Scheme for (2003) Engineering Physics II

Part A

I

1. $\omega \rightarrow$ rad/s, $\alpha \rightarrow$ rad/s^2 } (1+1)

2. Two uses → 2 marks

3. K.E$_{rotation} = \frac{1}{2} I\omega^2$ is less for $I = I_G$ → 2 marks

4. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ & $R_p = \frac{6}{5}\Omega$ (1+1)

5. Idea of nuclear fusion - 2 marks

Part B

II

1. Definition & SI unit of L & I (2+2)

   $I = dL/dt$ — 2 marks

2. Three equations of u, v, a & t → 3 marks

   " of $\omega_1, \omega_2, \alpha$ & t → 3 "

3. Newton's law of gravitation to $g = \frac{GM}{R^2}$ → 4 marks

   Steps to get $g' = 9.81$ m/s2 → 2 marks

4. Figure + Equation gravitational force & Centripetal force } 3 marks.

   $v = \sqrt{\frac{GM}{R+h}}$ ⟶ 1 mark

   Use $g = \frac{GM}{R^2}$ to get $v = \sqrt{\frac{gR^2}{R+h}}$ ⟶ 2 marks

5. Diagram + Wheatstone's bridge principle → 3 marks

   How it works + $X = \frac{l\,R}{(100-l)}$ ⟶ 3 marks.

6. $B = \frac{\mu_0}{4\pi} \frac{I\,dl\sin\theta}{r^2}$ - statement & Explanation. → 3 marks

   Substitution + Result, $B = 3.535 \times 10^{-8}$ T → 3 marks.

7. Characteristics of Laser — 3 marks

   Three Applications — 3 marks.

III (a) Outer surface → Inner
Normal reaction contribute to F_c } 3 marks

(b) Figure +
Steps to get $I = \frac{1}{2}MR^2$ (2+4 = 6 marks)

(c) $\alpha = \frac{\omega_2 - \omega_1}{t} = 6.28\ rad/s^2$ (3 marks)

$a = \alpha R = 18.84\ m/s^2$ (3 marks)

IV (a) Example + Idea of F_c (1+2)

(b) Figure, $K.E_{rot} = \frac{1}{2}I\omega^2 \rightarrow 2$

$I = \frac{1}{2}MR^2$, $K.E = \frac{1}{2}Mv^2 \rightarrow 2$

Steps to get $K.E_{tot} = \frac{3}{4}Mv^2 \rightarrow 2$

(c) $I = Mk^2 = 40\ kg\,m^2$
$\tau = I\alpha = I\left(\frac{\omega_2 - \omega_1}{t}\right)$ } 3 marks

Substitution to get $I = 2.512\ Ns \rightarrow 3$ marks

V (a) Polar satellite – Orbit direction
T, uses } 3 marks

(b) $U = -\frac{Gm_1m_2}{r}$ & expl → 2 marks

$V = -\frac{GM}{r}$ + Idea of $V \rightarrow 2$ "

$U = -7.63 \times 10^8\ J \rightarrow 2$ "

(c) $g_h = g\left(1 - \frac{2h}{R}\right) = 9.604\ m/s^2 \rightarrow 3$ marks

$g_d = g\left(1 - \frac{d}{R}\right) = 9.647\ m/s^2 \rightarrow 3$ marks

VI (a) $v_e = \sqrt{\frac{2GM}{R}} = 92.48\ km/s \rightarrow 3$ marks

(b) Figure, $U_{surface} = -\frac{GM_m}{r} \rightarrow 1+1$

$U_\infty = 0$, $K.E_{min} = \Delta U \rightarrow 1+1$

$v_e = \sqrt{\frac{2GM}{R}} = \sqrt{2gR} \rightarrow 2$

(c) $F = G\frac{m_1m_2}{r^2} = 3.015 \times 10^{33}\ N \rightarrow 3$ marks

$U = -\frac{Gm_1m_2}{r} = -Fr = -6.03 \times 10^{41}\ J \rightarrow 3$ marks

VII (a) $R = \rho L/A$ so $\frac{R_1}{R_2} = \frac{L_1}{L_2} \cdot \frac{r_1^2}{r_2^2}$ so $3:1$ → 3 marks

(b) Circuit diagram — 2
Kirchhoff, 1st & 2nd laws — 2
$I_g = 0$; $X = \frac{R_1R_3}{R_2}$ (dep. on figure) → 2

(c) Circuit → 2 marks
High resistance series
$I_g \propto$ p.d to be measured } 2 marks
$R = \frac{E}{I_g} - G$ → 2 marks.
expl of Extending I_g as full scale deflection

VIII (a) $\rho = R\frac{\pi r^2}{L} = 0.1884\ \Omega m$
$\sigma = 1/\rho = 5.308\ \Omega^{-1}m^{-1}$ } 1½ + 1½

(b) Circuit ——— 2 marks
Same potential diff } 2 marks
$I = I_1 + I_2$
$1/R_p = \frac{1}{R_1} + \frac{1}{R_2}$ — 2 marks

(c) Circuit diagram — 2 marks
$I_1 = V/R_1 = 3A$ — 2 "
$I_2 = V/R_2 = 0.6A$ — 2 "

IX (a) Quantum theory + $E = h\nu$ → 3 marks

(b) Laws + Explanation
→ (3 + 3 marks)

(c) $\phi = hc/\lambda_0$ If $\lambda < \lambda_0$
Photoelectric effect } 3 marks
$\lambda_0 = 1136.9\ nm > (\lambda = 400\ nm)$ Yes

$K.E_{max} = hc/\lambda - hc/\lambda_0 = 3.2095 \times 10^{-19}\ J$
$= 2.006\ eV$ } 3 marks.

X (a) Advantages of Gas laser → 3 marks

(b) Figure, Components → 2 marks
Pumping, Population inversion → 2 "
Stimulated emission, $\lambda = 694.3\ nm$ (Red) → 2 "

(c) $K.E = \frac{hc}{\lambda} - hc/\lambda_0$ ——— 2 marks
$\lambda = 5 \times 10^{-7}\ m$, $\lambda_0 = 6 \times 10^{-7}\ m$
& after substitution } 2 "
$K.E = 6.626 \times 10^{-20}\ J$ — 2 "