Homework 1

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Section 9.1

8

a) 5

b) 3

c) 7

d) $\sqrt{49+25} \approx 8.6$

e) $\sqrt{9+25} \approx 5.8$

f) $\sqrt{49+9} \approx 7.6$

12

$$\begin{aligned} radius &= \sqrt{(\sqrt{1^2+2^2})^2+3^2} = \sqrt{14} \\ (x-1)^2+(y-2)^2+(z-3)^2 &= (\sqrt{14})^2 \\ (x-1)^2+(y-2)^2+(z-3)^2 &= 14 \end{aligned}$$

14

$$\begin{aligned} x^2+8x+y^2-6y+z^2+2z &= -17 \\ (x+4)^2-16+(y-3)^2-9+(z+1)^2-1 &= -17 \\ (x+4)^2+(y-3)^2+(z+1)^2 &= -17+16+9+1 \\ (x+4)^2+(y-3)^2+(z+1)^2 &= 9 \end{aligned}$$

The equation represents a sphere with center (-4,3,-1) and radius = 3

16

$$\begin{aligned}
3(x^2+y^2+z^2) &= 10+6y+12z\\
x^2+y^2+z^2 &= \frac{10}{3}+2y+4z\\
x^2+y^2-2y+z^2-4z &= \frac{10}{3}\\
x^2+(y-1)^2-2+(z-2)^2-4 &= \frac{10}{3}\\
x^2+(y-1)^2+(z-2)^2 &= \frac{10}{3}+2+4\\
x^2+(y-1)^2+(z-2)^2 &= \frac{28}{3}
\end{aligned}$$

The equation represents a sphere with center (0,1,2) and radius $=2\sqrt{\frac{7}{3}}$

21-32

21) The vertical plane that lies over the line given by x=5 in the xy-plane
22) The vertical plane that lies over the line given by y=-2 in the xy-plane
23) The subspace containing all numbers smaller than the plane that goes through y=8
24) The subspace containing all numbes larger than the vertical plane that lies over the line given by x=-3 in the xy-plane
25) The subspace contained between (and including) the xy-planes that pass through z=0 and z=6
26) The cup-shaped shell defined by spinning the parabola given by $z^2 =$ 1spun around the z-axis
27) The circle that lies in the xy-plane and is centered at (0,0,-1) and has a radius = 2
28) The cylindrical shell of radius = 4 that is centered around the x-axis
29) The subspace contained within the sphere centered at (0,0,0) with radius $\leq \sqrt{3}$
30) The plane that extends out from the line given by x=z
31) The subspace that is outside the sphere centered at (0,0,1) with a radius of 1

38

$$\begin{aligned}
\sqrt{(x+1)^2+(y-5)^2+(z-3)^2} &= 2\sqrt{(x-6)^2+(y-2)^2+(z+2)^2} \\
x^2+2x+1+y^2-10y+25+z^2-6z+9 &= 4(x^2-12x+36+y^2-4y \\
&\quad +4+z^2+4z+4) \\
4x^2-x^2-48x-2x+4y^2-y^2-16y+10y+4z^2-z^2+16z+6z &= -141 \\
3x^2-50x+3y^2-6y+3z^2+22z &= -141 \\
x^2-\frac{50}{3}x+y^2-2y+z^2+\frac{22}{3}z &= -47 \\
(x-\frac{25}{3})^2+(y-1)^2+(z-\frac{11}{3})^2 &= -47+\frac{625}{9}+\frac{121}{9} \\
(x-\frac{25}{3})^2+(y-1)^2+(z-\frac{11}{3})^2 &= \frac{323}{9}
\end{aligned}$$

The center is (25/3, 1, 11/3) and the radius is $\frac{\sqrt{323}}{3}$

Section 9.2

22

$\langle \frac{-6}{\sqrt{6}}, \frac{12}{\sqrt{6}}, \frac{6}{\sqrt{6}} \rangle$

28

$$\begin{aligned}
wind &= \langle 50cos(\frac{7\pi}{4}), 50sin(\frac{7\pi}{4})\rangle \\
plane &= \langle 250cos(\frac{\pi}{6}), 250sin(\frac{\pi}{6})\rangle
\end{aligned}$$

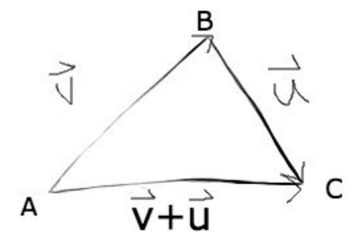
$truecourse = \langle 251.86, 89.64\rangle$ and $groundspeed = \sqrt{251.86^2+89.64^2} = 267.34$

38

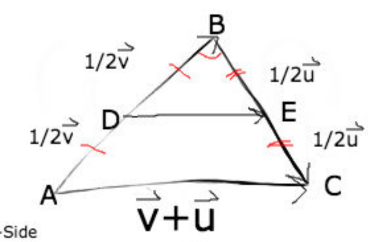
$$
\begin{aligned}
\vec{i} =& \langle 1,0,0\rangle \\
\vec{j} =& \langle 0,1,0\rangle \\
\vec{k} =& \langle 0,0,1\rangle \\
\vec{v} =& \langle a\vec{i}, b\vec{j}, c\vec{k}\rangle \\
hypotenuse = ||v|| =& \sqrt{a^2+b^2+c^2} \\
cos\alpha =& \frac{a}{\sqrt{a^2+b^2+c^2}} \\
cos\beta =& \frac{b}{\sqrt{a^2+b^2+c^2}} \\
cos\gamma =& \frac{c}{\sqrt{a^2+b^2+c^2}} \\
cos^2\alpha + cos^2\beta + cos^2\gamma =& \frac{a^2}{a^2+b^2+c^2} + \frac{b^2}{a^2+b^2+c^2} + \frac{c^2}{a^2+b^2+c^2} \\
cos^2\alpha + cos^2\beta + cos^2\gamma =& 1
\end{aligned}
$$

43

1) Draw a vector connecting the midpoint of AB to the midpoint of BC



2) By the definition of a midpoint we know that AD = DB and that each segment is 1/2v. Likewise BE = EC = 1/2u



3) We know that ABC and DBE are similar due to the Side-Angle-Side theorem. Therefore, DE must = 1/2AC which = 1/2(v+u)