

(4pts)  
 #1)  $d = \sqrt{(1-3)^2 + (4-(-1))^2 + (3-6)^2}$   
 $= \sqrt{(-2)^2 + (5)^2 + (-3)^2}$   
 $= \sqrt{4 + 25 + 9} = \sqrt{38}$

(4pts)  
 #2)  $\vec{PQ} = \langle 8-5, -2-2, 6-3 \rangle$   
 $= \langle 3, -4, 3 \rangle$

$x = 5 + 3t$   
 $y = 2 - 4t$   
 $z = 3 + 3t$

#3)  $\vec{a} = \langle 2, 5, -3 \rangle$   $\vec{b} = \langle 6, 2, 4 \rangle$   $\vec{c} = \langle 3, -4, 5 \rangle$

(2pts)  
 a.)  $4\vec{b} - 3\vec{c} = 4\langle 6, 2, 4 \rangle - 3\langle 3, -4, 5 \rangle$   
 $= \langle 24, 8, 16 \rangle + \langle -9, 12, -15 \rangle$   
 $= \langle 15, 20, 1 \rangle$

(3pts)  
 b.)  $|\vec{b} \times \vec{c}| = \sqrt{26^2 + 18^2 + 30^2}$   
 $= \sqrt{1900} = 10\sqrt{19}$

(2pts)  
 b.)  $|\vec{b}| = \sqrt{36 + 4 + 16} = \sqrt{56} = 2\sqrt{14}$

(3pts)  
 c.)  $\vec{a} \cdot \vec{b} = \langle 2, 5, -3 \rangle \cdot \langle 6, 2, 4 \rangle$   
 $= 12 + 10 - 12 = 10$

(2pts)  
 d.)  $\frac{\vec{b}}{|\vec{b}|} = \frac{\langle 6, 2, 4 \rangle}{2\sqrt{14}} = \left\langle \frac{3}{\sqrt{14}}, \frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}} \right\rangle$

(4pts)  
 e.)  $\vec{b} \times \vec{c} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 6 & 2 & 4 \\ 3 & -4 & 5 \end{vmatrix} = \hat{i}(10+16) - \hat{j}(30-12) + \hat{k}(-24-6)$   
 $= 26\hat{i} - 18\hat{j} - 30\hat{k}$

(3pts)  
 f.)  $\text{proj}_{\vec{a}} \vec{b} = \left( \frac{\vec{a} \cdot \vec{b}}{|\vec{a}|} \right) \frac{\vec{a}}{|\vec{a}|} = \left( \frac{10}{\sqrt{38}} \right) \frac{\langle 2, 5, -3 \rangle}{\sqrt{38}} = \frac{10}{38} \langle 2, 5, -3 \rangle = \frac{5}{19} \langle 2, 5, -3 \rangle$   
 $= \left\langle \frac{10}{19}, \frac{25}{19}, -\frac{15}{19} \right\rangle$   
 $|\vec{a}| = \sqrt{4 + 25 + 9} = \sqrt{38}$

4pts  
#4)  $P(3, 2, -5)$   $Q(4, 6, -2)$   $R(5, 4, 3)$

$$\vec{PQ} = \langle 1, 4, 3 \rangle$$

$$\vec{PR} = \langle 2, 2, 8 \rangle$$

$$\vec{PQ} \times \vec{PR} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 4 & 3 \\ 2 & 2 & 8 \end{vmatrix} = \hat{i}(32-6) - \hat{j}(8-6) + \hat{k}(2-8) \\ = 26\hat{i} - 2\hat{j} - 6\hat{k}$$

$$26(x-3) - 2(y-2) - 6(z+5) = 0$$

$$26x - 78 - 2y + 4 - 6z - 30 = 0$$

$$26x - 2y - 6z - 104 = 0$$

(4pts)  
#5)  $\text{Work} = \vec{F} \cdot \vec{D} = |\vec{F}| |\vec{D}| \cos \theta$

$$\text{Work} = (45 \text{ lb})(75 \text{ ft}) \cos 40^\circ \doteq 2585.4 \text{ ft}\cdot\text{lb}$$

(4pts)  
#6)  $|\vec{T}| = |\vec{r} \times \vec{F}| = |\vec{r}| |\vec{F}| \sin \theta$

$$= \left(\frac{3}{5} \text{ m}\right)(30 \text{ N}) \sin 25^\circ \doteq 7.6 \text{ N}\cdot\text{m}$$

(4pts)  
#7)  $P(4, -2, 3)$   $2x + 3y - 4z = 12$

$$P_0(6, 0, 0)$$

$$\vec{P_0P} = \langle -2, -2, 3 \rangle \quad \vec{n} = \langle 2, 3, -4 \rangle$$

$$\text{Comp}_{\vec{n}} \vec{P_0P} = \frac{\langle -2, -2, 3 \rangle \cdot \langle 2, 3, -4 \rangle}{\sqrt{4+9+16}} = \frac{-4-6-12}{\sqrt{29}} = \frac{-22}{\sqrt{29}} = \frac{22}{\sqrt{29}}$$

(4pts)  
#8)

$$\text{Volume} = \begin{vmatrix} 3 & -2 & 4 \\ 5 & -1 & 3 \\ 2 & 4 & 5 \end{vmatrix} = 3(-5-12) - (-2)(25-6) + 4(20+2) \\ = 3(-17) + 2(19) + 4(22) \\ = -51 + 38 + 88 = 75$$

(30 pts)  
#9)  $\lim_{t \rightarrow 0} \langle \sqrt{t^2+3t+2}, \sin t, 3t^2-4t+5 \rangle = \langle \sqrt{2}, 0, 5 \rangle$

(5 pts)  
#10)  $\vec{r}(t) = (t^2+3t)\hat{i} + (4e^{3t})\hat{j} + (\sin 4t)\hat{k}$   
 $\vec{r}'(t) = (2t+3)\hat{i} + (12e^{3t})\hat{j} + (4\cos 4t)\hat{k}$   
 $\vec{r}'(0) = 3\hat{i} + 12\hat{j} + 4\hat{k}$        $\vec{r}(0) = 0\hat{i} + 4\hat{j} + 0\hat{k}$        $P_0(0, 4, 0)$

$$x = 0 + 3t$$

$$y = 4 + 12t$$

$$z = 0 + 4t$$

(5 pts)  
#11)  $\int [(t^2+3t+2)\hat{i} + \sin(4t+3)\hat{j} + (5e^{2t})\hat{k}] dt$

$$= \left(\frac{t^3}{3} + \frac{3}{2}t^2 + 2t\right)\hat{i} + \left(-\frac{1}{4}\cos(4t+3)\right)\hat{j} + \left(\frac{5}{2}e^{2t}\right)\hat{k} + \vec{C}$$

(5 pts)  
#12)  $\int_0^1 \left[ \left(\frac{1}{1+t}\right)\hat{i} + (t^2)\hat{j} + (4e^{2t})\hat{k} \right] dt = \ln|1+t|\hat{i} + \frac{1}{3}t^3\hat{j} + 2e^{2t}\hat{k} \Big|_0^1$   
 $= (\ln 2)\hat{i} + \frac{1}{3}\hat{j} + 2e^2\hat{k} - (0\hat{i} + 0\hat{j} + 2\hat{k}) = \ln 2\hat{i} + \frac{1}{3}\hat{j} + (2e^2 - 2)\hat{k}$

(5 pts)  
#13)  $\vec{r}(t) = \langle t^2-2t, 1+3t, \frac{1}{2}t^3 + \frac{1}{2}t^2 \rangle$

$$\vec{r}'(t) = \langle 2t-2, 3, t^2+t \rangle$$

$$\vec{r}'(2) = \langle 2, 3, 6 \rangle$$

$$|\vec{r}'(2)| = \sqrt{4+9+36} = 7$$

$$\hat{T}(2) = \frac{\vec{r}'(2)}{|\vec{r}'(2)|} = \frac{\langle 2, 3, 6 \rangle}{7} = \left\langle \frac{2}{7}, \frac{3}{7}, \frac{6}{7} \right\rangle$$

1 pt each

#14) a.) ellipsoid

b.) cone

c.) hyperboloid of one sheet

d.) elliptic paraboloid

e.) sphere.