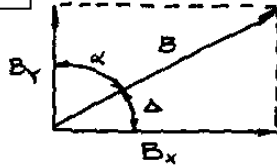


4.1


 GIVEN: $B_x = 7.2\text{m}$, $\Delta = 35^\circ$

 FIND: α , B_y , B

SOLUTION:

$$\alpha = 90^\circ - 35^\circ = \underline{\underline{55^\circ}}$$

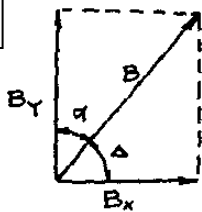
$$\tan \Delta = \frac{B_y}{B_x}$$

$$\begin{aligned} B_y &= B_x \tan \Delta \\ &= (7.2\text{m})(\tan 35^\circ) \\ &= 5.04 \approx \underline{\underline{5.0\text{m}}} \end{aligned}$$

$$\cos \Delta = \frac{B_x}{B}$$

$$\begin{aligned} B &= \frac{B_x}{\cos \Delta} = \frac{7.2\text{m}}{\cos 35^\circ} \\ &= 8.79 \approx \underline{\underline{8.8\text{m}}} \end{aligned}$$

4.2


 GIVEN: $\alpha = 51^\circ$, $B_y = 4.9\text{km}$

 FIND: Δ , B_x , B

SOLUTION:

$$\Delta = 90^\circ - 51^\circ = \underline{\underline{39^\circ}}$$

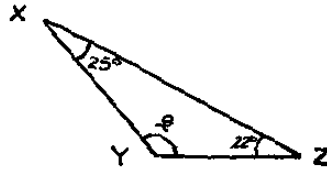
$$\tan \Delta = \frac{B_y}{B_x}$$

$$\begin{aligned} B_x &= \frac{B_y}{\tan \Delta} = \frac{4.9\text{km}}{\tan 39^\circ} \\ &= 6.051 \approx \underline{\underline{6.1\text{km}}} \end{aligned}$$

$$\cos \Delta = \frac{B_x}{B}$$

$$\begin{aligned} B &= \frac{B_x}{\cos \Delta} = \frac{6.051}{\cos 39^\circ} \\ &= 7.79 \approx \underline{\underline{7.8\text{km}}} \end{aligned}$$

4.3


 GIVEN: $YZ = 1.0 \times 10^6\text{m}$

 FIND: XZ

SOLUTION:

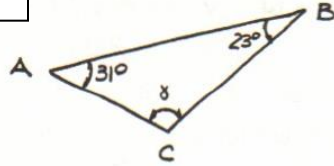
$$\beta = 180^\circ - 25^\circ - 22^\circ = 133^\circ$$

LAW OF SINES

$$\frac{XZ}{\sin \beta} = \frac{YZ}{\sin 25^\circ}$$

$$\begin{aligned} XZ &= \frac{YZ (\sin \beta)}{\sin 25^\circ} \\ &= \frac{(1.0 \times 10^6\text{m})(\sin 133^\circ)}{\sin 25^\circ} \\ &= \underline{\underline{1.7 \times 10^6\text{m}}} \end{aligned}$$

4.4


 GIVEN: $AC = 3.6 \times 10^3 \text{ m}$

 FIND: AB

SOLUTION:

$$\gamma = 180^\circ - 31^\circ - 23^\circ = 126^\circ$$

LAW OF SINES

$$\frac{AB}{\sin \gamma} = \frac{AC}{\sin 23^\circ}$$

$$\begin{aligned} AB &= \frac{AC (\sin \gamma)}{\sin 23^\circ} \\ &= \frac{(3.6 \times 10^3 \text{ m})(\sin 126^\circ)}{\sin 23^\circ} \\ &= \underline{\underline{7.5 \times 10^3 \text{ m}}} \end{aligned}$$

$$\begin{aligned} |\bar{C}| &= \frac{|\bar{B}| \sin \gamma}{\sin \beta} = \frac{(29 \text{ m})(\sin 127^\circ)}{\sin 22^\circ} \\ &= 61.83 \end{aligned}$$

AND

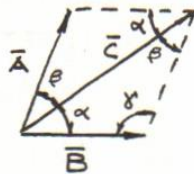
$$\frac{|\bar{A}|}{\sin \alpha} = \frac{|\bar{B}|}{\sin \beta}$$

$$\begin{aligned} |\bar{A}| &= \frac{|\bar{B}| \sin \alpha}{\sin \beta} \\ &= \frac{(29 \text{ m})(\sin 31^\circ)}{\sin 22^\circ} \\ &= 39.87 \end{aligned}$$

$$\bar{A} = 40 \text{ m } \angle 53^\circ$$

$$\bar{C} = \underline{\underline{62 \text{ m } \angle 31^\circ}}$$

4.5


 GIVEN: \bar{B} IS HORIZONTAL
 $\alpha = 31^\circ$, $\beta = 22^\circ$, $|\bar{B}| = 29 \text{ m}$

 FIND: $|\bar{A}|$, $|\bar{C}|$

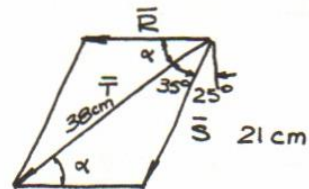
SOLUTION:

LAW OF SINES

$$\begin{aligned} \gamma &= 180^\circ - \alpha - \beta \\ &= 180^\circ - 31^\circ - 22^\circ = 127^\circ \end{aligned}$$

$$\frac{|\bar{C}|}{\sin \gamma} = \frac{|\bar{B}|}{\sin \beta}$$

4.6


 FIND: \bar{R}

SOLUTION:

LAW OF COSINES

$$\begin{aligned} |\bar{R}|^2 &= |\bar{S}|^2 + |\bar{T}|^2 - 2|\bar{S}||\bar{T}| \cos 35^\circ \\ |\bar{R}|^2 &= (21)^2 + (38)^2 - (2)(21)(38) \cos 35^\circ \\ |\bar{R}|^2 &= 577.63 \\ |\bar{R}| &= 24.03 \end{aligned}$$

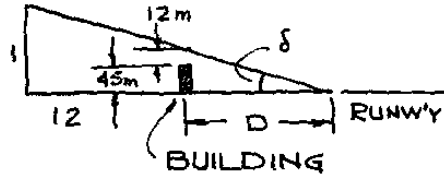
LAW OF SINES

$$\frac{\sin \alpha}{21} = \frac{\sin 35^\circ}{24.03}$$

$$\alpha = \sin^{-1} \left[\frac{(21) \sin 35^\circ}{24.03} \right] = 30.0^\circ$$

$$\bar{R} = \underline{\underline{24 \text{ cm } \leftarrow \text{HORIZONTAL}}}$$

4.7



$$\tan \delta = \frac{1}{12} = \frac{(45+12)m}{D}$$

$$D = 12(45+12) = 684$$

$$\approx \underline{\underline{6.8 \times 10^2 m}}$$

GIVEN: $VW = WX = XY$
 $VY = 20 m$

FIND: XT, XZ

SOLUTION:

$$\tan \beta = \frac{2.5}{10}$$

$$\beta = \tan^{-1}\left(\frac{2.5}{10}\right) = 14.04^\circ$$

$$\sin \beta = \frac{XZ}{XY} = \frac{XZ}{20/3}$$

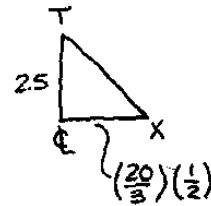
$$XZ = \left(\frac{20}{3}\right) \sin 14.04^\circ$$

$$= 1.62 m \approx \underline{\underline{1.6 m}}$$

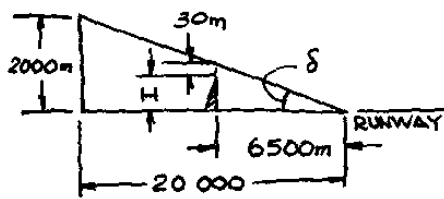
$$XT = \sqrt{(\text{HEIGHT})^2 + (\text{BASE})^2}$$

$$= \sqrt{(2.5)^2 + \left(\frac{20}{6}\right)^2}$$

$$= \underline{\underline{4.2 m}}$$



4.8

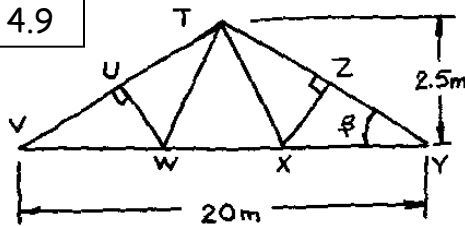


$$\tan \delta = \frac{2000}{20000} = \frac{H+30}{6500}$$

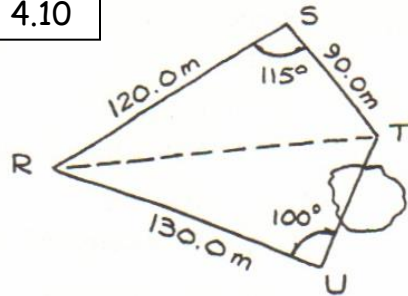
$$H = \left(\frac{2000}{20000}\right)(6500) - 30$$

$$= \underline{\underline{6.2 \times 10^2 m}}$$

4.9



4.10



FIND: UT & AREA OF PLOT

SOLUTION:

LAW OF COSINES

$$\begin{aligned}
 RT^2 &= (RS)^2 + (ST)^2 \\
 &\quad - (2)(ST)(RS) \cos(RST) \\
 &= (120)^2 + (90)^2 \\
 &\quad - (2)(120)(90) \cos 115^\circ \\
 RT &= 177.84 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 RT^2 &= (RU)^2 + (UT)^2 \\
 &\quad - (2)(RU)(UT) \cos(RUT) \\
 &= (130)^2 + (UT)^2 \\
 &\quad - (2)(130)(UT) \cos 100^\circ \\
 &= 177.84
 \end{aligned}$$

$$(UT)^2 + 45.15(UT) - 16722 = 0$$

$$UT = \frac{-45.15 \pm \sqrt{(45.15)^2 - (4)(-16722)}}{2}$$

$$= \frac{-45.15 \pm 262.54}{2}$$

$$= -153.85, 108.70$$

$$\therefore UT = \underline{109 \text{ m}}$$

AREA FORMULA:

$$AREA = \frac{1}{2} (A)(B) \sin C$$



FOR RST:

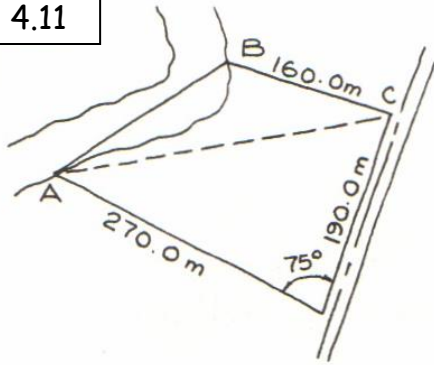
$$\begin{aligned}
 AREA &= \left(\frac{1}{2}\right)(120)(90) \sin 115^\circ \\
 &= 4894.06 \text{ m}^2
 \end{aligned}$$

FOR RUT:

$$\begin{aligned}
 AREA &= \left(\frac{1}{2}\right)(130)(108.70) \sin 100^\circ \\
 &= 6958.16 \text{ m}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{TOTAL AREA} &= 11852 \\
 &\cong \underline{\underline{1.19 \times 10^4 \text{ m}^2}}
 \end{aligned}$$

4.11



FIND:
AB & $\angle ABC$

SOLUTION:

LAW OF COSINES

$$\begin{aligned} AC^2 &= (AD)^2 + (CD)^2 \\ &\quad - 2(AD)(CD)\cos(\angle ADC) \\ &= (270)^2 + (190)^2 \\ &\quad - 2(270)(190)\cos 75^\circ \end{aligned}$$

$$AC = 287.13 \text{ m}$$

FROM THE LAW OF
SINES:

$$\frac{\sin \angle ACD}{270} = \frac{\sin 75^\circ}{287.13}$$

$$\begin{aligned} \angle ACD &= \sin^{-1} \left[\left(\frac{270}{287.13} \right) \sin 75^\circ \right] \\ &= 65.2714^\circ \end{aligned}$$

THEN

$$\begin{aligned} \angle BCA &= 90^\circ - 65.2714^\circ \\ &= 24.7286^\circ \end{aligned}$$

AGAIN FROM THE LAW
OF COSINES:

$$\begin{aligned} (AB)^2 &= (AC)^2 + (BC)^2 \\ &\quad - 2(AC)(BC)\cos(\angle BCA) \\ &= (287.13)^2 + (160)^2 \\ &\quad - 2(287.13)(160)\cos 24.7286^\circ \end{aligned}$$

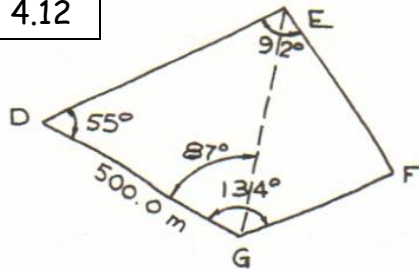
$$AB = 156.80 \text{ m} \cong \underline{\underline{156.8 \text{ m}}}$$

FROM LAW OF SINES:

$$\frac{\sin \angle ABC}{AC} = \frac{\sin \angle BCA}{AB}$$

$$\begin{aligned} \angle ABC &= \sin^{-1} \left[\frac{AC}{AB} \sin \angle BCA \right] \\ &= \sin^{-1} \left[\frac{287.13}{156.80} \sin 24.7286^\circ \right] \\ &= \underline{\underline{130.0^\circ}} \end{aligned}$$

4.12



FIND: DE, EF, FG, EG

SOLUTION:

$$\angle DEG = 180^\circ - 55^\circ - 87^\circ = 38^\circ$$

FROM LAW OF SINES:

$$\frac{\sin 38^\circ}{500.0} = \frac{\sin 87^\circ}{DE}$$

$$DE = (500) \frac{\sin 87^\circ}{\sin 38^\circ}$$

$$= 811.022 \text{ m}$$

$$\frac{\sin 38^\circ}{500.0} = \frac{\sin 55^\circ}{EG}$$

$$EG = (500.0) \frac{\sin 55^\circ}{\sin 38^\circ}$$

$$= 665.262 \text{ m}$$

$$\angle GEF = 92^\circ - 38^\circ = 54^\circ$$

$$\angle EGF = 134^\circ - 87^\circ = 47^\circ$$

$$\text{THEN } \angle GFE = 180^\circ - 54^\circ - 47^\circ$$

$$\angle GFE = 79^\circ$$

FROM THE LAW OF SINES

$$\frac{\sin 54^\circ}{FG} = \frac{\sin 79^\circ}{665.262}$$

$$FG = (665.262) \frac{\sin 54^\circ}{\sin 79^\circ}$$

$$= 548.28 \text{ m}$$

$$\frac{\sin 47^\circ}{EF} = \frac{\sin 79^\circ}{665.262}$$

$$EF = (665.262) \left(\frac{\sin 47^\circ}{\sin 79^\circ} \right)$$

$$= 495.65 \text{ m}$$

RESULTS:

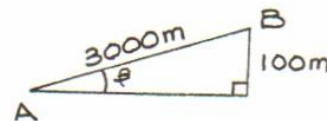
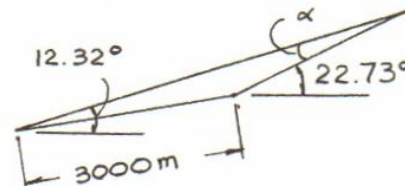
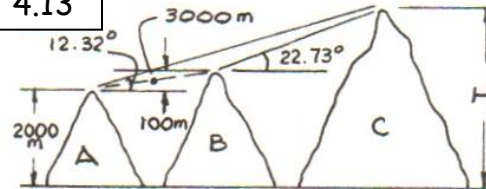
$$DE = 811.0 \text{ m}$$

$$EF = 495.7 \text{ m}$$

$$FG = 548.3 \text{ m}$$

$$\underline{\underline{EG = 665.3 \text{ m}}}$$

4.13



DETERMINE: H

$$\sin \beta = \frac{100}{3000}$$

$$\beta = \sin^{-1} \left[\frac{100}{3000} \right] = 1.910^\circ$$

$$\alpha = 22.73^\circ - 12.32^\circ = 10.41^\circ$$

$$\frac{\sin \alpha}{3000} = \frac{\sin (12.32 - 1.910)}{BC}$$

$$= \frac{\sin 10.41}{3000}$$

4.13 con't.

$$BC = \frac{3000 \sin (12.32 - 1.910)}{\sin 10.41}$$

$$= 3000 \text{ m}$$

$$H = 2000 + 100 + BC \sin 22.73^\circ$$

$$= 2000 + 100 + (3000)(\sin 22.73^\circ)$$

$$= \underline{\underline{3259 \text{ m}}}$$

LENGTH OF BELT ON SMALL PULLEY

$$L_2 = R_2 \theta_2 = (10)(3.2166)$$

$$= 31.041 \text{ cm}$$

TOTAL BELT LENGTH =

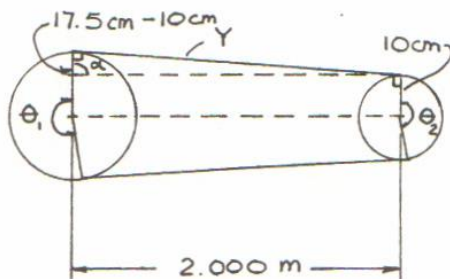
$$L_1 + L_2 + 2Y =$$

$$56.2905 + 31.041 + 2(199.78)$$

$$\cong \underline{\underline{486.9 \text{ cm}}}$$

4.14

ROTATING SAME DIRECTION



$$\cos \alpha = \frac{7.5}{200} \Rightarrow \alpha = 87.85^\circ$$

$$Y = 7.5 \tan 87.85^\circ \cong 199.78 \text{ cm}$$

$$\theta_1 = \pi + \frac{2(90 - 87.85)\pi}{180} = 3.2166 \text{ rad.}$$

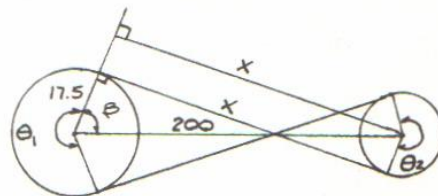
$$\theta_2 = \pi - \frac{2(90 - 87.85)\pi}{180} = 3.1041 \text{ rad.}$$

LENGTH OF BELT ON LARGE PULLEY

$$L_1 = R_1 \theta_1 = (17.5)(3.2166)$$

$$= 56.2905 \text{ cm}$$

ROTATING OPPOSITE DIRECTIONS:



ASSUMPTION: NEGLECT CROSSOVER INTERFERENCE

$$\cos \beta = \frac{17.5 + 10}{200} \Rightarrow \beta = 82.10^\circ$$

$$X = 27.5 \tan 82.10^\circ = 198.18 \text{ cm}$$

LENGTH OF BELT ON LARGE PULLEY

$$L_1 = R_1 \theta_1$$

$$= (17.5) \left[\pi + \frac{2(90 - 82.10)\pi}{180} \right]$$

$$= 59.804 \text{ cm}$$

LENGTH OF BELT ON SMALL PULLEY

$$L_2 = R_2 \theta_2$$

$$= (10) \left[\pi + \frac{2(90 - 82.10)\pi}{180} \right]$$

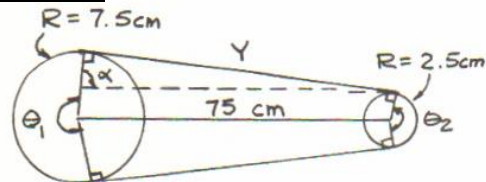
$$= 34.174 \text{ cm}$$

4.10 con't.

$$\begin{aligned}
 \text{TOTAL BELT LENGTH} &= \\
 L_1 + L_2 + 2X &= \\
 59.806 + 34.174 + 2(198.18) &= \\
 \underline{\underline{490.3 \text{ cm}}}
 \end{aligned}$$

$$\begin{aligned}
 \text{TOTAL CHAIN LENGTH} \\
 (\text{NO SLACK}) &= L_1 + L_2 + 2Y \\
 &= 24.56 + 7.52 + 2(74.88) \\
 &= \underline{\underline{1.8 \times 10^2 \text{ cm}}}
 \end{aligned}$$

4.15



$$\cos \alpha = \frac{7.5 - 2.5}{75} = \frac{5.0}{75}$$

$$\Rightarrow \alpha = 86.18^\circ$$

$$Y = 5.0 \tan 86.18^\circ = 74.88 \text{ cm}$$

$$\theta_1 = \pi + \frac{2(90 - 86.18)\pi}{180}$$

$$\theta_2 = \pi - \frac{2(90 - 86.18)\pi}{180}$$

LENGTH OF CHAIN ON
LARGE SPROCKET

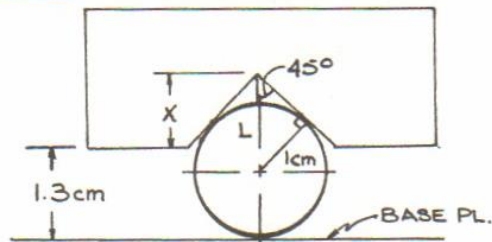
$$\begin{aligned}
 L_1 &= R_1 \theta_1 \\
 &= (7.5) \left[\pi + \frac{2(90 - 86.18)\pi}{180} \right]
 \end{aligned}$$

$$= 24.56 \text{ cm}$$

LENGTH OF CHAIN ON
SMALL SPROCKET

$$\begin{aligned}
 L_2 &= R_2 \theta_2 \\
 &= (2.5) \left[\pi - \frac{2(90 - 86.18)\pi}{180} \right] \\
 &= 7.52 \text{ cm}
 \end{aligned}$$

4.16



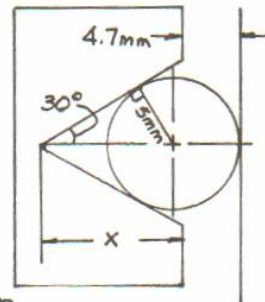
$$\sin 45^\circ = \frac{1 \text{ cm}}{L}$$

$$L = \frac{1 \text{ cm}}{\sin 45^\circ} = 1.414 \text{ cm}$$

$$X + 1.3 \text{ cm} = L + 1 \text{ cm}$$

$$X = 1.414 + 1 - 1.3 = \underline{\underline{1.1 \text{ cm}}}$$

4.17



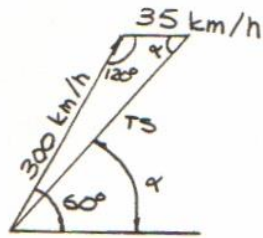
$$\sin 30^\circ = \frac{5 \text{ mm}}{L}$$

$$\begin{aligned}
 L &= \frac{5 \text{ mm}}{\sin 30^\circ} \\
 &= 10.00 \text{ mm}
 \end{aligned}$$

$$X + 4.7 \text{ mm} = L + 5 \text{ mm}$$

$$X = 10.00 + 5 - 4.7 = \underline{\underline{10.3 \text{ mm}}}$$

4.18



LAW OF COSINES

$$(TS)^2 = (300)^2 + (35)^2 - (2)(300)(35) \cos 120^\circ$$

$$TS = 318.94 \text{ km/h}$$

LAW OF SINES

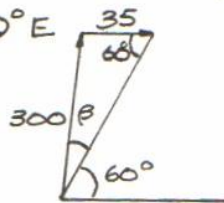
$$\frac{\sin \alpha}{300} = \frac{\sin 120^\circ}{318.94}$$

$$\alpha = \sin^{-1} \left[\frac{300}{318.94} \sin 120^\circ \right]$$

$$= 54.55^\circ$$

$$\underline{\underline{TS = 320 \text{ km/h N } 35^\circ \text{ E}}}$$

FOR A TRUE HEADING OF N 30° E



LAW OF SINES

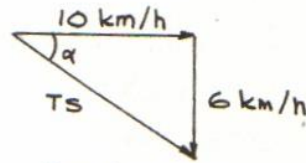
$$\frac{\sin 60^\circ}{300} = \frac{\sin \beta}{35}$$

$$\beta = \sin^{-1} \left[\frac{35}{300} \sin 60^\circ \right] = 5.8^\circ$$

$$(60^\circ + 5.8^\circ = 65.8^\circ)$$

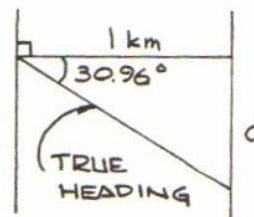
PILOT SHOULD FLY N 24° E
FOR A TRUE HEADING OF
N 30° E.

4.19



$$\tan \alpha = \frac{6 \text{ km/h}}{10 \text{ km/h}} = \frac{6}{10}$$

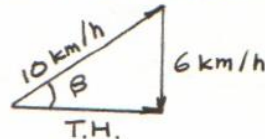
$$\alpha = \tan^{-1} \frac{6}{10} = 30.96^\circ$$



$$\tan 30.96^\circ = \frac{d}{1 \text{ km}}$$

$$d = 1 \tan 30.96^\circ = 0.6 \text{ km DOWN-STREAM}$$

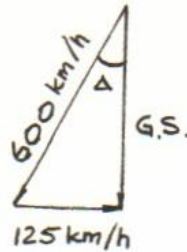
TO REACH OPPOSITE BANK
DIRECTLY ACROSS FROM
DOCK, MUST HAVE TRUE
HEADING \perp TO BANK



$$\sin \beta = \frac{6}{10}$$

$$\beta = \sin^{-1} \frac{6}{10} = \underline{\underline{36.87^\circ}}$$

4.20



$$\sin \Delta = \frac{125}{600}$$

$$\Delta = \sin^{-1} \left[\frac{125}{600} \right] = 12.02^\circ$$

$$\tan \Delta = \frac{125}{GS}$$

$$GS = \frac{125}{\tan 12.02^\circ} = 587.07 \text{ km/h}$$

HEADING MUST BE S12.0°W

TRUE GROUND SPEED = 587 km/h

4.21

WORST CASE

~~888~~

0.250"

$$300 \text{ PINS/h} (3h) = 900 \text{ pins}$$

$$A_{900 \text{ pins}} = (0.150)^2 (900) = 20.25 \text{ in}^2$$

$$A_{\text{missing}} = \frac{1}{2} (0.150)(0.150) = 0.01125 \text{ in}^2$$

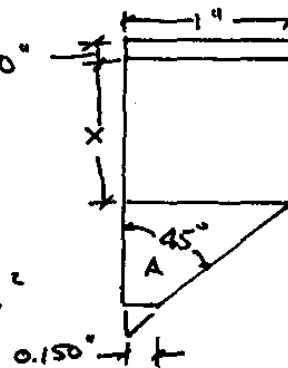
$$A_A = \left(\frac{1}{2} \right) (1.000)(1.000) - 0.01125 \\ = 0.48875 \text{ in}^2$$

$$(x)(1) + 0.48875 = 20.25$$

$$x = 19.761 \text{ in}$$

ADD 0.250"

$$\text{HEIGHT} = 19.761 + 0.250 = \underline{\underline{20''}}$$



4.22

MOUNTAIN:

$$(a) \quad C = \pi d = \pi(26) = 81.6814 \text{ in}$$

$$\frac{480 \text{ mi} \left| \frac{5280 \text{ ft}}{\text{mi}} \right| \frac{12 \text{ in}}{\text{ft}}}{\text{mi}} = 3.04128 \times 10^7 \text{ in}$$

$$\text{REVOLUTIONS} = \frac{3.04128 \times 10^7}{81.6814} = 372\,334 \text{ REV}$$

TOURING:

$$C = \pi(27) = 84.8230 \text{ in}$$

$$\text{REVOLUTIONS} = \frac{3.04128 \times 10^7}{84.8230} = 358\,544 \text{ REV}$$

$$\text{DIFFERENCE} = 372\,334 - 358\,544 = \underline{\underline{13\,790 \text{ REV}}}$$

$$(b) \quad 21 \text{ TEETH} : 42 \text{ TEETH}$$

$$1 \text{ REV} : 2 \text{ REV}$$

$$\left(\frac{13\,790}{2} \right) (0.85) = \underline{\underline{5861 \text{ REV}}}$$

$$(c) \quad 170 \text{ mm} = 6.6929 \text{ in}$$

$$S = 2\pi r = 42.0528 \text{ in}$$

MOUNTAIN:

$$\text{REV OF CHAINWHEEL} = (0.5)(372\,334)(0.85)$$

$$= 158\,242 \text{ REV}$$

$$\text{TOTAL PEDAL TRAVEL} = (158\,242)(42.0528) \text{ in}$$

$$= 105.027 \text{ mi}$$

$$\text{MA} = \frac{480 \text{ mi}}{105.027 \text{ mi}} = \underline{\underline{457\%}}$$

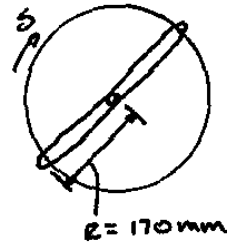
TOURING:

$$\text{REV OF CHAINWHEEL} = (0.5)(358\,544)(0.85) = 152\,381 \text{ REV}$$

$$\text{TOTAL PEDAL TRAVEL} = (152\,381)(42.0528) \text{ in}$$

$$= 101.137 \text{ mi}$$

$$\text{MA} = \frac{480 \text{ mi}}{101.137 \text{ mi}} = \underline{\underline{475\%}}$$



4.23

$$x = [(2.400)^2 - (1.200)^2]^{1/2} = 2.078 \text{ in}$$

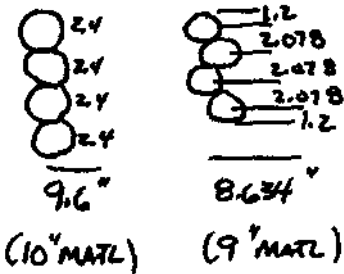
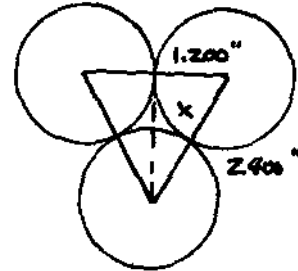
FOR CONFIGURATION SHOWN, 20 STAMPINGS/FT.

$$\text{NEED } \frac{38000}{20} = 1900 \text{ LINEAR FT.}$$

WITH 1" NARROWER MAT'L

$$(1900) \left(\frac{1}{12}\right) = 158.33 \text{ ft}^2 \text{ SAVED}$$

$$\begin{aligned} \frac{1}{2} \text{ SAVED} &= (158.33 \text{ ft}^2)(3.20 \text{ lb/ft}^2) \left(\frac{1}{2}\right) \\ &= \underline{\underline{101.33}} \end{aligned}$$

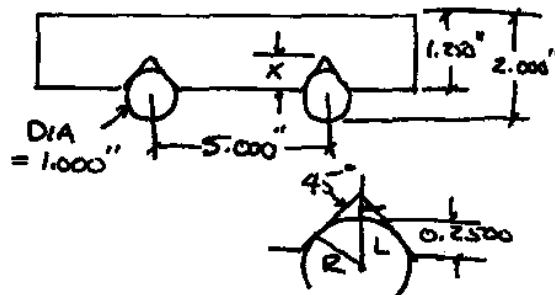


4.24

$$(a) \quad L = \frac{R}{\sin 45^\circ} = \frac{0.2500}{\sin 45^\circ} = 0.7071 \text{ in}$$

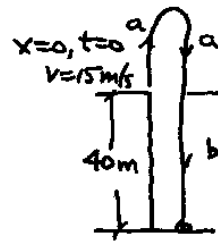
$$\begin{aligned} \text{DEPTH} &= 0.7071 - 0.2500 \\ &= \underline{\underline{0.4571 \text{ DEEP}}} \end{aligned}$$

$$(b) \quad h = 5 \sin 22.5^\circ = \underline{\underline{1.913 \text{ in}}}$$



4.25

ASSUME NO AIR FRICTION



(a) $V = \underline{0 \text{ m/s}}$

(b) $V^2 = V_0^2 + 2a(x - x_0)$

$$x = \frac{V^2 - V_0^2}{2a} + x_0$$

$$= \frac{0^2 - (15)^2}{2(-9.807)} + 0 = \underline{11.5 \text{ m}}$$

(c) $\underline{15 \text{ m/s Downward}}$

(d) $V^2 = V_0^2 + 2a(x - x_0)$

$$V = \left[(15)^2 + 2(9.807)(40 - 0) \right]^{1/2}$$

$$= \underline{31.8 \text{ m/s}}$$

(e) $V = V_0 + at$

$$t = \frac{V - V_0}{a} = \frac{31.77 + 15}{9.807} = \underline{4.77 \text{ s}}$$

4.26

$V_y = (28)(\sin 15^\circ) = 7.2469 \text{ m/s}$

$V_x = (28)(\cos 15^\circ) = 27.0459 \text{ m/s}$

$V_y^2 = V_{y0}^2 + 2a(y - y_0)$

$$V_y = \left[(7.2469)^2 + 2(-9.807)(25 - 0) \right]^{1/2}$$

$$= 23.299 \text{ m/s } \downarrow$$

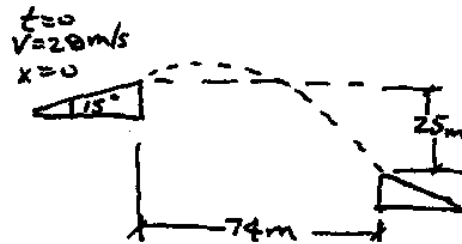
$V = V_0 + at$

$$t = \frac{-23.299 - 7.2469}{-9.807} = \underline{3.11 \text{ s}}$$

(a) $(3.11 \text{ s})(27.05 \text{ m/s}) = 84.125 \text{ m}$

YES WITH 10m TO SPARE

(b) $\underline{3.11 \text{ s}}$

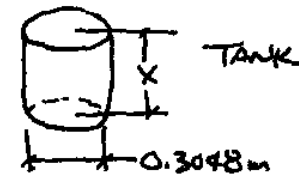
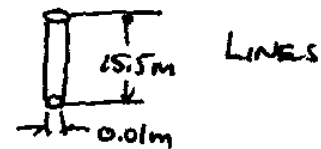
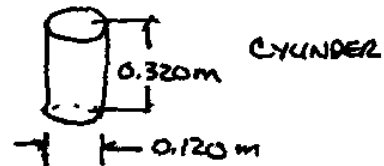


4.27

$$\begin{aligned} \text{VOL}_{\text{CYL}} &= (\pi) \left(\frac{0.120}{2} \right)^2 (0.320) \\ &= 0.003619 \text{ m}^3 \\ 4 \text{ VOL}_{\text{CYL}} &= 0.014476 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} \text{VOL}_{\text{LINES}} &= (\pi) \left(\frac{0.01}{2} \right)^2 (15.5) \\ &= 0.001217 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} \text{VOL}_{\text{TANK}} &= \pi \left(\frac{d}{2} \right)^2 x \\ x &= \frac{(0.014476 + 0.001217)(4.5)}{\pi \left(\frac{0.3048}{2} \right)^2} \\ &= 0.3226 \text{ m} \\ &= \underline{\underline{32.26 \text{ cm}}} \end{aligned}$$



4.28

$$\frac{50 \text{ tons}}{\text{Ton}} \left| \frac{2000 \text{ lb}}{\text{lb}} \right| \frac{2.2 \text{ kg}}{\text{kg}} = 2.20 \times 10^5 \text{ kg CAL}$$

$$\text{ENERGY} = (2.20 \times 10^5) (6.2 \times 10^6) = 1.364 \times 10^{12} \text{ J}$$

$$\epsilon = \frac{W}{\text{ENERGY}} = \frac{545.6 \times 10^9 \text{ J}}{1.364 \times 10^{12}} = 0.40 \text{ OR } \underline{\underline{40\%}}$$

4.29

$$\rho_{\text{COPPER}} = 1.72 \times 10^{-8} \Omega \cdot \text{m}$$

$$\rho_{\text{AL}} = 2.75 \times 10^{-8} \Omega \cdot \text{m}$$

$$V = 110 \text{ V}$$

$$d = 0.005 \text{ m}$$

$$L = 10000 \text{ m}$$

$$V = IR, R = \frac{\rho L}{A}$$

$$I = \frac{VA}{\rho L}, A = \pi \left(\frac{d}{2}\right)^2$$

$$I = \frac{V \pi \left(\frac{d}{2}\right)^2}{\rho L}$$

$$I_{\text{COPPER}} = \frac{(110 \text{ V}) \pi \left(\frac{0.005}{2}\right)^2}{(1.72 \times 10^{-8})(10000)} = 12.56 \text{ A}$$

$$I_{\text{AL}} = \frac{(110 \text{ V}) \pi \left(\frac{0.005}{2}\right)^2}{(2.75 \times 10^{-8})(10000)} = 7.95 \text{ A}$$

$$\text{DIFFERENCE} = 12.56 - 7.95 = \underline{\underline{4.71 \text{ A}}}$$

4.30

$$n_a \sin \theta_a = n_b \sin \theta_b$$

$$(1) \sin 38^\circ = n_b \sin 23^\circ$$

$$n_b = \underline{\underline{1.58}}$$

