Physic Final Exam

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Q1.a. $\alpha = 6t^4 - 4t^2$ $\alpha = rad/s^2$

$t = s$

$t = 0$ $\omega = +2.5\ rad/s$, $\theta = 1$

(i) α, $t = 2$

$\alpha = 6(2)^4 - 4(2)^2$

$= 80\ rad/s^2$

(ii) ω, $t = 2$

b. $1.5kg$ $t = 5$

$r = 2m$

$\omega = 4\ rev/s$

$= 8\pi\ rad/s$

(i) α

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$2 = 8\pi(5) + \frac{1}{2}\alpha(5)^2$

$2 - 8\pi(5) = \frac{1}{2}\alpha(5)^2$

$\frac{2 - 8\pi(5)}{12.5} = \alpha$

$\alpha = -9.89\ rad/s^2$

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C. $I_0 = 2.4 kgm^2$

$L_0 = 4 kgm^2/s$

$L_f = 0.8 kgm^2/s$

$t = 2$

(i) average torque

$\tau = \frac{0.8 - 4}{2}$

$= -1.6 Nm$ *

(ii) $t = 1.5$

$\theta = \omega_0 t + \frac{1}{2} \alpha t^2$

$\tau = I\alpha \qquad \omega = \frac{L_0}{I}$

$\frac{-1.6}{2.4} = \alpha \qquad \omega = \frac{4}{2.4}$

$\alpha = -0.067 rad/s^2 \qquad = 1.67 rad/s$

$\theta = 1.67(2) + \frac{1}{2}(-0.067)(2)^2$

$= 3.2 rad$

(iii) Work done

$W = Fd$

$= F(r\theta)$

$= \tau\theta$

$= -1.6(3.2)$

$= -5.12 J$

iv) Power

$P = \frac{W}{t}$

$= \frac{-5.12 J}{2}$

$= -2.56 W$

Q2.

a) $m = 450kg$

$900\,km = 900000\,m$

(i) t

$$T^2 = \left(\frac{4\pi^2}{GM}\right) r^3$$

$$= \left(\frac{4\pi^2}{[6.67\times10^{-11}][5.98\times10^{24}]}\right)([6.37\times10^6] + [900000])$$

$$= 7.1956$$

$$T = \sqrt{7.1956}$$

$$= 2.68\,s$$

(ii) Velocity

$$V = \frac{2\pi r}{T}$$

$$= \frac{2\pi([6.37\times10^6 + 900000])}{2.68}$$

$$= 1.7\times10^7\,m/s$$

(iii) $F = \frac{GMm}{r^2}$

$$= \frac{(6.67\times10^{-11})(450)(5.98\times10^{24})}{(6.37\times10^6 + 900000)^2}$$

$$= 3396\,N$$

R E T H
$= 7270000$

(iv) $V = -G\frac{Mm}{r}$

$$= -(6.67\times10^{-11})\left[\frac{(450)(5.98\times10^{24})}{[7270000]}\right]$$

$$= -2.5\times10^{10}\,J$$

Q2b.

height = 8 cm

= 0.08 m

$A = 14cm^2 = 14 \times 10^{-4} m^2$

density = $\rho_c = 0.15 g/cm^3$

$= \frac{0.15 / 1000}{1 \times 10^{-6}}$

$= 150 kg/m^3$

2cm above = 0.02 m

Volume of cylinder

V_c = area x height

$= (14 \times 10^{-4})(0.08)$

$= 1.12 \times 10^{-4}$

(Volume Submerge)

$V_s = (14 \times 10^{-4})(0.06)$

$= 8.4 \times 10^{-5} m^3$

weight (cylinder + ball) = f_b (cylinder + ball)

$\rho_c g V_c + \rho_i g V_{ball} = \rho_w g V_{submerged} + \rho_w g V_{ball}$

$(150)(1.12 \times 10^{-4}) + (7900)(V_{ball}) = 1000(8.4 \times 10^{-5}) + 1000(V_{ball})$

$0.0168 + 7900 V_{ball} = 0.084 + 1000 V_{ball}$

$6900 V_{ball} = 0.0672$

$V_{ball} = 9.74 \times 10^{-6}$

$\frac{4}{3}\pi r^3 = 9.74 \times 10^{-6}$

$r = 0.013 m$

Q2(c)

m = 5kg

k = 2000 N/m

(i) $T = 2\pi\sqrt{\frac{m}{k}}$

$= 2\pi\sqrt{\frac{5}{2000}}$

$= \frac{1}{10\pi}$

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

$f = \frac{1}{\left(\frac{1}{10\pi}\right)}$

$= 3.18\ Hz$

(ii) $x_i = 0.3\ m$

$U_i = \frac{1}{2}kx_i^2$

$= \frac{1}{2}(2000)(0.3)^2$

$= 90\ J$

(iii) K_i

$\frac{1}{2}(m)(v^2)$

$= \frac{1}{2}(5)(20)$

$= 50J$

d) $E = k_i + U_i$

$= 140J$

$E = \frac{1}{2}kx_m^2$

$140J = \frac{1}{2}(2000)(x_m^2)$

$x_m = 0.37\ m$

Q3) a) - one end closed

length = 60 cm
= 0.6 m

third harmonic n = 5

(i) $f = \frac{nv}{4L}$

$= \frac{5(343)}{4(0.6)}$

$= 715\,Hz$

(ii)

b) frequency

wavelength

$= 0.044$

$k = 144$

$k = \frac{2\pi}{\lambda}$

$144 = \frac{2\pi}{\lambda}$

$\lambda = 0.044$

3 c) $V_{c1} = 25$

$V_{c2} = 20$

d) $I = 7 \times 10^{-2}\ W/m^2$

$t = 0.2s$

height $= 100m$

$P = \frac{E}{t}$

(i) $P = I(A)$

$= 4\pi(r^2)(I)$

$= 4\pi (100)^2 (7 \times 10^{-2})$

$= 8796\ W$

(ii) Sound level

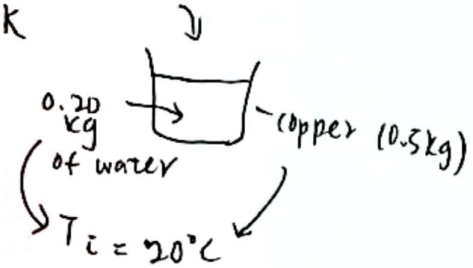
$\beta = 10\log\left(\frac{7 \times 10^{-2}}{1 \times 10^{-12}}\right)$

$= 108\ dB$

Q4.a)

$T = 336\,^{\circ}C$ = 609 K

0.12 kg (iron block)



$-Q_{metal} = Q_{water}$

$-(0.12)(470)(T_f - 336) = (0.5)(390)(T_f - 20) + (0.2)(4186)(T_f - 20)$

$-56.4(T_f - 336) = T_f - 20\,[195 + 837.2]$

$-56.4(T_f - 336) = (T_f - 20)(1032.2)$

$-56.4\,T_f + 18950.4 = 1032.2\,T_f - 20644$

$39594.4 = 1088.6\,T_f$

$\frac{39594.4}{1088.6} = T_f$

$T_f = 36\,^{\circ}C$

b) $\Delta T = 40\,K$

$\alpha = 10 \times 10^{-6}\,K^{-1}$

Δ

c) $T = 298K$

depth $= 14m$

$d = 3cm = 0.03m$

$r = 0.015m$

sphere

$V = \frac{4}{3}\pi r^3$

$pV = nRT$

$(1\times10^5)(V) = n\,(8.31)298$

d) 1900°C (combustion) 2173 K

430°C (exhaust) = 703 K

7.0×10^9 calories produce 1.4×10^{10} J (1 hour)

$7.0\times10^9 \times 4.186$

$= 2.9302\times10^{10}$ J

(i) $\varepsilon = 1 - \left(\frac{T_L}{T_H}\right) \times 100\%$

$= 1 - \left(\frac{703}{2173}\right) \times 100\%$

$= 67.6\%$

Actual $= \frac{1.4\times10^{10}\,J}{2.9302\times10^{10}} \times 100\%$

$= 47.78\%$

(ii) output

$P = \frac{W}{t}$

$= \frac{1.4\times10^{10}}{1\text{hour}}$

$= \frac{1.4\times10^{10}}{3600}$

$= 3.88\times10^6\,W$