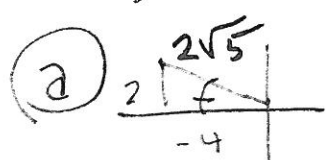
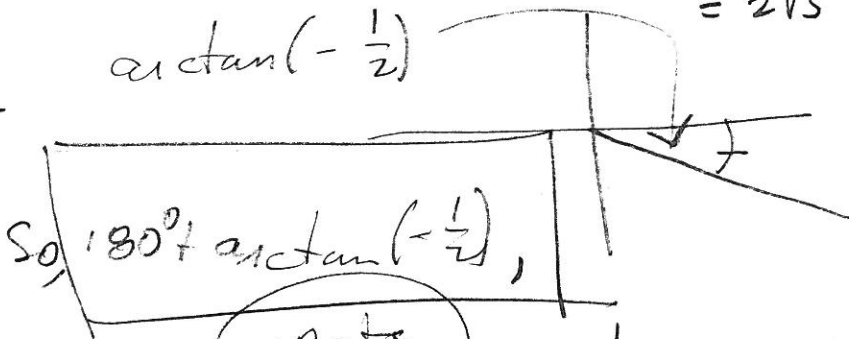


①  $(x, y) = (-4, 2)$   $r = \sqrt{4^2 + 2^2} = \sqrt{20} = 2\sqrt{5}$



$\arctan(-\frac{1}{2})$



$S_0, 180^\circ + \arctan(-\frac{1}{2}),$

10pts

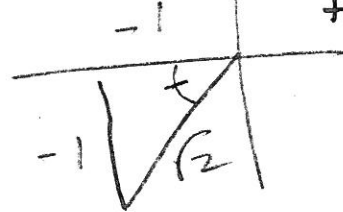
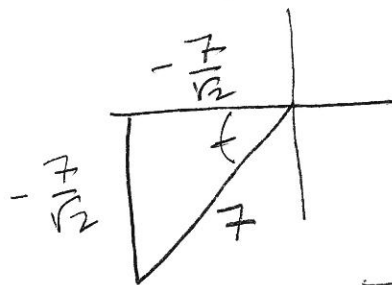
and so,

$(2\sqrt{5}, 180^\circ + \arctan(-\frac{1}{2}))$

is final ans. a  $\pi$   
 $(4.472135955, 153.4349^\circ)$   
 to 4 places, for b.

②  $\approx 153.4349^\circ$  10pts

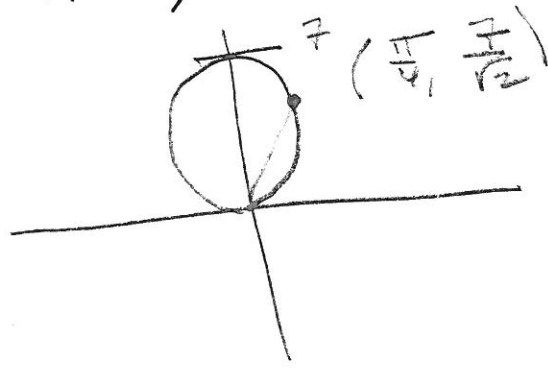
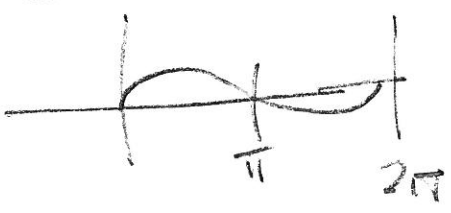
②  $(r, \theta) = (7, \frac{5\pi}{4})$



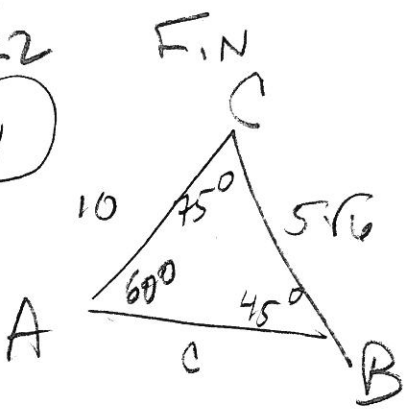
$\sqrt{2} \cdot \frac{7}{\sqrt{2}} = 7, SO$  10pts

$S_0, (x, y) = (-\frac{7\sqrt{2}}{2}, -\frac{7\sqrt{2}}{2})$   
 $\approx (-4.9497, -4.9497)$

③  $r = 7 \sin \theta$



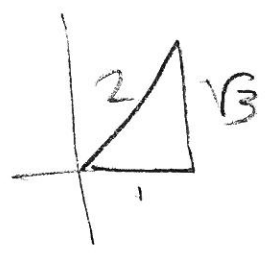
122  
 (4)



$$\frac{\sin B}{10} = \frac{\sin 60^\circ}{5\sqrt{6}}$$

$$= \frac{\sqrt{3}}{2} \cdot \frac{10}{5\sqrt{6}}$$

$$= \frac{1}{\sqrt{2}} \Rightarrow B = 45^\circ$$



$$\frac{c}{\sin C} = \frac{10}{\sin 45^\circ}$$

$$c = \frac{10 \sin 75^\circ}{\sin 45^\circ} \approx 13.66025404 \approx 13.66 \text{ mi} = c$$

$$c^2 = 150 + 100 - 2ab \cos 75^\circ \approx 13.66025404$$

20 pts

75° = C  
 45° = B

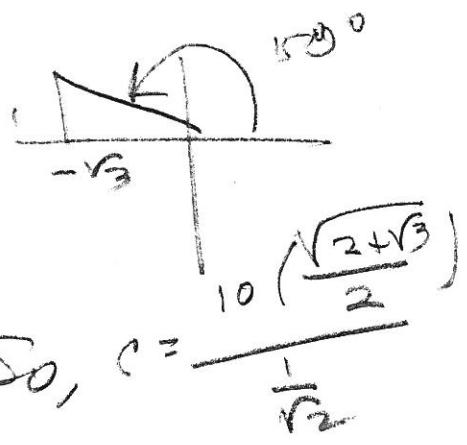
Bornus - 10 pts

$$75 = \frac{2 \cdot 75}{2} = \frac{150}{2}$$

$$\sin 75^\circ = \sqrt{\frac{1 - \cos(150^\circ)}{2}}$$

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

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



$$\text{So, } c = \frac{10 \left( \frac{\sqrt{2 + \sqrt{3}}}{2} \right)}{\frac{1}{\sqrt{2}}}$$

$$= \frac{5\sqrt{2 + \sqrt{3}}}{\frac{1}{\sqrt{2}}} \cdot \frac{2}{1} = \frac{10\sqrt{2}\sqrt{2 + \sqrt{3}}}{2}$$

$$= 5\sqrt{2}\sqrt{2 + \sqrt{3}}$$

cleanest

$$5\sqrt{4 + 2\sqrt{3}}$$

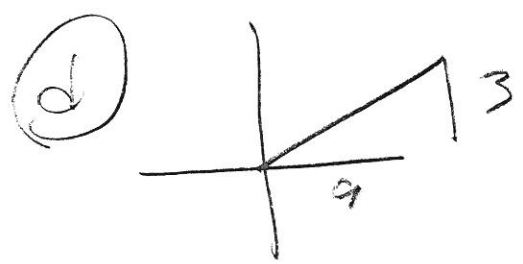
5)  $\vec{u} = \langle 4 - (-5), -1 - (-4) \rangle$

a)  $\vec{u} = \langle 9, 3 \rangle = \vec{u}$  (10 pts)

2 | 90  
3 | 45  
3 | 15

b)  $\|\vec{u}\| = \sqrt{9^2 + 3^2} = \sqrt{81 + 9} = \sqrt{90} = 3\sqrt{10} = \|\vec{u}\|$  (10 pts)

c)  $\vec{u} = 9\vec{i} + 3\vec{j}$  (10 pts)  $\approx 9.486832981$



$\theta = \arctan\left(\frac{3}{9}\right)$   
 $= \arctan\left(\frac{1}{3}\right)$

$\approx 18.43494882^\circ$

$\approx 18.4349^\circ \approx \theta$

Bonus! sum identity

$75^\circ = 30^\circ + 45^\circ$

$\sin(75^\circ) = \sin 30^\circ \cos 45^\circ + \sin 45^\circ \cos 30^\circ$   
 $= \left(\frac{1}{2}\right)\left(\frac{1}{\sqrt{2}}\right) + \left(\frac{1}{\sqrt{2}}\right)\left(\frac{\sqrt{3}}{2}\right) = \frac{\sqrt{3} + 1}{2\sqrt{2}} = \frac{\sqrt{6} + \sqrt{2}}{4}$

so,  $c = \frac{10 \sin 75^\circ}{\sin 45^\circ} = \frac{10 \left(\frac{\sqrt{6} + \sqrt{2}}{4}\right)}{\frac{1}{\sqrt{2}}} = \frac{5(\sqrt{6} + \sqrt{2})}{2} \left(\frac{\sqrt{2}}{1}\right)$   
 $= \frac{5(2\sqrt{3} + 2)}{2} = 5(\sqrt{3} + 1)$

6)  $f(x) = 2x^3 - 19x^2 + 62x - 70$

a) 
$$\begin{array}{r|rrrr} 3+i & 2 & -19 & 62 & -70 \\ & & 6+1 & -41-7i & 70 \\ \hline 3-i & 2 & -13+2i & 21-7i & 0 \\ & & 6+2i & 21-7i & \\ \hline & 2 & -7 & 0 & \end{array}$$

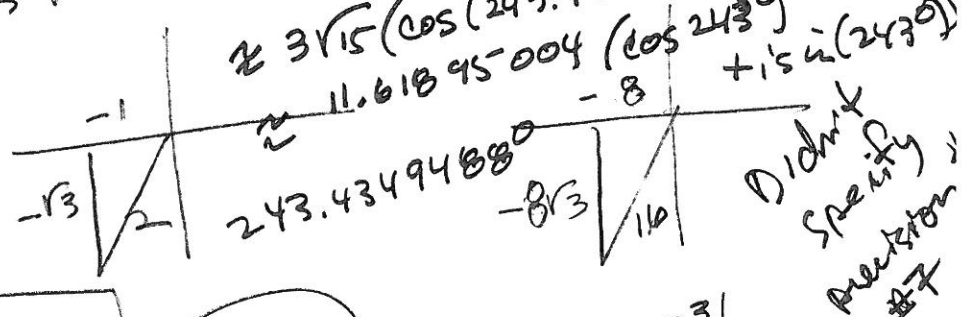
See 10pts  
 $(-13+2i)(3+i)$   
 $-39-13i+6i-2$   
 $= -41-7i$   
 $21-7i = 7(3-i)$

b) So,  $f(x) = (2x-7)(x-3-i)(x-3+i)$   $7(3+i)(3-i) = 7(9+1) = 70$

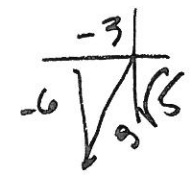
10pts

7)  $-3-6i$  :  $\theta = \arctan(2)$ ,  $r = \sqrt{45} = 3\sqrt{5}$   
 $z = (3\sqrt{5})(\cos(\pi + \arctan(2)) + i\sin(\pi + \arctan(2)))$  10pts

a)  $z = 16(\cos(-\frac{2\pi}{3}) + i\sin(-\frac{2\pi}{3}))$   
 $r = 16$ ,  $\theta = -\frac{2\pi}{3}$



$z = -8 - 8\sqrt{3}i$   
 $z = -8 - 13.85640646i$  10pts



b) 
$$\sqrt[4]{z} = \sqrt[4]{16}(\cos(-\frac{\pi}{6}) + i\sin(-\frac{\pi}{6}))$$
  

$$= 2(\cos(-\frac{\pi}{6}) + i\sin(-\frac{\pi}{6})) = \sqrt[4]{z}$$

$\frac{-2\pi/3}{4} = -\frac{\pi}{6}$

10pts

(8) (1)  $\frac{2\pi}{4} = \frac{\pi}{2}$

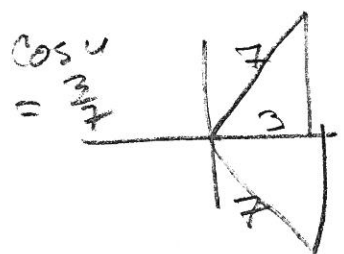
(d)  $w = 2(\cos(\frac{\pi}{6}) + i\sin(\frac{\pi}{6}))$

$-\frac{\pi}{6} + \frac{3\pi}{6} = \frac{2\pi}{6} = \frac{\pi}{3} \rightarrow z^3 w = 32(\cos(-\frac{\pi}{2}) + i\sin(-\frac{\pi}{2}))$   
 $\frac{2\pi}{6} + \frac{3\pi}{6} = \frac{5\pi}{6} \quad -\frac{2\pi}{3} = -\frac{4\pi}{6} \rightarrow = -32i!$   
 $\frac{5\pi}{6} + \frac{3\pi}{6} = \frac{8\pi}{6} = \frac{4\pi}{3} \quad -\frac{4\pi}{6} + \frac{\pi}{6} = -\frac{\pi}{2}$   
 $\frac{8\pi}{6} + \frac{3\pi}{6} = \frac{11\pi}{6} \leftrightarrow -\frac{\pi}{6} \checkmark$

$2(\cos(\frac{\pi}{3}) + i\sin(\frac{\pi}{3}))$   
 $2(\cos(\frac{5\pi}{6}) + i\sin(\frac{5\pi}{6}))$   
 $2(\cos(\frac{4\pi}{3}) + i\sin(\frac{4\pi}{3}))$

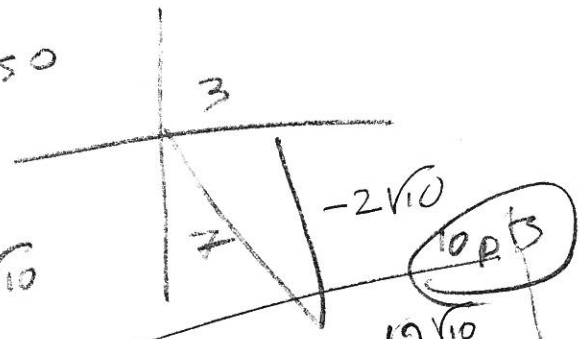
10 pts

(9)  $\cos u = \frac{3}{7}$  &  $\sin(u) < 0$



$\sin u < 0$ , so

$49 - 9 = 40$   
 $\sqrt{40} = 2\sqrt{10}$



10 pts

$\sin(2u) = 2\sin u \cos u$

$= 2(-\frac{2\sqrt{10}}{7})(\frac{3}{7}) = -\frac{12\sqrt{10}}{49} = \sin(2u)$

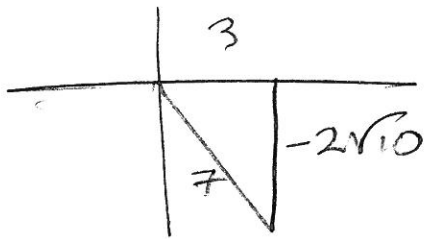
$\tan(2u) = \frac{19\sqrt{10}}{31}$

$\cos(2u) = 2\cos^2 u - 1 = 2(\frac{3}{7})^2 - 1 = \frac{18 - 49}{49} = -\frac{31}{49} = \cos(2u)$

$-\frac{31}{49} = \cos(2u)$

(10)

$$\cos u = \frac{3}{7}, \sin u < 0$$



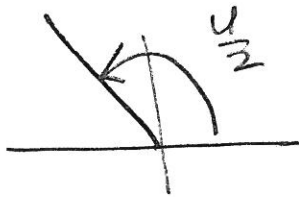
$$270^\circ < u < 360^\circ$$

$$\text{So } 135^\circ < \frac{u}{2} < 180^\circ$$

This is Q II

$$\frac{3\pi}{2} < u < 2\pi \rightarrow$$

$$\frac{3\pi}{4} < \frac{u}{2} < \pi \rightarrow \text{Q II}$$



$$\sin \frac{u}{2} = \sqrt{\frac{1 - \cos(u)}{2}} = \sqrt{\frac{1 - \frac{3}{7}}{2}} = \sqrt{\frac{\frac{4}{7}}{2}}$$

$$= \sqrt{\frac{4}{14}} = \sqrt{\frac{2}{7}} = \sin\left(\frac{u}{2}\right)$$

.5345224838

$$\cos \frac{u}{2} = -\sqrt{\frac{1 + \cos u}{2}} = -\sqrt{\frac{1 + \frac{3}{7}}{2}} = -\sqrt{\frac{\frac{10}{7}}{2}}$$

$$= -\sqrt{\frac{5}{7}} = \cos\left(\frac{u}{2}\right)$$

.8451542547

10 prs

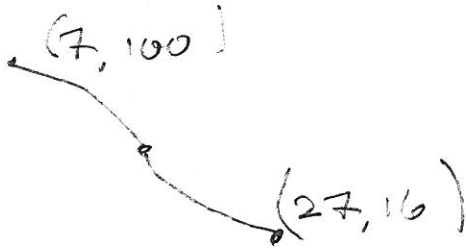
$$\text{So } \tan\left(\frac{u}{2}\right) = \sqrt{\frac{2}{7} \cdot \frac{7}{5}} = \sqrt{\frac{2}{5}} = \tan\left(\frac{u}{2}\right)$$

.632455532

122

FIN

(11)

start  $x=7$ 

$$\frac{\text{High} - \text{Low}}{2} = \frac{100 - 16}{2} = \frac{84}{2} = \text{Amp} = 42$$

$$\frac{\text{High} + \text{Low}}{2} = \frac{116}{2} = 58 = \text{midline}$$

Period:  $27 - 7 = 20$  is  $\frac{1}{2}$ -period

$$f(x) = 42 \cos\left(\frac{\pi}{20}(x-7)\right) + 58$$

Check:  $T=40$ ?

$$bx = 2\pi \text{ when } x=40$$

$$40b = 2\pi$$

$$b = \frac{2\pi}{40} = \frac{\pi}{20} \checkmark$$

122 FIN

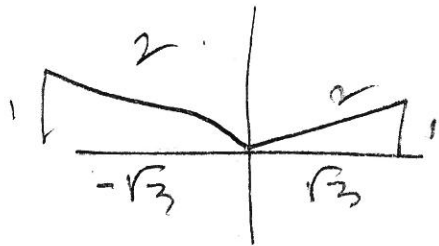
(B2)

$$2 \sin(2x) - 1 = 0$$

$$0 \leq x < 2\pi$$

$$\sin(2x) = \frac{1}{2}$$

$$0 \leq 2x < 4\pi$$



$$2x = \frac{\pi}{6}$$

$$2x = \frac{5\pi}{6}$$

$$2x = \frac{13\pi}{6}$$

$$x = \frac{\pi}{12}$$

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

$$x = \frac{13\pi}{12}$$

$$2x = \frac{17\pi}{6}$$

$$x = \frac{17\pi}{12}$$

$$\text{So, } x \in \left\{ \frac{\pi}{12}, \frac{5\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12} \right\}$$

(B\*)



122  
~~B4~~

$\sqrt{N}$

(B4)

$$f(\theta) = 11 \sin\left(\frac{\pi}{14}\theta - \frac{26\pi}{7}\right) + 4$$

$$\left(\frac{26\pi}{7}\right) / \left(\frac{\pi}{14}\right) = 52$$

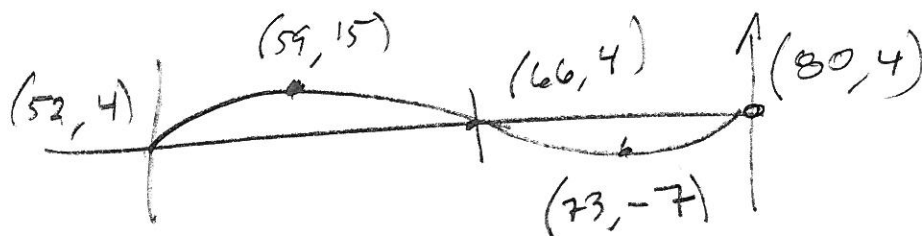
$$11 \sin\left(\frac{\pi}{14}(\theta - 52)\right) + 4$$

$$T = 14 \cdot 2 = 28?$$

$$\frac{\pi}{14}x = 2\pi \text{ when?}$$

$$\frac{28}{4} = 7$$

$$x = 28 \checkmark$$

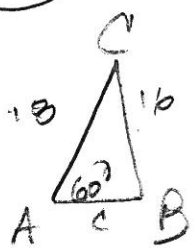


(B3) (a)

$$h = 18 \sin 60^\circ = \frac{18\sqrt{3}}{2} = 9\sqrt{3} \approx 15.58845727$$

$$h \approx 15.6 < 16 = a < 18 = b \checkmark$$

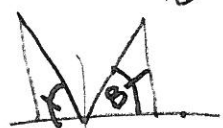
50 B



(b)

$$\frac{\sin B}{18} = \frac{\sin 60^\circ}{16} \Rightarrow \sin B = \frac{9\sqrt{3}}{16}$$

$$= \frac{9\sqrt{3}}{16} \Rightarrow 76.97671882 \approx B$$



$$\text{Other } B: 180^\circ - B \approx 103.0232812$$

D.S.