This print-out should have 10 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

Calculate the flux of the vector field

$$\mathbf{F}(x,\, y,\, z) \;=\; 3\langle x+y,\, x-y,\, x^2+y^2-2z\rangle$$

through the surface S parametrized by

$$\mathbf{\Phi}(u,\, v) \;=\; \left\langle\, u+2v,\, u-2v,\, u^2+2v^2 \,\right\rangle$$

with $0 \le u,\, v \le 1$, and oriented by $\mathbf{\Phi}_u \times \mathbf{\Phi}_v$.

1. $I \;=\; -6$

2. $I \;=\; -5$

3. $I \;=\; -9$

4. $I \;=\; -7$

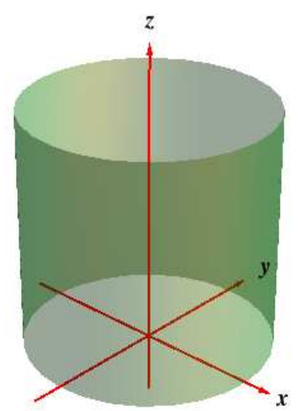
5. $I \;=\; -8$

002 10.0 points

Calculate the flux of the vector field

$$\mathbf{F}(x, y, z) \;=\; \left\langle\, z(x^2+y^2),\, zy,\, zx \,\right\rangle$$

through the outwardly-oriented open cylinder



having radius 1 and lying between the planes $z = 0$ and $z = 2$.

1. $I \;=\; \dfrac{3}{2}\pi$

2. $I \;=\; 0\pi$

3. $I \;=\; \dfrac{1}{2}\pi$

4. $I \;=\; 2\pi$

5. $I \;=\; \pi$

003 10.0 points

Evaluate the integral

$$I \;=\; \int\!\!\int_S \mathbf{F}\cdot d\mathbf{S}$$

for the vector field

$$\mathbf{F} \;=\; 3x\,\mathbf{i} + 2y\,\mathbf{j} - 2z\mathbf{k}$$

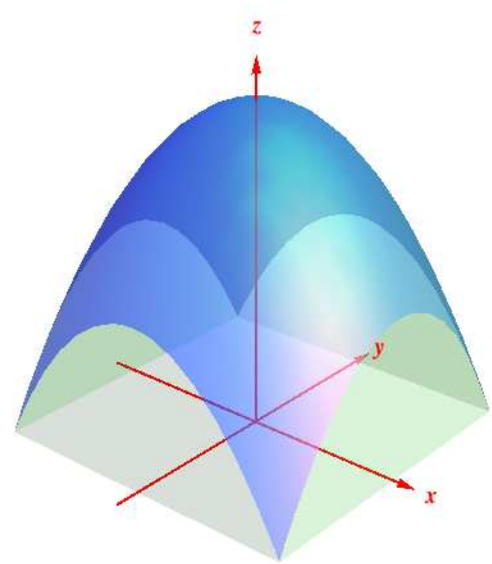
when S is the part of the paraboloid

$$z \;=\; 2 - x^2 - y^2\,,$$

oriented upwards, lying above the square

$$-1 \;\le\; x \;\le\; 1\,, \quad -1 \;\le\; y \;\le\; 1\,,$$

as shown in



1. $I \;=\; 1$

2. $I \;=\; \dfrac{2}{3}$

3. $I = 2$

4. $I = \dfrac{4}{3}$

5. $I = \dfrac{8}{3}$

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004 10.0 points

Evaluate the surface integral

$$I = \int\int_S \mathbf{F} \cdot d\mathbf{S}$$

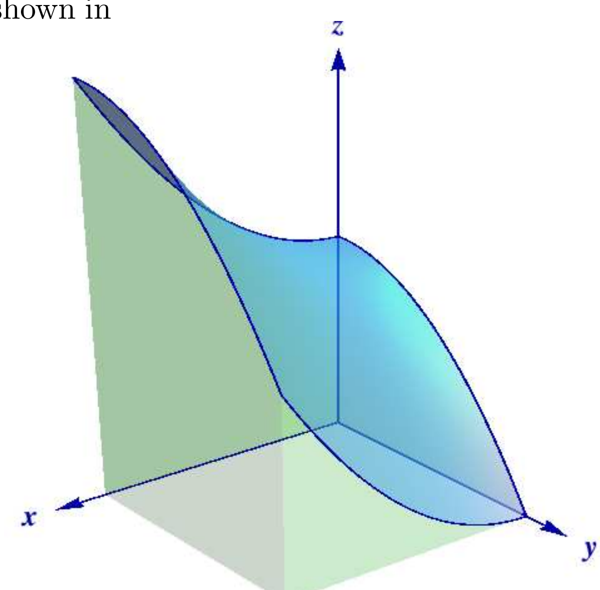
when

$$\mathbf{F}(x, y, z) = 2y^2\,\mathbf{i} + 3x^2\,\mathbf{j}$$

and S is the graph of

$$z = \frac{1}{2}(1 + x^2 - y^2), \quad 0 \leq x, y \leq 1,$$

shown in



1. $I = \dfrac{1}{3}$

2. $I = \dfrac{5}{6}$

3. $I = \dfrac{1}{6}$

4. $I = \dfrac{2}{3}$

5. $I = \dfrac{1}{2}$

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005 10.0 points

Evaluate the integral

$$I = \int_S f\,dS$$

when

$$f(x, y, z) = 3(1 + y^2 + z^2)^{1/2}$$

and S is the surface given parametrically by

$$\mathbf{\Phi}(u, v) = (2uv, u + v, u - v)$$

for $u^2 + v^2 \leq 1$.

1. $I = 12\pi$

2. $I = 3\pi$

3. $I = 18\pi$

4. $I = 4\pi$

5. $I = 6\pi$

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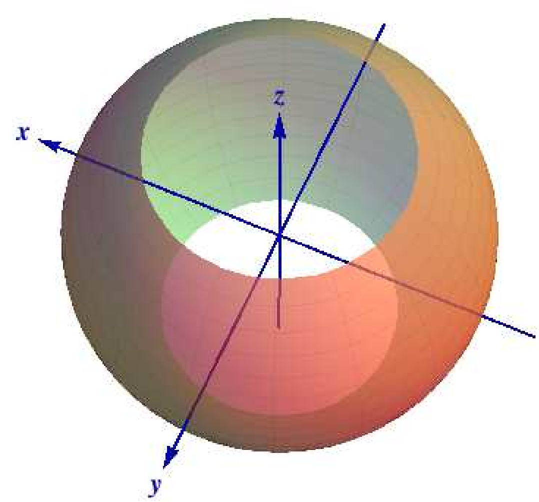
006 10.0 points

The surface S shown in



is the portion of the sphere

$$x^2 + y^2 + z^2 = 16$$

where

$$x^2 + y^2 \geq 12\,.$$

Determine the surface area of S.

1. Surface Area $=$ 16 sq. units

2. Surface Area $=$ 24 sq. units

3. Surface Area $=$ 32 sq. units

4. Surface Area $=$ 32π sq. units

5. Surface Area $=$ 24π sq. units

6. Surface Area $=$ 16π sq. units

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007 10.0 points

Use the fact that

$$\mathbf{F}(x,\, y) = 2e^y\,\mathbf{i} + (2xe^y - 3)\,\mathbf{j}$$

is a gradient vector field to evaluate the line integral

$$I = \int_C \mathbf{F}\cdot d\mathbf{s}$$

along the curve C given parametrically by

$$\mathbf{c}(t) = te^t\,\mathbf{i} + (1+t)\,\mathbf{j}\,, \quad 0 \leq t \leq 1\,.$$

1. $I = -3e^2 - 2$

2. $I = 2e^2 - 3$

3. $I = -3e^3 + 2$

4. $I = 2e^3 - 3$

5. $I = 2e^3 + 6$

6. $I = -3e^2 + 6$

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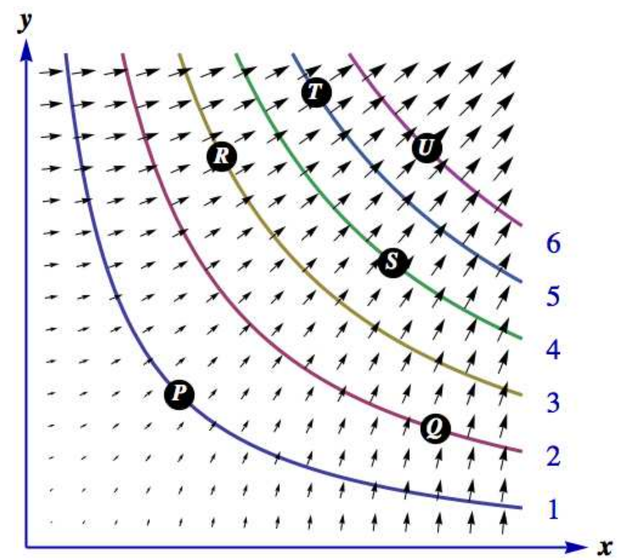
008 10.0 points

A gradient vector field $\mathbf{F} = \nabla f$ and points $P,\, Q,\, \ldots,\, U$ on contour lines of $z = f(x,\, y)$ are shown in



Determine the value of the line integral

$$I = \int_C \mathbf{F}\cdot d\mathbf{s}$$

when C is the line segment from S to R and the values of $f(x,\, y)$ on the contour lines are listed to the right.

1. $I = 3$

2. $I = 4$

3. $I = -4$

4. $I = 1$

5. $I = -1$

6. $I = -3$

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009 10.0 points

Use the fact that

$$\mathbf{F} = (6xy + 4\cos y)\,\mathbf{i} + (3x^2 - 4x\sin y)\,\mathbf{j}\,,$$

is a gradient vector field to evaluate the line integral

$$I = \int_C \mathbf{F} \cdot d\mathbf{s}$$

along a smooth curve C in the plane from

$$P = (1, \pi) \quad \text{to} \quad Q = \left(2, \frac{\pi}{2}\right).$$

1. $I = 3 + 4\pi$

2. $I = 6 + 4\pi$

3. $I = 6 - 4\pi$

4. $I = 6\pi - 4$

5. $I = 3\pi - 4$

6. $I = 3\pi + 4$

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010 10.0 points

Find the work done by the force field

$$\mathbf{F}(x, y) = (xy^2 + 3)\,\mathbf{i} + (x^2y + 5)\,\mathbf{j}$$

in moving a particle along a smooth path in the plane from $A(1, 0)$ to $B(2, 1)$.

1. work done $=$ 10 units

2. work done $=$ 11 units

3. work done $=$ 12 units

4. work done $=$ 9 units

5. work done $=$ 8 units