Question 2

Not yet answered

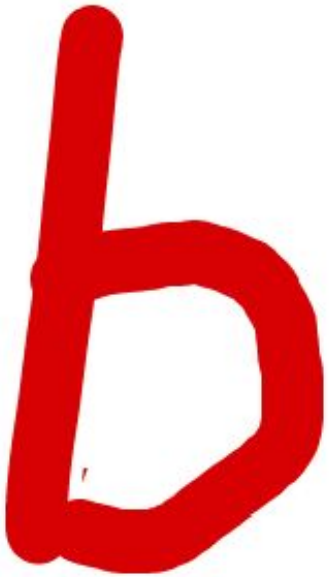
Marked out of 1.00

Flag question

Consider a uniformly charged sphere of radius R carrying a charge $+Q$. The electrostatic flux passing through a sphere of radius r and concentric with the charge distribution will

Select one:

- a. Is independent of r only for $0 < r < R$
- b. Is independent of r only for $r > R$
- c. Be independent of r for all values of r
- d. Depends on r for all values of r



What is the value of the integral $\int_{(1,0,1)}^{(2,0,2)} \vec{\nabla} f \cdot d\vec{l}$ for $f = x^2 + y^2 + z^2$?

Select one:

- a. 6
- b. 8
- c. 2
- d. 4

$$\vec{\nabla} f = \frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z}$$

$$= 2x\hat{i} + 2y\hat{j} + 2z\hat{k}$$

$$\vec{\nabla} f \cdot d\vec{l} = 2x\,dx + 2y\,dy + 2z\,dz$$

$$\int_{(1,0,1)}^{2,0,2} \vec{\nabla} f \cdot d\vec{l} = 2\left[\frac{x^2}{2}\right]_1^2 + 2\left[\frac{y^2}{2}\right]_0^0 + 2\left[\frac{z^2}{2}\right]_1^2$$

$$= (4-1) + 0 + (4-1)$$

$$= 6$$

If a point charge +q is located at the center of a sphere of radius 'r', what is the electric flux passing through a portion of the surface of the sphere defined by $0 < \theta < \frac{\pi}{2}$ and $0 < \phi < \frac{\pi}{2}$?

Select one:

- a. $\frac{q}{8\epsilon_0}$
- b. $\frac{q}{8\pi\epsilon_0}$
- c. $\frac{q}{4\epsilon_0}$
- d. $\frac{q}{4\pi\epsilon_0}$

$$Q_{enc} = \int_0^r \int_0^r r^2 (\sin\theta \, d\theta) \, d\phi \, dr$$

$$= \int_0^r r^2 dr \int_0^{\pi/2} (\sin\theta \, d\theta) \int_0^{\pi/2} d\phi$$

$$= \left[\frac{r^3}{3}\right]_0^r \times \left[-\cos\theta\right]_0^{\pi/2} \times \pi/2$$

$$= \frac{\rho r^3}{3} \times (-1) \times \frac{\pi}{2}$$

$$= \frac{\rho \pi r^3}{6}$$

$$\rho = \frac{Q}{\frac{4}{3}\pi r^3}$$

$$Q_{enc} = \frac{Q}{4\pi r^3} \times 3 \times \frac{\rho \pi r^3}{2}$$

$$= \frac{3Q}{8}$$

$$\phi = \frac{Q_{enc}}{\epsilon_0}$$

$$= \frac{Q}{8\epsilon_0}$$

Question 3

Not yet answered

Marked out of 1.00

Flag question

The electrostatic field in a certain region of space is given by $\vec{E} = E_0\vec{r}$. This region

Select one:

- a. Has no charges
- b. Has a uniform charge density
- c. Has charges with charge density increasing radially from the origin
- d. Has charges with charge density decreasing radially from the origin

b

Question 3

Not yet answered

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Flag question

A point charge of {-5\epsilon}_0 is located at the origin and a second point charge $+3\epsilon_0$ is placed at a point with coordinates (2,2,0). The electrostatic flux passing through a sphere centred at the origin and of radius 2.5 (all distances are in meters) is

Select one:

- a. +2
- b. -2
- c. -5
- d. +5

$$q = -5\varepsilon_0$$

(+3ε₀)

(2,2,0)

(Q)

$$r = \sqrt{2^2 + 2^2}$$

$$= \sqrt{4+4} = 4\sqrt{2}$$

∴ out of gaussian sphere

∴ for $r = 2.5$

$$\phi = \frac{-5\varepsilon_0}{\varepsilon_0} = -5$$

What is the spherical coordinates of the point (1,1,0) in Cartesian coordinate system?

Select one:

- a. $(\sqrt{2}, 90^{\circ}, 45^{\circ})$
- b. $(1, 90^{\circ}, 45^{\circ})$
- c. $(\sqrt{2}, 45^{\circ}, 90^{\circ})$
- d. $(1, 45^{\circ}, 90^{\circ})$

Which of the following is an electrostatic field?

(i) $\vec{E}_1 = xy\,\hat{x} + 2yz\,\hat{y} + 3xz\,\hat{z}$

(ii) $\vec{E}_2 = y^2\,\hat{x} + (2xy + z)\,\hat{y} + 2yz\,\hat{z}$

Select one:

- a. Both (i) and (ii)
- b. Only (i)
- c. None of them
- d. Only (ii)

Curl $E = 0$

$$\vec{\nabla} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ xy & 2yz & 3xz \end{vmatrix}$$

$$= \hat{i}[0 - 2y] - \hat{j}[3z - 0] + \hat{k}[0 - x]$$

$$= -2y\hat{i} - 3z\hat{j} - x\hat{k}$$

F is not E

Curl $E = 0$

$$\vec{\nabla} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ y^2 & 2xy+z & 2yz \end{vmatrix}$$

$$= \hat{i}[2z - 1] - \hat{j}[0 - 0] + \hat{k}[2y - 2y]$$

F is not E

Consider a uniformly charged sphere of radius R carrying a charge +Q. In such a case divergence of the electrostatic field produced by the sphere is

Select one:

- a. zero outside the sphere and non zero inside the sphere
- b. non zero everywhere
- c. zero everywhere
- d. zero inside the sphere and non zero outside the sphere

d

Two charges +Q and -Q are placed on the axis at points (a,0) and (-a,0) respectively. Another charge +q is placed on the y-axis at a distance y from the origin. What is the force $\vec{F}$ on charge q?

Select one:

- a. $-\frac{Qq}{4\pi\epsilon_0}\frac{2a}{(y^2+a^2)^{3/2}}\hat{x}$
- b. $\frac{Qq}{4\pi\epsilon_0}\frac{2y}{(y^2+a^2)^{3/2}}\hat{x}$
- c. $\frac{Qq}{4\pi\epsilon_0}\frac{2a}{(y^2+a^2)^{3/2}}\hat{x}$
- d. $-\frac{Qq}{4\pi\epsilon_0}\frac{2y}{(y^2+a^2)^{3/2}}\hat{x}$

Question 6

Not yet answered

Marked out of 1.00

Flag question

The electrostatic potential in a region of space is given by $V(x, y, z) = 10x^2 + 5$. The magnitude of the electrostatic field at $x = 1$ is

Select one:

- a. -10
- b. +20
- c. -20
- d. Zero

$$\vec{E} = -\nabla V = -(\text{grd } V)$$

$$\nabla V = \frac{\partial(10x^2+5)}{\partial x} + \frac{\partial(10x^2+5)}{\partial y} + \frac{\partial(10x^2+5)}{\partial z}$$

$$= 20x$$

$$\vec{E}(1) = -20x(1)$$

$$= -20$$

Question 7

Not yet answered

Marked out of 1.00

Flag question

Find the Cartesian coordinates of the point whose spherical coordinates are $(4, 0°, 90°)$.

Select one:

- a. (0, 1, 4)
- b. (4, 0, 0)
- c. (4, 1, 1)
- d. (0, 0, 4)

$$r = 4 \quad , \quad \phi = 90^\circ$$

$$\sqrt{x^2+y^2+z^2} = 4$$

$$90 = \tan^{-1}\left(\frac{y}{x}\right)$$

$$\frac{1}{0} = \frac{y}{x}$$

$$y = 1, \quad x = 0$$

$$\theta = \cos^{-1}\left(\frac{z}{4}\right)$$

$$1 = \frac{z}{4} \qquad \boxed{z = 4}$$

Question 8

Not yet answered

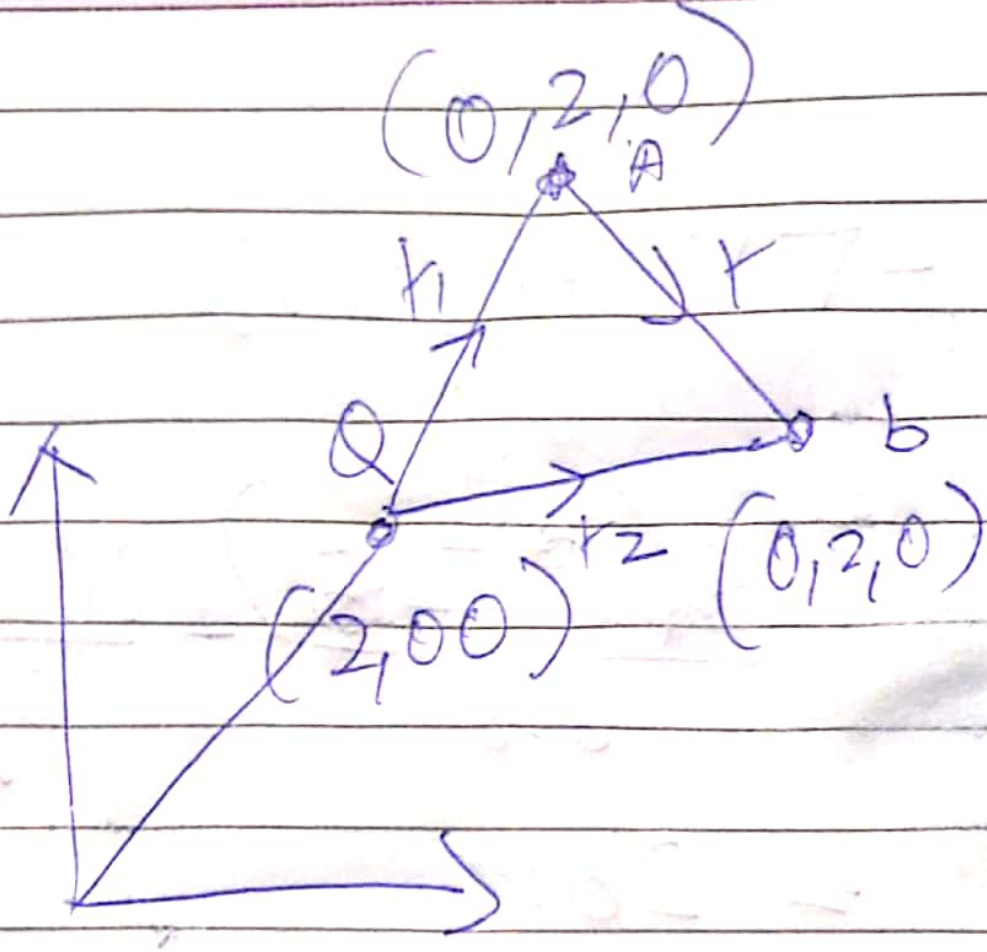
Marked out of 1.00

Flag question

A point charge Q is located at a point with Cartesian coordinates (2,0,0). The potential difference between two points with coordinates (0, 2, 0) and (0, -2, 0) will be

Select one:

- a. Zero
- b. $\frac{Q}{8\pi\epsilon_0}$
- c. $\frac{Q}{16\pi\epsilon_0}$
- d. $\frac{Q}{\epsilon_0}$



$$\vec{r_1} + \vec{r} = \vec{r_2}$$

$$\vec{r} = \vec{r_2} - \vec{r_1}$$

$$V = \frac{kq}{r} \quad (\text{some})$$

$$W = q\,(V_A - V_B)$$

$$= 0$$

Question 9

Not yet answered

Marked out of 1.00

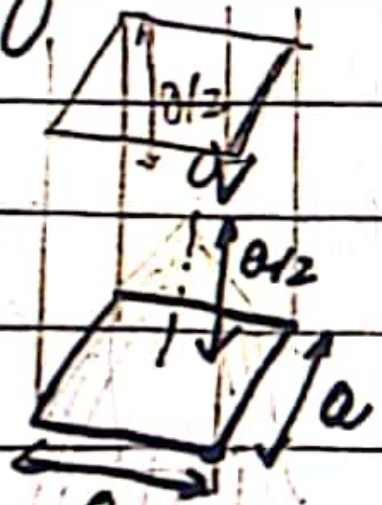
Flag question

A perfectly cubical Gaussian surface has a point charge of Q exactly at its geometric center. The Electric flux through one of the six faces of the cube is

Select one:

- a. $\frac{q}{\epsilon_0}$
- b. $\frac{q}{2\epsilon_0}$
- c. $\frac{q}{6\epsilon_0}$
- d. 0

Q3 Find the electric flux due to q from this plate



$$\Phi_{cube} = \frac{q}{\varepsilon_0}$$

$$\Phi_{half\ cube} = \frac{q}{2\varepsilon_0}$$

$$\boxed{\Phi_{one\ face} = \frac{q}{6\varepsilon_0}}$$

Question 10

Not yet answered

Marked out of 1.00

Flag question

What is the magnitude of the electrostatic field outside two oppositely charged plane sheets of charge density σ?

Select one:

- a. 0
- b. $\frac{\sigma}{2\epsilon_0}$
- c. $\frac{\sigma}{\epsilon_0}$
- d. $-\frac{\sigma}{2\epsilon_0}$

Question 11

Not yet answered

Marked out of 1.00

Flag question

A positively charged particle is released from rest in an uniform electrostatic field. The electric potential energy of the charge

Select one:

- a. decreases because the charge moves along the electrostatic field
- b. remains a constant because the electrostatic field is uniform
- c. decreases because the charge moves opposite to the electrostatic field
- d. increases because the charge moves along the electrostatic field

A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge

A remains a constant because the electric field is uniform.

B increases because the charge moves along the electric field.

Correct Answer

C decreases because the charge moves along the electric field.

D decreases because the charge moves opposite to the electric field.

Question 7

Incorrect

Mark 0.00 out of 1.00

Flag question

Find the Cartesian coordinates of the point whose spherical coordinates are $(4, 0°, 90°)$.

Select one:

- a. (0, 1, 4) ✗
- b. (4, 0, 0)
- c. (4, 1, 1)
- d. (0, 0, 4)

Your answer is incorrect.

The correct answer is: (0, 0, 4)

$$(r, \theta, \phi) = (4, 0^\circ, 90^\circ)$$

$$4 = \sqrt{x^2 + y^2 + z^2}$$

$$90^\circ = \tan^{-1}\left(\frac{y}{x}\right) \Rightarrow \frac{y}{0} = \infty$$

$$\therefore \boxed{x = 0}$$

$$0^\circ = \cos^{-1}\left(\frac{z}{r}\right) \Rightarrow \frac{z}{4} = 1$$

$$\Rightarrow \boxed{z = 4}$$

↓

Put in r

$$4 = \sqrt{0 + y^2 + 4^2}$$

$$\therefore \boxed{y = 0}$$

Question 13

Incorrect

Mark 0.00 out of 1.00

Flag question

Consider a uniformly charged sphere of radius R with volume charge density ρ. The value of $\vec{\nabla}.\vec{E}$ at a point with Cartesian coordinates $\left(\frac{\dot{R}}{2}, R, 0\right)$ will be

Select one:

a. Zero

b. $\frac{\rho}{4\pi\epsilon_0}$

c. $\frac{\rho}{\epsilon_0}\hat{r}$

d. $\frac{\rho}{\epsilon_0}$

Your answer is incorrect.

The correct answer is: Zero

Question 12

Incorrect

Mark 0.00 out of 1.00

Flag question

Two positive point charges of $12\mu C$ and $8\mu C$ respectively are placed 10 cm apart in air. Find the work done to bring them 4 cm closer so that, they are 6 cm apart. Given the value of Coulomb's constant = $9 \times 10^9 Nm^2/(Coulomb)^2$

Select one:

- a. zero
- b. 3.8 J
- c. 4.8 J ✗
- d. 5.8 J

Your answer is incorrect.

The correct answer is: 5.8 J

Work done = change in Potential energy

$$= \frac{q_1 q_2}{4\pi\varepsilon_0 r_1} - \frac{q_1 q_2}{4\pi\varepsilon_0 r_2}$$

$r_1 = 6$ cm, $r_2 = 10$ cm

$$W = \frac{q_1 q_2}{4\pi\varepsilon_0}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

≈ 5.76 J