1.(8 points) Convert radian to degree, or degree to radian

(a) $-\frac{\pi}{12}$

$$\frac{-\frac{\pi}{12}}{\pi} = \frac{\text{degree}}{180^\circ}$$

$$\text{degree} = \boxed{-15^\circ}$$

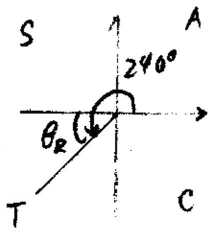
(b) 225^0

$$\frac{225^\circ}{180^\circ} = \frac{\text{radian}}{\pi}$$

$$\text{radian} = \boxed{\frac{5\pi}{4}}$$

2. (5 points each) Using reference angles, give the exact value of the following:

a) $\cos(240^\circ) = -\cos 60^\circ = -\frac{1}{2}$



Let $\theta = 240^\circ$

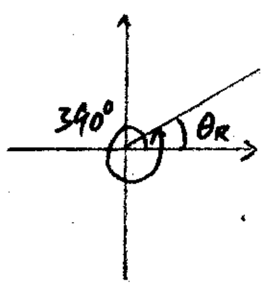
$\theta_R = 240^\circ - 180^\circ = \boxed{60^\circ}$

$|\cos 240^\circ| = \cos 60^\circ$

In Q III, $\cos\theta < 0$

so, $\cos 240^\circ = -\cos 60^\circ = \boxed{-\frac{1}{2}}$

b) $\tan(390^0) =$

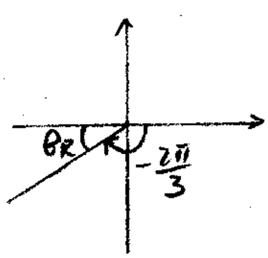


$\theta_R = 390^\circ - 360^\circ = \boxed{30^\circ}$

In Q I, $\tan\theta > 0$

$\tan 390^\circ = \tan 30^\circ = \frac{1}{\sqrt{3}} = \boxed{\frac{\sqrt{3}}{3}}$

c) $\csc\left(-\frac{2\pi}{3}\right) = \frac{1}{\sin\left(-\frac{2\pi}{3}\right)} = \frac{1}{-\sin\frac{\pi}{3}} = \frac{1}{-\frac{\sqrt{3}}{2}} = \boxed{-\frac{2}{\sqrt{3}}}$



$\theta_R = \pi - \frac{2\pi}{3} = \boxed{\frac{\pi}{3}}$

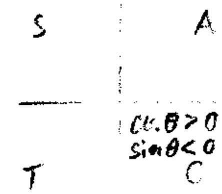
In Q IV, $\sin\theta < 0$

3. (6 points) If $\sec\theta = (4)$ and $\sin\theta < 0$ find:

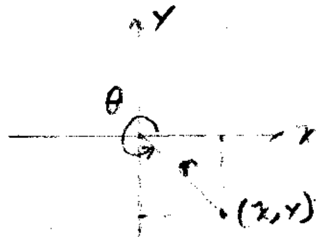
a) The quadrant in which θ is

Since $\sec\theta > 0$, then $\cos\theta > 0$

Since $\cos\theta > 0$ and $\sin\theta < 0$, θ in $\boxed{Q4}$.



b) $\cos\theta = \dfrac{1}{\sec\theta} = \boxed{\dfrac{1}{4}}$



$\cos\theta = \dfrac{x}{r} = \dfrac{1}{4}$

so, $x = 1$, $r = 4$

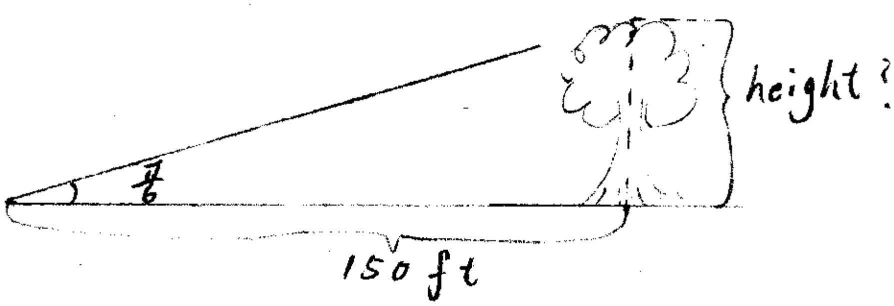
c) $\sin\theta =$

$y^2 = r^2 - x^2$

$y = \sqrt{4^2 - 1^2} = \sqrt{15}$

$\sin\theta = \dfrac{y}{r} = \boxed{\dfrac{\sqrt{15}}{-4}}$

4. (4 points) When the top of a tree is viewed from a distance of 150 feet from the base, the angle of elevation is $\dfrac{\pi}{6}$. Find the height of the tree.



$\tan\dfrac{\pi}{6} = \dfrac{\text{height}}{150}$

$\text{height} = 150 \cdot \tan\dfrac{\pi}{6}$

$\text{height} = \boxed{\dfrac{150}{\sqrt{3}}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}}$

$\text{height} = \boxed{50\sqrt{3}\ \text{ft}}$

5. (12 points) Refer to the graph below.

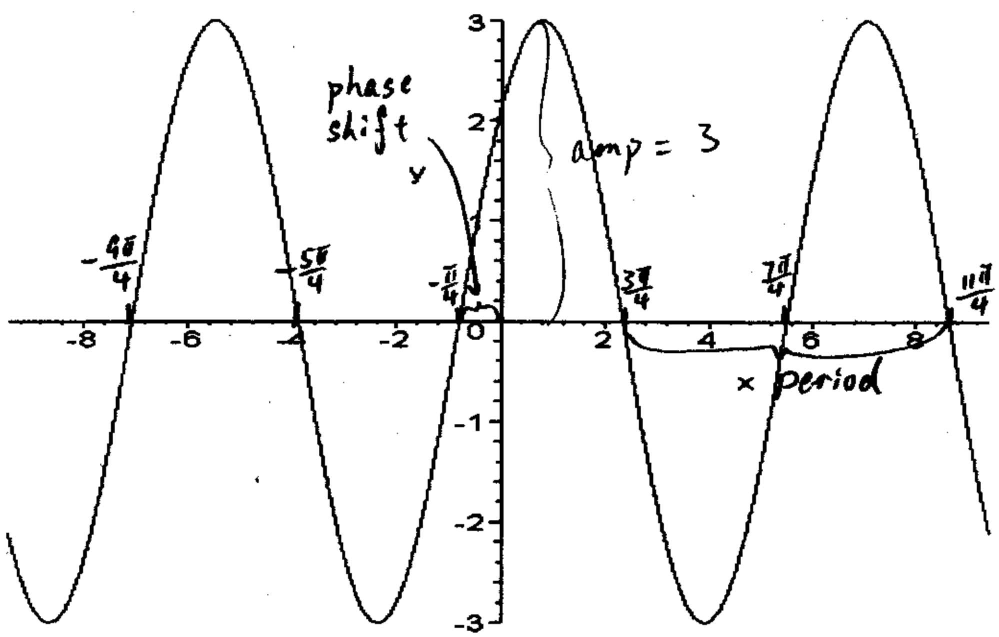
a) Find the amplitude: $\boxed{3}$

b) Find the period: $\frac{11\pi}{4} - \frac{3\pi}{4} = \boxed{2\pi}$

c) Circle the correct equation for the graph.

$y=-3\cos\left(\frac{1}{2}x\right)$ $\quad y=3\cos\left(x+\frac{\pi}{4}\right)$ $\quad y=3\cos\left(\frac{1}{4}x+\frac{\pi}{4}\right)$

$y=-2\sin\left(\frac{1}{2}x\right)$ $\quad y=3\sin\left(x+\frac{\pi}{4}\right)$ $\quad y=3\sin\left(\frac{1}{4}x+\frac{\pi}{4}\right)$



Let $y = a\sin(bx + c)$

1) $a = 3$,

2) period $= \frac{2\pi}{|b|} = 2\pi \Rightarrow b = 1$

3) phase shift $= -\frac{c}{b} = -c = -\frac{\pi}{4} \Rightarrow c = \frac{\pi}{4}$

6. (10 points) Verify the identity by transforming the left side of the equation into the right.

$$(\tan\theta + \cot\theta)\tan\theta = \sec^2\theta$$

L.H.S. $= (\tan\theta + \cot\theta)\tan\theta$

$= \left(\tan\theta + \frac{1}{\tan\theta}\right)\tan\theta$

$= \left(\frac{\tan^2\theta + 1}{\cancel{\tan\theta}}\right)\cancel{\tan\theta}$

$= \tan^2\theta + 1$

$= \sec^2\theta$

$=$ R.H.S.

7. (5 points each)

a) Find the length of the arc cut off by a sector with central angle 150^0 on a circle of diameter 16 cm.

$S = r\theta$ radian

$= \frac{d}{2}\theta$

$= \frac{16}{2}\cdot\frac{5\pi}{6}$

$S = \boxed{\frac{20\pi}{3}\ cm}$

$\frac{150^\circ}{180^\circ} = \frac{\text{radian}}{\pi}$

radian $= \frac{5\pi}{6}$

b) Find the area of the sector in part (a).

$A = \frac{1}{2}r^2\theta$ radian

$= \frac{1}{2}\left(\frac{16}{2}\right)^2\cdot\frac{5\pi}{6}$

$= \frac{1}{2}\cdot 64\cdot\frac{5\pi}{6}$

$A = \boxed{\frac{80\pi}{3}\ cm^2}$

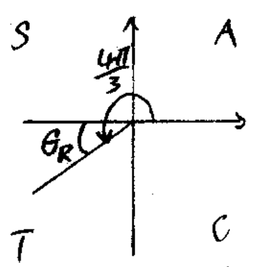
8. (10 points) Verify by transforming the left side into the right side:

$$\cot(-\theta)\cos(-\theta)+\sin(-\theta)=-\csc\theta$$

$$\begin{aligned}
L.H.S &= \cot(-\theta)\cos(-\theta)+\sin(-\theta)\\
&= -\cot\theta\cdot\cos\theta-\sin\theta\\
&= -\frac{\cos\theta}{\sin\theta}\cdot\cos\theta-\sin\theta\cdot\boxed{\frac{\sin\theta}{\sin\theta}}=1\\
&= \frac{-\cos^2\theta-\sin^2\theta}{\sin\theta}\\
&= \frac{-(\cos^2\theta+\sin^2\theta)}{\sin\theta}=-\frac{1}{\sin\theta}=-\csc\theta=R.H.S.
\end{aligned}$$

9. (5 points each) **Use a formula for negatives** to find the exact value of each of the following:

a) $\cot\left(-\frac{4\pi}{3}\right) = -\cot\frac{4\pi}{3}$

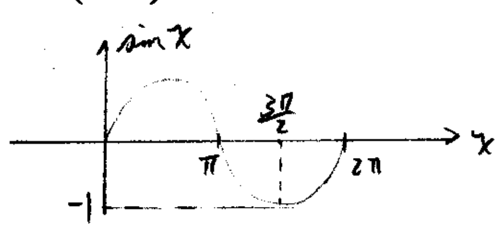


Let $\theta=\frac{4\pi}{3}$

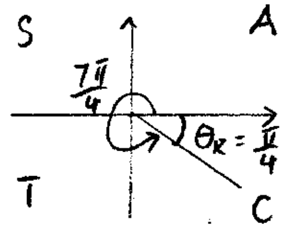
$\theta_R=\frac{4\pi}{3}-\pi=\frac{\pi}{3}$

$-\cot\frac{4\pi}{3}=-\left(+\cot\frac{\pi}{3}\right)=-\frac{1}{\tan\frac{\pi}{3}}=\boxed{-\frac{1}{\sqrt{3}}}$

b) $\sin\left(-\frac{3\pi}{2}\right)=-\sin\frac{3\pi}{2}=-(-1)=\boxed{1}$



c) $\sec\left(\frac{-7\pi}{4}\right) = \sec\frac{7\pi}{4} = \frac{1}{\cos\frac{7\pi}{4}} = \frac{1}{+\cos\frac{\pi}{4}} = \frac{1}{\frac{\sqrt{2}}{2}} = \boxed{\sqrt{2}}$



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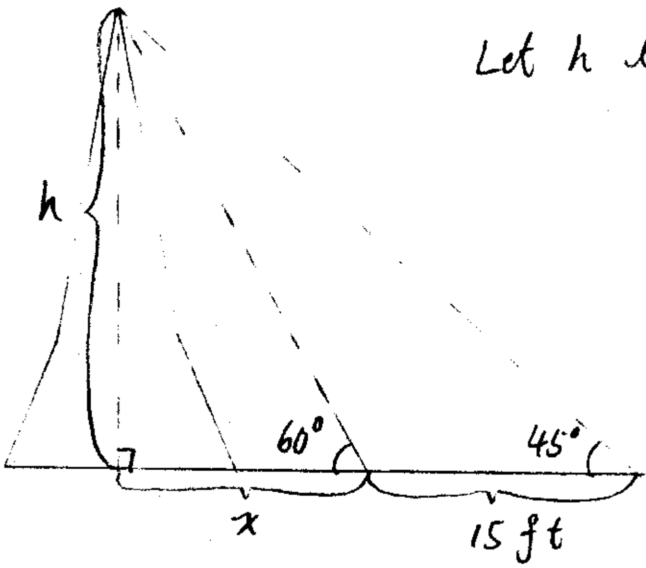
10. (10 points) From a point on level ground the angle of elevation of the ground to the top of a tower is 45^0. From a point 15 feet closer, the angle of elevation is 60^0. Find the height of the tower.

Let h be the height of the Tower.



ground

$\tan 45^\circ = \frac{h}{x+15}$ — ① $\tan 60^0 = \frac{h}{x}$ — ②

$1 = \frac{h}{x+15}$ $\sqrt{3} = \frac{h}{x}$

$h = x + 15$ $x = \frac{h}{\sqrt{3}}$

$h = \frac{h}{\sqrt{3}} + 15$

$h - \frac{h}{\sqrt{3}} = 15$

$h\left(1 - \frac{1}{\sqrt{3}}\right) = 15$

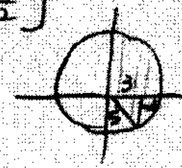
$h = \boxed{15 \Big/ \left(1 - \frac{1}{\sqrt{3}}\right)} = \frac{15\sqrt{3}}{\sqrt{3}-1} = \frac{15\sqrt{3}(\sqrt{3}+1)}{2} = \frac{45+15\sqrt{3}}{2}$

1. **Evaluate:** (6 points each)

a) $\cos\left[2\arcsin\left(-\frac{4}{5}\right)\right] =$

Let $\arcsin(-\frac{4}{5}) = \theta$ & $\theta \in [-\frac{\pi}{2}, \frac{\pi}{2}]$

So. $\sin\theta = -\frac{4}{5}$ & θ in QIV



Thus $\cos[2\arcsin(-\frac{4}{5})] = \cos 2\theta = 1 - 2\sin^2\theta = \boxed{-\frac{7}{25}}$

b) $\cot\left(\arcsin\left(\frac{12}{13}\right)\right) =$

Let $\theta = \arcsin\frac{12}{13}$ & $\theta \in [-\frac{\pi}{2}, \frac{\pi}{2}]$

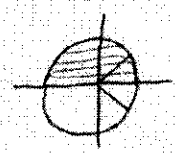
So $\sin\theta = \frac{12}{13}$ & θ in QI

$\Rightarrow \cos\theta = \frac{5}{13}$

Thus $\cot(\arcsin\frac{12}{13}) = \cot\theta = \frac{\cos\theta}{\sin\theta} = \boxed{\frac{5}{12}}$

c) $\cos^{-1}\left(\cos\left(\frac{11\pi}{6}\right)\right) = \alpha$ $\alpha \in [0, \pi]$ and $\cos\alpha = \cos\frac{11\pi}{6}$

So. $\alpha = 2\pi - \frac{11\pi}{6} = \boxed{\frac{\pi}{6}}$



d) $\sin\left(\sin^{-1}\left(\frac{\pi}{2}\right)\right) =$ No solution since $\frac{\pi}{2} > 1$

2. For f $f(x) = \frac{2}{7x-1}$

a) **Show that f(x) is one to one.** **(5 points)**
(Use the definition.)

$f(a) = f(b) \Rightarrow \frac{2}{7a-1} = \frac{2}{7b-1} \Rightarrow a = b \Rightarrow 1-1$

b) **Find $f^{-1}(x)$.** **(5 points)**

$y = \frac{2}{7x-1} \Rightarrow (7x-1)y = 2 \Rightarrow 7xy = y+2$

$\Rightarrow x = \frac{y+2}{7y}$

$f^{-1}(x) = \frac{y+2}{7x}$

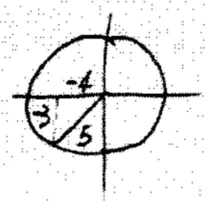
3. **Express the following as a single sine or cosine and give <u>the value</u> of the expression:**
(6 points)

$$\sin\frac{5\pi}{6}\cos\frac{\pi}{6} - \cos\frac{5\pi}{6}\sin\frac{\pi}{6} = \sin\left(\frac{5\pi}{6} - \frac{\pi}{6}\right) = \sin\frac{2\pi}{3} = \sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}$$

4. If θ is in Quadrant III and $\cot\theta = \frac{4}{3}$, find: (6 points)

$$\sin\left(\frac{\pi}{2}-\theta\right) = \cos\theta$$

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



5. Find all the solutions of $2\sin 2\theta - \sqrt{2} = 0$. (10 points)

Sol. $\sin 2\theta = \frac{\sqrt{2}}{2}$

$2\theta = \frac{\pi}{4} + 2k\pi$

or $2\theta = \left(\pi - \frac{\pi}{4}\right) + 2k\pi = \frac{3\pi}{4} + 2k\pi$

So. $\theta = \frac{\pi}{8} + k\pi$ or $\theta = \frac{3\pi}{8} + k\pi$

6. Verify the following: (7 points each)

a) $\frac{\sin^2(2\theta)}{\sin^2\theta} = 4 - 4\sin^2\theta$

$$LS = \frac{(2\sin\theta\cos\theta)^2}{\sin^2\theta} = \frac{4\cancel{\sin^2\theta}\cos^2\theta}{\cancel{\sin^2\theta}} = 4\cos^2\theta = 4(1-\sin^2\theta)$$

$$= 4 - 4\sin^2\theta = RS$$

b) $\cos\left(x-\frac{5\pi}{2}\right)=\sin x$

$$LS=\cos\left(x-\frac{\pi}{2}\right)=\cos x\cos\frac{\pi}{2}+\sin x\sin\frac{\pi}{2}=0+\sin x=RS$$

7. Find the exact value of ~~cos 15°~~. (10 points)
(Use $15° = 45° - 30°$)

$$\cos(15°)=\cos(45°-30°)=\cos 45°\cos 30°+\sin 45°\sin 30°$$

$$=\frac{\sqrt{2}}{2}\cdot\frac{\sqrt{3}}{2}+\frac{\sqrt{2}}{2}\cdot\frac{1}{2}=\frac{\sqrt{6}+\sqrt{2}}{4}$$

$2\cos^2 x+\sin x=-1$

8. Find the solutions of $2\cos^2 x+3\cos x=-1$ in the interval $[0,2\pi)$. (10 points)

$2\cos^2 x+3\cos x=-1$

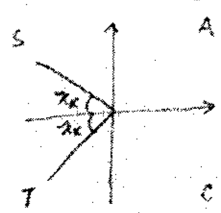
$2\cos^2 x+3\cos x+1=0$

$(2\cos x+1)(\cos x+1)=0$

$2\cos x+1=0$ or $\cos x+1=0$

$\cos x=-\frac{1}{2}$ $\qquad$ $\cos x=-1$

$x=\boxed{\pi}$



$\cos x_R=|\cos x|=\frac{1}{2}$

$x_R=\frac{\pi}{3}$

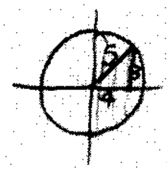
In Q II: $x=\pi-\frac{\pi}{3}=\boxed{\frac{2\pi}{3}}$

In Q III: $x=\pi+\frac{\pi}{3}=\boxed{\frac{4\pi}{3}}$

9. Find $\cos\left(\sin^{-1}\left(\frac{3}{5}\right)-\tan^{-1}\left(-\frac{4}{3}\right)\right)$ (10 points)

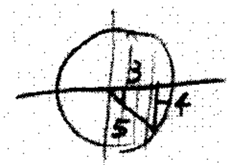
Sol. ① Let $\alpha = \sin^{-1}\left(\frac{3}{5}\right)$ $\beta = \tan^{-1}\left(-\frac{4}{3}\right)$

② Then $\sin\alpha = \frac{3}{5}$ & α in QI



$\Rightarrow \cos\alpha = \frac{4}{5}$

and $\tan\beta = -\frac{4}{3}$ & β in QIV



$\Rightarrow \sin\beta = -\frac{4}{5}$, $\cos\beta = \frac{3}{5}$

Thus $\cos\left(\sin^{-1}\left(\frac{3}{5}\right)-\tan^{-1}\left(-\frac{4}{3}\right)\right)$

$= \cos(\alpha - \beta)$

$= \cos\alpha\cos\beta + \sin\alpha\sin\beta$

$= \frac{4}{5}\cdot\frac{3}{5} + \frac{3}{5}\left(-\frac{4}{5}\right) = \boxed{0}$

1. (10 points)

a) Convert the point $\left(-2\sqrt{2}, 2\sqrt{2}\right)$ from rectangular coordinates to polar coordinates with $r > 0$ and $0 \le \theta < 2\pi$

$$\begin{cases} x = -2\sqrt{2} \\ y = 2\sqrt{2} \end{cases} \Rightarrow \begin{cases} r = \sqrt{x^2+y^2} = 4 \\ \theta . \end{cases} \quad |\tan\theta_r| = 1 \Rightarrow \theta_r = 45^\circ$$

$$\Rightarrow \theta = 135^\circ$$

So $\left(-2\sqrt{2}, 2\sqrt{2}\right) = \left(4, \frac{3\pi}{4}\right)$

b) Convert the point $\left(5, \frac{7\pi}{6}\right)$ from polar to rectangular coordinates.

$$\begin{cases} r = 5 \\ \theta = \frac{7\pi}{6} \end{cases} \Rightarrow \begin{array}{l} x = r\cos\theta = 5\cos\frac{7\pi}{6} = 5\left(-\cos\frac{\pi}{6}\right) = \frac{-5\sqrt{3}}{2} \\ y = r\sin\theta = 5\sin\frac{7\pi}{6} = 5\left(-\sin\frac{\pi}{6}\right) = -\frac{5}{2} \end{array}$$

So $\left(5, \frac{7\pi}{6}\right) = \left(-\frac{5\sqrt{3}}{2}, \frac{-5}{2}\right)$

2. (5 points) Express in the form a + bi: $-5cis\frac{5\pi}{2}$.

$$\begin{cases} r = -5 \\ \theta = \frac{5\pi}{2} \end{cases} \Rightarrow \begin{array}{l} a = r\cos\theta = (-5)\cos\frac{5\pi}{2} = 0 \\ b = r\sin\theta = (-5)\sin\frac{5\pi}{2} = -5 \end{array}$$

So $-5cis\frac{5\pi}{2} = -5i$

3. (10 points) Find the value of the following:

a) $|5-8i| = \sqrt{5^2+(-8)^2} = \sqrt{25+64} = \sqrt{89}$

b) $|-\sqrt{3}i| = \sqrt{3}$

4. (10 points) Use DeMoivre's Theorem to change $\left(-\frac{\sqrt{3}}{2}-\frac{1}{2}i\right)^5$ to a + bi form.

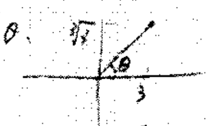
$-\frac{\sqrt{3}}{2}-\frac{1}{2}i = 1\cdot cis\left(\frac{7\pi}{6}\right)$

$\left(-\frac{\sqrt{3}}{2}-\frac{1}{2}i\right)^5 = cis\left(\frac{7\pi}{6}\times 5\right) = cis\left(\frac{35}{6}\pi\right) = cis\left(-\frac{11\pi}{6}\right)$

$= 1\cdot \cos\frac{11\pi}{6} + i\cdot 1\cdot \sin\frac{11\pi}{6} = \frac{\sqrt{3}}{2} - i\cdot\frac{1}{2}$

5. (5 points) Express $3+3\sqrt{3}i$ in trigonometric form with $0 \le \theta < 2\pi$.

$\begin{cases} a = 3 \\ b = 3\sqrt{3} \end{cases} \Rightarrow \begin{cases} r = \sqrt{a^2+b^2} = 6 \\ \theta. \end{cases}$



$\tan\theta = \frac{b}{a} = \sqrt{3} \Rightarrow \theta = \frac{\pi}{3}$

So $3+3\sqrt{3}\,i = 6\,cis\left(\frac{\pi}{3}\right)$

6. (12 points) Given $z_1 = 4i$ and $z_2 = 3+3i$.

a) Find z_1z_2 and put your answer in a + bi form.

$z_1z_2 = 4i(3+3i) = 12i - 12 = -12 + 12i$

or $z_1 = 4i = 4\,cis\,\frac{\pi}{2}$

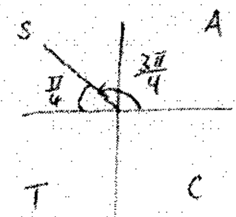
$z_2 = 3+3i = 3\sqrt{2}\,cis\,\frac{\pi}{4}$

$z_1\cdot z_2 = 4\cdot 3\sqrt{2}\,cis\left(\frac{\pi}{2}+\frac{\pi}{4}\right)$

$= 12\sqrt{2}\left(\cos\frac{3\pi}{4} + i\sin\frac{3\pi}{4}\right)$

$= 12\sqrt{2}\cdot\left(-\frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2}\right)$

$= \boxed{-12+12i}$



b) Find $\frac{z_1}{z_2}$ and put your answer in a + bi form.

$$\frac{z_1}{z_2} = \frac{4i}{3+3i} = \frac{4i(3-3i)}{9+9} = \frac{12i+12}{18} = \frac{2}{3}(1+i)$$

$$\text{or } \frac{z_1}{z_2} = \frac{4}{3\sqrt{2}}\, cis\left(\frac{\pi}{2}-\frac{\pi}{4}\right) = \frac{4}{3\sqrt{2}}\left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)$$

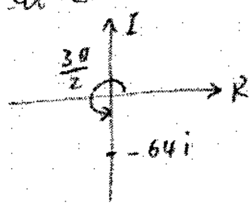
$$= \frac{4}{3\sqrt{2}}\left(\frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2}\right)$$

$$= \boxed{\frac{2}{3} + \frac{2}{3}i}$$

7. (8 points) Find the two square roots of -64i. Put your answer in a + bi form.

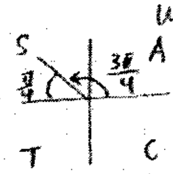
$$w_k = \sqrt[n]{r}\left[\cos\left(\frac{\theta+2\pi k}{n}\right) + i\sin\left(\frac{\theta+2\pi k}{n}\right)\right] \text{ where } k = 0,1,2,\ldots,n-1$$

Let $z = -64i = 64\ cis\ \frac{3\pi}{2}$, $n = 2$



$$(z)^{\frac{1}{2}} = W_k = \sqrt{64}\ cis\left(\frac{\frac{3\pi}{2}+2k\pi}{2}\right), k=0,1$$

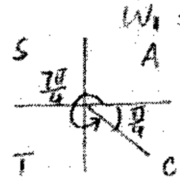
$$W_0 = 8\ cis\ \frac{3\pi}{4} = 8\left(\cos\frac{3\pi}{4} + i\sin\frac{3\pi}{4}\right)$$



$$= 8\left(-\frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2}\right)$$

$$W_0 = \boxed{-4\sqrt{2} + i4\sqrt{2}}$$

$$W_1 = 8\ cis\left(\frac{7\pi}{4}\right) = 8\left(\cos\frac{7\pi}{4} + i\sin\frac{7\pi}{4}\right)$$



$$= 8\left(\frac{\sqrt{2}}{2} + i\left(-\frac{\sqrt{2}}{2}\right)\right)$$

$$= 4\sqrt{2} - i4\sqrt{2}$$

8. (10 points) Find the four fourth roots of $-5\sqrt{2}+5\sqrt{2}i$. **Leave your answers in trigonometric form.**

$$z = -5\sqrt{2} + 5\sqrt{2}i = 10\ cis\left(\frac{3\pi}{4}\right)$$

$$\sqrt[4]{z} = \left[10\ cis\left(\frac{3\pi}{4}\right)\right]^{\frac{1}{4}} = \sqrt[4]{10}\ cis\left(\frac{\frac{3\pi}{4}+2k\pi}{4}\right) \quad k=0,1,2,3$$

So. $W_0 = \sqrt[4]{10}\ cis\ \frac{3\pi}{16}$ $\qquad W_4 = \sqrt[4]{10}\ cis\left(\frac{27\pi}{16}\right)$

$W_1 = \sqrt[4]{10}\ cis\left(\frac{11\pi}{16}\right)$

$W_2 = \sqrt[4]{10}\ cis\left(\frac{19}{16}\pi\right)$

9. (10 points) Prove by induction $1+4+7+...+(3n-2)=\frac{n(3n-1)}{2}$ is true for all the Natural Numbers. (Show **ALL YOUR WORK,** each step must be shown.)

Proof ① $n=1$ $\quad 3n-2=1 \Rightarrow LS=1$

$RS=\frac{1(3\cdot1-1)}{2}=1$

$LS=RS$

② Assume
$n=k$ $\quad 1+4+7+\dots+(3k-2)=\frac{k(3k-1)}{2}$ ⊛

③ then
$n=k+1$ $\quad 3n-1=3(k+1)-2$

$LS=\underbrace{1+4+7+\quad+(3k-2)}+[3(k+1)-2]$

$\overset{⊛}{=}\frac{k(3k-1)}{2}+[3(k+1)-2]$

$=\frac{3k^2-k+6k+2}{2}=\frac{3k^2+5k+2}{2}$

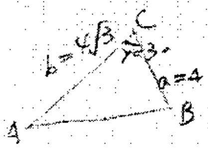
$RS=\frac{(k+1)(3(k+1)-1)}{2}=\frac{(k+1)(3k+2)}{2}$

$=\frac{3k^2+5k+2}{2}$

$\therefore LS=RS$

④ Thus $1+4+7+\quad+(3n-2)=\frac{n(3n-1)}{2}\quad \forall\ n\geq1$

10. (10 points) In triangle ABC, $\gamma = 30^\circ, b = 4\sqrt{3}, a = 4$. Find the possible values of β, α, c.



① Find c

Sol. $c^2 = a^2 + b^2 - 2ab\cos\gamma$

$= 16 + 48 - 2 \times 4 \times 4\sqrt{3}\cos 30^\circ$

$= 64 - \cancel{32}^{16}\sqrt{3} \times \frac{\sqrt{3}}{\cancel{2}} = 64 - 48 = 16$

$\therefore \boxed{c = 4}$

② Find α

$a^2 = b^2 + c^2 - 2bc\cos\alpha$

$\cos\alpha = \frac{b^2 + c^2 - a^2}{2bc} = \frac{48 + 16 - 16}{2 \times 4\sqrt{3} \times 4} = \frac{\sqrt{3}}{2}$

$\therefore \boxed{\alpha = \frac{\pi}{6} = 30^\circ}$

③ Find β

$\boxed{\beta = \pi - \alpha - \gamma = \pi - \frac{\pi}{6} - \frac{\pi}{6} = \frac{2\pi}{3} = 120^\circ}$