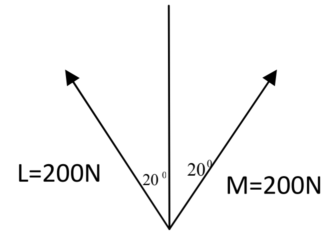
Model Answer – CHU 1140/CHE 3140

2010/2011

Q1. (i)



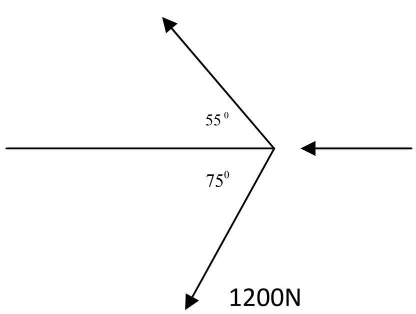
Resultant $\uparrow R = 200\,Cos\,20^0 + 200\,Cos\,20^0$

$= \underline{\underline{375.88N}}$

Direction, vertically upwards

This will give support to the centripetal force which is required to walk.

(ii)



Resultant force $R_x = 1200\,Cos 55^0 + 1200 Cos 75^0$

$R_x = 998.87N$

$\downarrow$, Resultant force $R_y = 1200\,Sin\,75^0 - 1200\,Sin\,55^0$

R_y=176.13N

$$\therefore \text{Resultant } R = \sqrt{R_x^2 + R_y^2}$$
$$= \sqrt{(998.87)^2 + (176.13)^2}$$
$$= \underline{\underline{1014.28N}}$$

Direction with the horizontal,

$$\theta = \tan^{-1}\left(\frac{176.13}{998.87}\right)$$
$$= \underline{\underline{10^0}}$$

(iii) Taking movements around the knee,

$$F_Q \text{x} \frac{2}{10^2} - 40\text{x}\frac{20}{10^2} - 100\frac{38}{10^2} = 0$$

$$F_Q = 40\text{x}10 - 100\text{x}19$$

$$\underline{\underline{F_Q = 2300N}}$$

Q2 (i) (a) Power $P = \frac{W}{t}$

= mgh/t

=60x10x2/7.0

$= \underline{\underline{171.4W}}$

(b) Power $P = \frac{W}{t}$

=mgh/t

= 60x10x2/2

$= \underline{\underline{600W}}$

(ii) $Ex\frac{20}{100} = 60x10x2$

$E = \underline{\underline{6000J}}$

(iii) (a) Thermal energy = 6000-60x10x2

=6000-1200

= $\underline{\underline{4800\text{J}}}$

(b) Rate of production of thermal energy when he walks up $= \frac{4800}{7}$

$= \underline{\underline{685.71W}}$

(c) Rate of production of thermal energy when he runs up $= \frac{4800}{2}$

$= \underline{\underline{2400W}}$

Q3 (a). Please refer the book

(b) (i) short sight

(ii) Concave lenses

(iii) $u = \alpha, v = +0.50m, f = ?$

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

$$\frac{1}{+0.50} - \frac{1}{\alpha} = \frac{1}{f}$$

$$\frac{1}{f} = \frac{+1}{0.50}$$

$$P = \frac{-100}{50} = -2D$$

(iv) $v = +0.20m, f = +0.50m, u + ?$

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

$$\frac{1}{0.20} - \frac{1}{u} = \frac{1}{0.50}$$

$$\frac{1}{0.20} - \frac{-1}{0.50} = \frac{1}{u}$$

$$\frac{0.3}{0.20x0.50} = \frac{1}{u}$$

$$u = \frac{1}{3}$$

$$\underline{\underline{u = 0.33m}}$$

(c) (i) This is usually, due to the surface of the cornea not being spherical. The eye has different focal lengths in different planes.

(ii) Astigmatism can be corrected by using a suitably oriented cylindrical lens.

Q4 (a) (i) & (ii)

(iii) It takes account of the fact that loudness is frequency dependent.

(b) (i) S=ut

=331x4

= 1324m

=1.3km

The distance between the lighting stroke and the observation site = $\underline{\underline{1.3km}}$

(ii) The peak sound intensity = I Wm^{-2}

$$100 = 10\log_{10}\left(\frac{I}{I_o}\right)$$

$$100 = 10\log_{10}\left(\frac{I}{10^{-12}}\right)$$

$$10 = \log_{10}\left(\frac{I}{10^{-12}}\right)$$

$$\log_{10}10^{10} = \log_{10}\left(\frac{I}{10^{-12}}\right)$$

$$10^{10} = \frac{I}{10^{-12}}$$

$$\therefore I = 10^{-2}Wm^{-2}$$

$$\underline{\underline{\therefore \text{The peaksound intensity} = 1x10^{-2}Wm^{-2}}}$$

(iii) The peak acoustic power = P W

$$\frac{P}{4\pi(1324)^2} = 10^{-2}$$

$$P = 4\pi(1324)^2 x10^{-2}$$

$$\underline{\underline{P = 2.2x10^5 W}}$$

(c) (i) B_1, Malleus

B_2, Incus

B_3, stapes

(ii) By taking movements around P,

$$F_T.\ell_T = F_o.\ell_o$$

$$\therefore F_o = F_T.(\ell_T / \ell_o)$$

(iii) $P_o = \frac{F_o}{A_o}$ & $P_T = \frac{F_T}{A_T}$

$$\therefore \frac{F_o}{A_o A_T} = \frac{F_T}{A_o A_T}.\frac{\ell_T}{\ell_o}$$

$$\therefore \frac{P_o}{A_T} = \frac{P_T}{A_o}.\frac{\ell_T}{\ell_o}$$

$$\underline{\underline{P_o = P_{T.}(A_T \ell_T / A_o.\ell_o)}}$$

Q5 (a) (i) Please refer the book.

(iI) Please refer the book.

(b) (i) $A_1V_1=A_2V_2$

A_1-cross section area of a capillary

A_2- cross section area of aorta

V_1- velocity of blood flow through a capillary and

V_2- velocity of blood flow through aorta

$$\pi(3x10^{-6})^2.V_1 = \pi(1.2x10^{-2})^2 x20x10^{-2}$$

$$V_1 = \frac{20x10^{-2}x1.2^2x10^{-4}}{9x10^{-12}}$$

$$V_1 = \underline{\underline{3.2x10^6 ms^{-1}}}$$

(ii) On average,

Time a red blood cell spend in a capillary= $\frac{\ell}{\upsilon}$

$$= \frac{0.75x10^{-3}}{3.2x10^{6}} s$$
$$= 2.34x10^{-9} s$$
$$= \underline{\underline{2.34ns}}$$

(c) The total area of all the capillary walls $= \left(2\text{x}\pi\text{x}\left(3x10^{-6}\right)\text{x}0.75\text{x}10^{-3}\right)12\text{x}10^{9}$

=169.65m^2

The total surface area of all the red blood cells $= 2\pi\text{x}4\text{x}10^{-6}\text{x}2\text{x}10^{-6}\text{x}5\text{x}10^{12}\text{x}5\text{x}10^{3}$

$= 4\pi\text{x}10^{5}$

=1.26x10^{6}m^2

Ratio between two areas = $\frac{1.26\text{x}10^{6}}{169.56}$

= $7.43\text{x}10^{3}$

7000

Q6. (a) Let m be the mass of water this cyclist evaporate.

$$400\text{x}\frac{80}{100}\text{x}60 = m\text{x}L$$
$$m = 400\text{x}\frac{80}{100}\text{x}60\text{x}\frac{1}{2436x10^{3}} kg$$
$$= 7.9\text{x}10^{-3} kg$$

(b) $Q = mc\Delta\theta$

$$\Delta\theta = Q / mc$$
$$= 400\text{x}\frac{80}{100}\text{x}60\text{x}\frac{60}{78x3.47x10^{3}}\,{}^{0}C$$
$$\underline{\underline{\Delta\theta = 4.3^{0} c}}$$

(c) (i) His power consumption $= \frac{4.10x10^4}{60}$

$= \underline{\underline{683W}}$

(ii) His power output in useful work $= \frac{1200x70x9.81}{4x60x60}$

$= \underline{\underline{57.23W}}$

(iii) His efficiency $= \frac{1200x70x9.81}{4.10x10^4 x4x60} x100$

$= \underline{\underline{8.37\%}}$