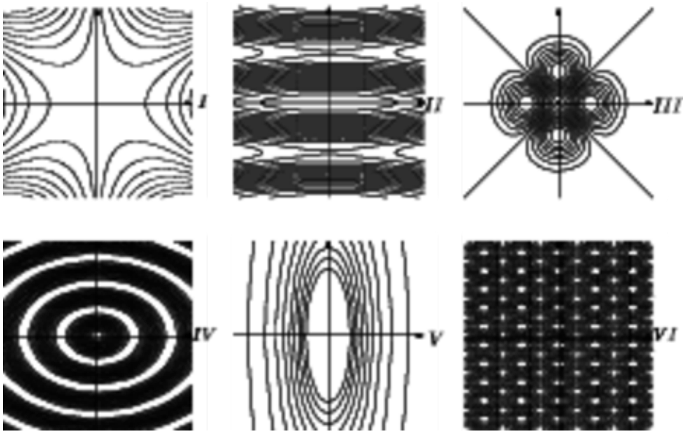
Question 1

Not yet answered

Marked out of 10

Match each of the functions to the level sets shown in the illustration.



$f(x,y) = \frac{15}{9x^2+y^2+1}$ Choose...

$f(x,y) = \cos(x)\sin(2y)$ Choose...

$f(x,y) = x^3 - 3xy^2$ Choose...

$f(x,y) = 6\cos^2 y - \frac{x^2}{10}$ Choose...

$f(x,y) = \cos\sqrt{x^2+2y^2}$ Choose...

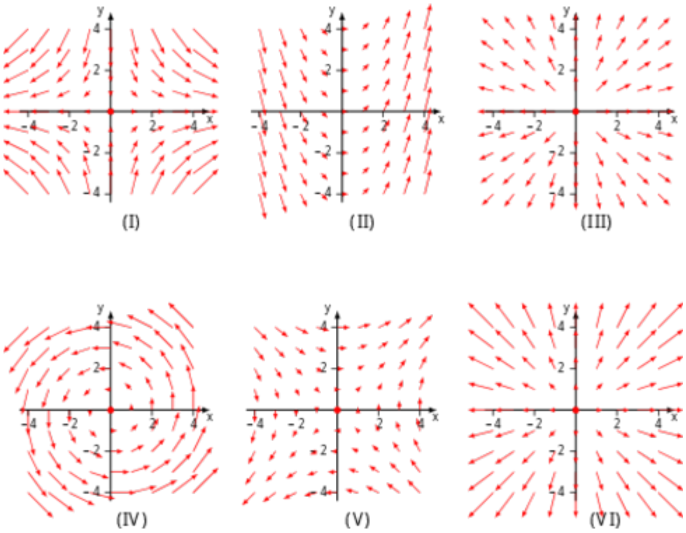
$f(x,y) = (x^2-y^2)e^{-(x^2+y^2)}$ Choose...

Question 2

Not yet answered

Marked out of 10

Match each of the functions to the vector fields shown in the illustration.



$\mathbf{F}(x,y) = y\mathbf{i} + x\mathbf{j}$	Choose...
$\mathbf{F}(x,y) = \mathbf{i} + x\mathbf{j}$	Choose...
$\mathbf{F}(x,y) = 2x\mathbf{i} + -2y\mathbf{j}$	Choose...
$\mathbf{F}(x,y) = \nabla f$, where $f(x,y) = x^2 + y^2$	Choose...
$\mathbf{F}(x,y) = \nabla f$, where $f(x,y) = xy$	Choose...
$\mathbf{F}(x,y) = \nabla f$, where $f(x,y) = \sqrt{x^2+y^2}$	Choose...
$\mathbf{F}(x,y) = -y\mathbf{i} + x\mathbf{j}$	Choose...
$\mathbf{F}(x,y) = \nabla f$, where $f(x,y) = x^2 - y^2$	Choose...

Question 3

Not yet answered

Marked out of 1

The length of the arc

$$\gamma(t) = (t, 3t^2), \quad t \in [0,1]$$

is equal to (enter the approximate answer in decimal format):

Hint: freely use the indefinite integral $\int \sqrt{1+x^2}\, dx = \frac{x}{2}\sqrt{1+x^2} + \frac{1}{2}\ln(\sqrt{1+x^2}+x) + C$.

Question 4

Not yet answered

Marked out of 2

The length of the arc

$$\gamma(t) = (t^2, t^2, t^3), \quad t \in [0,1]$$

is equal to $(\boxed{a}\sqrt{17} - \boxed{b}\sqrt{2})/27$ where the missing numbers are $\boxed{a}$: , $\boxed{b}$: .

Question **5**

Not yet answered

Marked out of 3

Consider the vector field

$$\mathbf{f}(x,y,z) = x\ \mathbf{i} + y\ \mathbf{j} + z\ \mathbf{k}.$$

The curl of the vector field is equal to

$$\nabla \times \mathbf{f}(x,y,z) = \begin{pmatrix} \boxed{\text{a}} \\ \boxed{\text{b}} \\ \boxed{\text{c}} \end{pmatrix} 0$$

where the missing numbers are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____, $\boxed{\text{c}}$: ____.

Question **6**

Not yet answered

Marked out of 2

Consider the vector field

$$\mathbf{f}(x,y,z) = xyz\ \mathbf{i} + z\sin(y)\ \mathbf{j} + xe^y\ \mathbf{k}.$$

The curl of the vector field is equal to

$$\nabla \times \mathbf{f}(x,y,z) = (\boxed{\text{a}}e^y - \sin y)\ \mathbf{i} - (e^y - xy)\ \mathbf{j} + x\boxed{\text{b}}\mathbf{k}$$

where the missing symbols are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____.

Question **7**

Not yet answered

Marked out of 3

The divergence of the vector field

$$\mathbf{f}(x,y) = \cos(x+2y)\ \mathbf{i} + e^{2x+y}\ \mathbf{j}$$

is

$$\nabla \cdot \mathbf{f}(x,y) = -\sin(\boxed{\text{a}} + \boxed{\text{b}}y) + \boxed{\text{c}}e^{2\boxed{\text{a}}+y}$$

where the missing symbol is $\boxed{\text{a}}$: ____, and the missing numbers are $\boxed{\text{b}}$: ____, $\boxed{\text{c}}$: ____.

Question **8**

Not yet answered

Marked out of 4

The divergence of the vector field

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

is

$$\nabla \cdot \mathbf{f}(x,y,z) = \boxed{\text{a}} + \boxed{\text{b}}y + \boxed{\text{c}}z^{\boxed{\text{d}}}$$

and the missing numbers are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____, $\boxed{\text{c}}$: ____, $\boxed{\text{d}}$: ____.

Question **9**

Not yet answered

Marked out of 2

Find the extrema of $f(x,y) = 2x^2 + y^2$ constrained to the set $G = \{(x,y) \in \mathbb{R}^2 : x^4 - x^2 + y^2 - 5 = 0\}$.

The maximum is ____ /4 and the minimum is ____.

Question **10**

Not yet answered

Marked out of 3

Find the extrema of $f(x,y) = 4x^2 + y^2 - 2x - 4y + 1$ constrained to the set $G = \{(x,y) \in \mathbb{R}^2 : 4x^2 + y^2 - 1 = 0\}$.
The maximum is $2 + \sqrt{17}$ and the minimum is $2 - \sqrt{17}$, these values are attained at the points

$$\left(\frac{1}{2\sqrt{\boxed{\text{a}}}}, \frac{-4}{\sqrt{\boxed{\text{a}}}} \right), \quad \left(\frac{\boxed{\text{b}}}{2\sqrt{\boxed{\text{a}}}}, \frac{\boxed{\text{c}}}{\sqrt{\boxed{\text{a}}}} \right)$$

respectively. The missing values are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____, $\boxed{\text{c}}$: ____.

Question **11**

Not yet answered

Marked out of 2

Eliminate the parameters u, v to obtain an equation in x, y, z representing the trace of

$$\boldsymbol{\sigma}(u,v) = au\cos v\ \mathbf{i} + bu\sin v\ \mathbf{j} + u^2\ \mathbf{k}.$$

The equation is

$$\frac{\boxed{\text{a}}^2}{a^2} + \frac{y^2}{\boxed{\text{b}}^2} = z$$

where the missing symbols are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____.

Question **12**

Not yet answered

Marked out of 2

Eliminate the parameters u, v to obtain an equation in x, y, z representing the trace of

$$\boldsymbol{\sigma}(u,v) = u\ \mathbf{i} + a\sin v\ \mathbf{j} + a\cos v\ \mathbf{k}.$$

The equation is

$$\boxed{\text{a}}^2 + z^2 = a^{\boxed{\text{b}}}$$

where the missing symbols are $\boxed{\text{a}}$: ____, $\boxed{\text{b}}$: ____.

Question **13**

Not yet answered

Marked out of 1

Consider the scalar function

$$f(x,y,z) = \frac{x^2(1+8y)}{\sqrt{1+y+4x^2y}}$$

and the path defined by

$$\gamma(t) = (t, t^2, \log t), \quad t \in [1,2].$$

The integral of f along the path γ is equal to ____ /2.

Question **14**

Not yet answered

Marked out of 1

Let Γ be the union of the curve $y = 4 - x^2$ from $A = (-2,0)$ to $B = (2,0)$ and the circle $x^2 + y^2 = 4$ from B to A. The integral of the scalar function $f(x,y) = x$ along the closed curve Γ is equal to ____.

Question **15**

Not yet answered

Marked out of 1

Let Γ be the path composed of a straight line segment from the origin to $A = (\sqrt{2}, 0)$, the circular arc $x^2 + y^2 = 2$ from A to $B = (1,1)$ and the straight line segment from B to the origin. Consider the scalar function

$$f(x,y) = \frac{1}{x^2+y^2+1}.$$

The integral of f along the closed curve Γ is equal to

$$2\arctan(\sqrt{2}) + \frac{\sqrt{2}}{\boxed{\mathrm{a}}}\pi$$

where the missing coefficient is $\boxed{\mathrm{a}}$: ____.

Question **16**

Not yet answered

Marked out of 1

Consider the vector field

$$\mathbf{f}(x,y,z) = z\mathbf{i} + y\mathbf{j} + 2x\mathbf{k}$$

and the path defined by

$$\gamma(t) = (t, t^2, t^3), \quad t \in [0,1].$$

The path integral of $\mathbf{f}$ along the path defined by γ is equal to ____ /4.

Question **17**

Not yet answered

Marked out of 1

Consider the vector field

$$\mathbf{f}(x, y, z) = 2\sqrt{z}\mathbf{i} + x\mathbf{j} + y\mathbf{k}$$

and the path defined by

$$\gamma(t) = (-\sin t, \cos t, t^2), \quad t \in [0, \tfrac{\pi}{2}].$$

The path integral of $\mathbf{f}$ along the path defined by γ is equal to \pi / [ ].

Question **18**

Not yet answered

Marked out of 10

Find the extrema of $f(x, y, z) = 3x + 3y + 8z$ constrained to the intersection of the two cylinders, $x^2 + z^2 = 1$ and $y^2 + z^2 = 1$.

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Question **19**

Not yet answered

Marked out of 10

- Parametrize with a curve the straight line between the point $(1, 3, 2)$ and $(3, 1, 2)$.
- Parametrize with a curve the intersection of the plane $x + y + z = 1$ and the cylinder $z = x^2$.
- Parametrize with a curve the intersection of $x^2 + y^2 = 16$ and $z = x + y$.

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Question **20**

Not yet answered

Marked out of 10

Compute the integral of $\mathbf{f}(x, y) = (xy^2, x^2y)$ along Γ, the closed path formed of straight line segments connecting $A = (0, 1)$, $B = (1, 1)$, $C = (0, 2)$, $D = (1, 2)$ (in that order).
Hint: the final answer is 2.

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