1. (1 pt) Suppose you are standing at a point on the equator of a sphere, parameterized by spherical coordinates \(\theta\) and \(\phi\). Let "north" point to the top of the sphere and "west" and "east" similarly be chosen as if the sphere were a globe.
What can you say about your initial \(\phi\) coordinate?

\[ \Phi_0 = \] __________

Let your initial \(\theta\) coordinate be \(\theta = a\). If you go east two thirds of the way around the equator and halfway up toward the north pole along a longitude, what are your new \(\theta\) and \(\phi\) coordinates?

\[ \theta = \] __________
[\(\phi = \) __________

2. (1 pt) Find parametric equations for the sphere centered at the origin and with radius 5. Use the parameters \(s\) and \(t\) in your answer.

\[ x(s,t) = \] ____________
\[ y(s,t) = \] ____________, and
\[ z(s,t) = \] ____________ where
\[ \leq s \leq \] ____________ and
\[ \leq t \leq \] ____________

3. (1 pt)

A torus of radius 6 (and cross-sectional radius 1) can be represented parametrically by the function \(\Phi : D \to \mathbb{R}^3\) by:

\[ \Phi(\theta, \phi) = ((6 + \cos \phi) \cos \theta, (6 + \cos \phi) \sin \theta, \sin \phi) \]

where \(D\) is the rectangle given by \(0 \leq \theta \leq 2\pi\), \(0 \leq \phi \leq 2\pi\).

The surface area of the torus is ____________

4. (1 pt) Match the parametric equations with the verbal descriptions of the surfaces by putting the letter of the verbal description to the left of the letter of the parametric equation.

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1. \(r(u,v) = u \cos v i + u \sin v j + u^2 k\)

2. \(r(u,v) = u i + v j + (2u - 3v) k\)

3. \(r(u,v) = u i + u \cos v j + u \sin v k\)

4. \(r(u,v) = u i + \cos v j + \sin v k\)

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A. cone
B. circular paraboloid
C. plane
D. circular cylinder

5. (1 pt) Find the surface area of the part of the sphere \(x^2 + y^2 + z^2 = 25\) that lies above the cone \(z = \sqrt{x^2 + y^2}\)

Surface Area = ____________

6. (1 pt)

Find the surface area of that part of the plane \(6x + 4y + z = 5\) that lies inside the elliptic cylinder \(\frac{x^2}{36} + \frac{y^2}{16} = 1\)

Surface Area = ____________

7. (1 pt) Evaluate \(\iint_S \sqrt{1 + x^2 + y^2} \, dS\) where \(S\) is the helicoid: \(r(u,v) = u \cos(v)i + u \sin(v)j + vk\), with \(0 \leq u \leq 3\), \(0 \leq v \leq 3\pi\)

Flux = ____________

8. (1 pt) (a) Set up a double integral for calculating the flux of the vector field \(F(x,y,z) = -6xz i - 6yz j + z^2 k\) through the part of the cone \(z = \sqrt{x^2 + y^2}\) for \(0 \leq z \leq 2\), oriented upward.

\[ \text{Flux} = \iint_{Disk} \] ____________

(b) Evaluate the integral.

\[ \text{Flux} = \iint_S \] ____________
9. (1 pt) Calculate the flux of the vector field \( \mathbf{F}(x, y, z) = \cos(x^2 + y^2)\mathbf{k} \) through the disk \( x^2 + y^2 \leq 49 \) oriented upward in the plane \( z = 5 \).

\[ \text{Flux} = \] 

10. (1 pt) Calculate the flux of the vector field \( \mathbf{F}(x, y, z) = (6x + 9)i \) through a disk of radius 5 centered at the origin in the \( yz \)-plane, oriented in the negative \( x \)-direction.

\[ \text{Flux} = \] 

11. (1 pt) Calculate the flux of the vector field \( \mathbf{F}(x, y, z) = 5\mathbf{i} - 4\mathbf{j} + 9\mathbf{k} \) through a square of side length 3 lying in the plane \( 2x + 3y + 4z = 1 \), oriented away from the origin.

\[ \text{Flux} = \] 

12. (1 pt) (a) Calculate the flux of the vector field \( \mathbf{F}(x, y, z) = 8\mathbf{i} - 7\mathbf{k} \) through a sphere of radius 3 centered at the origin, oriented outward.

\[ \text{Flux} = \] 

(b) Calculate the flux of the vector field \( \mathbf{F}(x, y, z) = \mathbf{i} - 3\mathbf{j} + 8\mathbf{k} \) through a cube of side length 3 with sides parallel to the axes, oriented outward.

\[ \text{Flux} = \]