G.C.E. (Advanced Level) Examination - August 2011

PHYSICS - I

Provisional Scheme of Marking

2011 - Answers

Question	Answer	Question	Answer	Question	Answer
01	2	21	4	41	1
02	5	22	3	42	5
03	3	23	1	43	2
04	1	24	3	44	3
05	2	25	5	45	1
06	1	26	1	46	4
07	4	27	2	47	3
08	3	28	2	48	2
09	1	29	5	49	1
10	5	30	3	50	3
11	2	31	5		
12	4	32	1		
13	4	33	3		
14	5	34	4		
15	5	35	1		
16	3	36	4		
17	2	37	2		
18	5	38	2		
19	5	39	3		
20	1	40	4		

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PHYSICS - II

Provisional Scheme of Marking

A - PART

01. (a) 0.01mm / 0.001 cm / 0.00001m

(b) By ensuring that the tip of the screw touches its image formed by the glass plate. 01

(c) (i) Turn the screw until its tip touches the surface. 01

(ii) The number of rotations of the circular scale and reading of the circular scale.

OR

the readings of the vertical seale and the circular scale. 01

(d) Waste of the serew / threads OR

The screw might travel through the thimble loosely

OR

The crrcular scale might wobble OR

The coroular scale might be inclined OR

The circular scale may not be horizontal 01

(e) (i) Meter Ruler / half meter ruler / veriner calipers 01

(ii) Place the spherometer on a sheet of paper and press to imprint/ emboss its leg marks 01

mesure the distances between adjacent marks produced by the spherometer legs.

(f) Thickness of a microscope slide OR Thickness of a small glass slide / Thickness of a small disc (CD) OR small depth of a cavity OR small depressions / elevations of a structure.

(g) Reduce the progress made by the circular scale on the vertical scale.

Reduce the pitch of the screw / Reduce the progress made by the circular scale on the vertical scale after one complete rotation of the circular scale/ Divide the circular into more divisions. 01

02. (a) (i) Heat absorbed by Calorimeter = $100 \times 10^{-3} \times 375 \times (45 - 30)$

$= 562.5\ J$

(ii) Heat absorbed by water $= 50 \times 10^{-3} \times 4200 \times (45 - 30)$

$= 5 \times 42 \times 15$

Heat given out by Iron balls $= 150 \times 10^{-3} \times C_{Fe} \times (100 - 45)$

$= 0.15 \times 55 \times C_{Fe}$

$562.5 + 5 \times 42 \times 15 = 0.15 \times 55 \times C_{Fe}$

$$C_{Fe} = \frac{562.5 + 5 \times 42 \times 15}{0.15 \times 55}$$

$$= 450\ Jkg^{-1}k^{-1}$$

(b) Heat absorbed by styrofoam cup = heat given out by iron balls - heat absorbed by water

$= 150 \times 10^{-3} \times 450 \times (100 - 47) - 50 \times 10^{-3} \times 4200 \times (47 - 30)$ -01

$= 7.5\ J$

(c) Heat absorbed by styrofoam cup is very small compared to heat absorbed by the water OR

Heat absorbed by styrofoam cup (7.5J) is very small compared to heat absorbed by the calorimeter (562.5J)

01

(d) Setting up and handling of items will be easy compared to the calorimeter experiment / with styorfoam it is not necessary to use a heat insulation / Heat absorbed by the styrofoam cup can be neglected. 01

(e) (i) Measured Temperature will not be equal to that of the outer surface of the cup OR

Outer surface will not reach the same temperature as its contents OR.

There will be a temperture gradient across the wall of the cup. 01

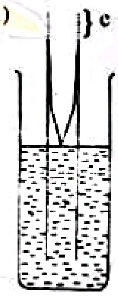
(ii) Rate of cooling will be very small OR

Temperature of the outer surface of the cup will be almost that of air.

03. (a) longitudinal or standing (any one or both) 01

(b) (i) To produce a closed - end tube with variable length 01

(ii)



Correct wave pattern with end correction and labeled (e)

01

(iii) The tuning fork of 480Hz or highest frequency.

The resonance length is lowest for highest frequecy.

Then, the fundamental resonace length for other tuning forks can be obtained, without being missed out by continuously raising the tube.

Correct answer and reason 01

(iv) Minimum length $= \frac{\lambda}{4} = \frac{V}{4f} = \frac{345.6}{4 \times 288}$

$= 0.30m$ 01

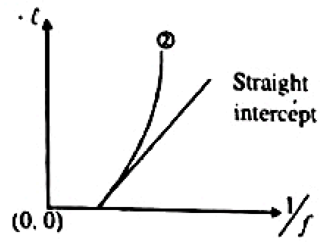
(v) $V = f\lambda$

$V = 4f(l + e)$ 01

$l = \frac{V}{4}\left(\frac{1}{f}\right) - e$ 01

(vi) The tuning fork with f = 406. 4. Hz (or $1/f = 2.5 \times 10^{-3}$) 01

(vii)



Straight line with negative intercept labels as shown 01

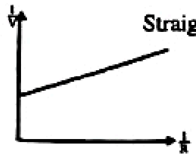
(viii) For correct curve drawn on the plot and labeled as ②

$(V \propto \sqrt{T})$ 01

04. (a)  01

(b) (i) $V_0 = \frac{V}{R}(R + R_v)$ 01

(ii) $\frac{1}{V} = \frac{R_v}{V_0} \cdot \frac{1}{R} + \frac{1}{V_0}$ 01

(iii) 

Straight line with positive intercept 01

labels as shown 01

(iv) $\frac{\text{gradient}}{\text{intercept}}$ 01

(v) from intercept OR $\frac{1}{\text{intercept}}$

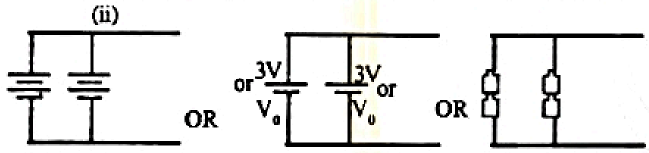
(c) 25Ω - 500Ω range

Reason : Equation of the form y = mx + c. can be obtained only when $R <<<$ the internal resistance of the voltmeler/ straight line is possible only when the value of R chosen is very much smaller than the internal resistance of the voltmeter.

as the internal resistance of the voltmeter is in parallel with R its influence on R can be neglected only if R is small compared fo 1500Ω 01

(d) (i) Repeat the first readings at the end of the experiment

(ii)



PART B

05. (a) (i) let v be the speed of the capsule at depth h Applying law of conservation of energy.

$Mgh = 1/2\ MV^2$ 01

$\upsilon = \sqrt{2gh}$ 01

(ii) ω- is the Angular speed

$\upsilon = R\omega$

$\omega = \frac{\sqrt{2gh}}{R}$ 01

(b) kinetic energy of the pulley $= \frac{1}{2} I\omega^2$

$= \frac{1}{2}(\frac{1}{2} mR^2)\omega^2$ 01

From the law of conservation of energy

$Mgh = ½ MV^2 + ½I\omega^2$

$Mgh = ½MV^2 + ½.½ mR^2\omega^2$

$Mgh = ½MV^2 + ¼mV^2$

$Mgh = \frac{V^2}{4}(2M + m)$

$$V = \sqrt{\frac{4Mgh}{2M + m}}$$

$$\omega = V/R$$

$$\omega = \frac{1}{R}\sqrt{\frac{4Mgh}{2M + m}}$$

(c) (i) work done against the frictional torque = $\tau_f \theta_0$ 01

(ii) Applying the law of conservation of energy

$$Mgh - \tau_f h/R = \frac{1}{2}MV^2 + \frac{1}{2}I\omega^2$$

$$Mgh - \frac{\tau_f h}{R} = \frac{1}{2}MV^2 + \frac{1}{4}mR^2\omega^2$$

$$Mgh - \frac{\tau_f h}{R} = \frac{1}{2}MV^2 + \frac{1}{4}mV^2$$

$$V = \sqrt{\frac{4(Mgh - \frac{\tau_f R}{h})}{2M + m}}$$

$\omega = V/R$

$$\omega = I/R\sqrt{\frac{4(Mgh - \frac{\tau_f R}{h})}{2M + m}}$$

(iii) let w_0 be the Angular speed of the pulley when Capsule the depth h_0.

Work done against the frictional torque = Rotational K. E. of the pulley.

$$n \cdot 2\pi\tau_f = \frac{1}{2}I\omega_0^2$$

$$n\ 2\pi\tau_f = \frac{1}{4}mR^2\omega_0^2$$

$$n\ 2\pi\tau_f = \frac{1}{4}mR^2 \cdot \frac{4}{R^2}\left(\frac{Mgh - \tau_f h/R}{2M + m}\right)$$

$$n = \frac{m}{2\pi\tau_f}\left(\frac{Mgh - \tau_f h/R}{2M + m}\right)$$

(d) For Constant angular speed the net torgue acting on the pulley should be zero 02

$$\tau_e = \tau_f + (M + m_0)gR$$ 01

06. (a) $d < f_1$ OR d is smaller than f_1 01

$(f_1 - d < f_2)$.

(b) Applying the lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Considering object as vertical and image as real.

Object distance Without the sign convention $u = f_1 - d$

The Applying the lens formula

$$\frac{-1}{V} + \frac{1}{f_1 - d} = \frac{1}{f_2} \quad \text{OR} \quad \frac{1}{V} + \frac{1}{f_1 - d} = \frac{1}{f_2}$$

Alternative method - considering object as real and image as virtual

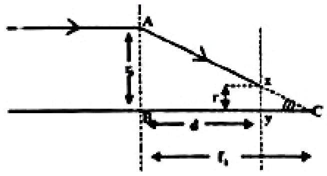
Image distance without the sign convention $V = (f_1 - d)$ 01

The applying the lens formula $\frac{1}{f_1 - d} - \frac{1}{v} = \frac{1}{f_2}$ 01

$$\frac{1}{v}=\frac{1}{f_1-d}-\frac{1}{f_2}$$

$$v=\frac{f_2(f_1-d)}{(f_2-f_1+d)} \text{ OR } v=\frac{-f_2(f_1-d)}{(f_2-f_1+d)} \text{ OR } v=\frac{f_2(f_1-d)}{(f_1-f_2-d)}$$

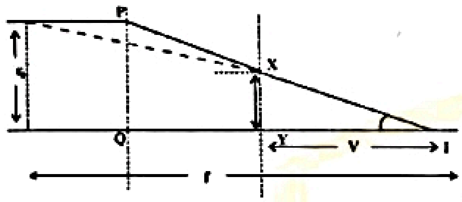
c. (i) Using similar triangles (ABC Δ and XYC Δ) or tan θ



$$\frac{r}{f_1-d}=\frac{r_o}{f_1} \text{ or}$$

$$r/r_o=\frac{f_1-d}{f_1}$$ 01

(ii) Using similar triangles PQIΔ and XYIΔ or tan θ



01

$r/r_0 = v/f$ 01

$f = r/r_0 \; V$ 01

Substituting for ro/r and V

$$f=\frac{f_1}{(f_1-d)}\;\frac{f_2(f_1-d)}{(f_2-f_1+d)} \text{ OR } f=\frac{f_1 f_2 (f_1-d)}{(f_1-d)(f_1-f_2-d)}$$

$$f=\frac{f_1 f_2}{(f_2-f_1+d)} \text{ OR } f=\frac{f_1 f_2}{(f_1-f_2-d)}$$

(iii) minimum value for f is d = 4cm

$$f=\frac{12\times18}{18-12+4} \text{ OR } f=\frac{12\times18}{12-18-4}$$

f = 21.6 cm OR f = -21.6cm 01

maximum value for f is d = 0

$$f=\frac{12\times18}{18-12} \text{ OR } f=\frac{12\times18}{12-18} \text{ cm}$$

f = 36cm OR f = -36cm 01

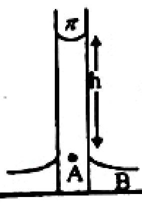
(iv) yes for a change of 4cm in *d* there is a change of 14.4cm in *f* OR
for a change of 4cm in *d* there is a considerable change in *f*.
OR
f has changed more than 3 times compared to a change of 4cm in *d*. 01

07. (a) Equating the pressure differences

$P_A = P_B$

$$\pi-\frac{2T}{r}+h\rho g=\pi$$

$$h=\frac{2T}{r\rho g}$$



[equating the surface tension forces to the weight of the water column. $2\pi rT = \pi r^2 h\rho g$] -01

(b) (i) $h=\frac{2\times7.2\times10^{-2}}{10^3\times100\times10^{-6}\times10}$ 01

$h=0.144m\,(14.4\times10^{-2}m, 14.4cm)$ 01

(ii) $r=\frac{2\times7.2\times10^{-2}}{10^3\times100\times10}$ 01

$r=1.44\times10^{-7}m\,(0.144\mu m)$ 01

(c) (i) hρg = pressure difference OR hρg = Δ P 01

$h \times 10^3 \times 10 = [-10^2 - (-10^3)] \times 10^3$ 01

$$H=\frac{10^2(10-1)}{10}$$

$H = 90\ m$

(d) (i) V - speed of water

Applying poiseuille's equation

$$\pi r^2 V=\frac{\Delta P\pi r^4}{8\eta\ell}$$

$$V=\frac{\Delta P r^2}{8\eta\ell}$$

$$V=\frac{9\times10^5(100\times10^{-6})^2}{8\times10^{-3}\times90}$$

$V=1.25\times10^{-2}ms^{-1}\,(1.25\ cms^{-1})$

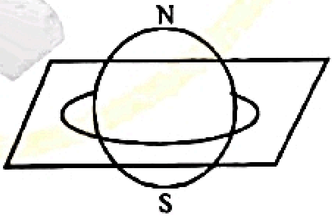
(ii) Power = $\Delta P . \pi r^2 V$ (P = FV) -01

$= 9 \times 10^5 \times 3 \times (100 \times 10^{-6})^2 \times 1.25 \times 10^{-2}$ 01

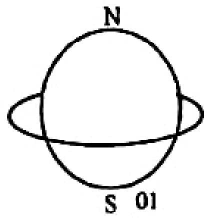
$= 3.375 \times 10^{-4}$ W $(3.37 - 3.40) \times 10^{-4}$ W 01

08. (a) The period of geostationary satellite (GSS) = 24 hours 01

(b)



OR



01

(c) Polar Satellite
Hubble space telescope
International space station — Anyone 01

(d) $\frac{GM_E}{r^2} = \frac{mv^2}{r}$ OR mrw^2 OR $mr\left(\frac{2\pi}{T}\right)^2$

$\frac{GM_E}{r^2} = \frac{v^2}{r}$ OR rw^2 OR $r\left(\frac{2\pi}{T}\right)^2$

$$r=\left[GM_E\left(\frac{T}{2\pi}\right)^2\right]^{\frac{1}{3}}$$

$$r=\left[40\times10^{13}\left(\frac{24\times60\times60}{2\pi}\right)^2\right]^{\frac{1}{3}}$$ 01
01

(π = 22/7 OR 3.14)

(e) Time delay $= \frac{2 \times 36000 \times 10^3}{3 \times 10^8}$

$= 0.24$ S — 01

(f) $\frac{GM_E\, m}{r^2} = \frac{mv^2}{r}$ OR $mr\omega^2$ OR $mr\left(\frac{2\pi}{T}\right)^2$

OR $T^2 = \frac{r^3(2\pi)^2}{GM_E}$ — 01

$T^2 = \frac{(6700 \times 10^3)^3 \times 4 \times 10}{40 \times 10^{13}}$

$T = 67\ ^2/_3 \times 10$

$T = 5484$ S — 01

This is LEOS Because
- it is in an inclined plane
- the height is in the range of 160 - 2000km
- Period is less then 24 hours

Any one reasons 01

(g) advantages of LEOS
- Reduced time delay for EM signals
- Possibility of using of Simple non - directional antennas
- Higher clarity pictures of the earth.
- Less exposoure fo EM radiation from the sun
- less energy and resources to place the satellite in to a LEO
- need less powerful amplifiers

any three correct — 01

(h) L_2 is better because at this locatron the earth partially blocks solar radiation falling on the satellite.

(i) Angular speed of the plank space absrvatory 2π rad year^{-1} — 01

(j) Orbital equation for plank observatory

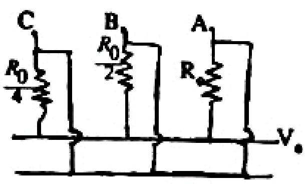
$$\frac{GM_S m}{(R+r)^2} + \frac{GM_E m}{r^2} = \frac{mV^2}{(R+r)} \quad \text{OR} \quad \frac{GM_S m}{(R+r)^2} + \frac{GM_E m}{r^2} = m(R+r)\omega^2$$

(k) For a Satallite at L_1 $\quad \frac{GM_S m}{(R-r)^2} - \frac{GM_E m}{r^2} = m(R-r)\left(\frac{2\pi}{T}\right)^2$

For a Satallik at L_2 $\quad \frac{GM_S m}{(R+r)^2} + \frac{GM_E m}{r^2} = m(R+r)\left(\frac{2\pi}{T}\right)^2$

At L_1 the force on the satellite is reduced due to the earth and at L_1 the force increased due of the earth — 01

09. (A) (a) (i)



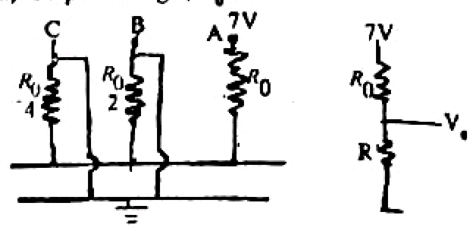
R - the equivalent resistance across ZY

$$\frac{1}{R} = \frac{1}{R_0} + \frac{2}{R_0} + \frac{4}{R_0} = \frac{7}{R_0}$$

$$R = \frac{R_0}{7}$$

(ii) Output Voltage, $V_0 = 0$ — 01

(b)



$$\frac{1}{R_1} = \frac{2}{R_0} + \frac{4}{R_0}$$

$$R_1 = \frac{R_0}{6}$$

$$V_0 = \left(\frac{7}{7/6\, R_0}\right) \times \frac{R_0}{6}$$

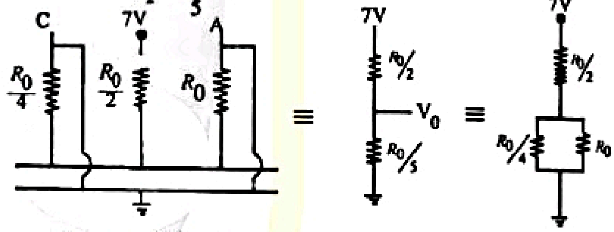
$$V_0 = 1V$$

(c) (i) R' ⇨ Parallel Comnination of $\frac{R_0}{4}$ and R_0

Equivalent resistance.

$$\frac{1}{R_2} = \frac{4}{R_0} + \frac{1}{R_0}$$ — 01

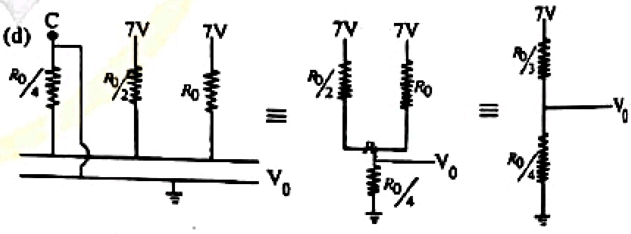
$$R_2 = \frac{R_0}{5}$$



Digram 1 OR 2 OR 3 — 01

$$V_0 = \frac{7}{\frac{7R_0}{10}} \times \frac{R_0}{5} = 2V$$

(d)



For diagram (1) OR (2) OR (3) — 01

(OR Diagram 2 OR 3) — 01

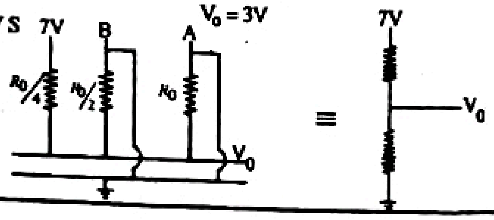
$$\frac{1}{R'''} = \frac{1}{R_0} + \frac{2}{R_0}$$

$$R''' = \frac{R_0}{3}$$

$$V = \frac{R_0/4}{\frac{7R_0}{12}} \times V_0$$

$V_0 = 3V$

R.W.S



$$\frac{1}{R'''} = \frac{1}{R_0} + \frac{2}{R_0}$$

$$R''' = \frac{R_0}{3}$$

$$V_0 = \frac{R_0/3}{\frac{7R_0}{12}} \times 7$$

$V_0 = 4V$ 01

(For the diagram (1) OR (2) and Calculation of V_0)

(e) (i)

	V_C(Volts)	V_B(Volts)	V_A(Volts)	V_0(Volts)
Row 1	0	0	0	0
Row 2	0	0	7	1
Row 3	0	7	0	2
Row 4	0	7	7	3
Row 5	7	0	0	4
Row 6	7	0	7	5
Row 7	7	7	0	6
Row 8	7	7	7	7

(Complete V_0 column) 01

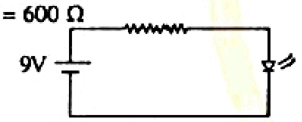
(ii) Binary to decimal convertor
OR The circuit will act as a Digital of Analogue Convertor (DAC) 01

09. (B) (a) (i) 30mA 01

(ii) Because the minority Carrier concentration depends on temperature. 01

(iii) $9 - 3 = 10 \times 10^{-3} R$

$R = 600\ \Omega$ 01



(iv) $V_R = 600 \times 10.3 \times 10^{-3}$
$= 6.18V$ 01

$V_D = 9 - 6.18$
$= 2.82V$ 01

Power dissipated by the LED at 30 °C = 3 x 10 = 30mV
power dissipated when heated = 2.82 x 10.3 = 29mV
Therefore power dissipated has decreated 01
when current increases, V_R will increase and V_D will decrease 01

(b) (i) Since i_D flows through R_E aswell

$i_D R_B = 9 - 3$

$i_D = 6 / 3000$

$= 2 \times 10^{-3}$ A, 2mA 01

(ii) $3 = 0.7 + 10 \times 10^{-3} \times R_E$, OR $2.3 = 10 \times 10^{-3} \times R_E$ 01

$R_E = 2.3 \times 10^3 \div 3$ 01

$R_E = 230\ \Omega$ 01

(iii) $9 = V_D + V_{CE} + iR_E$

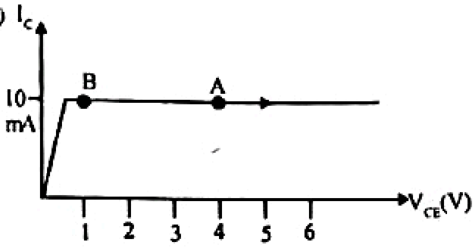
$9 = 3 + V_{CE} + 10 \times 10^{-3} \times 230$ 01

$V_{CE} = 3.7V$ 01

OR $9 = V_D + V_{CE} + V_E$

$= 3 + V_{CE} + 2.3$ 01

(iv)



For making point A 01

(v) For making the arrow 01

(vi) $V_{CE} = 0.7V$
For making point B 01

10. A. (a) Absolute Humidity (AH) of atmospheric air at 30°C is given by the expression.

$$\text{Relative humdity (AH)} = \frac{(AH)30}{(\text{AH of air saturated with water vapour})30}$$

OR

$$\text{Relative hiumdity (AH)} = \frac{\text{mass of water vapour pressent in a given volume of air}}{\text{mass required to saturate it at the same temperature.}}$$

01

$(AH)_{30} = 30 \times \frac{80}{100}$ 01

Ab solute humidity of atmospheric air $= 24 gm^{-3}$

AH of dried air $= 24 \times \frac{50}{100}$ 01

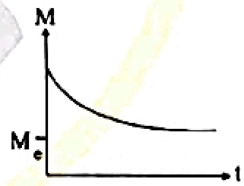
$= 12\ gm^{-3}$ 01

(b) mass of the moisture present in paddy sample.

$= 750 \times \frac{20}{100}$

$= 150g$ 01

(C) (i)



1. Rate of decrease of M with t graduallg becomey smaller as the air becomes more and more humid due to evaporation of misture from the paddy. and therefore the rate of evaporation decrease with time. 01

2. Finally M attains a constant value because air becomes saturated with water vapour and no further evaporation is possible. 01

(ii) RH = 100% 01

(iii) $M_e = 750 - (30 - 12)$
$= 732g$ 01

(iv) Remaining moisture content in the paddy sample
= 150 - 18
= 132g 01

(d) Since each $1m^3$ of dry air can absorb 18g of moistre from paddy, the minimum volume of the requied chamber would be $75/18\ m^3$
$= 4.17m^3$ OR 4.2m3 01

(e) (i) Initial relative humidity $= \frac{24}{216} \times 100\%$
$= 11\%$ 01

(ii) $1m^3$ of air at 70°C is capable of absorbing (216-24)g. 192g of moisture from the paddy sample Therefore $M_e = 600g$ 01

10. (B) (a) (i) $N = \frac{20 \times 10^{-12}}{2.8 \times 10^{-26} \times 10^{3}} = \frac{10^{12}}{1.4}$ 01

$A = \frac{0.7}{120} \times \frac{10^{12}}{1.4}$ 01

$= 4.2 \times 10^{9}$ Bq 01
(4.16 - 4.20)

(ii) Activity in the brain 2 min after the injection
$= 4.2 \times 10^{9} \times 0.1 \times 0.5$ 02
$= 2.1 \times 10^{8}$ Bq 01
(2.08 - 2.10)

(iii) 40 min = 20 half fives. There fore, the activity after 40min
$= \frac{A}{2^{20}} = \frac{4.2 \times 10^{9}}{10^{6}}$
$= 4.2 \times 10^{3}$ Bq

This is less than the natural activity of 10^4 Bq

(vi) Most of the radioactvity will be removed from the body very quickly OR

If is possible to obtain a very high activity from the body using a small amount of radsoactive matcrial.
01

(b)(i) β^{-} rays will be absorbed by the body tissues OR
β^{+} rays cannot produce γ rays in the body. 01

(ii) Suppose the momenta of the two γ rays are p_1 and p_2.
Initial momentum = 0 Final momentum $= p_1 + p_2$
Therefore, from the law of consevration of momentum
$O = P_1 + P_2$
$P_1 = - P_2$ 01
The directrons will be opposite
Because the magnitudes of the momentum are equal, the energies will be equal. 01

(iii) From the law of coservation of energy.
Mass of the positron + mass of the electron = 2 x γ ray energy 01
Therefore γ rays energy $E_\gamma = 511$ kev 01

(c) Total energy released $= 2NE_\gamma = 2 \times \frac{10^{12}}{1.4} \times 511 \times 1.6 \times 10^{-16}$
01

absorbed dose $= 2 \times \frac{10^{12}}{1.4} \times 511 \times 1.6 \times 10^{-16} \times \frac{1}{51.1}$
(Fer dividing by 51.1)
$= 2.3 \times 10^{-6}$ Gy 01
(2.28 - 2.30)