Physics, astronomy and planetary science > Discover > Prepare and make a head start > Preparation for Level 3 physics modules > SM381 Electromagnetism > Are You Ready For SM381?

This item is also available in Preparation for Level 3 physics modules.

Information

The following questions will allow you to test how prepared you are for embarking on studying SM381. They assess the knowledge that we expect you to know already and be comfortable using Many of these questions have multiple algebraic or numerical variants, so you may get a different set of questions each time you attempt the quiz, which you may do as often as you wish.

When entering algebraic answers, you may use the symbols "+" (plus), "-" (multiply), "" (divide) and "^" (raise to the power of) as well as brackets (" and ")". Use "'s for $\sqrt{-1}$, use "s for the exponential function, and use "sqrt" to indicate the square root function. For Greek letters, simply type the name, such as "pi" for π or "theta" for θ .

When entering numerical answers you should also include units, if necessary, for example "3.2*m/s" or "6.8*kg*m^2/s^2".

Question 1 Not answered

A component of a vector in Cartesian coordinates

 $\mathbf{r} = 4 \, \mathbf{e}_y + 2 \, \mathbf{e}_z$ is a vector.

| Give the value of | the e _z -component of r |
|-------------------|------------------------------------|
| eg-component = | |

The $\mathbf{e_{g}}$ -component is the coefficient of $\mathbf{e_{g}}$ in the vector, **r.** For $\mathbf{r} = 4\mathbf{e_{y}} + 2\mathbf{e_{g}}$ is it **2**.

See An introduction to vector algebra Section 3.

Question 2 Not answered Marked out of 1.00

Tidy STACK question tool | Question tests & deployed
The magnitude of a vector in Cartesian coordinates

 $\mathbf{r} = a_{\mathbf{x}} \mathbf{e}_{\mathbf{x}} + a_{\mathbf{y}} \mathbf{e}_{\mathbf{y}} + a_{\mathbf{x}} \mathbf{e}_{\mathbf{x}}$ is given by $\mathbf{a} = \sqrt{a_{\mathbf{x}}^2 + a_{\mathbf{y}}^2 + a_{\mathbf{x}}^2}$. In this case, $a_{\mathbf{x}} = 2$, $a_{\mathbf{y}} = 0$ and $a_{\mathbf{x}} = 1$ giving $\mathbf{a} = \sqrt{4 + 0 + 1} = \sqrt{5}$.

See An Introduction to Vector Algebra Section 3.

Question 3 Not answered Marked out of 1.00

Tidy STACK question tool | Question tests & deployed variants

Tidy STACK question tool | Question tests & deployed var

Unit vectors in Cartesian coordinates

 $\mathbf{r} = 4\mathbf{e}_y + 2\mathbf{e}_z$ is a vector. Calculate the unit vector $\hat{\mathbf{r}}$. (Type ei to input \mathbf{e}_g , ey to input \mathbf{e}_g , ez to input \mathbf{e}_g and sqrt(c) to input \sqrt{c}) $\hat{\mathbf{r}} =$.

 $\hat{\mathbf{r}}$ is the unit vector of \mathbf{r} and is given by $\frac{1}{|\mathbf{r}|}\mathbf{r}$. It has the same direction as \mathbf{r} and and magnitude of 1.

The magnitude of **r** is $|\mathbf{r}| = \sqrt{r_x^2 + r_y^2 + r_z^2}$.

In this case, $\mathbf{r}_{\mathbf{s}} = \mathbf{0}, \mathbf{r}_{\mathbf{y}} = \mathbf{4}$ and $\mathbf{r}_{\mathbf{s}} = \mathbf{2}$ giving $|\mathbf{r}| = \sqrt{\mathbf{0}^2 + \mathbf{4}^2 + \mathbf{2}^2} = 2\sqrt{5}$. This gives the unit vector $\frac{1}{|\mathbf{r}|}\mathbf{r} = \frac{1}{2\sqrt{5}}(\mathbf{4}\mathbf{e}_{\mathbf{y}} + \mathbf{2}\mathbf{e}_{\mathbf{s}})$

and so $\hat{\mathbf{r}} = \frac{2 \mathbf{e}_y}{\sqrt{5}} + \frac{\mathbf{e}_z}{\sqrt{5}}$.

See An Introduction to Vector Algebra Section 2.

Help

| Question 4 Not answered Marked out of 1.00 | Telu OTACK evention ten! A varian tests & danlaved variante |
|---|--|
| Scaling a vector | Tidy STACK question tool Question tests & deployed variants |
| $\mathbf{a} = 2 \mathbf{e}_{\mathbf{z}} + \mathbf{e}_{\mathbf{z}}$, write down $2\mathbf{a}$. | |
| 2a = | |
| (Type ei for $\mathbf{e}_{\mathbf{z}}$, ey for $\mathbf{e}_{\mathbf{y}}$ and ez for $\mathbf{e}_{\mathbf{z}}$.) | |
| | |
| For a vector a and a (non-zero) scalar $\boldsymbol{\lambda}$, the scalar multiplication of the scalar multiplicatio | |
| $ \lambda \mathbf{a} $, and has the same direction as \mathbf{a} if $\lambda > 0$ or the | |
| In this case, the scale factor is 2 . Each component is mu $2\mathbf{a} = 4\mathbf{e}_{x} + 2\mathbf{e}_{x}$. | uniplied by the scale factor, giving |
| | |
| See An Introduction to Vector Algebra Section 2. | |
| | |
| Question 5 Not answered | |
| | Tidy STACK question tool Question tests & deployed variants |
| Vector products | |
| Determine the vector product $\mathbf{b} \times \mathbf{a}$ given $\mathbf{a} = \mathbf{e}_{x} - 5 \mathbf{e}_{y}$ (Type ei for \mathbf{e}_{x} , ey for \mathbf{e}_{y} and ez for \mathbf{e}_{z} .) | and $\mathbf{v} = \mathbf{z} \mathbf{e}_{\mathbf{z}} - \mathbf{s} \mathbf{e}_{\mathbf{z}}$. |
| b×a = | |
| | |
| | |
| Using a determinant, the vector product is | |
| | |
| $\mathbf{b} \times \mathbf{a} = \begin{vmatrix} \mathbf{e}_{x} & \mathbf{e}_{y} & \mathbf{e}_{z} \\ \mathbf{b}_{x} & \mathbf{b}_{y} & \mathbf{b}_{z} \\ \mathbf{a}_{x} & \mathbf{a}_{y} & \mathbf{a}_{z} \end{vmatrix} = \begin{vmatrix} \mathbf{e}_{x} & \mathbf{e}_{y} & \mathbf{e}_{z} \\ 2 & 0 & -3 \\ 1 & -5 & 0 \end{vmatrix}$ | |
| $= -15 \mathbf{e}_x - 3 \mathbf{e}_y - 10 \mathbf{e}_z.$ | |
| | |
| See An Introduction to Vector Algebra 4.2. | |
| | |
| Question 6 Not answered | |
| Marked out of 1.00 | Tidy STACK question tool Question tests & deployed variants |
| Trigonometry | |
| Given $f(x) = -\cos^2(x) + \sin^2(x)$, write $f(x)$ in terms | s of cos(2x) . |
| | |
| $\cos^2(x) - \sin^2(x) = \cos(2x)$ and $\sin(2x) = \cos(x)\sin(x)$. | |
| These can be combined and rearranged to give $\cos^2(x) = \frac{1}{2}(1 + \cos(2x)),$ | |
| $\sin^2(x)=\tfrac{1}{2}(1-\cos(2x))$ | |
| and $\sin^2(2x)=1-\cos^2(2x).$ | |
| These equations can be used to show that | |
| $f(x) = -\cos^2(x) + \sin^2(x)$ | |
| $= \frac{-1 - \cos(2x)}{2} + \frac{1 - \cos(2x)}{2}$ | |
| $=-\cos(2x)$ | |
| See Algebra and other useful mathematical notation See | ction 4. |
| | |
| | |
| Question 7 Not answered Marked out of 1.00 | |
| Finding the square modulus of a com | Tidy STACK question tool Question tests & deployed variants |
| Given $z = 3 + 7i$ where $i = \sqrt{-1}$. | -prest framou |
| Given $z = 3 + 7i$ where $i = \sqrt{-1}$. Determine $ z ^2$, the square modulus of z . | |
| $ 3 + 7\mathbf{i} ^2 =$ | |
| | |
| $ z ^2 = z^* z = (x - yi)(x + yi) = x^2 + xyi - z$ | |
| Therefore, $ 3+7i ^2 = (3-7i)(3+7i) = 9+4$ | 49 = bö. |
| See Complex numbers Section 1. | |
| | |
| Question 8 Not answered | |
| Question 8 Not answered Marked out of 1.00 | Tidy STACK question tool Question tests & deployed variants |
| Finding the square of a complex num | |
| Given $z = -7 + 4i$ where $i = \sqrt{-1}$. | |
| Determine x^2 , the square of x . | |
| (-7+4i) ² = | |
| | |
| $z^2 = (x + yi)^2 = x^2 + 2xyi - y^2$ | |
| Therefore, $z^2 = (-7 + 4i)^2 = 49 - 56i - 16 = 33$ | 3 — 56 i |
| See Complex numbers Section 1. | |
| | |

| The polar form of complex numbers Sign the complex number $z = \frac{x_1^2}{2} - \frac{1}{2}$ which has the Cartesian coordinates $(z, y) = (\frac{x_1^2}{2}, -\frac{1}{2})$. There mise the polar coordinates (r, θ) of z . Type p for r_{1} . The polar form of a complex number is $z = r(\cos \theta + i\sin \theta)$. where the radial coordinate, $r = \sqrt{z^2 + y^2}$ and the angular coordinate is θ A unique value of θ is chosen with $-r < 0 \le x \le 0$ and be calculated by solving $\tan \theta = y/z$ and making sure that θ is the correct quadrant. In this case, $r = \sqrt{(\frac{x^2}{2})^2 + (-\frac{1}{2})^2} = 1$ and $\tan \theta = -\frac{x_1^2}{2} = -\frac{1}{4}$. Choosing θ is the correct quadrant gives $\theta = -\frac{\pi}{5}$. See Complex numbers Section 2. Lustion 10 Not answered there are part of z is real. Write down Re(z), the real part of z . $r_{0}(z) =$ | Question 9 Not answered Marked out of 1.00 |
|---|---|
| prevente the pole coordinates $(\mathbf{r}, \mathbf{\theta})$ of \mathbf{z} Type \mathbf{p} for $\mathbf{r}_{}$ The poler form of a complex number is $\mathbf{z} = \mathbf{r}(\cos \theta + \mathbf{i} \sin \theta)$. where the notical coordinate, $\mathbf{r} = \sqrt{a^2 + a^2}$ and the angular coordinate is θ . A unque value of θ is in the control quadrant. In this case, $\mathbf{r} = \sqrt{(\frac{a}{2}, \frac{1}{2})^2 + (-\frac{1}{2})^2} = 1$ and $\tan \theta = -\frac{1}{2} = -\frac{1}{2}$. Choosing θ in the correct quadrant gives $\theta = -\frac{2}{2}$. See Complex numbers Section 2. Using Euler's formula: $\mathbf{z} = Aa^{\frac{1}{2}} = -A(\cos((\mathbf{z}^{2}) + \mathbf{i} \sin((\mathbf{z}))))$ gives $\mathbf{z} = e^{1/2} - \cos(\theta \mathbf{z}) + \mathbf{i} \sin(\theta \mathbf{z})$. See Complex numbers and Euler's formula Display Euler's formula: $\mathbf{z} = Aa^{\frac{1}{2}} = -A(\cos((\mathbf{z}^{2}) + \mathbf{i} \sin(\mathbf{z})))$ gives $\mathbf{z} = e^{1/2} - \cos(\theta \mathbf{z}) + \mathbf{i} \sin(\theta \mathbf{z})$. See Complex numbers Section 3. Using Euler's formula: $\mathbf{z} = Aa^{\frac{1}{2}} = -A(\cos((\mathbf{z}^{2}) + \mathbf{i} \sin(\mathbf{z})))$ gives $\mathbf{z} = e^{-1/2} - \cos(\theta \mathbf{z}) + \mathbf{i} \sin(\theta \mathbf{z})$. See Complex numbers Section 3. Using Euler's formula: $\mathbf{z} = Aa^{\frac{1}{2}} = -A(\cos((\mathbf{z}^{2}) + \mathbf{i} \sin(\mathbf{z})))$ gives $\mathbf{z} = \mathbf{z} - \mathbf{z}^{-1/2} - \cos(\theta \mathbf{z}) - \mathbf{z} \sin(\mathbf{z})$. See Complex numbers Section 3. Using Euler's formula: $\mathbf{z} = Aa^{\frac{1}{2}} = -A(\cos((\mathbf{z}^{2}) + \mathbf{i} \sin(\mathbf{z})))$ gives $\mathbf{z} = \mathbf{z} - \mathbf{z}^{-1/2} - \cos(\mathbf{z}(\mathbf{z}) - \mathbf{z}) \sin(\mathbf{z})$. See Complex numbers Section 3. See Complex numbers Section 3. The total dual of 100 The the section $\mathbf{z} = \mathbf{z} - \mathbf{z}$. See Complex numbers Section 3. See Complex numbers Section 3. See Complex numbers Section 3. The complex point $\mathbf{z} = \mathbf{z} - \mathbf{z} = \mathbf{z} - \mathbf{z}$. The this case, $\mathbf{z} = \mathbf{z} - \mathbf{z} = \mathbf{z} - \mathbf{z} = \mathbf{z} = \mathbf{z}$. The second point $\mathbf{y} = (\mathbf{z}^{-1} + \mathbf{z})^{2} + \mathbf{z} = $ | Tidy STACK question tool Question tests & deployed variants The polar form of complex numbers |
| $ \begin{aligned} $ | Given the complex number $z = \frac{\sqrt{3}}{2} - \frac{1}{2}$ which has the Cartesian coordinates $(x, y) = (\frac{\sqrt{3}}{2}, -\frac{1}{2})$. Determine the polar coordinates (r, θ) of z . (Type pi for π .) |
| where the radial coordinate, $\mathbf{r} = \sqrt{\mathbf{s}^2 + \mathbf{y}^2}$ and the angular coordinate is θ . A unique value of θ is chosen with $-\mathbf{r} < \theta \leq \mathbf{r} = \theta$ and the calculated by solving $\tan \theta = \frac{1}{2} = -\frac{1}{4}$. Choosing θ is the correct quadrant gives $\theta = -\frac{\pi}{5}$. See Complex numbers Section 2. Lussion 10 Not answered that do not 100 To SECC quadrant θ is a solution of $\mathbf{r} = \frac{1}{2} = -\frac{1}{4}$. Choosing θ is the correct quadrant gives $\theta = -\frac{\pi}{5}$. See Complex numbers and Euler's formula Bios $\mathbf{r} = e^{1/\mathbf{r}}$ where \mathbf{r} is real. While do not 100 Lussion 11 Not answered that do not 100 Lussion 12 Not answered Lussion 14 Lussion 100 Lussion 12 Not answered Lussion 12 Not 2 N | $\boldsymbol{\tau} = $ |
| Question 10 Not answered Examples numbers and Euler's formula State $z = e^{1z}$ where z is real. Wite down Re(z), is meal part of z . $R^c(z) = [$ | where the radial coordinate, $\mathbf{r} = \sqrt{x^2 + y^2}$ and the angular coordinate is $\boldsymbol{\theta}$. A unique value of $\boldsymbol{\theta}$ is chosen with $-\pi < \boldsymbol{\theta} \le \pi$. $\boldsymbol{\theta}$ can be calculated by solving $\tan \boldsymbol{\theta} = y/x$ and making sure that $\boldsymbol{\theta}$ is in the correct quadrant. In this case, $\mathbf{r} = \sqrt{\left(\frac{\sqrt{3}}{2}\right)^2 + \left(-\frac{1}{2}\right)^2} = 1$ and $\tan \boldsymbol{\theta} = \frac{-\frac{1}{2}}{\frac{\sqrt{3}}{2}} = -\frac{1}{\sqrt{3}}$. Choosing $\boldsymbol{\theta}$ in the correct |
| <pre>tended and a spectral spectrad spectral spectrad spectrad spectrad spectrad spe</pre> | See Complex numbers Section 2. |
| Deprivation of the maximum of the the maximum of t | Question 10 Not answered |
| Since $\mathbf{z} = e^{\mathbf{i}\cdot\mathbf{z}}$ where \mathbf{z} is real. Write down Re(\mathbf{z}), the real part of \mathbf{z} . Re(\mathbf{z}) = | Marked out of 1.00 Tidy STACK question tool Question tests & deployed variants |
| White down Re(2), the real part of \mathbf{z} . Re(\mathbf{z}) = | Complex numbers and Euler's formula |
| $\operatorname{Re}(a) = \left[\begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$ | Given $\pmb{x} = \pmb{e^{B1 \pmb{x}}}$ where \pmb{x} is real. Write down Re(\pmb{x}), the real part of \pmb{x} . |
| $z = e^{iz} = \cos(8 z) + i \sin(8 z),$ so the real part of z is $\cos(8 z)$. See Complex numbers Section 3. Cuestion 11 Not answered texted out of 100 Thy STACK question text & deployed variants Complex numbers and Euler's formula Siven $z = 8e^{-4iz}$ where z is real. With down $\ln(z)$, the imaginary part of z. m(z) = Using Euler's formula, $z = Ae^{ibz} = A(\cos(bz) + i\sin(bz))$ gives $z = 8e^{-4iz} = 8 \cos(4z) - 8i \sin(4z)$. See Complex numbers Section 3. Cuestion 12 Not answered texted out of 100 Thy STACK question text & deployed variants Cyclindrical coordinates z, ϕ, z . Type pi for π . = | |
| $z = e^{iz} = \cos(8 z) + i \sin(8 z),$ so the real part of z is $\cos(8 z)$. See Complex numbers Section 3. Cuestion 11 Not answered texted out of 100 Thy STACK question text & deployed variants Complex numbers and Euler's formula Siven $z = 8e^{-4iz}$ where z is real. With down $\ln(z)$, the imaginary part of z. m(z) = Using Euler's formula, $z = Ae^{ibz} = A(\cos(bz) + i\sin(bz))$ gives $z = 8e^{-4iz} = 8 \cos(4z) - 8i \sin(4z)$. See Complex numbers Section 3. Cuestion 12 Not answered texted out of 100 Thy STACK question text & deployed variants Cyclindrical coordinates z, ϕ, z . Type pi for π . = | |
| $z = e^{iz} = \cos(8 z) + i \sin(8 z),$ so the real part of z is $\cos(8 z)$. See Complex numbers Section 3. Cuestion 11 Not answered texted out of 100 Thy STACK question text & deployed variants Complex numbers and Euler's formula Siven $z = 8e^{-4iz}$ where z is real. With down $\ln(z)$, the imaginary part of z. m(z) = Using Euler's formula, $z = Ae^{ibz} = A(\cos(bz) + i\sin(bz))$ gives $z = 8e^{-4iz} = 8 \cos(4z) - 8i \sin(4z)$. See Complex numbers Section 3. Cuestion 12 Not answered texted out of 100 Thy STACK question text & deployed variants Cyclindrical coordinates z, ϕ, z . Type pi for π . = | |
| so the real part of z is $\cos(8z)$. See Complex numbers Section 3. Cuestion 11 Not answered taxed out of 100 Try STACK question ted () Cuestion tests & deployed vectors Complex numbers and Euler's formula We also also also also also also also also | |
| Question 11 Not answered tarked out of 1.00 Thy STACK question ted (Question tests & deployed variance) Complex numbers and Euler's formula Where z is real. Write down in(z), the imaginary part of z . m(z) = Imaginary part of z . $m(z) = $ Using Euler's formula, $z = Ae^{id_z} = A(\cos(kz) + i \sin(kz))$ gives $z = 8e^{-4iz} = 8 \cos(4z) - 8i \sin(4z)$, so the imaginary part of z is $-8 \sin(4z)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Thy STACK question tests & deployed variance Cylindrical coordinates r_x, ϕ_x). Type pi for π .) = The cylindrical coordinates $(x, y, z) = (1, 0, -1)$, in cylindrical coordinates r_x, ϕ_x .) The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/2}$, than $\phi = \frac{y}{z}$ and $\cos \phi = \frac{z}{z}$, and $z = x$. In this case, $x = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1$, than $\phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $z = -1$. | |
| <pre>tended of 10 Description of given by Cartesian coordinates, (<i>x</i>, <i>y</i>, <i>z</i>) = (1, 0, -1), in cylindrical coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of an of <i>z</i> = <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>z</i>, <i>z</i>, <i>z</i>, <i>z</i>.) Description coordinates (<i>x</i>, <i>z</i>, <i>z</i>, <i>z</i>, <i>z</i>.) Description c</pre> | See Complex numbers Section 3. |
| <pre>tended of 10 Description of the imaginary part of the imag</pre> | |
| <pre>tended of 10 Description of the imaginary part of the imag</pre> | |
| <pre>tended of 10 Description of given by Cartesian coordinates, (<i>x</i>, <i>y</i>, <i>z</i>) = (1, 0, -1), in cylindrical coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of an of <i>z</i> = <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of a point are related to the Cartesian coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>y</i>, <i>z</i>) of <i>z</i>, <i>z</i>, <i>z</i>. Description coordinates (<i>x</i>, <i>z</i>, <i>z</i>, <i>z</i>, <i>z</i>.) Description coordinates (<i>x</i>, <i>z</i>, <i>z</i>, <i>z</i>, <i>z</i>.) Description c</pre> | Question 11 Not answered |
| Complex numbers and Euler's formula Siven $z = \delta e^{-4iz}$ where z is real. Write down Im(\hat{z}), the imaginary part of z . Im(\hat{z}) = | Marked out of 1.00 |
| Write down Im (2), the imaginary part of \mathbf{z} . Im (\mathbf{z}) = | Complex numbers and Euler's formula |
| $Im(x) = $ Using Euler's formula, $x = Ae^{4bx} = A(\cos(kx) + i\sin(kx))$ gives $x = 8e^{-41x} = 8\cos(4x) - 8i\sin(4x)$, so the imaginary part of x is $-8\sin(4x)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Toy STACK question tod Question tests & deployed variants Cylindrical coordinates express the point given by Cartesian coordinates. $(x, y, z) = (1, 0, -1)$, in cylindrical coordinates r, ϕ, z). Type pi for π .) = = The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/3}$, $\tan \phi = \frac{y}{x}$ and $\cos \phi = \frac{x}{r}$, and $x = x$. In this case, $x = 1, y = 0$ and $z = -1$ giving $\phi = 0$, and $z = -1$. | Given $z = 8e^{-4iz}$ where z is real. |
| Using Euler's formula, $z = Ae^{4z} = A(\cos(kz) + i \sin(kz))$ gives $z = 3e^{-41z} = 3\cos(4z) - 8i \sin(4z)$, so the imaginary part of z is $-8\sin(4z)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Tely STACK question tests à depiqued variants Cylindrical coordinates Express the point given by Cartesian coordinates. $(x, y, z) = (1, 0, -1)$, in cylindrical coordinates r, ϕ, z). Type pi for π .) = = The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/3}$, $\tan \phi = \frac{y}{z}$ and $\cos \phi = \frac{z}{z}$, and $x = x$. In this case, $x = 1, y = 0$ and $z = -1$ giving $\phi = 0$, and $z = -1$. | Write down $Im(\mathbf{z})$, the imaginary part of \mathbf{z} , $Im(\mathbf{z}) = \mathbf{z}$ |
| $z = 3e^{-41z} = 8\cos(4z) - 8i\sin(4z),$ so the imaginary part of z is $-8\sin(4z)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Tay STROK question tod Question tots & deployed variants Cylindrical coordinates Express the point given by Cartesian coordinates. $(x, y, z) = (1, 0, -1),$ in cylindrical coordinates $r, \phi, z).$ Type pi for π .) The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/2}$, $\tan \phi = \frac{y}{z}$ and $\cos \phi = \frac{x}{z}$, and $z = z$. In this case, $x = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $z = -1$. | |
| $z = 3e^{-4iz} = 8 \cos(4z) - 8i \sin(4z),$ so the imaginary part of z is $-8 \sin(4z)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Tray STROK question test 3. deployed variants Cylindrical coordinates Express the point given by Cartesian coordinates. $(x, y, z) = (1, 0, -1),$ in cylindrical coordinates r, ϕ, z .). Type pi for π .) = = The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/2}$, $\tan \phi = \frac{y}{z}$ and $\cos \phi = \frac{x}{z}$, and $z = x$. In this case, $x = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1, \tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $z = -1$. | |
| so the imaginary part of \mathbf{z} is $-8 \sin(4z)$. See Complex numbers Section 3. Question 12 Not answered tarked out of 1.00 Tray STACK question tool Question tests & deployed variants Cylindrical coordinates express the point given by Cartesian coordinates. $(\mathbf{x}, \mathbf{y}, \mathbf{z}) = (1, 0, -1)$, in cylindrical coordinates $\mathbf{r}, \phi, \mathbf{z}$). Type pi for $\mathbf{\pi}$.) $\mathbf{r} = [$ | Using Euler's formula, $z = Ae^{i\mathbf{k}\mathbf{x}} = A(\cos{(\mathbf{k}\mathbf{x})} + i\sin{(\mathbf{k}\mathbf{x})})$ gives |
| See Complex numbers Section 3. Question 12 Not answered larked out of 1.00 Try STACK question tool Question tests & deployed variants Cylindrical coordinates (x, y, z) = (1, 0, -1), in cylindrical coordinates (1, 0, -1), in cyl | |
| Question 12 Not answered tarked out of 1.00 Try STACK question tod [Question tests & deployed variants Cylindrical coordinates (x, y, x) = (1, 0, -1), in cylindrical coordinates (x, y, z) = (1, 0, -1), in cylindrica | so the imaginary part of z is $-8 \sin(4z)$. |
| taked out of 1.00 Cyclindrical coordinates tr, p, s, b). Type pi for π .) • | See Complex numbers Section 3. |
| taked out of 1.00 Cyclindrical coordinates tr, p, s, b). Type pi for π .) • | |
| taked out of 1.00 Cyclindrical coordinates tr, p, s, b). Type pi for π .) • | |
| The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates $(x, y, z) = (1, 0, -1)$, in cylindrical coordinates (r, ϕ, z) . The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates $(x, y, z) = (z, z)$. The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/2}$, $\tan \phi = \frac{y}{z}$ and $\cos \phi = \frac{z}{r}$, and $z = x$. In this case, $x = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $z = -1$. | Question 12 Not answered |
| Type pi for π .) Type pi for π .) Type pi for π .) The cylindrical coordinates (r, ϕ, z) of a point are related to the Cartesian coordinates (x, y, z) of the same point by $r = (x^2 + y^2)^{1/2}$, $\tan \phi = \frac{y}{x}$ and $\cos \phi = \frac{\pi}{x}$, and $z = z$. In this case, $x = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1$. $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $z = -1$. | Tidy STACK question tool Question tests & deployed variants |
| $\mathbf{r}, \phi, \mathbf{z}).$ Type pi for π .) $= $ $= $ $\mathbf{z} = $ The cylindrical coordinates $(\mathbf{r}, \phi, \mathbf{z})$ of a point are related to the Cartesian coordinates $(\mathbf{x}, \mathbf{y}, \mathbf{z})$ of the same point by $\mathbf{r} = (\mathbf{z}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{x}}$ and $\cos \phi = \frac{\pi}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{x} = 1, \mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$. $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | Cylindrical coordinates |
| The cylindrical coordinates $(\mathbf{r}, \phi, \mathbf{z})$ of a point are related to the Cartesian coordinates $(\mathbf{x}, \mathbf{y}, \mathbf{z})$ of the same point by $\mathbf{r} = (\mathbf{x}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\sigma}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{x} = 1, \mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | Express the point given by Cartesian coordinates, $(x, y, z) = (1, 0, -1)$, in cylindrical coordinates (r, ϕ, z) . |
| the same point by $\mathbf{r} = (\mathbf{z}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\mathbf{z}}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{z} = 1$, $\mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | (Type pi for π .) |
| the same point by $\mathbf{r} = (\mathbf{z}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\mathbf{z}}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{z} = 1$, $\mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | r = |
| the same point by $\mathbf{r} = (\mathbf{z}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\mathbf{z}}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{z} = 1$, $\mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | ¢ = |
| the same point by $\mathbf{r} = (\mathbf{z}^2 + \mathbf{y}^2)^{1/2}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\mathbf{z}}{\mathbf{r}}$, and $\mathbf{z} = \mathbf{z}$. In this case, $\mathbf{z} = 1$, $\mathbf{y} = 0$ and $\mathbf{z} = -1$ giving $\mathbf{r} = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{(0)}{(1)} = 0$ and $\cos \phi = \frac{(1)}{(1)} = 1$ giving $\phi = 0$, and $\mathbf{z} = -1$. | z = |
| $\cos\phi=rac{(1)}{(1)}=1$ giving $\phi=0,$ and $z=-1.$ | the same point by $r = (x^2 + y^2)^{1/2}$, $\tan \phi = \frac{y}{x}$ and $\cos \phi = \frac{x}{r}$, and $z = z$. |
| | In this case, $z = 1, y = 0$ and $z = -1$ giving $r = \sqrt{(1)^2 + (0)^2} = 1$, $\tan \phi = \frac{ \psi }{\langle 1 \rangle} = 0$ and $\cos \phi = \frac{\langle 1 \rangle}{\langle 1 \rangle} = 1$ giving $\phi = 0$, and $z = -1$. |
| See Coordinate systems Section 5. | |
| | See Coordinate systems Section 5. |
| | |

| Marked out of 1.00 | Tidy STACK question tool Question tests & deployed variant |
|---|--|
| Spherical coordina | tes |
| Express the point given by Ca | rtesian coordinates, $(x,y,z)=(rac{1}{\sqrt{2}},rac{1}{\sqrt{2}},1),$ in spherical coordinates |
| (r, θ, ϕ) . | v= v= |
| Your angles must be given in | radians. |
| (Type sqrt(a) for \sqrt{a} and pi fo | r π .) |
| r = | |
| • | |
| θ= | |
| \$\$ = 1 | |
| | |
| | |
| | |
| The spherical coordinates | $(\pmb{r},\pmb{\theta},\pmb{\phi})$ of a point are related to the Cartesian coordinates $(\pmb{x},\pmb{y},\pmb{z})$ of |
| | $(\mathbf{r}, \theta, \phi)$ of a point are related to the Cartesian coordinates $(\mathbf{z}, \mathbf{y}, \mathbf{z})$ of + $\mathbf{y}^2 + \mathbf{z}^2)^{1/2}$, $\cos \theta = \frac{\mathbf{z}}{\mathbf{r}}$, $\tan \phi = \frac{\mathbf{y}}{\mathbf{z}}$ and $\cos \phi = \frac{\mathbf{z}}{\mathbf{z} + \mathbf{n} \mathbf{z}}$. |
| the same point by $r = (x^2)$ | $(z,y)^2 + z^2)^{1/2}, \cos\theta = \frac{z}{r}, \tan\phi = \frac{y}{z} \text{ and } \cos\phi = \frac{z}{r \sin\theta}.$ |
| the same point by $\mathbf{r} = (\mathbf{x}^2)$ In this case, $\mathbf{x} = \frac{1}{\sqrt{2}}, \mathbf{y} = \frac{1}{\sqrt{2}}$ | $+y^2 + z^2)^{1/2}$, $\cos \theta = \frac{x}{r}$, $\tan \phi = \frac{y}{x}$ and $\cos \phi = \frac{s}{r \sin \theta}$. $\frac{1}{\sqrt{2}}$ and $z = 1$ giving |
| the same point by $\mathbf{r} = (\mathbf{x}^2)$ In this case, $\mathbf{x} = \frac{1}{\sqrt{2}}, \mathbf{y} = \frac{1}{\sqrt{2}}$ | $+y^2 + z^2)^{1/2}$, $\cos \theta = \frac{x}{r}$, $\tan \phi = \frac{y}{x}$ and $\cos \phi = \frac{s}{r \sin \theta}$. $\frac{1}{\sqrt{2}}$ and $z = 1$ giving |
| the same point by $\mathbf{r} = (\mathbf{x}^2)^2$ In this case, $\mathbf{x} = \frac{1}{\sqrt{2}}, \mathbf{y} = \mathbf{r} = \sqrt{(\frac{1}{\sqrt{2}})^2 + (\frac{1}{\sqrt{2}})^2 + (\frac$ | $+ y^2 + z^2)^{1/2}, \cos \theta = \frac{z}{r}, \tan \phi = \frac{y}{r} \operatorname{and} \cos \phi = \frac{z}{r \sin \theta}.$ $\frac{1}{\sqrt{3}} \operatorname{and} z = 1 \text{ giving}$ $\frac{1}{\sqrt{3}} = \sqrt{2}, \cos \theta = \frac{1}{\sqrt{3}} = \frac{1}{\sqrt{3}} \text{ giving } \theta = \frac{\pi}{4} \operatorname{and} \tan \phi = \frac{\frac{1}{\sqrt{3}}}{\frac{1}{\sqrt{3}}} = 1$ |
| the same point by $\mathbf{r} = (\mathbf{x}^2)$ In this case, $\mathbf{x} = \frac{1}{\sqrt{2}}, \mathbf{y} = \frac{1}{\sqrt{2}}$ | $+ y^2 + z^2)^{1/2}, \cos \theta = \frac{z}{r}, \tan \phi = \frac{y}{r} \operatorname{and} \cos \phi = \frac{z}{r \sin \theta}.$ $\frac{1}{\sqrt{3}} \operatorname{and} z = 1 \text{ giving}$ $\frac{1}{\sqrt{3}} = \sqrt{2}, \cos \theta = \frac{1}{\sqrt{3}} = \frac{1}{\sqrt{3}} \text{ giving } \theta = \frac{\pi}{4} \operatorname{and} \tan \phi = \frac{\frac{1}{\sqrt{3}}}{\frac{1}{\sqrt{3}}} = 1$ |

Tidy STACK question tool | Question tests & deployed variants

Question 14 Not answered Marked out of 1.00

The determinant of a matrix Calculate the determinant of $\mathbf{A} = \begin{pmatrix} a & b & c \\ x & 0 & y \\ x & z & -y \end{pmatrix}$. det $\mathbf{A} =$

| For a $3 	imes 3$ matrix, the determinant is given by |
|--|
| $ \det \mathbf{A} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \\ = a_1(b_2c_3 - b_3c_2) - a_2(b_1c_3 - b_3c_1) + a_3(b_1c_2 - b_2c_1). $ |
| So for the matrix $\mathbf{A} = \begin{pmatrix} a & b & c \\ z & 0 & y \\ x & z & -y \end{pmatrix}$. |
| the determinant is $-ayz + cxz + 2bxy$. |
| See Matrices and determinants Section 4. |

Question 15 Not answered Marked out of 1.00

| Marked but of 1.00 | Tidy STACK question tool Question tests & deployed variants |
|---|---|
| Sum notation | |
| Evaluate | |
| (a) | |
| $S_1 = \sum_{j=1}^4 j.$ | |
| S 1 =(b) | |
| $S_2 = \sum_{j=1}^{2} (j^2 + 1).$ $S_2 = $ | |
| Given a set of numbers $a_1, a_2, a_3, \ldots, a_n$, then $\sum_{i=1}^n a_i = a_1 + a_2 + a_3 + \ldots + a_n.$ Therefore, | |
| $\sum_{j=1}^{4} j = 1 + 2 + 3 + 4 = 10$ | |
| and $\sum_{j=1}^{2} (j^2 + 1) = 2 + 5 = 7$ | |
| See Algebra and other useful mathematical notation Section 5. | |

| Marked out of 1.00 | |
|---|--|
| | Tidy STACK question tool Question tests & deployed varia |
| Differentiating using the product ru | le |
| ifferentiate $\boldsymbol{y} = rac{\boldsymbol{s} \mathbf{n}(\boldsymbol{x})}{\boldsymbol{a}^2 + \boldsymbol{a}^2}$, with respect to \boldsymbol{x} . | |
| | |
| If u and v are functions of x , the product rule gives $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}.$ | |
| Using the product rule for $\mathbf{y} = \frac{\sin(x)}{a^2 + x^2}$, and letting \mathbf{u} $\frac{\mathrm{d}\mathbf{y}}{\mathrm{d}x} = \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{a^2 + x^2} \left(\frac{1}{a^2 + x^2}\right) \frac{\mathrm{d}x}{\mathrm{d}x} (\sin(x)) + (\sin(x)) = \frac{1}{$ | |
| | _ (= (=) |
| $= \left(\frac{1}{a^2 + x^2}\right) (\cos(x)) + \left(-\frac{2x}{(a^2 + x^2)^2}\right)$ | $\int (\sin(x))$ |
| $=\frac{\cos(x)}{a^2+x^2}-\frac{2x\sin(x)}{(a^2+x^2)^2}.$ | |
| () | |
| | |
| See Differentiation Section 2.3. | |
| See Differentiation Section 2.3. | |
| | |
| Question 17 Not answered | |
| Question 17 Not answered | |
| Question 17 Not answered | |
| Question 17 Not answered lanked out of 1.00 Differentiating an exponential func | tion once |
| Question 17 Not answered larked out of 1.00 Differentiating an exponential func Wifferentiate $u(t) = 2e^{2iat}$, with respect to t , where | tion once |
| Question 17 Not answered tarked out of 1.00 Differentiating an exponential func: Wifferentiate $u(t) = 2e^{2i\omega t}$, with respect to t , where $u = \sqrt{-1}$. | tion once |
| Question 17 Not answered tarked out of 1.00 Differentiating an exponential func: Wifferentiate $u(t) = 2e^{2i\omega t}$, with respect to t , where $u = \sqrt{-1}$. | tion once |
| Question 17 Not answered Marked out of 1.00 Differentiating an exponential func: Differentiate $u(t) = 2e^{2ia t}$, with respect to t , where $t = \sqrt{-1}$. $\frac{du}{dt} = \begin{bmatrix} t \\ t \end{bmatrix}$ | tion once a is a constant and |
| Question 17 Not answered latted out of 1.00 Differentiating an exponential func differentiate $u(t) = 2e^{2i\omega t}$, with respect to t , where $= \sqrt{-1}$. $\frac{4u}{dt} = $ Using the composite or chain rule with $u = 2e^{2i\omega t}$. | tion once a is a constant and |
| Question 17 Not answered Marked out of 1.00 Differentiating an exponential function ifferentiate $u(t) = 2e^{2i\alpha t}$, with respect to t , where $t = \sqrt{-1}$. $\frac{du}{dt} = $ Using the composite or chain rule with $u = 2e^{2i\alpha t}$, $\frac{du}{dt} = 2e^{2i\alpha t} \times \frac{d}{dt} (2i\alpha t)$ | a is a constant and |
| Question 17 Not answered latted out of 1.00 Differentiating an exponential func differentiate $u(t) = 2e^{2i\omega t}$, with respect to t , where $= \sqrt{-1}$. $\frac{4u}{dt} = $ Using the composite or chain rule with $u = 2e^{2i\omega t}$. | tion once a is a constant and |
| Question 17 Not answered lated out of 1.00 Differentiating an exponential function ifferentiate $u(t) = 2e^{2iat}$, with respect to t , where $= \sqrt{-1}$. $\frac{du}{dt} = $ Using the composite or chain rule with $u = 2e^{2iat}$, $\frac{du}{dt} = 2e^{2iat} \times \frac{d}{dt} (2iat)$ | tion once a is a constant and |

Question 18 Not answered Marked out of 1.00

Tidy STACK question tool | Question tests & deployed variants

Differentiating an exponential function twice

Given $u(t) = 3e^{-iat}$, where a is a constant and $i = \sqrt{-1}$. Determine the second order differential, $\frac{d^2u}{d^2}$. $\frac{d^2u}{d^2} =$

Using the composite or chain rule with $\boldsymbol{u}=3\,\boldsymbol{e}^{-i\,\boldsymbol{a}\,\boldsymbol{t}},$ we have

 $\frac{\mathrm{d}u}{\mathrm{d}t} = 3\,\mathrm{e}^{-\mathrm{i}\,a\,t} \times \frac{\mathrm{d}}{\mathrm{d}t}(-\mathrm{i}\,a\,t)$ $= -3\,\mathrm{i}\,a\,\mathrm{e}^{-\mathrm{i}\,a\,t}.$

 $\begin{aligned} \frac{\mathrm{d}^2 u}{\mathrm{d}t^2} &= -3\mathrm{i}a\frac{\mathrm{d}}{\mathrm{d}t}\left(\mathrm{e}^{-\mathrm{i}\,a\,t}\right) = -3\mathrm{i}a\left(-\mathrm{i}a\mathrm{e}^{-\mathrm{i}\,a\,t}\right) \\ &= -3\,a^2\,\mathrm{e}^{-\mathrm{i}\,a\,t}. \end{aligned}$

The final simplication used $\mathbf{i}^2 = -1$.

See Differentiation Section 2.4.

| Question 19 Not answered | |
|--------------------------|---|
| Marked out of 1.00 | |
| | Tidy STACK question tool Question tests & deployed variants |

Linear differential equations

(a) Find the values of **k** for which **cos(kt)** and **sin(kt)** are solutions of the differential equation

| $\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} + 9y = 0.$ | |
|--|----|
| k = | or |

(b) Select a linear combination of the solutions in part (a) which is a general solution to the differential equation.

| 0 | No | answer | given) | |
|---|----|--------|--------|--|
| | | | | |

 $y = \alpha \cos(kt) + \beta \sin(kt)$ $y = \beta \sin(kt)$

 $y = \alpha \cos(kt)$

(c) Select the property of the differential equation that guarantees that this linear combination is a solution.

| (No answer given) | ~ |
|-------------------|---|
| | |

(a) Consider $y = \cos(kt)$, then $\frac{dy}{dt} = -k\sin(kt)$ and $\frac{d^2y}{dt^2} = -k^2\cos(kt)$.

Substituting for **y** and $\frac{d_y}{dt^2}$ into the original differential equation gives $-k^2 \cos(kt) + 9 \cos(kt) = 0.$ This equation must be valid for all values of **t**, therefore,

 $-k^2 + 9 = 0$ $k^2 = 9$

 $k = \pm 3.$

Similarly for $y = \sin(kt)$, the solution is $k = \pm 3$.

(b) The solutions in part (a) are $y = \cos(3t)$ and $y = \pm \sin(3t)$. An arbitrary linear combination of them is $y = \alpha \cos(3t) + \beta \sin(3t)$ where α and β are arbitrary constants. As there are two arbitrary constants and this is a second order differential equation, this is a general solution.

(c) The fact that the differential equation is *linear* guarantees that this is a solution

See Differential equations Sections 2 and 4.

Question 20 Not answered Marked out of 1.00

Integration by substitution

Evaluate the integral $I = \int_0^q -\frac{r}{br^2 + 4} \, \mathrm{d}r,$ where **b** and **g** are positive constants. I =

The method to use is integration by substitution and this is a definite integral.

Let $u = br^2 + 4$, then $\frac{du}{dr} = 2br$. The limits of integration r = 0 and r = q correspond to u = 4 and $u = bq^2 + 4$. Hence

 $\int_{r=0}^{r=q} -\frac{r}{br^2+4} dr = \left(-\frac{1}{2b}\right) \int_{u=0}^{u=bq^2+4} \frac{1}{u} du$ $= \left(-\frac{1}{2b}\right) \left[\ln(u)\right]_{u=4}^{u=bq^2+4}$ $= \frac{\ln(4)}{2b} - \frac{\ln(bq^2+4)}{2b}.$ See Integration 4.3 and 5.

Question 21 Not answered Marked out of 1.00

Tidy STACK question tool | Question tests & deployed variants

Tidy STACK question tool | Question tests & deployed

The gradient of a scalar field Consider $f = -z + 3 z^2$. Evaluate grad f. (Type et to input e_x , ey to input e_y and ez to input e_x .) grad f =

The gradient of a scalar field, **f** is a vector field given by

 $\mathbf{F} = \operatorname{grad} f = \nabla f = \frac{\partial f}{\partial x} \mathbf{e}_x + \frac{\partial f}{\partial y} \mathbf{e}_y + \frac{\partial f}{\partial z} \mathbf{e}_z.$

In this case, $f = -z + 3z^2$, so that, $\frac{\partial f}{\partial x} = 0$, $\frac{\partial f}{\partial y} = 0$, and $\frac{\partial f}{\partial z} = -1 + 6z$, which gives the vector field $\mathbf{F} = (-1 + 6z) \mathbf{e}_z$.

See Vector calculus and fields Section 7.

| ne divergence of a vector field in spherical coord | linates |
|--|--|
| onsider the vector field | |
| $\mathbf{F} = \left(-\frac{\cos(\theta)}{r^2}\right) \mathbf{e}_r + (-r) \mathbf{e}_{\theta} + (-r\cos(\theta)) \mathbf{e}_{\phi}$ | |
| nich is written in spherical coordinates, $(r,	heta,\phi)$. | |
| valuate the divergence of ${f r}$. your answer type r for coordinate ${f r}$, theta for coordinate ${f 	heta}$ and phi for coordi | |
| you answer type i to coordinate \mathbf{r} , theta for coordinate \mathbf{v} and printor coordinate v | nate φ . |
| | |
| | |
| In spherical coordinates $\operatorname{div} \mathbf{F} = \frac{1}{r^2} \frac{\partial (r^2 F_r)}{\partial r} + \frac{1}{r \sin \theta} \frac{\partial (\sin \theta F_\theta)}{\partial \theta} + \frac{1}{r \sin \theta} \frac{\partial F_{\theta}}{\partial \phi}$ | |
| In this case $F_r=-rac{\cos(\theta)}{r^2},$ $F_{\theta}=-r$ and $F_{\phi}=-r\cos(\theta),$ giving | |
| $\frac{\theta(r^3 F_r)}{\partial r} = \frac{\theta(r^3 \left(-\frac{\cos(\theta)}{r^3}\right))}{\partial r} = \frac{\theta(-\cos(\theta))}{\partial r} = 0$ and | |
| $\frac{\partial(\sin\thetaF_\theta)}{\partial\theta}=\frac{\partial(\sin\theta(-\tau))}{\partial\theta}=\frac{\partial(-\tau\sin(\theta))}{\partial\theta}=-\tau\cos(\theta)$ and | |
| F_{ϕ} is independent of ϕ so that $rac{\partial(F_{\phi})}{\partial\phi}=0.$ | |
| Bringing everything together gives | |
| div $\mathbf{F} = \frac{1}{r^2}(0) + \frac{1}{r\sin\theta}(-r\cos(\theta))$ $\cos(\theta)$ | |
| $=-rac{\cos(heta)}{\sin(heta)}.$ | |
| See Vector calculus and fields Section 3 | |
| USO VOLUT CATCURUS AND REIUS DECLION J. | |
| | |
| | $\left(\frac{\partial}{x}(4x^2)\right)\mathbf{e}_y + \left(\frac{\partial}{\partial t}+2x\right)\mathbf{e}_x$ |
| und \mathbf{A} = curl $\mathbf{A} = \begin{vmatrix} \mathbf{e}_{\mathbf{x}} & \mathbf{e}_{\mathbf{y}} & \mathbf{e}_{\mathbf{z}} \\ \frac{\partial}{\partial z} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -2yz & -5xy & 4z^2 \\ = \left(\frac{\partial}{\partial y}(4x^2) - \frac{\partial}{\partial z}(-5xy)\right)\mathbf{e}_{\mathbf{z}} + \left(\frac{\partial}{\partial z}(-2yz) - \frac{\partial}{\partial z} \\ = ((0) - (0))\mathbf{e}_{\mathbf{z}} + ((-2y) - (8x))\mathbf{e}_{\mathbf{y}} + ((-5y) - (-2z) \\ = (-8x - 2y)\mathbf{e}_{\mathbf{y}} + (-5y + 2z)\mathbf{e}_{\mathbf{z}} \end{vmatrix}$ See Vector calculus and fields Section 5. Question 24 Not answered tarted out of 1.00 Tay STACK quest Line integrals Evaluate the line integral $I = \int_{\mathbf{c}}^{\mathbf{B}} \mathbf{B} \cdot \mathbf{d}_{\mathbf{h}}$ | tion tool Question tests & displayed variants |
| $\operatorname{curl} \mathbf{A} = \begin{bmatrix} \mathbf{e}_{x} & \mathbf{e}_{y} & \mathbf{e}_{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -2yz & -5zy & 4z^{2} \\ = \left(\frac{\partial}{\partial y} (4x^{2}) - \frac{\partial}{\partial z} (-5zy) \right) \mathbf{e}_{x} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ = ((0) - (0))\mathbf{e}_{y} + ((-2y) - (8z))\mathbf{e}_{y} + ((-5y) - (-2z))\mathbf{e}_{z} \\ = (-8z - 2y) \mathbf{e}_{y} + (-5y + 2z) \mathbf{e}_{z} \end{bmatrix}$ See Vector calculus and fields Section 5. Question 24 Not answered Aarted out of 1.00 Tay STACK quest Line integrals Evaluate the line integral $I = \int_{C} \mathbf{E} \cdot \mathbf{d}_{1},$ where $\mathbf{E} = z^{3} \mathbf{e}_{x} + 2y \mathbf{e}_{y} + z^{3} \mathbf{e}_{z}$ and C is the path from $(0, 0, 0)$ to $(1, 0)$ | tion tool Question tests & displayed variants |
| $\operatorname{curl} \mathbf{A} = \begin{bmatrix} \mathbf{e}_{\mathbf{x}} & \mathbf{e}_{\mathbf{y}} & \mathbf{e}_{\mathbf{z}} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -2yz & -5zy & 4z^2 \\ = \left(\frac{\partial}{\partial y}(4z^2) - \frac{\partial}{\partial z}(-5zy)\right) \mathbf{e}_{\mathbf{z}} + \left(\frac{\partial}{\partial z}(-2yz) - \frac{\partial}{\partial z} \\ = ((0) - (0))\mathbf{e}_{\mathbf{z}} + ((-2y) - (8z))\mathbf{e}_{\mathbf{z}} + ((-5y) - (-2z) \\ = (-8z - 2y)\mathbf{e}_{\mathbf{z}} + (-5y + 2z)\mathbf{e}_{\mathbf{z}} \end{bmatrix}$ See Vector calculus and fields Section 5. Question 24 Not answered farked out of 1.00 Tright Stack quest Line integrals Evaluate the line integral $I = \int_{C} \mathbf{E} \cdot \mathbf{d}_{\mathbf{x}},$ where $\mathbf{E} = z^2 \mathbf{e}_{\mathbf{x}} + 2y \mathbf{e}_{\mathbf{y}} + z^2 \mathbf{e}_{\mathbf{z}}$ and C is the path from $(0, 0, 0)$ to $(1, 0)$ $I = $ For the path from $(0, 0, 0)$ to $(1, 0, 0)$, a small directed element along the path from $(0, 0, 0)$ to $(1, 0, 0)$. | iton tool Question tests & deployed variants (0) to (1, 1, 0). |
| $= \left(\frac{\partial}{\partial y}(4x^2) - \frac{\partial}{\partial x}(-5xy)\right)\mathbf{e}_x + \left(\frac{\partial}{\partial x}(-2yx) - \frac{\partial}{\partial x}\right)\mathbf{e}_x + \left((-5y) - (-2yx) - \frac{\partial}{\partial x}\right)\mathbf{e}_x + \left((-5y) - (-2y) - (-2y) - \frac{\partial}{\partial x}\right)\mathbf{e}_x + \left((-5y) - (-2y) - (-2y$ | tion bot Cuestion tests & deptoyed variants (0) to $(1, 1, 0)$. with is $\delta \mathbf{l} = \mathbf{e}_{x} \delta x$. |
| $\operatorname{curl} \mathbf{A} = \begin{bmatrix} \mathbf{e}_{\mathbf{x}} & \mathbf{e}_{\mathbf{y}} & \mathbf{e}_{\mathbf{z}} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -2yz & -5zy & 4z^2 \\ = \left(\frac{\partial}{\partial y}(4z^2) - \frac{\partial}{\partial z}(-5zy)\right) \mathbf{e}_{\mathbf{z}} + \left(\frac{\partial}{\partial z}(-2yz) - \frac{\partial}{\partial z} \\ = ((0) - (0))\mathbf{e}_{\mathbf{z}} + ((-2y) - (8z))\mathbf{e}_{\mathbf{z}} + ((-5y) - (-2z) \\ = (-8z - 2y)\mathbf{e}_{\mathbf{z}} + (-5y + 2z)\mathbf{e}_{\mathbf{z}} \end{bmatrix}$ See Vector calculus and fields Section 5. Question 24 Not answered farked out of 1.00 Tright Stack quest Line integrals Evaluate the line integral $I = \int_{C} \mathbf{E} \cdot \mathbf{d}_{\mathbf{x}},$ where $\mathbf{E} = z^2 \mathbf{e}_{\mathbf{x}} + 2y \mathbf{e}_{\mathbf{y}} + z^2 \mathbf{e}_{\mathbf{z}}$ and C is the path from $(0, 0, 0)$ to $(1, 0)$ $I = $ For the path from $(0, 0, 0)$ to $(1, 0, 0)$, a small directed element along the path from $(0, 0, 0)$ to $(1, 0, 0)$. | tion bot Cuestion tests & deptoyed variants (0) to $(1, 1, 0)$. with is $\delta \mathbf{l} = \mathbf{e}_{x} \delta x$. |
| curl $\mathbf{A} =$ curl $\mathbf{A} =$ $\begin{bmatrix} \mathbf{e}_{\mathbf{x}} & \mathbf{e}_{\mathbf{y}} & \mathbf{e}_{\mathbf{z}} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} (dz^2) - \frac{\partial}{\partial z} (-5xy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (dz^2) - \frac{\partial}{\partial z} (-5xy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (dz^2) - \frac{\partial}{\partial z} (-5xy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (dz^2) - \frac{\partial}{\partial z} (-5yy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (dz^2) - \frac{\partial}{\partial z} (-5xy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (-5yy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (-5yy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} (-2yz) - \frac{\partial}{\partial z} \\ \frac{\partial}{\partial y} (-5yy) \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial z} - \frac{\partial}{\partial z} \right) \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial y} (-5yy) - \frac{\partial}{\partial z} \right) \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial y} (-5yy) - \frac{\partial}{\partial z} \right) \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial y} (-5yy) - \frac{\partial}{\partial z} \right) \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \left(\frac{\partial}{\partial y} (-5yy) - \frac{\partial}{\partial z} \right) \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} \\ \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} + \frac{\partial}{\partial y} \mathbf{e}_{\mathbf{x}} \\ \frac{\partial}$ | tion bot Cuestion tests & deptoyed variants (0) to $(1, 1, 0)$. with is $\delta \mathbf{l} = \mathbf{e}_{x} \delta x$. |

Question 25 Not answered Marked out of 1.00 Tidy STACK question tool | Question tests & deployed variants Volume integrals Evaluate the volume integral $I = \int_B 4r^2 \, \mathrm{d}V$ using spherical coordinates, where $m{B}$ is a spherical volume of radius $m{a}$, centred on the origin (Type pi to enter π). I = [The integrand does not depend on the spherical coordinates θ and ϕ . Consequently, the quickest way of doing the integral is to split the sphere into many spherical shells. A typical spherical shell has radius \mathbf{r} , thickness $\delta \mathbf{r}$ and volume $4\pi r^2 \delta \mathbf{r}$. The volume integral is then $\int_{B} 4r^{2} dV = \int_{0}^{a} 4r^{2} \times 4\pi r^{2} dr$ $= 16\pi \int_{0}^{a} r^{4} dr$ $= \frac{16\pi a^{5}}{5}.$ $=\frac{10\pi^2}{5}.$ Alternatively, a method which would work in more general cases is: $\int_B 4r^2 dV = \int_{r=0}^{r=0} \int_{\theta=0}^{\theta=\pi} \int_{\theta=0}^{\theta=\pi} dr^2 x r^2 \sin\theta d\phi d\theta dr$ $= \int_{r=0}^{r=0} \int_{\theta=0}^{\theta=\pi} 2\pi \times 4r^4 \sin\theta d\theta dr$ $= \int_0^a 2 \times 2\pi \times 4r^4 dr$ $= 16\pi \int_0^a r^4 dr$ $= \frac{16\pi a^5}{5}.$

Send feedback