

Fully-Worked Solutions

CHAPTER 5 Trigonometric Ratios

UPSKILL 5.1A

1 (a) Opposite side = PR
Adjacent side = PQ
Hypotenuse = QR

(b) Opposite side = AB
Adjacent side = BC
Hypotenuse = AC

2 (a) $\frac{3}{2}$ (b) $\frac{3}{\sqrt{13}}$ (c) $\frac{2}{\sqrt{13}}$

3 $AB = \sqrt{17^2 - 15^2}$
 $= 8 \text{ cm}$

(a) $\sin \theta = \frac{15}{17}$

(b) $\cos \theta = \frac{8}{17}$

(c) $\tan \theta = \frac{15}{8}$

4 $EF = \sqrt{15^2 - 12^2}$
 $= 9 \text{ cm}$

(a) $\cos \theta = \frac{12}{15} = \frac{4}{5}$

(b) $\tan \theta = \frac{9}{12} = \frac{3}{4}$

(c) $\sin \theta = \frac{9}{15} = \frac{3}{5}$

5 (a) $\tan \theta = \frac{ST}{SR} = \frac{3}{4}$

(b) $RT = \sqrt{3^2 + 4^2} = 5 \text{ units}$

$$\cos \theta = \frac{RS}{RT}$$

$$= \frac{4}{5}$$

(c) $\sin \theta = \frac{ST}{RT} = \frac{3}{5}$

6 (a) $\tan \beta = \frac{JM}{ML} = \frac{12}{5}$

(b) $JL = \sqrt{5^2 + 12^2}$
 $= 13 \text{ cm}$

$$\sin \beta = \frac{JM}{JL} = \frac{12}{13}$$

7 (a) $\frac{KL}{LM} = \frac{KL}{KN} = \frac{5}{2}$

$$\tan \alpha = \frac{5}{2}$$

(b) $\frac{KN}{NT} = \frac{KN}{\frac{1}{2}KL} = 2\left(\frac{KN}{KL}\right)$

$$= 2\left(\frac{2}{5}\right) = \frac{4}{5}$$

$$\tan \theta = \frac{4}{5}$$

8 (a) $\sin \alpha = \frac{TP}{PS} = \frac{20-12}{12}$
 $= \frac{8}{12} = \frac{2}{3}$

(b) $ST = \sqrt{12^2 - 8^2} = \sqrt{80} \text{ cm}$

$$\tan \alpha = \frac{TP}{ST} = \frac{8}{\sqrt{80}}$$

$$= \frac{8}{4\sqrt{5}} = \frac{2}{\sqrt{5}}$$

9 (a) $\cos y = \frac{3}{9} = \frac{1}{3}$

(b) $VM = \sqrt{9^2 - 3^2} = \sqrt{72} = 3\sqrt{8} \text{ cm}$

$$\tan x = \frac{3}{3\sqrt{8}} = \frac{1}{\sqrt{8}}$$

10 (a) $QS = \sqrt{6.5^2 - 2.5^2}$
 $= 6 \text{ cm}$

$$\tan x = \frac{6}{2.5} = \frac{12}{5}$$

(b) $RS = \sqrt{10^2 - 6^2}$
 $= 8 \text{ cm}$

$$\cos y = \frac{8}{10} = \frac{4}{5}$$

11 $\tan \angle B = \frac{\sin \angle B}{\cos \angle B}$

$$= \frac{\frac{8}{17}}{\frac{15}{17}}$$

$$= \frac{8}{15}$$

12 $\sin \theta = \tan \theta \times \cos \theta$

$$= \frac{3}{2} \times \frac{2}{\sqrt{3}}$$

$$= \frac{3}{\sqrt{3}}$$

13 $\cos \theta = \frac{\sin \theta}{\tan \theta}$

$$= \frac{1}{\frac{\sqrt{2}}{1}}$$

$$= \frac{1}{\sqrt{2}}$$

14 (a) (i) $\sin \angle ABC = \frac{AC}{BC}$

$$\frac{p}{12} = \frac{2}{3}$$

$$p = 12 \times \frac{2}{3} = 8 \text{ cm}$$

(ii) $\sin \angle DFE = \frac{DE}{EF}$

$$\frac{p}{36} = \frac{4}{9}$$

$$p = 36 \times \frac{4}{9} = 16 \text{ cm}$$

(iii) $\sin \angle GHJ = \frac{GJ}{HJ}$

$$\frac{15}{p} = \frac{5}{7}$$

$$p = 15 \times \frac{7}{5} = 21 \text{ cm}$$

$$(b) \quad (i) \quad \cos \angle KLM = \frac{KL}{ML}$$

$$\frac{q}{16} = \frac{3}{4}$$

$$q = 16 \times \frac{3}{4} = 12 \text{ cm}$$

$$(ii) \quad \cos \angle NQP = \frac{NQ}{PQ}$$

$$\frac{q}{35} = \frac{5}{7}$$

$$q = 35 \times \frac{5}{7} = 25 \text{ cm}$$

$$(iii) \quad \cos \angle RTS = \frac{RT}{ST}$$

$$\frac{12}{q} = 0.4$$

$$q = \frac{12}{0.4} = 30 \text{ cm}$$

$$(c) \quad (i) \quad \tan \angle UWV = \frac{UV}{UW}$$

$$\frac{r}{18} = \frac{5}{6}$$

$$r = 18 \times \frac{5}{6} = 15 \text{ cm}$$

$$(ii) \quad \tan \angle XZY = \frac{XY}{XZ}$$

$$\frac{r}{20} = 1.2$$

$$r = 1.2 \times 20 \text{ cm} = 24 \text{ cm}$$

$$(iii) \quad \tan \angle ACB = \frac{AB}{AC}$$

$$\frac{8.4}{r} = 0.7$$

$$r = \frac{8.4}{0.7} = 12 \text{ cm}$$

$$15 \quad \text{In } \triangle RST, \quad \cos \theta = \frac{SR}{ST}$$

$$\frac{2}{3} = \frac{SR}{12}$$

$$SR = 12 \times \frac{2}{3}$$

$$= 8 \text{ cm}$$

$$SR : SQ = 2 : 5 \rightarrow \frac{8}{SQ} = \frac{2}{5}$$

$$SQ = 8 \times \frac{5}{2}$$

$$= 20 \text{ cm}$$

$$\text{In } \triangle PQS, \quad \sin \alpha = \frac{PS}{SQ}$$

$$\frac{3}{5} = \frac{PS}{20}$$

$$PS = 20 \times \frac{3}{5}$$

$$= 12 \text{ cm}$$

$$PQ = \sqrt{20^2 - 12^2}$$

$$= \sqrt{256}$$

$$= 16 \text{ cm}$$

UPSKILL 5.1B

$$1 \quad (a) \quad \sin 45^\circ = \frac{1}{1} = 1$$

$$(b) \quad BC = \sqrt{CD^2 - BD^2} = \sqrt{2^2 - 1^2} = \sqrt{3}$$

$$\tan 60^\circ = \frac{\sqrt{3}}{1} = \sqrt{3}$$

$$(c) \quad \cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$2 \quad (a) \quad \sin \theta = \frac{3\sqrt{2}}{6\sqrt{2}} = \frac{1}{2} \quad (b) \quad 30^\circ$$

$$3 \quad (c) \quad \tan \alpha = \frac{2}{\left(\frac{2}{\sqrt{3}}\right)} = \sqrt{3} \quad (d) \quad 60^\circ$$

$$4 \quad (a) \quad \cos y = \frac{\sqrt{12}}{4} = \frac{2\sqrt{3}}{4} = \frac{\sqrt{3}}{2}$$

$$(b) \quad 30^\circ$$

$$5 \quad (a) \quad \tan z = \frac{4\sqrt{3}}{12} = \frac{\sqrt{3}}{3} = \frac{\sqrt{3} \times \sqrt{3}}{3 \times \sqrt{3}} = \frac{1}{\sqrt{3}}$$

$$(b) \quad 30^\circ$$

$$6 \quad (a) \quad 6 \cos 60^\circ - 2 \sin 30^\circ = 6\left(\frac{1}{2}\right) - 2\left(\frac{1}{2}\right)$$

$$= 3 - 1 = 2$$

$$(b) \quad 5 \sin 60^\circ + 9 \cos 30^\circ = 5\left(\frac{\sqrt{3}}{2}\right) + 9\left(\frac{\sqrt{3}}{2}\right)$$

$$= 7\sqrt{3}$$

$$(c) \quad \frac{1}{2} \tan 45^\circ + 5 \cos 60^\circ = \frac{1}{2}(1) + 5\left(\frac{1}{2}\right)$$

$$= 3$$

$$(d) \quad 4 \tan 60^\circ - 2 \sin 60^\circ = 4(\sqrt{3}) - 2\left(\frac{\sqrt{3}}{2}\right)$$

$$= 3\sqrt{3}$$

$$(e) \quad 8 \cos 30^\circ - \tan 60^\circ = 8\left(\frac{\sqrt{3}}{2}\right) - \sqrt{3}$$

$$= 3\sqrt{3}$$

$$(f) \quad \sqrt{2} \sin 45^\circ - \frac{1}{\sqrt{2}} \cos 45^\circ = \sqrt{2}\left(\frac{1}{\sqrt{2}}\right) - \frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\right)$$

$$= 1 - \frac{1}{2} = \frac{1}{2}$$

$$(g) \quad 2(\tan 30^\circ)^2 + (\cos 45^\circ)^2 = 2\left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2$$

$$= \frac{2}{3} + \frac{1}{2}$$

$$= \frac{4+3}{6}$$

$$= \frac{7}{6}$$

$$(h) \quad 3(\cos 30^\circ)^2 + 2(\sin 45^\circ)^2 = 3\left(\frac{\sqrt{3}}{2}\right)^2 + 2\left(\frac{1}{\sqrt{2}}\right)^2$$

$$= \frac{9}{4} + 1$$

$$= \frac{13}{4}$$

$$(i) \quad (2 \tan 60^\circ)^2 - (4 \sin 60^\circ)^2 = 4(\sqrt{3})^2 - 16\left(\frac{\sqrt{3}}{2}\right)^2$$

$$= 12 - 12 = 0$$

$$(j) \quad 6(\tan 30^\circ)^2 - (2 \cos 45^\circ)^2 = 6\left(\frac{1}{\sqrt{3}}\right)^2 - 4\left(\frac{1}{\sqrt{2}}\right)^2$$

$$= 2 - 2 = 0$$

7 (a) In $\triangle PQR$,

$$\cos 60^\circ = \frac{PQ}{QR}$$

$$\frac{1}{2} = \frac{PQ}{12}$$

$$PQ = \frac{1}{2} \times 12$$

$$= 6 \text{ cm}$$

(b) In $\triangle RST$,

$$\sin 30^\circ = \frac{RT}{ST}$$

$$\frac{1}{2} = \frac{RT}{10}$$

$$RT = \frac{1}{2} \times 10 \\ = 5 \text{ cm}$$

(c) In ΔRST ,

$$\cos 30^\circ = \frac{RS}{ST}$$

$$\frac{\sqrt{3}}{2} = \frac{RS}{10}$$

$$RS = \frac{\sqrt{3}}{2} \times 10$$

$$= 5\sqrt{3} \text{ cm}$$

8 (a) $8.3^\circ = 8^\circ + (0.3 \times 60)'$
 $= 8^\circ 18'$

(b) $63.7^\circ = 63^\circ + (0.7 \times 60)'$
 $= 63^\circ 42'$

(c) $32.5^\circ = 32^\circ + (0.5 \times 60)'$
 $= 32^\circ 30'$

(d) $87.15^\circ = 87^\circ + (0.15 \times 60)'$
 $= 87^\circ 9'$

(e) $70.25^\circ = 70^\circ + (0.25 \times 60)'$
 $= 70^\circ 15'$

(f) $29.45^\circ = 29^\circ + (0.45 \times 60)'$
 $= 29^\circ 27'$

9 (a) $4^\circ 36' = \left(4 + \frac{36}{60}\right)^\circ$
 $= 4.6^\circ$

(b) $76^\circ 12' = \left(76 + \frac{12}{60}\right)^\circ$
 $= 76.2^\circ$

(c) $20^\circ 54' = \left(20 + \frac{54}{60}\right)^\circ$
 $= 20.9^\circ$

(d) $51^\circ 9' = \left(51 + \frac{9}{60}\right)^\circ$
 $= 51.15^\circ$

(e) $83^\circ 33' = \left(83 + \frac{33}{60}\right)^\circ$
 $= 83.55^\circ$

(f) $54^\circ 51' = \left(54 + \frac{51}{60}\right)^\circ$
 $= 54.85^\circ$

10 (a) 0.9903 (b) 0.6428 (c) 2.3789

(d) 0.1513 (e) 1.6372 (f) 0.8919

11 (a) 65°

(b) 33°

(c) $17.5^\circ (= 17^\circ 30')$

(d) $47.2^\circ (= 47^\circ 12')$

(e) $26.74^\circ (= 26^\circ 44')$

(f) $84.72^\circ (= 84^\circ 43')$

12 (a) $\tan \theta = \frac{7.8}{5}$

$$= 1.56$$

$$\theta = 57^\circ 20'$$

(b) $\cos \theta = \frac{2.5}{3.1}$

$$= 0.80645$$

$$\theta = 36^\circ 15'$$

(c) $\sin \theta = \frac{\sqrt{40}}{11}$

$$= 0.57496$$

$$\theta = 35^\circ 6'$$

(d) $\cos \theta = \frac{25}{40}$

$$= 0.625$$

$$\theta = 51^\circ 19'$$

13 (a) $\frac{x}{20} = \tan 20^\circ$

$$x = 20 \tan 20^\circ \\ = 7.28 \text{ cm}$$

(b) $\frac{x}{12} = \cos 75^\circ$

$$x = 12 \cos 75^\circ \\ = 3.11 \text{ cm}$$

(c) $\frac{4.8}{x} = \sin 53^\circ$

$$x = \frac{4.8}{\sin 53^\circ} \\ = 6.01 \text{ cm}$$

UPSKILL 5.1C

1 $\frac{BC}{18} = \tan 42^\circ$

$$BC = 18 \tan 42^\circ \\ = 16.207 \text{ cm}$$

$$\frac{18}{BD} = \tan 36^\circ$$

$$BD = \frac{18}{\tan 36^\circ}$$

$$= 24.775 \text{ cm}$$

$$CD = 24.775 - 16.207$$

$$= 8.57 \text{ cm}$$

2 (a) $\frac{ST}{8} = \sin 55^\circ$

$$ST = 8 \sin 55^\circ$$

$$= 6.5532 \text{ cm}$$

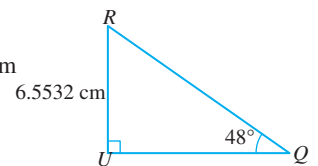
$$= 6.55 \text{ cm}$$

(b) $PT = 8 \cos 55^\circ = 4.59 \text{ cm}$

$$\frac{6.5532}{QU} = \tan 48^\circ$$

$$QU = \frac{6.5532}{\tan 48^\circ} = 5.90 \text{ cm}$$

$$\therefore PQ = 4.59 + 8 + 5.9 \\ = 18.49 \text{ cm}$$



3 $\cos \angle QPR = \frac{5}{6}$

$$\frac{10}{PR} = \frac{5}{6}$$

$$PR = 12 \text{ cm}$$

$$PS = \sqrt{RS^2 - PR^2}$$

$$= \sqrt{208 - 144}$$

$$= \sqrt{64}$$

$$= 8 \text{ cm}$$

$$\tan x = \frac{PS}{PR}$$

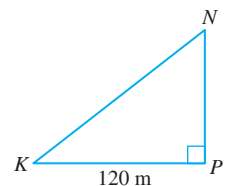
$$= \frac{8}{12} = \frac{2}{3}$$

4 $\frac{NP}{KP} = \tan 41^\circ 35'$

$$NP = 120 \tan 41^\circ 35'$$

$$= 106.48 \text{ m}$$

$$\therefore \text{Height of tower} = 1.2 + 106.48 \\ = 107.68 \text{ m}$$



5 (a) $\angle NPM = 42^\circ$

$$\frac{24}{PN} = \tan 42^\circ$$

$$PN = \frac{24}{\tan 42^\circ}$$

$$= 26.655 \text{ m}$$

(b) $\frac{24}{QN} = \tan 32^\circ$

$$QN = \frac{24}{\tan 32^\circ}$$

$$= 38.408 \text{ m}$$

$$PQ = 38.408 - 26.655 \\ = 11.75 \text{ m}$$

$$6 \text{ (a) } AC = \sqrt{AB^2 + BC^2} \\ = \sqrt{6^2 + 8^2} \\ = 10 \text{ cm}$$

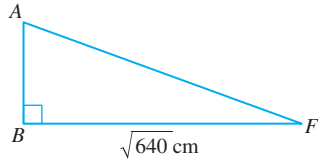
$$\sin \angle ACB = \frac{6}{10} = \frac{3}{5}$$

$$(b) \tan \angle DCF = \frac{DF}{CF} \\ = \frac{10}{24} = \frac{5}{12}$$

$$(c) BF = \sqrt{BC^2 + CF^2} \\ = \sqrt{8^2 + 24^2} \\ = \sqrt{640}$$

$$AF = \sqrt{AB^2 + BF^2} \\ = \sqrt{6^2 + (\sqrt{640})^2} \\ = \sqrt{676} \\ = 26 \text{ cm}$$

$$\cos \angle AFB = \frac{\sqrt{640}}{26} \\ = 0.9730$$



$$7 \text{ (a) In } \triangle OAB, \sin 30^\circ = \frac{2}{OB} \\ OB = 4 \text{ cm}$$

$$\frac{BC}{OB} = \tan 30^\circ$$

$$BC = 4 \tan 30^\circ \\ = 2.31 \text{ cm}$$

$$(b) \text{ In } \triangle OBC, \frac{OB}{OC} = \cos 30^\circ$$

$$OC = \frac{OB}{\cos 30^\circ}$$

$$= \frac{4}{\cos 30^\circ}$$

$$= 4.6188 \text{ cm}$$

$$\text{In } \triangle OCD, \frac{OC}{OD} = \cos 30^\circ$$

$$OD = \frac{OC}{\cos 30^\circ}$$

$$= \frac{4.6188}{\cos 30^\circ}$$

$$= 5.33 \text{ cm}$$

Summative Practice 5

Section A

$$1 \tan x + \cos y = \frac{8}{15} + \frac{6}{7.5} \\ = \frac{8+12}{15} \\ = \frac{20}{15} = \frac{4}{3}$$

Answer: A

$$2 \tan \left(57\frac{3}{4}\right)^\circ + \cos 68^\circ 20' = 1.5849 + 0.3692 \\ = 1.9541$$

Answer: C

$$3 \sin \theta = \frac{6.5}{11} \\ = 0.5909 \\ \theta = 36^\circ 13'$$

Answer: B

$$4 \ 4 \cos 60^\circ \div (\tan 30^\circ)^2 = 4\left(\frac{1}{2}\right) \div \left(\frac{1}{\sqrt{3}}\right)^2 \\ = 2 \times 3 = 6$$

Answer: D

$$5 \ AB = \sqrt{17^2 - 8^2} = 15 \text{ cm}$$

$$\tan \theta = \frac{8}{15}$$

Answer: A

$$6 \ \sin \angle QPR = \frac{QR}{PR} = \frac{1}{2}$$

$$\angle QPR = 30^\circ$$

Answer: B

$$7 \ \text{If } \tan \theta = \frac{4}{3}, \text{ then Pythagorean triple is } 3^2 + 4^2 = 5^2.$$

$$\sin \theta = \frac{4}{5} = \frac{16}{20}$$

$$\cos \theta = \frac{3}{5} = \frac{12}{20}$$

$$\text{Perimeter} = 12 + 16 + 20 \\ = 48 \text{ cm}$$

Answer: B

$$8 \ \text{If } \cos x = \frac{12}{13}, \text{ then opposite side} = \sqrt{13^2 - 12^2} = 5$$

$$\tan x = \frac{5}{12}$$

$$\tan (90^\circ - x) = \frac{12}{5}$$

Answer: C

$$9 \ \cos \angle QST = \frac{QS}{ST} = \frac{3}{4}$$

$$QS = \frac{3}{4} \times 24$$

$$= 18 \text{ cm}$$

$$PQ = 3\left(\frac{1}{2}QS\right)$$

$$= \frac{3}{2} \times 18$$

$$= 27 \text{ cm}$$

$$\sin \angle PRQ = \frac{PQ}{PR} = \frac{9}{11}$$

$$PR = \frac{11}{9} \times 27$$

$$= 33 \text{ cm}$$

Answer: D

$$10 \ \sin \theta = \frac{7}{10} = \frac{14}{20}$$

$$AC = 20 \text{ cm}$$

$$\therefore EC = 10 \text{ cm}$$

$$CD = \sqrt{10^2 - 8^2} \\ = 6 \text{ cm}$$

$$\cos x = \frac{6}{10} = \frac{3}{5}$$

Answer: B

Section B

$$1 \text{ (a) True} \quad (b) \text{ False} \quad (c) \text{ True} \quad (d) \text{ True}$$

$$2 \text{ (a) } \frac{QR}{6\sqrt{3}} = \tan 30^\circ$$

$$QR = 6\sqrt{3} \tan 30^\circ$$

$$= 6\sqrt{3}\left(\frac{1}{\sqrt{3}}\right)$$

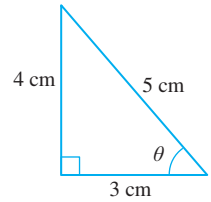
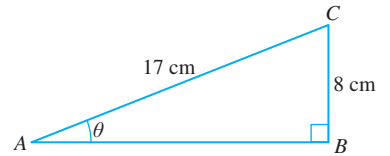
$$= 6 \text{ cm}$$

$$(b) \frac{6\sqrt{3}}{PQ} = \cos 30^\circ$$

$$= \frac{\sqrt{3}}{2}$$

$$PQ = 6\sqrt{3} \times \frac{2}{\sqrt{3}}$$

$$= 12 \text{ cm}$$



$$(c) \frac{6\sqrt{3}}{RS} = \tan y$$

$$= \frac{\sqrt{3}}{2}$$

$$RS = \frac{2}{\sqrt{3}} \times 6\sqrt{3}$$

$$= 12 \text{ cm}$$

$$(d) QS = 6 + 12$$

$$= 18 \text{ cm}$$

$$3 (a) (i) \text{ Hypotenuse} = \sqrt{3^2 + (\sqrt{7})^2}$$

$$= 4 \text{ cm}$$

$$\cos x = \frac{3}{4}$$

$$(ii) \text{ Adjacent side} = \sqrt{(\sqrt{13})^2 - 2^2}$$

$$= 3 \text{ cm}$$

$$\tan y = \frac{2}{3}$$

$$(b) (i) \tan x = \frac{KN}{JK}$$

$$\frac{4}{5} = \frac{KN}{15}$$

$$= 15 \times \frac{4}{5}$$

$$= 12 \text{ cm}$$

$$KM = 8 + 12$$

$$= 20 \text{ cm}$$

$$(ii) \sin y = \frac{20}{25}$$

$$= \frac{4}{5}$$

$$4 (a) \angle RPS$$

$$(b) \angle PRQ$$

$$(c) 28 \tan 35^\circ$$

$$(d) \frac{28}{\tan 48^\circ}$$

Section C

$$1 (a) (i) 8 \cos 30^\circ - 2 \tan 60^\circ = 8\left(\frac{\sqrt{3}}{2}\right) - 2\sqrt{3} = 2\sqrt{3}$$

$$(ii) \sqrt{18} \sin 45^\circ + \sqrt{12} \tan 30^\circ$$

$$= \sqrt{18}\left(\frac{1}{\sqrt{2}}\right) + \sqrt{12}\left(\frac{1}{\sqrt{3}}\right)$$

$$= \sqrt{\frac{18}{2}} + \sqrt{\frac{12}{3}}$$

$$= \sqrt{9} + \sqrt{4}$$

$$= 5$$

$$(b) (i) \tan x = \frac{1}{4}$$

$$\frac{DE}{12} = \frac{1}{4}$$

$$DE = 3 \text{ cm}$$

$$(ii) CD = CE + ED$$

$$= 6 + 3$$

$$= 9 \text{ cm}$$

$$AC = \sqrt{12^2 + 9^2}$$

$$= 15 \text{ cm}$$

$$\cos y = \frac{9}{15} = \frac{3}{5}$$

$$(c) (i) \tan \angle QUT = \frac{6}{5}$$

$$\frac{TQ}{2.5} = \frac{6}{5}$$

$$TQ = \frac{6}{5} \times 2.5$$

$$= 3 \text{ cm}$$

$$TU = \sqrt{2.5^2 + 3^2}$$

$$= 3.905 \text{ cm}$$

$$\text{Length of ladder} = 3.905 \text{ m}$$

$$(ii) \cos \theta = \frac{2.5 - 0.6}{3.905}$$

$$= 0.48656$$

$$\theta = 60^\circ 53'$$

$$2 (a) (i) 51^\circ 20'$$

$$(ii) 31^\circ 47'$$

$$(b) (i) \frac{x}{KL} = \tan \angle MKL$$

$$x = 20 \times \frac{12}{5}$$

$$= 48 \text{ cm}$$

$$(ii) \tan \angle MRL = \frac{2}{3}$$

$$\frac{x}{y} = \frac{2}{3}$$

$$\frac{48}{y} = \frac{2}{3}$$

$$y = 48 \times \frac{3}{2} = 72 \text{ cm}$$

$$(iii) MR = \sqrt{48^2 + 72^2}$$

$$= 86.533 \text{ cm}$$

$$\cos \angle QMR = \frac{MQ}{MR}$$

$$= \frac{72}{86.533}$$

$$= 0.832$$

$$(iv) \tan \angle PMR = \frac{PR}{MR}$$

$$= \frac{20}{86.533}$$

$$= 0.2311$$

$$\angle PMR = 13^\circ 1'$$