GRADE 12 TRIAL EXAMINATIONS

7 SEPTEMBER 2010

PHYSICAL SCIENCES: PHYSICS (Paper 1)

MEMORANDUM

MARKS: 150

TIME: 3 HOURS

GRADE 12 TRIAL EXAMINATIONS SEPTEMBER 2010

PHYSICAL SCIENCES: PHYSICS (PAPER 1)

ANSWER SHEET: SECTION A

NAME	MEMORANDUM

QUESTION 1: ONE-WORD/TERM ITEMS

1.1	(net) force
1.2	inelastic
1.3	wavefront
1.4	electromagnetic induction
1.5	radio waves

[5]

QUESTION 2: MULTIPLE CHOICE

2.1	A	B	~~C~~	D
2.2	A	B	C	~~D~~
2.3	A	~~B~~	C	D
2.4	~~A~~	B	C	D
2.5	A	B	~~C~~	D

2.6	A	~~B~~ ✓	C	D
2.7	A	B	C	~~D~~ ✓
2.8	A	B	~~C~~ ✓	D
2.9	A	B	C	~~D~~ ✓
2.10	~~A~~ ✓	B	C	D

[2 X 10 = 20]

SECTION A: TOTAL [25]

SECTION B

QUESTION 3

3.1 2,94 ✓ $m \cdot s^{-1}$ upward ✓
OR $-2,94 m \cdot s^{-1}$

3.2 acceleration ✓ (due to gravity)

3.3 • the hammer reached its maximum height ✓
• (v = 0), point at which hammer changes direction ✓

3.4 gradient ✓ $= \frac{\Delta v}{\Delta t}$
$\therefore$ 9,8 ✓ $= \frac{v_f - 0}{(4-0,3)}$ ✓
$v_f = 9,8 \times 3,7$
$= 36,26 m \cdot s^{-1}$ ✓
downward

OR gradient $= \frac{\Delta v}{\Delta t}$
$9,8 = \frac{v_f - (-2,94)}{4}$
$\therefore v_f = (9,8 \times 4) - 2,94$
$= 36,26 m \cdot s^{-1}$
downward

v_f : ✓ marking

3.5 height = displacement
= area under graph ✓
= $(\frac{1}{2} \times 0,3 \times -2,94) + (\frac{1}{2} \times 3,7 \times 36,26)$ ✓
= $-0,441 + 67,081$
= 66,64 m ✓ height.

[13]

QUESTION 4

4.1 The total linear momentum in an isolated system remains constant in magnitude and direction ✓✓ 2/2 or 0/2

[OR momentum before a collision equals momentum after, in a closed system]

4.2 $p_{before} = p_{after}$ ✓ $\rightarrow +$

$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$

$(1400)(25) + (1600)(20) = (1400)(21) + 1600 v_{Bf}$

$\therefore v_{Bf} = \frac{37600}{1600}$

$= 23,50 m \cdot s^{-1}$ to the right

4.3 $F_{net}\Delta t = \Delta p$ ✓

$F_{net}\Delta = mv_f - mv_i = m(v_f - v_i)$

$F_{net} \times 1,2 = 1400(21 - 25)$ ✓

$F_{net} = -4,67.10^3 N$

$= 4,67.10^3 N$ to the left.

4.4 • the features are designed to increase contact time (Δt) ✓ during which momentum changes

• as $F_{net} = \frac{\Delta p}{\Delta t}$ ✓, as Δt increases, force during impact decreases ✓

[16]

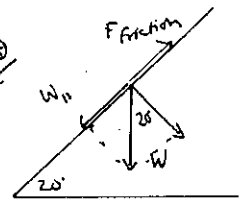
QUESTION 5

5.1 $F_{net} = W_{//} + F_{friction}$ ✓

$= mg\sin 20° + F_{friction}$ ✓

$= (70)(9,8)(\sin 20) + (-50)$ ✓

$= 184,63 N$ ✓



↓ ⊕ marking

5.2 Work done by net force:

$W = F\Delta x\cos\theta$ ✓

$= (184,63)(30)(\cos 0°)$ ✓

$= 5538,90 J$

$W_{net} = \Delta K = E_{kf} - E_{ki}$ ✓

$5538,90 = E_{kf} - \frac{1}{2}mv_i^2$

$E_{kf} = 5538,90 + \frac{1}{2}(70)(4)^2$ ✓

$= 6098,90 J$

$\therefore \frac{1}{2}mv_f^2 = 6098,90$ ✓

$\frac{1}{2}(70)v_f^2 = 6098,90$

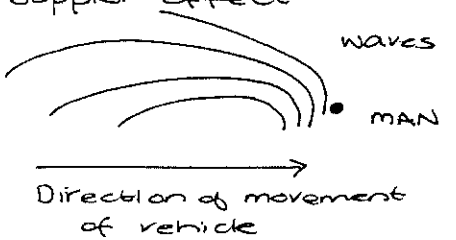
$\therefore v_f = 13,20 m \cdot s^{-1}$ ✓

[11]

QUESTION 6

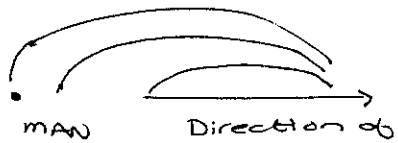
6.1 Doppler Effect ✓

6.2.1



waves are compressed ✓
∴ shorter wavelength ✓
HIGHER PITCH ✓ (frequency)
* must relate to diagram

6.2.2



waves 'stretch' ✓
∴ longer wavelength
LOWER pitch ✓ (lower frequency)
* relate to diagram

6.3 $f_L = \frac{(v \pm v_L)}{(v \pm v_S)} f_S$ or $f_L = \frac{v}{v - v_S} \cdot f_S$ ✓

$\therefore f_L = \frac{340}{340-25} \times 400$ ✓ ✓

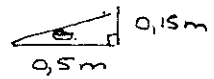
$= 431,75 \text{ Hz}$ ✓

[11]

QUESTION 7

7.1 light of a single frequency ✓ (or single wavelength) only.

7.2 $\tan\theta = \frac{0,15}{0,5}$ ✓



$\therefore \theta = \tan^{-1}\left(\frac{0,15}{0,5}\right)$

$= 16,699...^{\circ}$

$\sin\theta = \frac{m\lambda}{a}$ ✓

$\sin(16,\ 99...) = \frac{2\lambda}{4500.10^{-9}}$ ✓ ✓

$\therefore \lambda = 6,47 \times 10^{-7} \text{ m}$ ✓

7.3 • decrease width of slit ✓

[or decrease distance between slit and screen]

[7]

QUESTION 8

8.1 It is a region in space in which an electric charge experiences a force. ✓✓ 2/2 or 0/2

8.2 Electric field at X due to Q_1:

$$E_1 = \frac{kQ_1}{r^2} \checkmark$$

$$= \frac{9.10^9 \times 16.10^{-6}}{(0,8)^2} \checkmark$$

$$= 2,25 \times 10^5 \text{ N.C}^{-1} \text{ to the right}$$

Electric field at X due to Q_2:

$$E_2 = \frac{kQ}{r^2}$$

$$= \frac{9.10^9 \times 4.10^{-6}}{1^2} \checkmark$$

$$= 3,60.10^4 \text{ N.C}^{-1} \text{ to the left}$$

$\rightarrow \oplus$

$$\therefore E_{net} = 2,25.10^5 + (-3,60.10^4) \checkmark$$

$$= 1,89.10^5 \text{ N.C}^{-1} \checkmark \text{ to the right} \checkmark$$

$\oplus$ marking ↓

8.3 $E = \frac{F}{q}$ ✓

$$\therefore F = qE$$

$$= 1,6.10^{-19} \times 1,89.10^5 \checkmark$$

$$= 3,02 \times 10^{-14} \text{ N} \checkmark \text{ to the left} \checkmark$$

[12]

QUESTION 9

9.1 $A = 25.10^{-3} \times 25.10^{-3}$ ✓

$$= 6,25.10^{-4} \text{ m}^2$$

$$C = \frac{\varepsilon_0 A}{d} \checkmark$$

$$= \frac{8,85.10^{-12} \times 6,25.10^{-4}}{0,5.10^{-3}} \checkmark$$

$$= 1,11 \times 10^{-11} \text{ F} \checkmark$$

9.2 $C = \frac{Q}{V}$ ✓

$$1,11 \times 10^{-11} = \frac{Q}{200} \checkmark$$

$$\therefore Q = 2,22 \times 10^{-9} \text{ C} \checkmark$$

9.3
- The dielectric becomes polarized ✓ when it is inserted in the gap
- An electric field is induced in the dielectric ✓ which opposes the field between the plates ✓
- The (net) electric field between the plates decreases ✓ as a result
- This decreases p.d across the plates ∴ capacitance increases ✓ (C or $\frac{1}{V}$)

[12]

QUESTION 10

10.1 12 V ✓

10.2 12 V ✓

10.3 0 V ✓

10.4 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$= \frac{1}{4} + \frac{1}{6}$ ✓

$= \frac{5}{12}$

$\therefore R_p = 2,4\ \Omega$

$R_{ext} = R_3 + R_p$

$= 2 + 2,4$ ✓

$= 4,4\ \Omega$

$R_{ext} = \frac{V_t}{I}$ ✓

$4,4 = \frac{8,8}{I}$ ✓

$\therefore I = 2A$ ✓

10.5 $r = \frac{V_{int}}{I}$

$r = \frac{12 - 8,8}{4,4}$

$r = 1,6\ \Omega$

OR ✓ $\varepsilon = I(R + r)$ ✓ ⊕ marking.

✓ $12 = 2(4,4 + r)$ ✓

$\therefore r = 1,6\ \Omega$ ✓

[14]

QUESTION 11

11.1 electrical energy to mechanical energy or (kinetic) ✓ 1/1 or 0/1

11.2.1) A: split-ring commutator ✓

2) B: carbon brushes ✓

11.3 • every $\frac{1}{4}$ rotation, contact with brushes is broken – momentum carries coil over

• every $\frac{1}{2}$ rotation, connections to cell terminals are reversed ✓

• (This ensures force acting on specific length of coil reverses direction every $\frac{1}{2}$-rotation) and ∴ motor rotates in ONE direction ✓ only.

11.4 • increase current ✓

• increase number of coils ✓

• increase strength of magnetic field. (ANY 2)

11.5 use electromagnets ✓ instead of permanent ✓ magnets.

[9]

QUESTION 12

12.1
- voltage can be stepped up or stepped down at transformers ✓
- easier to generate and transmit ac than dc ✓
- easier to convert a.c. to d.c. than other way around
- by transporting electrical energy at low current ac, energy loss is restricted

(ANY 2)

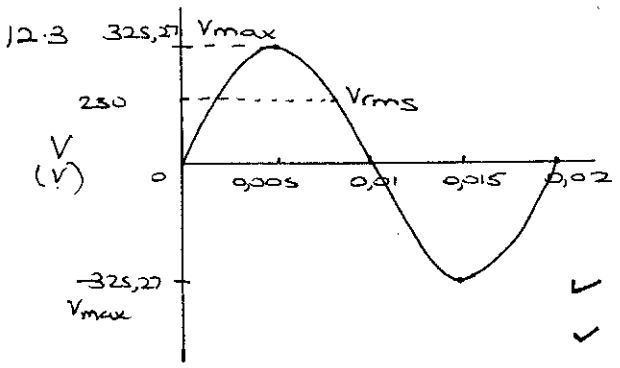
12.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$230 = \frac{V_{max}}{\sqrt{2}}$ ✓

$\therefore V_{max} = 230 \times \sqrt{2}$

$= 325,27\ V$ ✓ ✓

12.3



$T = \frac{1}{f}$

$= \frac{1}{50}$

$= 0,02s$

[9]

- ✓ shape
- ✓ axes correctly labelled
- ✓ V_{max} (+ & − values shown) at correct times
- ✓ V_{rms} shown

QUESTION 13

13.1 The minimum frequency (required by incident light) at which an electron will be ejected from a certain metal

✓✓ 2/2 or 0/2

13.2 $W_0 = hf_0$ ✓

✓ $1,8 \times 10^{-19} = 6,63 \times 10^{-34} f_0$

$\therefore f_0 = 2,71 \times 10^{14}\ Hz$ ✓

13.3 $c = f\lambda$ ✓

$3 \times 10^8 = f \times 500.10^{-9}$ ✓

$\therefore f = \frac{3 \times 10^8}{500 \times 10^{-9}}$

$= 6 \times 10^{14}\ Hz$ ✓ (frequency of incident light)

$\therefore f > f_0$ ✓ $\therefore$ Yes, e^- ejected

13.4.1 stays the same ✓

13.4.2 increase ✓

[11]