Queen's College
Mock Examination 2020
Mock examination paper 1
Solution

PAPER 1A

1. C	2. A	3. D	4. A	5. C
6. B	7. A	8. C	9. B	10. A
11. B	12. C	13. C	14. C	15. C
16. D	17. D	18. C	19. B	20. A
21. C	22. D	23. B	24. B	25. A
26. A	27. B	28. D	29. C	30. A
31. B	32. D	33. B		

PAPER 1B

1.(a) Connect the power supplied, Joulemeter and the immersion heater. Put the immersion heater into the water.

Put the beaker with water onto the electronic balance. Start the power supply to the heater. Wait until the water starts to boil. Record the initial reading of the electronic balance m_1 and Joulemeter E_1. When about 100g of water has boiled away, record the final reading of the and electronic balance m_2 and Joulemeter E_2. (5 marks)

The specific latent heat of vaporization of water is

$$l_v = (E_2 - E_1)/(m_2 - m_1)$$ (1 mark)

(b) The experimental value is higher than the real value because great amount of heat loss to the surrounding. [1+1]

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2.(a) Apply

$$PV = nRT$$

$\therefore$ $(1.01 \times 10^5)(5.6 \times 10^{-3}) = n(8.31)(25 + 273)$ [1]

$\therefore$ $n = 0.2284$

$\therefore$ no. of air molecules $= (0.2284)(6.02 \times 10^{23})$

$= 1.375 \times 10^{23}$

$\fallingdotseq \underline{\underline{1.38 \times 10^{23}}}$ [1]

(b) Apply

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\therefore \frac{(1.01)V}{(298)} = \frac{P_2(1.1V)}{(311)}$$ [1]

$$\therefore P_2 = 0.9582 \times 10^5$$

$$\approx \underline{\underline{0.958 \times 10^5 \text{ Pa}}}$$ [1]

(c) The student is wrong. [1]

The internal energy of the air molecules inside the balloon is the total KE of random motion of the air molecules. The internal energy is directly proportional to absolute temperature. Since absolute zero can never be reached, internal energy of gas molecule cannot be zero. [1+1]

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3. (a) To make sure there is no extra applied force given to the bowling ball when it is released. In this way when the ball is released it is perfectly at rest there will be no KE on the ball. [3 marks]

(b) By conservation of energy, when the ball returns it will be at rest at the same height when it is released. Thus it just stops at the nose of the student.

[1+1]

(c) (i) Max. PE gained = mgh

$= (5)(9.81)(0.25)$ [1]

$= 12.26$

$\fallingdotseq 12.3$ J [1]

(ii) By conservation of energy,

PE loss = KE gained

$\therefore$ $(12.26) = (1/2)(5)(v^2)$ [1]

$\therefore$ $v = 2.214$

$\fallingdotseq 2.21\ ms^{-1}$ [1]

(iii) Maximum tension in wire occurs when the ball is at lowest position

$T - mg = mv^2/r$

$\therefore$ $T - (5)(9.81) = (5)(2.214)^2/(1.5)$ [1]

$\therefore$ $T = 65.39$

$\fallingdotseq 65.4$ N [1]

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4. (a) Speed of vehicle $= D/t$

$= (0.1)/(0.8)$ [1]

$= 0.125\ ms^{-1}$ [1]

(b) (i) Apply conservation of momentum,

$m_1u = (m_1 + m_2)v$

$\therefore (0.005)(u) = (0.005 + 0.5)(0.125)$ [1]

$\therefore$ $u = 12.63$

$\fallingdotseq 12.6\ ms^{-1}$ [1]

(ii) Inelastic collision occurs. This is because the bullet and the plasticine merged to form one piece after collision.

[1+1]

(c) (i) Consider vertical motion only, apply

$s = ut + (1/2)at^2$

$\therefore \quad (-0.3) = 0 + (1/2)(-9.81)(t^2)$

$\therefore \quad t = 0.2473$ s [1]

Consider horizontal motion only, apply

$v = D/t$

$\therefore \quad (12.63) = D/(0.2473)$ [1]

$\therefore \quad D = 3.123$

$\fallingdotseq$ $\underline{\underline{3.12 \text{ m}}}$ [1]

(ii) Consider vertical motion only, apply

$s = ut + (1/2)at^2$

$\therefore \quad (0) = u(0.2473) + (1/2)(-9.81)(0.2473^2)$

$\therefore \quad u_y = 1.213 \text{ ms}^{-1}$ [1]

$\therefore \quad \tan\theta = u_y/u_x = (1.213)/(3.123)$

$\therefore \quad \theta = 21.22^o$

$\fallingdotseq \underline{\underline{21.2^o}}$ [1]

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5. (a) (i) Consider the wave passing over the plastic block,

$\lambda_1 = (12)/6 = 2$ cm [1]

Hence speed of wave just before entering
The plastic block

$v_2 = v_1 \text{ x } (\lambda_2/\lambda_1)$

$= (8)(3/2)$

$= \underline{\underline{12 \text{ cm s}^{-1}}}$ [1]

(ii) Apply

$v = f\lambda$

$\therefore \quad (12) = (f)(3)$ [1]

$\therefore \quad f = \underline{\underline{4 \text{ Hz}}}$ [1]

(b) P will <u>oscillate in vertical direction</u> with the <u>same frequency</u> as the water wave. [1+1]

(c) (i) The <u>direction of travel</u> of water wave will <u>bend towards the normal</u> And the <u>wavelength will decrease</u>. [0.5+0.5+1]

(ii) Apply

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$

$$\therefore \frac{\sin 22^o}{\sin r} = \frac{12}{8}$$ [1]

$$\therefore r = 14.46^o \approx \underline{\underline{14.5^o}}$$ [1]

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6. (a) From the given diagram, the separation of the red fringes

$y_{red} = (2.4)/3$ [1]
$= \underline{\underline{0.8 \text{ cm}}}$ [1]

(b) Apply

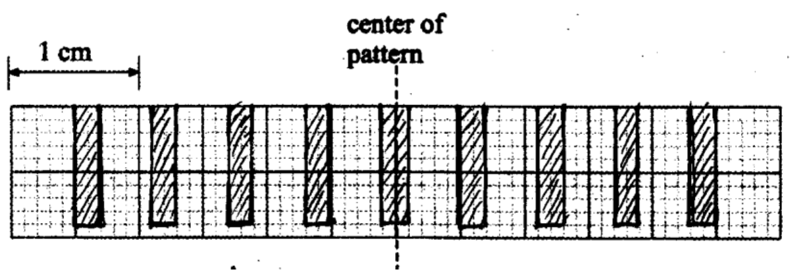
$\lambda = (ay)/D$
$\therefore \quad y = \lambda(D/a)$

$\therefore \quad (D/a) = y/\lambda$
$= (0.8 \times 10^{-2})/(640 \times 10^{-9})$ [1]
$= \underline{\underline{12500}}$ [1]

(c) (i) Apply

$(D/a) = y/\lambda$
$\therefore \quad (12500) = y_{blue}/(480 \times 10^{-9})$ [1]
$\therefore \quad y_{blue} = \underline{\underline{0.6 \text{ cm}}}$ [1]

(ii)



[correction separation: 1 mark]
[suitable number of fringes: 1 mark]

(d) (i) The fringe separation will decrease. [1]

(ii) The central fringe will be purple in colour. [1]
The outer fringes will have blue inner edge and red outer edge. [any one: 1]
the 4th fringe will be purple in colour. [1]

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7. (a) (i) Apply

$Q = It$
$\therefore \quad Q = (4.8)(3600)$ [1]
$= 17280$
$\fallingdotseq \underline{\underline{17300 \text{ C}}}$ [1]

(ii) Apply

$Q = It$
$\therefore \quad (17280) = (2.1)(t)$ [1]
$\therefore \quad t = 8229 \fallingdotseq \underline{\underline{8230 \text{ s}}}$ [1]

(b) (i) A.C. supply could be easily found (or convenient) in the socket at home. In addition, battery d.c. supply could be easily used up during time. [1+1]

(ii) Apply

$V_2/V_1 = N_2/N_1$

$\therefore$ (6)/(220) = (N_2)/(3000) [1]

$\therefore$ N_2 = 81.82

≒ 82 [1]

(c) This is because there is resistance in the copper wires in the coil causing heat loss. In addition, there is eddy currents formed on the core of the transformer and magnetic flux leakage may causing efficiency drop.

[any two : 2 marks]

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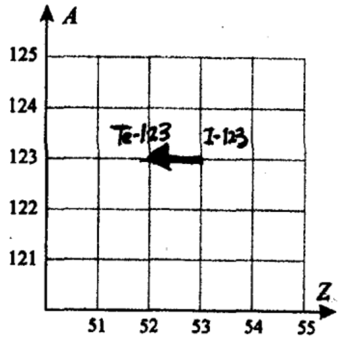
8. (a)

$^{123}_{53}I + ^{0}_{-1}e \rightarrow ^{123}_{52}T + \gamma$ [1]

(b)



[correct diagram:1]

(c) γ ray has a very weak ionization power and hence it is least harmful to human body. [1+1]

(d) (i) Because background radiation is in the order of around 1 count s^{-1} which is negligible comparing the strong 500 count s^{-1} initial activity of the sample. [1 mark]

(ii) From the graph,

half-life = 13 hours. [1]

(e) Radioisotope decay rapidly and so harmful time inside our body is short. In addition, short half-life means stronger activity and hence more easy to be detected by apparatus outside our body. [1+1]

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9. (a) Angular speed of the coil, $\omega = 2(2\pi)/(1)$
$= 12.57 \text{ rad s}^{-1}$ [1]

$\therefore \quad v = r\omega$
$= (0.4)(12.57)$
$= 5.028$
$\fallingdotseq \underline{\underline{5.03 \text{ ms}^{-1}}}$ [1]

(b) Induced e.m.f. on LM

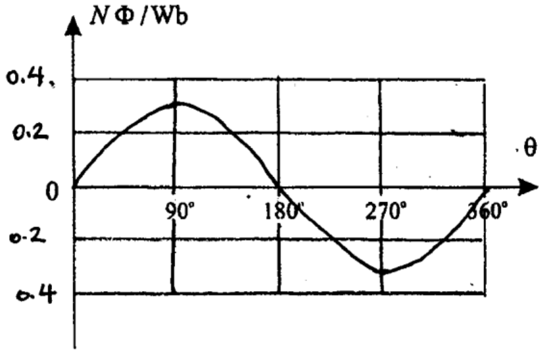
$\varepsilon = NBlv$
$= (4)(0.1)(1)(5.028)$
$= 2.012 \text{ V}$ [1]

Since limb *LM* and *PQ* are connected in series,

$\therefore$ total output voltage $= 2\varepsilon$
$= (2)(2.012)$
$= 4.024$
$\fallingdotseq \underline{\underline{4.03 \text{ V}}}$ [1]

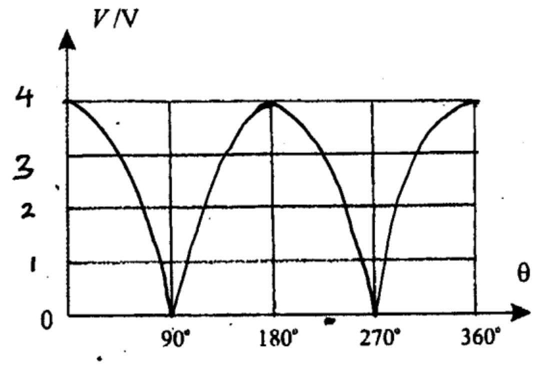
(c) Average power = (peak power)/2
$= (1/2)(V^2/R)$
$= (1/2)(4.012^2/0.8)$ [1]
$= 10.06$
$\fallingdotseq \underline{\underline{10.1 \text{ W}}}$ [1]

(d)



[correct graph: 1]
[correct labels: 1]

(e)



[correct graph: 1]
[correct labels: 1]

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