





Examination Solutions

(To Accompany the examination paper sent to external
examiner but not to be shown to students.)

Programme	HND Mechanical Engineering	Level	IV
Module:	PCPO4001 Engineering Science		
Author	P R Taylor	Page	

Q No	Solution	Marks
1.	a. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \dots$ $\frac{1}{R} = \frac{1}{15} + \frac{1}{25}$ $R = 9.375 \Omega$ $15 + 9.375 = 24.375 \Omega$ $\frac{1}{R} = \frac{1}{12} + \frac{1}{20} + \frac{1}{14.5}$ $R = 5.42 \Omega$ $15 + 10 + 5.42$ $\Sigma R = 30.42 \Omega$	1 1 1 1 1

Q No	Solution	Marks
1.	b_i $15\text{ nF} + 80\text{ nF} = 95\text{ nF}$ $\frac{1}{C} = \frac{1}{220 \times 10^{-9}} + \frac{1}{35 \times 10^{-12}} + \frac{1}{95 \times 10^{-9}}$ $= 35\text{ pF}$ b_{ii} $C = \frac{q}{V}$ $q = CV$ $= 35 \times 10^{-12} \times 12$ $q = 420\text{ pC}$ b_{iii} $W = \frac{1}{2} CV^2$ $= 0.5 \times 35 \times 10^{-12} \times 12^2$ $= 2.52\text{ nJ}$	5 5 5

Q No	Solution	Marks
2	a. $r = 0.25 \text{ mm}$ $L = 6.2 \text{ m}$ $R = 24 \Omega$ Calculate ρ resistivity. $\rho = \frac{R A}{l}$ $= 24 \times \frac{\pi \times 0.5^2}{4} \times \frac{1}{6.2}$ $\rho = \frac{24 \times \pi \times 0.5^2}{4 \times 6.2}$ $\rho = .76 \Omega/\text{m}$ <u>Wire ii</u> $L = 5 \times 6.2 = 31 \text{ m}$ $r = 2 \times 0.25 = 0.5 \text{ m}$ $\rho = \frac{R A}{l}$ $R = \frac{\rho l}{A}$ $= \frac{0.76 \times 31 \times 4}{\pi \times 0^2}$ $R = 30 \Omega$	2 2 1 1 2 2

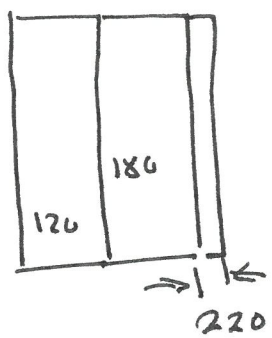
Q No	Solution	Marks
2	b. $R = R_0 (1 + \alpha t)$ $R = 100 (1 + 0.00392 \times 40)$ $R = 115.68 \Omega$	10

Q No	Solution	Marks
3.	a $h_i = ?$ $h_o = 7\text{cm}$ $d_o = 40\text{cm}$ $f = 20\text{cm}$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $\frac{1}{20} = \frac{1}{40} + \frac{1}{d_i}$ $\frac{1}{d_i} = \frac{1}{20} - \frac{1}{40}$ $d_i = 40\text{cm}$ $\frac{h_i}{h_o} = - \frac{d_i}{d_o}$ $\frac{h_i}{7} = - \frac{40}{40}$ $h_i = -7.$	2 2 1 2 2 1

Q No	Solution	Marks
3	b $h_o = 5 \text{ cm}$ $d_o = 30.5 \text{ cm}$ $f = -15.2.$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $-\frac{1}{15.2} = \frac{1}{30.5} + \frac{1}{d_i}$ $\frac{1}{d_i} = -\frac{1}{15.2} - \frac{1}{30.5}$ $d_i = -10.1 \text{ cm}$ $\frac{h_i}{h_o} = -\frac{d_i}{d_o}$ $\frac{h_i}{5} = -\left(\frac{-10.1}{30.5}\right)$ $\frac{h_i}{5} = 0.33.$ $h_i = 5 \times 0.33$ $= 1.66 \text{ cm}$	? 2 2 2

Q No	Solution	Marks
4	a $d_o = 18 \text{ cm}$ $f = 38 \text{ cm}$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $\frac{1}{38} = \frac{1}{18} + \frac{1}{d_i}$ $\frac{1}{d_i} = \frac{1}{38} - \frac{1}{18}$ $d_i = -34.2$ $\frac{h_i}{h_o} = -\frac{d_i}{d_o}$ <u>Ans</u> Image is real.	5

Q No	Solution	Marks
4	c $d_i = -14.58$ $\frac{h_i}{h_o} = -\frac{d_i}{d_o}$ $\frac{h_i}{4} = -\left(\frac{-14.58}{25}\right)$ $h_i = 4 \times 0.583$ $= 2.3 \text{ cm}$	1 2 1

Q No	Solution	Marks
5	a  $k_{r. \text{brick}} = 1.6 \text{ W/mK}$ $k_{\text{brick}} = 0.3 \text{ W/mK}$ $k_{\text{plaster}} = 0.14 \text{ W/mK}$ Total R $= \frac{0.12}{1.6} + \frac{0.18}{0.3} + \frac{0.22}{0.14}$ $= 0.075 + 0.6 + 1.57$ $\Sigma R = 2.245 \text{ W/m}$ $\dot{Q} = \frac{A (t_i - t_o)}{\Sigma R}$ $= \frac{4 (1373 - 323)}{2.245}$ $\dot{Q} = 1870.82 \text{ W}$	5 5 5