1. (8 points) **Note: No partial credit for this problem.**

   Let $\vec{v} = \langle 2, 1, 3 \rangle$ and $\vec{w} = \langle 2, 0, -1 \rangle$. Compute the following:

   (a) $2\vec{v} - 3\vec{w} =$ ______________

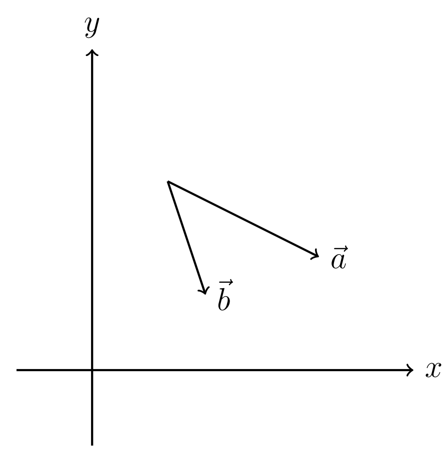
   (b) $|\vec{v}| =$ ______________

   (c) $\vec{v} \cdot \vec{w} =$ ______________

   (d) $\vec{v} \times \vec{w} =$ ______________

2. (6 points) Use the graphs to select the best possible answer. All graphed vectors lie in the xy-plane.

   (a) If $|\vec{a}| = 2$, then $\vec{a} \cdot \vec{b}$ is

   (A) -4

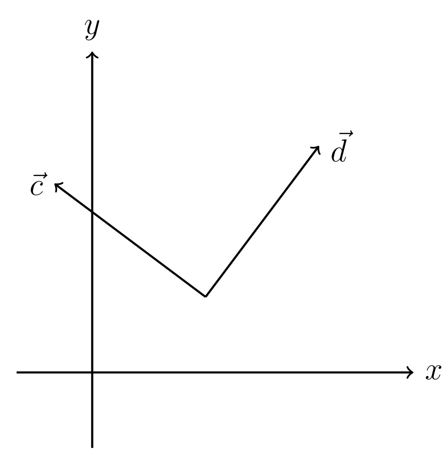
   (B) -2

   (C) 0

   (D) 2

   (E) 4

   (b) If $|\vec{c}| = 3$, then $\vec{c} \times \vec{d}$ is

   (A) $-9\vec{k}$

   (B) $-3\vec{k}$

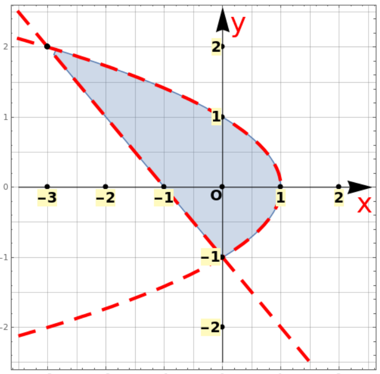
   (C) $\langle 0, 0, 0 \rangle$

   (D) $3\vec{k}$

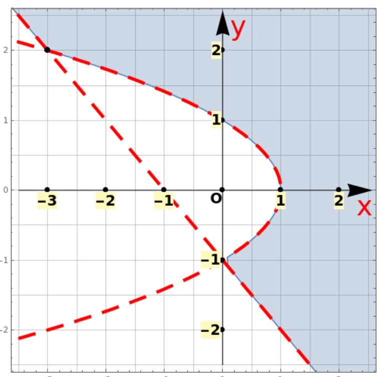
   (E) $9\vec{k}$

3. (3 points) Let $f(x,y) = \dfrac{\ln(x+y^2-1)}{\sqrt{x+y+1}}$. Which one of the shaded regions below is the domain of f? A dotted line indicates the curve is not part of the domain and a solid line indicates the curve is part of the domain.

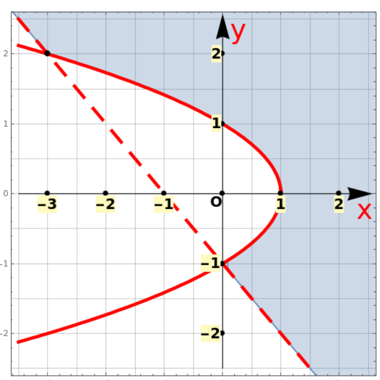
(A)



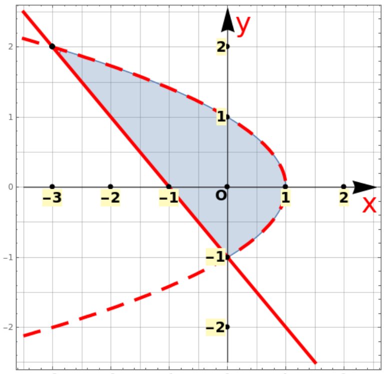
(B)



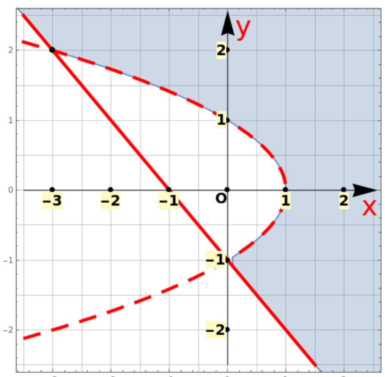
(C)



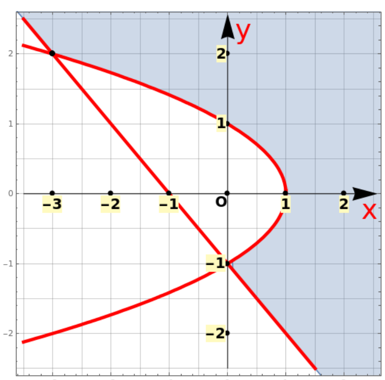
(D)



(E)

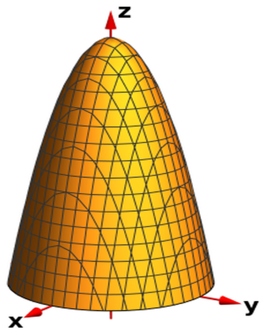


(F)

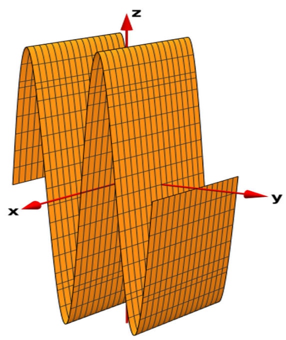


4. (8 points) Match each 3D surface with one of the equations on the right side. Not all equations will be matched.

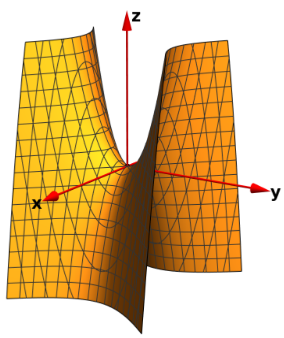
(i) ______



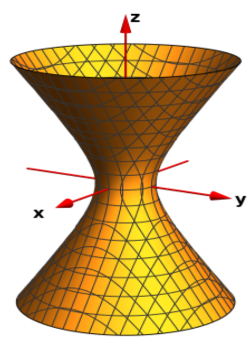
(ii) ______



(iii) ______



(iv) ______



(A) $z - x^2 + y^2 = 0$

(B) $z + x^2 - y^2 = 0$

(C) $z + x^2 + y^2 - 1 = 0$

(D) $x^2 + y^2 - z^2 - 1 = 0$

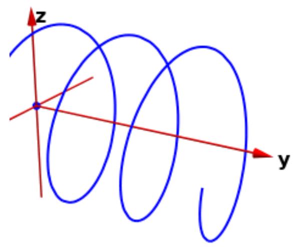
(E) $x^2 + y^2 - z^2 + 1 = 0$

(F) $z - \sin x = 0$

(G) $z - \sin y = 0$

5. (6 points) Match the vector equation with the curve that it parametrizes. Not all equations will be matched.

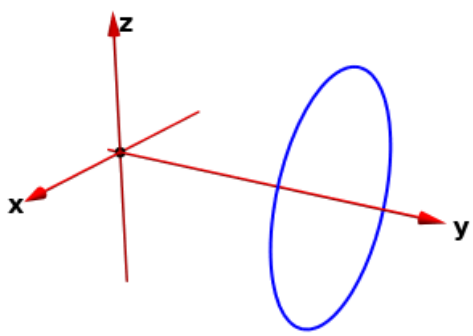
(i) ______



(A) $\vec{r}(t) = \langle t\cos t,\ t\sin t,\ t\rangle$, $0 \le t \le 6\pi$

(B) $\vec{r}(t) = \langle t\cos t,\ t, t\sin t\rangle$, $0 \le t \le 6\pi$

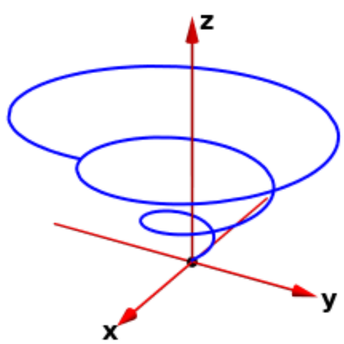
(ii) ______



(C) $\vec{r}(t) = \langle \cos t,\ t,\ \sin t\rangle$, $0 \le t \le 6\pi$

(D) $\vec{r}(t) = \langle \cos t,\ \sin t,\ 2\rangle$, $0 \le t \le 6\pi$

(iii) ______



(E) $\vec{r}(t) = \langle 2,\ \cos t,\ \sin t\rangle$, $0 \le t \le 6\pi$

(F) $\vec{r}(t) = \langle \cos t,\ 2,\ \sin t\rangle$, $0 \le t \le 6\pi$

6. (a) (5 points) Find a rectagular (Cartesian) equation for the surface whose **cylindrical** equation is

$$r = 2\cos\theta.$$

(b) (5 points) Which of the following equations in **spherical** coordinates is the surface given by the rectangular (Cartesian) equation

$$x^2 + y^2 + z^2 - 2z = 0?$$

(A) $\rho - 2\sin\phi = 0$

(B) $\rho - 2\cos\phi = 0$

(C) $\rho - 2\sin\theta = 0$

(D) $\rho - 2\cos\theta = 0$

(E) $\rho^2 - 2\sin\theta = 0$

(F) $\rho^2 - 2\cos\theta = 0$

7. Suppose a particle is moving along a path. The particle's velocity vector is

$$\vec{v}(t) = \sin(t)\,\vec{i} + t^3\,\vec{j} + e^t\,\vec{k}$$

(a) (4 points) Find the function representing the particles acceleration.

(b) (9 points) Suppose the particle's initial position is at $P(2,\,1,\,-1)$. Find the particle's position vector $\vec{r}(t)$.

8. (10 points) Compute the area of triangle with vertices at $(-1, 0, 2)$, $(2, 1, 6)$ and $(1, 1, 2)$.

9. (12 points) Calculate the distance between the plane $x + y + z = 5$ and the line $\vec{r}(t) = \langle t,\, 3 - 2t,\, t + 1\rangle$, $t \in \mathbb{R}$. The plane and the line do **not** intersect.

10. A particle begins at $A(1,0,0)$ and follows a path C: $\vec{r}(t) = \langle \cos(3t), \sin(3t), 4t \rangle$, where $t \geq 0$ represents time.

(a) (9 points) Reparametrize the curve with respect to arc length measured from the point $A(1,0,0)$ in the direction of increasing t.

(b) (3 points) Determine at which value of t the particle has traveled 20 units along the curve from $A(1,0,0)$.

11. (12 points) Consider a surface given as a part of the sphere $x^2 + y^2 + z^2 = 16$ that lies inside the cylinder $x^2 + y^2 = 4$ and above the xy-plane ($z \geq 0$). Find a parametric representation for the surface. Specify the bounds for the parameter(s).