = -15 \Delta t + \frac{1}{2} (9,8) \Delta t^2$ (1) ✓
 Ball B: $\Delta x = v_i \Delta t + \frac{1}{2} g \Delta t^2$
 $\Delta x = 1,5 \Delta t^2$ (2) ✓
 Subst 2 into 1: (method)
 $1,5 \Delta t^2 = -15 \Delta t + 4,9 \Delta t^2$ ✓
 $3,4 \Delta t^2 - 15 \Delta t = 0$
 $\Delta t (3,4 \Delta t - 15) = 0$
 $\Delta t = 4,41 \text{ s}$ ✓ (5)

2.12 Both Start at origin ✓
 Correct Curve for A ✓
 Correct Curve for B ✓
 Graphs crossing at time range in q. 2.11 ✓
 A crossing x-axis time correct ✓ (5)

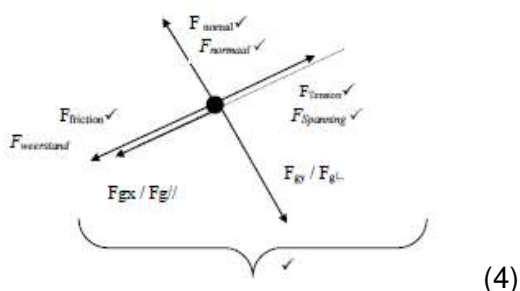
Question 3

3.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the (net) force ✓ where the acceleration is directly proportional to the (net) force ✓ and inversely proportional to the mass of the object. ✓ (3)

3.2 ✓✓✓✓



OR



(4)

$$\begin{aligned}
 3.3 \quad F_f &= \mu N \\
 &= \mu \cdot mg \cdot \cos \theta \\
 &= (0,1)(3 \times 9,8 \times \cos 20) \\
 &= 2,76 \text{ N}
 \end{aligned}
 \quad (3)$$

3.4 **Object B:**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 T + (-F_{\text{friction}}) + (-F_{g\parallel}) &= ma \\
 T - 2,76 - (3 \times 9,8 \times \sin 20) &= 3a \\
 T - 12,82 &= 3a
 \end{aligned}$$

Object A:

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_{g\parallel} - T &= ma \\
 (3 \times 9,8 \times \sin 40) - T &= 3a \\
 18,9 - T &= 3a
 \end{aligned}$$

$$\begin{aligned}
 T - 12,82 &= 18,9 - T \\
 T &= 15,86 \text{ N}
 \end{aligned}
 \quad (7)$$

$$\begin{aligned}
 3.5 \quad 3a &= T - 12,82 \quad (\text{c.o.e q 3.4}) \\
 a &= 1,01 \text{ m.s}^{-2}
 \end{aligned}
 \quad (2)$$

3.6 Angle decreases which makes $\sin \theta$ decrease ✓ $F_{g\parallel}$ directly proportional to $\sin \theta$. Therefore $F_{g\parallel}$ would decrease. ✓ F_{net} force would decrease ✓ and Acceleration directly proportional. ✓ Acceleration decreases. ✓ (5)

Question 4

$$4.1.1 \quad \text{normal} \checkmark \text{ of } F_g \quad (1)$$

$$\begin{aligned}
 4.1.2 \quad E_k &= \frac{1}{2} mv^2 \\
 &= \frac{1}{2} (70)(4)^2 \\
 &= 560 \text{ J}
 \end{aligned}
 \quad (3)$$

$$\begin{aligned}
 4.1.3 \quad F_{\text{net}} &= F_{\text{applied}} - F_f \\
 &= 234,63 - 190 \\
 &= 44,63 \text{ N}
 \end{aligned}
 \quad (3)$$

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

$$\begin{aligned}
 4.1.5 \quad F_{\text{net}} \cdot \Delta x &= \Delta E_k \\
 (44,63)(18) &= (\frac{1}{2} mv^2)_L - 560 \quad \text{c.o.e 4.3 \& 4.3} \\
 \frac{1}{2}(70)(v^2) &= 1363,34 \\
 v &= 6,24 \text{ m.s}^{-1}
 \end{aligned}
 \quad (5)$$

4.2

$$\begin{aligned}
 W_{\text{net}} &= \sum W_i \\
 &= W_{g,AC} + W_{f,BC} \\
 &= F_{g,\parallel} d \cos \theta_g + f_k L \cos \theta_f \\
 &= mg (\sin \alpha) d \cos \theta_g + \\
 &\quad \mu_k mg (\cos \alpha) L \cos \theta_f \\
 &= mg (\sin \alpha) d - \mu_k mg (\cos \alpha) L
 \end{aligned}
 \quad (6)$$

[20]

Question 5

5.1 The total (linear) momentum of an isolated system ✓ is constant ✓ (is conserved) (2)

$$\begin{aligned}
 5.2 \quad \Sigma p_{\text{before}} &= \Sigma p_{\text{after}} \\
 m_1 v_{1i} + m_2 v_{2i} &= m_1 v_f + m_2 v_f \\
 (0,005)(200) + (0) &= (0,195 + 0,005)(v) \\
 \therefore v &= 5 \text{ m.s}^{-1}
 \end{aligned}
 \quad (4)$$

$$\begin{aligned}
 5.3 \quad (E_k + E_p)_{\text{before}} &= (E_k + E_p)_{\text{after}} \\
 [\frac{1}{2}(0,2)(5^2) + 0] &= [0 + (0,2)(9,8)h] \\
 h &= 1,28 \text{ m}
 \end{aligned}
 \quad (\text{c.o.e 5.2})$$

$$\begin{aligned}
 \text{or} \quad v_f^2 &= v_i^2 + 2g\Delta x \\
 0 &= 5^2 + 2(-9,8)\Delta x \\
 \Delta x &= 1,28 \text{ m (magnitude)}
 \end{aligned}
 \quad (4)$$

5.4 Equal. ✓ Newton's third law. ✓ The bullet will exert an equal but opposite force on the block ✓ (3)

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

5.6 $F_{\text{net}} = m(v_f - v_i) / t$ ✓
 $= 0,005(5 - 200) / 0,18$ c.o.e ✓
 $= -5,42 \text{ N}$
 $= 5,42 \text{ N}$ ✓ downwards ✓ (4)
[19]

Question 6

6.1.1 D to J. ✓ ✓ (2)

6.1.2 $(-9+15) / 2 \text{ nC} = +3 \text{ nC}$ ✓ (2)

6.1.3 No. of e $= 12 \times 10^{-9} / 1,6 \times 10^{-19}$ ✓
 $= 7,5 \times 10^{10}$ ✓ (2)

6.2.1 Each object in the universe attracts every other object ✓ with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres ✓. (3)

6.2.2 To the right as positive
 Force attracting m to earth, F_E

$$F_E = -G \frac{mM_E}{x^2}$$

Force attracting m to moon, F_M

$$F_M = G \frac{mM_M}{(r-x)^2}$$

Net force on m, $F_E + F_M$

$$-G \frac{mM_E}{x^2} + G \frac{mM_M}{(r-x)^2} = 0$$

$$-G \frac{mM_E}{x^2} + G \frac{mM_M}{(r-x)^2} = 0$$

$$r^2 - 2rx + 0,99x^2 = 0$$

(4)
[13]

Question 7

7.1 Resistance within the cell ✓ (1)

7.2 Temperature ✓ (1)

7.3 Volts (V) / Potential difference (V) ✓ (1)

7.4 Internal resistance ✓ (1)

7.5 7,2 V ✓ (1)

7.6 slope $= \Delta V / \Delta I$
 $= 0 - 7,2 / 0,8 - 0$ ✓
 $= -9$
 $r = 9 \Omega$ ✓
 7.7 7,2 V ✓

(2)
 (1)
[8]

Question 8

8.1 $P = V^2 / R$ ✓
 $60 = 12^2 / R$ ✓
 $\therefore R = 2,4 \Omega$ ✓ (3)

8.2 $V = IR$ ✓
 $12 = I \times 2,4$ ✓
 $I = 5 \text{ A}$ ✓

Or

$P = VI$
 $60 = 12 I$
 $I = 5 \text{ A}$ (3)

8.3 $V = IR$
 $= 5(4)$ ✓
 $= 20 \text{ V}$ ✓ (2)

8.4 $40 = V_p + 12 + 20$
 $V_p = 8 \text{ V}$ ✓ (2)

8.5 $V = IR$
 $8 = IR$ ✓
 $R = 1,6 \Omega$ ✓

$1/R_p = 1/R_1 + 1/R_2$
 $1/1,6 = 1/2 + 1/R_2$ ✓
 $R_x = 8 \Omega$ ✓

Or

• $I = V/R = 8/2 = 4 \text{ A}$, so $I = 5 - 4 = 1 \text{ A}$, so
 $R = V/I = 8/1 = 8 \text{ ohms}$ (4)

8.6 $W = V^2 t / R$ ✓
 $= (8^2)(2 \times 60) / 2$ ✓
 $= 3840 \text{ J}$ ✓

Or

Use $W = VIt$ (3)

8.7 Total Resistance increases ✓ therefore total current decreases. ✓
 V of motor decreases ✓
 Would still work. ✓ (4)

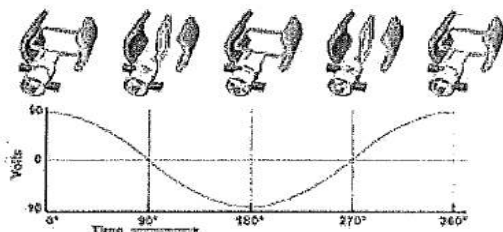
[21]

Question 9

- 9.1 17,52 ✓
20,40 ✓ (2)
- 9.2 Bottom of electromagnet is NORTH pole ✓ (1)
- 9.3 F is directly proportional to I ✓ The strength of the force is determined by the current strength through the electromagnet. ✓ (2)
- 9.4 Y axis label (Δm) ✓
(must occupy > 1/2 grid)
X axis label (I) ✓
(must occupy > 1/2 grid)
[reversed axes -2]
- Scale ✓
Plots ✓
LOBF ✓ (5)
- 9.5 Distance of electromagnet above block
Orientation of magnet relative to solenoid
Direction of current ✓ (1)
Any one
[11]

Question 10

- 10.1 mechanical to electrical ✓ (1)
- 10.2 A : brushes ✓
B : slip rings ✓ (2)
- 10.3 Clockwise ✓ (2)
- 10.4 Flemings RH dynamo rule ✓ (1)
- 10.5 Shape ✓
Axes ✓
Max at $t=0$ ✓



(3)

- 10.6 X = soft iron core ✓
Y = secondary coils ✓ (2)
- 10.7 Step-up ✓ (1)
- 10.8 By increasing the voltage the current is reduced ✓ and thus less heat is lost ✓ in the powerlines. (2)
- 10.9 Faradays Law ✓ (1)
[15]

Question 11

- 11.1 The minimum frequency of incident radiation ✓ at which electrons will be emitted ✓ from a particular metal (2)
- 11.2 Metal A. ✓
The frequency of radiation is greater than threshold frequency of (3×10^{14} Hz) of metal A ✓
OR
While frequency of radiation is lower than metal B's threshold frequency (6×10^{14} Hz) and electrons will not be ejected. (2)
- 11.3 $W = h f_0$ ✓
 $= (6,63 \times 10^{-34}) \times (6 \times 10^{14})$ ✓
 $= 3,98 \times 10^{-19} \text{ J}$ ✓ (3)
- 11.4 $hf = W + \frac{1}{2} mv^2$ ✓
 $(6,63 \times 10^{-34})(9 \times 10^{14})$ ✓ $= 3,98 \times 10^{-19}$ ✓ $+ \frac{1}{2}$
 $(9,11 \times 10^{-31})v^2$ ✓ (c.o.e 11.3)
 $v = 6,60 \times 10^5 \text{ m.s}^{-1}$ ✓ ($660472,50$)
(Accept values between $6,57 \times 10^5$ and $6,61 \times 10^5$) (5)
- 11.5.1 Remain the same ✓ (1)
- 11.5.2 Increase ✓ (1)
[14]

TOTAL: 200 MARKS

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