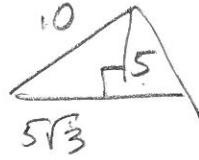
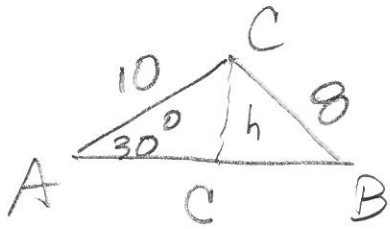


(1) (a)



$$\frac{h}{10} = \sin 30^\circ = \frac{1}{2} \Rightarrow$$

$h = 5$ and $h < a < b \Rightarrow 2$ possible triangles



(b) $c^2 = a^2 + b^2 - 2ab \cos \theta$
 $= 8^2 + 10^2 - 2(8)(10) \cos C$
 Can't be done!

(c) $\frac{\sin B}{10} = \frac{\sin 30^\circ}{8}$
 $\sin B = \frac{10(\frac{1}{2})}{8} = \frac{5}{8} \Rightarrow$

$B \approx 38.6828745^\circ$
 So $C = 180^\circ - 30^\circ - B \approx 111.3178125^\circ \approx C$

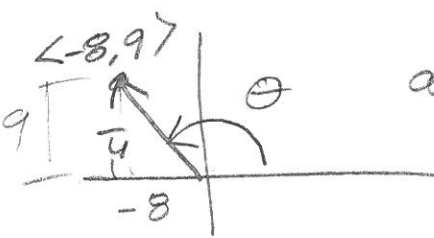
(d) $c^2 = 164 - 160 \cos C$
 $\approx 222.1665383 \Rightarrow c \approx 14.90525204 \text{ cm}$

122

T4

$$(2) \quad \vec{u} = \langle -5-3, 4-(-5) \rangle = \langle -8, 9 \rangle = \vec{u}$$

$$(b) \quad \|\vec{u}\| = \sqrt{(-8)^2 + 9^2} = \sqrt{64 + 81} = \sqrt{145} = \|\vec{u}\|$$

(c)  $\arctan\left(-\frac{9}{8}\right)$

$$\approx -48.36646066^\circ$$

So ref angle is \curvearrowright of

$$\text{So } \theta = 180^\circ - |\text{previous}|$$

$$\approx 180^\circ - 48.366^\circ$$

$$\approx 131.6335393$$

$$\approx \boxed{131.6335^\circ \approx \ominus}$$

$$(3) \quad (a) \quad \vec{u} = \langle -3, 7 \rangle = -3\vec{i} + 7\vec{j}$$

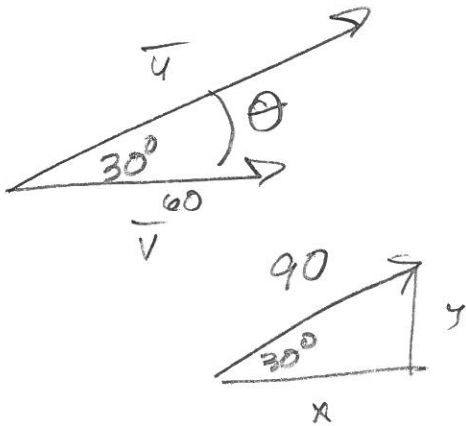
(b) Resultant.

~~(c)~~

(4)

$$\|\vec{u}\| = 90 \text{ N}, \|\vec{v}\| = 60 \text{ N}$$

(a)



$$\vec{u} =$$

$$\begin{aligned} x &= 90 \cos 30^\circ \\ &= \frac{90\sqrt{3}}{2} = 45\sqrt{3} \\ y &= 90 \sin 30^\circ \\ &= 90 \cdot \frac{1}{2} = 45 \end{aligned}$$

$$\vec{u} = \langle 45\sqrt{3}, 45 \rangle$$

$$\vec{v} = \langle 60, 0 \rangle$$

(b)

$$\vec{u} + \vec{v} = \langle 45\sqrt{3} + 60, 45 \rangle$$

(c)

$$\arctan\left(\frac{45}{45\sqrt{3} + 60}\right)$$

$$\approx 18.06753729^\circ$$

$$\approx 18.0675^\circ \approx \ominus$$

$$(5) f(x) = 5x^3 - 23x^2 + 77x - 39$$

$$(a) f(2): \quad \begin{array}{r|rrrr} 2 & 5 & -23 & 77 & -39 \\ & & 10 & -26 & 102 \\ \hline & 5 & -13 & 51 & \end{array}$$

$$63 = f(2)$$

$$(b) 2+3i \text{ is a zero.}$$

$$\begin{array}{r|rrrr} 2+3i & 5 & -23 & 77 & -39 \\ & & 10+15i & -71-9i & 39 \\ \hline & 5 & -13+15i & 6-9i & 0 \end{array}$$

$$(c) \begin{array}{r|rrrr} 2-3i & 5 & -13+15i & 6-9i & 0 \\ & & 10-15i & -6+9i & \\ \hline & 5 & -3 & 0 & \end{array}$$

$$f(x) = (x - (2+3i))(x - (2-3i))(5x-3)$$

$$\begin{aligned} (2+3i)(-13+15i) &= -26 + 30i - 39i + 45i^2 \\ &= -26 - 9i - 45 \\ &= -71 - 9i \end{aligned}$$

$$\begin{aligned} (6-9i)(2+3i) &= 3(2-3i)(2+3i) = 3(2^2 + 3^2) \\ &= 3(13) = 39 \end{aligned}$$

122

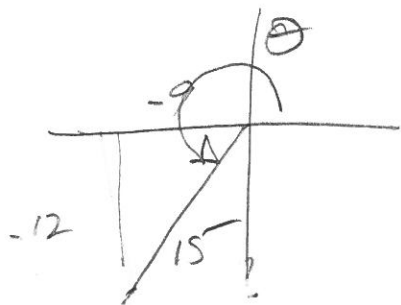
 $\sqrt{3}$

$$(6) z = -9 - 12i$$

$$(a) z + \bar{z} = 2\operatorname{Re}(z) = \boxed{-18 = z + \bar{z}}$$

$$z\bar{z} = 9^2 + 12^2 = 81 + 144 = 225 = z\bar{z}$$

(b)



$$\begin{array}{r} 3 \overline{) 225} \\ 3 \overline{) 75} \\ 5 \overline{) 25} \\ 5 \end{array}$$

$$\theta = \arctan\left(\frac{12}{9}\right) + 180^\circ$$

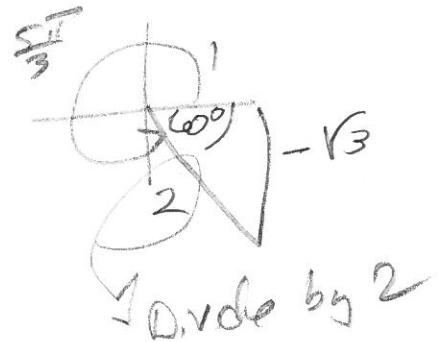
$$\approx 233.1301024^\circ \rightarrow$$

$$z \approx 15(\cos(233^\circ) + i\sin(233^\circ))$$

(7)

$$z = \cos\left(\frac{5\pi}{3}\right) + i\sin\left(\frac{5\pi}{3}\right)$$

$$= \boxed{\frac{1}{2} - \frac{\sqrt{3}}{2}i}$$



122 T3

$$(7) (b) \sqrt{z} = \cos \frac{\pi}{3} + i \sin \frac{\pi}{3} \quad k=0$$

$$(c) \text{Increment is } \frac{2\pi}{5}$$

$$\frac{\pi}{3} + \frac{2\pi}{5} = \frac{5\pi + 6\pi}{15} = \frac{11\pi}{15} \quad k=1$$

$$\frac{11\pi}{15} + \frac{6\pi}{15} = \frac{17\pi}{15} \quad k=2$$

$$\frac{17\pi + 6\pi}{15} = \frac{23\pi}{15} \quad k=3$$

$$\frac{23\pi + 6\pi}{15} = \frac{29\pi}{15} \quad k=4$$

CHECK = k=5

$$\frac{29\pi + 6\pi}{15} = \frac{35\pi}{15} = \frac{30\pi}{15} + \frac{5\pi}{15} = 2\pi + \frac{\pi}{3},$$

so full
circle

$$\cos \frac{11\pi}{15} + i \sin \frac{11\pi}{15}$$

$$\cos \frac{17\pi}{15} + i \sin \frac{17\pi}{15}$$

$$\cos \frac{23\pi}{15} + i \sin \frac{23\pi}{15}$$

$$\cos \frac{29\pi}{15} + i \sin \frac{29\pi}{15}$$

$$\textcircled{7} \textcircled{a} \quad z^3 = \cos(5\pi) + i \sin(5\pi)$$

$$= \cos \pi + i \sin \pi$$

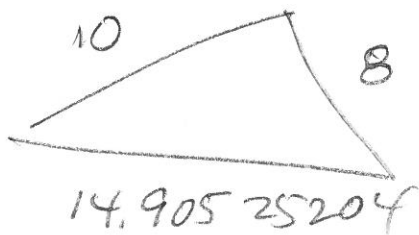
$$= \boxed{-1 = z^3}$$

$$\textcircled{e} \quad zw = \left(\cos \frac{5\pi}{3} + i \sin \frac{5\pi}{3} \right) \left(5 \left(\cos \frac{4\pi}{7} + i \sin \frac{4\pi}{7} \right) \right)$$

$$= 5 \left(\cos \frac{47\pi}{21} + i \sin \frac{47\pi}{21} \right)$$

$$\frac{5\pi}{3} + \frac{4\pi}{7} = \frac{(35+12)\pi}{21} = \frac{47\pi}{21}$$

B1



$$s = \frac{10 + 8 + 14.90525204}{2}$$

$$\approx 81.45262602, \text{ so}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\approx \sqrt{29448641.63}$$

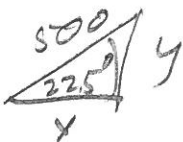
$$\approx \boxed{5333.726805 \text{ cm}^2}$$

122 T 3

B2



a



$$x = 500 \cos 22.5^\circ \approx 461.9397663$$

$$x \approx 462 \frac{\text{m}}{\text{s}}$$

$$y = 500 \sin 22.5^\circ \approx 191.3417162$$

$$y \approx 191 \frac{\text{m}}{\text{s}}$$

b

$$500 \cos 22.5 = 500 \sqrt{\frac{1 + \cos 45^\circ}{2}}$$

$$= 500 \sqrt{\frac{1 + \frac{1}{\sqrt{2}}}{2}} = 500 \sqrt{\frac{\sqrt{2} + 1}{2\sqrt{2}}}$$

$$= 500 \sqrt{\frac{2 + \sqrt{2}}{4}} = 250 \sqrt{2 + \sqrt{2}} \frac{\text{m}}{\text{s}} = x$$

$$y = 500 \sin 22.5 = 500 \sqrt{\frac{1 - \frac{\sqrt{2}}{2}}{2}} = 500 \sqrt{\frac{2 - \sqrt{2}}{4}}$$

$$= 250 \sqrt{2 - \sqrt{2}} \frac{\text{m}}{\text{s}} = y$$

(B2)

$$(c) S = \frac{1}{2}gt^2 + v_0 t + s_0$$

$$= -4.9t^2 + 250\sqrt{2-\sqrt{2}}t + 0$$

$$= -4.9 \left(t^2 - \frac{250\sqrt{2-\sqrt{2}}}{4.9} t \right) \stackrel{\text{SET}}{=} 0$$

$$\Rightarrow t \left(t - \frac{250\sqrt{2-\sqrt{2}}}{4.9} \right) = 0$$

$$\Rightarrow t = 0 \text{ or } t = \frac{250\sqrt{2-\sqrt{2}}}{4.9}$$

$$\approx 39.04932983 \text{ s}$$

\Rightarrow Horizontal distance $v_x t = \text{distance}$

$$\approx (500 \cos(22.5^\circ)) (39.04932983)$$

$$= (250\sqrt{2+\sqrt{2}}) (39.04932983) \approx 18038.4383$$

$$\approx \boxed{18,038 \text{ m}} \approx \text{Distance traveled.}$$

122 $\sqrt{3}$

(B3)

$$\cos u = -\frac{2}{5} \quad \& \quad \sin u > 0$$

$$90^\circ < u < 180^\circ$$

$$180^\circ < 2u < 360^\circ$$

Q III



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

$$= 2 \left(\frac{\sqrt{29}}{5} \right) \left(-\frac{2}{5} \right)$$

$$= \boxed{-\frac{4\sqrt{29}}{25} = \sin(2u)}$$

$$\cos(2u) = 2 \cos^2 u - 1$$

$$= 2 \left(-\frac{2}{5} \right)^2 - 1$$

$$= 2 \left(\frac{4}{25} \right) - 1$$

$$= \frac{+8 - 25}{25}$$

$$= \boxed{-\frac{17}{25} = \cos(2u)}$$

$$\tan(2u) = \frac{\sin(2u)}{\cos(2u)}$$

$$= \left(-\frac{4\sqrt{29}}{25} \right) \left(-\frac{25}{17} \right)$$

$$= \boxed{\frac{4\sqrt{29}}{17} = \tan(2u)}$$

122

T3

(B4)

(7, 500)

(13, -8)

 $\frac{1}{2}T$

$$= 13 - 7 = 6 \Rightarrow$$

$$T = 12$$

$$12b = 2\pi$$

$$b = \frac{\pi}{6}$$

$$* \cos\left(\frac{\pi}{6}(x-7)\right) + *$$

STARTS @ $x=7$

$$\text{MIDLINE: } \frac{500 + (-8)}{2} = \frac{492}{2} = 246 = y$$

$$* \cos\left(\frac{\pi}{6}(x-7)\right) + 246$$

$$\text{AMP: } \frac{500 - (-8)}{2} = \frac{508}{2} = 254$$

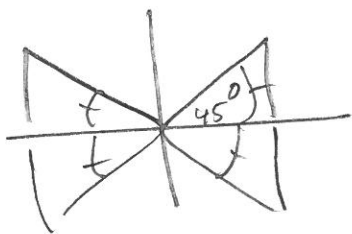
$$f(x) = 254 \cos\left(\frac{\pi}{6}(x-7)\right) + 246$$

(B5)

$$2\sin^2(3x) - 1 = 0$$

$$\sin^2(3x) = \frac{1}{2}$$

$$\sin(3x) = \pm \frac{1}{\sqrt{2}}$$



$$3x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$$

$$x = \frac{\pi}{12}, \frac{3\pi}{12}, \frac{5\pi}{12}, \frac{7\pi}{12}$$

That's the easy part.

But there are more solutions.

Take $3x$'s to 6π or take x 's to 2π

$$3x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}, \frac{9\pi}{4}, \frac{13\pi}{4}, \frac{15\pi}{4}, \frac{17\pi}{4}, \frac{19\pi}{4},$$

$$\frac{21\pi}{4}, \frac{23\pi}{4}, \frac{25\pi}{4}, \frac{27\pi}{4}$$

$$\text{So } x \in \left\{ \frac{2n-1}{12} \pi \mid n=1, 2, \dots, 12 \right\}$$

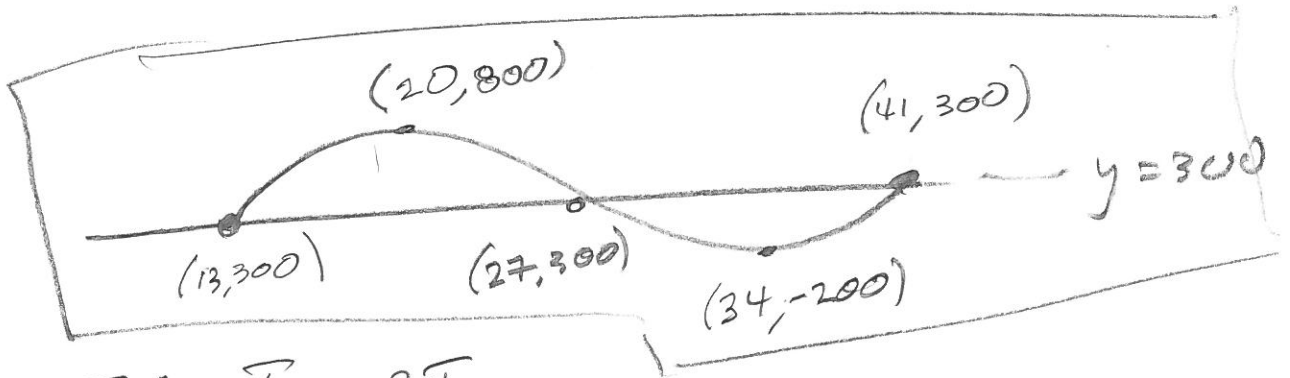
$$= \left\{ \frac{\pi}{12}, \frac{3\pi}{12}, \frac{5\pi}{12}, \frac{7\pi}{12}, \frac{9\pi}{12}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{15\pi}{12}, \frac{17\pi}{12}, \frac{19\pi}{12}, \frac{21\pi}{12}, \frac{23\pi}{12} \right\}$$

122

T3

(B6)

$$f(x) = 500 \sin\left(\frac{\pi}{14}(x - 13)\right) + 300$$



$$T: \frac{\pi}{14}x = 2\pi$$

$$x = 28 = T$$

$\frac{T}{4} = 7$, so add 7 to each x-coord, proceeding to the right.

B7

B7

$$\vec{u} = \langle -7, 7 \rangle$$

$$\vec{v} = \langle 15, 5\sqrt{3} \rangle$$

a) $\theta = ?$

b) $\text{proj}_{\vec{v}} \vec{u} = ?$

$$\begin{aligned} \text{a) } \cos \theta &= \frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\| \|\vec{v}\|} = \frac{-7(15) + 7(5\sqrt{3})}{\sqrt{49+49} \sqrt{225+75}} \\ &= \frac{-105 + 35\sqrt{3}}{(7\sqrt{2})(10\sqrt{3})} = \frac{-105 + 35\sqrt{3}}{70\sqrt{6}} \end{aligned}$$

$$\Rightarrow \theta = 105^\circ$$

$$\begin{aligned} \text{b) } \text{proj}_{\vec{v}} \vec{u} &= \frac{\vec{u} \cdot \vec{v}}{\|\vec{v}\|^2} \vec{v} = \frac{-105 + 35\sqrt{3}}{300} \langle 15, 5\sqrt{3} \rangle \\ &= \frac{-21 + 7\sqrt{3}}{60} \langle 15, 5\sqrt{3} \rangle \\ &= \frac{-21 + 7\sqrt{3}}{20} \langle 3, \sqrt{3} \rangle \end{aligned}$$

$\text{proj}_{\vec{v}} \vec{u} :$

$$\approx \langle -2.218911087, -1.281088913 \rangle$$