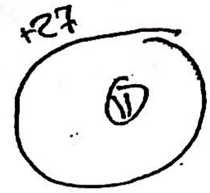
4. 27 C of charge are placed on a spherical conducting shell. A 11 C-point charge is placed at the center of the cavity. The net charge on the outer surface of the shell is:

$27+11, 38$



A) 0 C
B) +27 C
[✓ C) +16 C]
[✓ D) +38 C]
E) -16 C

5. A particle has a mass of 6.4×10^{-27} kg and a charge +2e is released from rest in a uniform electric field of magnitude 8.0×10^4 N/C. The acceleration of the particle in m/s^2 is:

$E = \frac{F}{q}$ $\quad 2 \times 1.6 \times 10^{-19} = \boxed{3.2}$ $\quad F = Ma.$

$Eq = F$ $\quad a = \frac{Eq}{m} = \frac{8 \times 10^{4} \times 3.2 \times 10^{-19}}{6.4 \times 10^{-27}} = 4 \times 10^{12}$

$Eq = Ma$

[✓ A) 4.0×10^{12}]
B) 0.48×10^{12}
C) 3.86×10^{12}
D) 1.6×10^{10}
E) 0.96×10^{12}

$F = ma$ $\quad \cancel{Eq} = ma \Rightarrow a = \frac{qE}{m} = \frac{8 \times 10^{4}}{6.4 \times 10^{-27}} \times 2 \times 1.6 \times 10^{-16}$ $\quad 0.2$

$\cancel{\frac{1}{128} \times 10^{4}}$ $\quad 10$

6. A 5×10^{-8} C charge is fixed at the origin. A -8×10^{-8} C charge is moved from x = 10 cm on the x axis to y = 20 cm on the y axis. The change in potential energy is:

$\Delta U = U_f - U_i$ $\quad U_f = \frac{kq_1q_2}{r} = \frac{9 \times 10^{9} \times 5 \times 10^{-8} \times -8 \times 10^{-8}}{0.1}$ $\quad 3.9 \times 10$

A) 1.1×10^{-5} J
B) 9.0×10^{-5} J
[✓ C) 1.8×10^{-4} J]
D) zero
E) -1.1×10^{-4} J

$U_f = \frac{kq_1q_2}{r} = \frac{9 \times 10^{9} \times 5 \times 10^{-8} \times -8 \times 10^{-8}}{0.2}$ $\quad 3600 \times 10^{-7}$ $\quad - = 3.6 \times 10^{-4}$

$= -1.8 \times 10^{-4} - -3.6 \times 10^{-4}$

$= 1800 \times 10^{-7}$

$= -1.8 \times 10^{-4}$ $\quad a$ $\quad \cancel{F} = E\cancel{q}$ $\quad = \frac{Eq}{m}$

7. When the dipole moment of a dipole in a uniform electric field rotates to become more nearly aligned with the field:

$P = qd$ $\quad V = \frac{Vq}{r}$

A) the field does no work
B) the field does positive work and the potential energy decreases
C) the field does negative work and the potential energy decreases
D) the field does negative work and the potential energy increases
E) the field does positive work and the potential energy increases

$q = \frac{2\times10^{-4}\times \cancel{8}\,10}{500}$ $mg = Eq$ ↕

$= \frac{1}{25}$ 0.4×10^{-4}

why 10^{-6} ?

12. A charged oil drop with a mass of 2.0x10^{-4} kg is held suspended by a $\boxed{\text{downward}}$ electric field of 500 N/C. The charge on the drop is:

$E = \frac{F}{q}$ $Eq = F$ $\frac{F}{E}$ ↓E ↓mg ↓500 q ↓ mg

$500 = \frac{2\times10^{-4}}{q}$

$\frac{500q}{500} = \frac{2\times10^{-4}}{500}$

$\frac{2\times10^{-4}\times10}{500}$

0.4×10^{-4}

4×10^{-5}

[✓ A)] -4.5x10^{-4} C
B) +2.5x10^{-4} C
[✓ C)] -4.0x10^{-6} C
D) +2x10^{-4} C
E) +4.0x10^{-6} C

---

13. A 25.0-μC point charge is placed at the center of a cube. The electric flux in N·m^2/C through one side of the cube is:

$\Phi = \frac{q_{enc}}{\varepsilon_0}$

عدد اوجه المكعب = 6

$\frac{\Phi_{total}}{6} = \frac{q}{6\varepsilon_0}$

$\Phi = \frac{25\times10^{-6}}{\varepsilon_0}$

$= \frac{25\times10^{-6}}{8.85\times10^{-12}}$

$= 2.8\times10^{6}$

0.47×10^{6}

A) 1.1 x10^5
B) 0
C) 5.6 x10^5
D) 1.5 x10^5
[✓ E)] 4.6 x10^5

14. A 5-cm radius conducting sphere has a charge density of 8x10^{-6} C/m^2 on its surface. Its electric potential, relative to the potential far away, is:

$\sigma = 8\times10^{-6}$

$q = \sigma(4\pi r^2)$

$V = \frac{kq}{r} = \frac{k\,\sigma(4\pi r^2)}{r} = 9\times10^{9}\times8\times10^{-6}$

$= 45\cancel{2}\times10$

$q = 8\times10^{-6}(4\pi$

$\boxed{25\times10^{-9}}$

$\frac{9\times10^{9}(0.25\times10^{-6})}{0.05} =$

$= \cancel{45}\ 45\times10^{3} = 4.5\times10^{4}$

[✓ A)] 4.4 x10^4 V
B) 3.6 x10^5 V
C) 7.2 x10^6 V
D) 2.2 x10^4 V
E) 1.1 x10^4 V

15. The electric potential at points in an xyz space is given by :
V = 3x^{2}y - 3y^{2}z + 4xz^2 V/m^3 . The electric field at the point p(1,0,2) is

$\boxed{x}$ $-6xy + 4z^2 = -16\hat{i}$

(y) $-\{3x^2 - 6yz = -3\hat{j}$

3 -

z $-\{-3y^2 + 8x\cancel{z}$

$-16\hat{k}$

A) **E** = 0
[✓ B)] **E** = -16**i** - 3**j** - 16**k** N/C
C) **E** = -12**i** - 3**j** + 12**k** N/C
D) **E** = -16**i** + 5**j** N/C
E) **E** = -16**i** + 9**j** + 4**k** N/C

$\epsilon_0 = 8.85 \times 10^{-12}\ C^2 / N.m^2$

$k = 1/4\pi\epsilon_0 = 9.0 \times 10^9\ N.m^2/C^2$

1. A particle (m = 50 g, q = 5.0 μC) is released from rest when it is 40 cm from a second particle (Q = –20 μC). Determine the magnitude of the initial acceleration of the 50-g particle.

$Q = -20 \times 10^{-6} c$.

$m = 0.5 kg$

$q = 5 \times 10^{-6} c$

40cm

$F = ma$

$a = \frac{F}{m} = 112$

- a. $50\ m/s^2$
- b. $28\ m/s^2$
- c. $72\ m/s^2$
- [✓ d.] $112\ m/s^2$
- e. None of these

$F = \frac{1}{4\pi\epsilon_0} \frac{qQ}{r^2} = 5.6\ N.$

$ma = Eq$

$50 \times 10^{-3} a = \frac{Kq}{r^2} q \Rightarrow a = \frac{9 \times 10^9 \times 5 \times 10^{-6} \times 20 \times 10^{-6}}{50 \times 10^{-3} \times (40)^2 \times 10^{-4}} =$

2. Three point charges, two positive and one negative, each having a magnitude of 25μC are placed at the vertices of an equilateral triangle (30 cm on a side). What is the magnitude of the electrostatic force on the negative charge?

$F = 62.47$

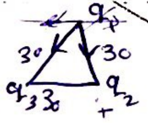
0.2235 x 10

- a. 156 N
- [✓ b.] 108 N
- c. 69 N
- d. 39 N
- e. 75 N

$dE = \frac{1}{4\pi\epsilon_0} \frac{dq}{(6-x)^2}$

$q = 25 \times 10^{-6}$

$E = \frac{\lambda}{4\pi\epsilon_0} \int_0^2 \frac{dx}{(6-x)^2}$



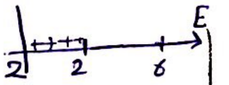
$K\lambda \int_0^2 \frac{dx}{(6-x)^2}$ $\frac{1}{4} - \frac{1}{6}$ $= \frac{\lambda}{4\pi\epsilon_0} \frac{1}{6-x}\Big|_0^2$

$F = \frac{2Kq^2}{(30)^2 \times 10^{-4}}$ $\frac{2 \times 9 \times 10^9 \times (25 \times 10^{-6})^2}{900 \times 10^{-4}} = 12.5$

3. A charge of 80 nC is uniformly distributed along the x axis from x = 0 to x = 2.0 m. Determine the magnitude of the electric field at a point on the x axis with x = 6.0 m.

$\frac{-1}{(6-x)}\Big]_0^2$

3x10



$\lambda = 4 \times 10^{-8} c/m.$

$q = 80 nc$

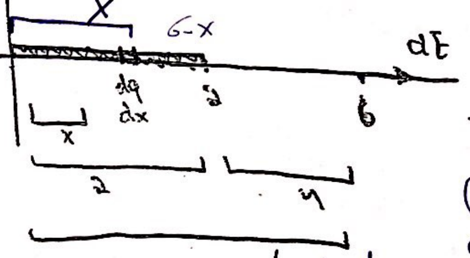
$\frac{\lambda}{4\pi\epsilon_0} \frac{-(6-1)}{(6-x)^2}$

- [✓ a.] 30 N/C
- b. 15 N/C
- c. 9 N/C
- d. 90 N/C
- e. 60 N/C

$E = \int_0 \frac{9 \times 10^9 \times 80 \times 10^{-9}}{8}$

$E = \int_0 \frac{K\lambda\, d\ell}{\ell^2}$

$= K\lambda \left(\frac{-1}{\ell}\right)\Big]_0^2$



$dE = \frac{1}{4\pi\epsilon_0} \frac{dq}{r^2} = \frac{1}{4\pi\epsilon_0} \frac{dq}{(6-x)^2}$

$= K\lambda \frac{1}{2}$

$= \frac{9 \times 10^9}{2} x$

$(K\lambda)\frac{1}{2}$

$\frac{9 \times 10^9 \times 80 \times 10^{-9}}{2 \cdot 8}$

$\frac{1}{4} - \frac{1}{6}$

$E = \frac{1}{4\pi\epsilon_0} \int_{x=0}^{x=2} \frac{dq}{(6-x)^2}$

$= + \frac{\lambda}{4\pi\epsilon_0} \int_{x=0}^{x=2} \frac{+dx}{(6-x)^2}$

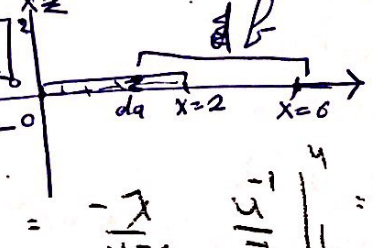
$E = \int_0^2 \frac{K\,dq}{d^2}$

$= K \int_0^2 \frac{\lambda\, d\ell}{d^2}$

$\lambda = \frac{q}{2}$ $dq = \lambda\, dx$

$K\lambda \frac{-1}{d}\Big]_0^2$

$K\lambda \frac{-1}{2} - 0$



$u = 6 - x$

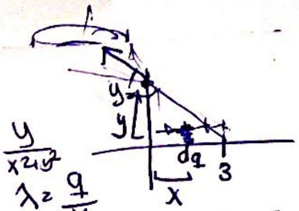
$du = -dx$ $E = K\lambda \int_{4}^{2}$ 1

$\frac{\lambda}{4\pi\epsilon_0}$

$\frac{\lambda}{4\pi\epsilon_0} \int_6^4 \frac{-du}{u^2} = -\frac{\lambda}{4\pi\epsilon_0} \int u^{-2} du = -\frac{\lambda}{4\pi\epsilon_0} \frac{u^{-1}}{-1}\Big|_6^4 = +\frac{\lambda}{4\pi\epsilon_0} \frac{1}{u}$

$E = \int_0^3 \frac{k\,dq}{r^2} \cdot \frac{y}{x^2+y^2}$

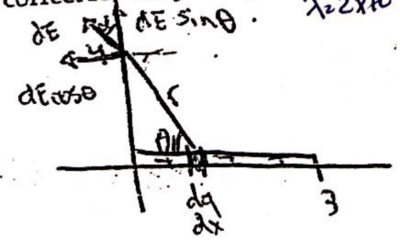
$\lambda = \frac{q}{x}$



$E = k\int_0^3 \frac{\lambda\,dx}{x^2+y^2} = k\lambda\int_0^3 \frac{1}{(4^2+x^2)}$ $\frac{15k\lambda}{(16+x^2)^{3/2}}$

4. 6.0 nC charge is uniformly distributed along the x axis from $x = 0$ to $x = 3$ m. Which of the following integrals is correct for the y component of the electric field at $y = 4$ m on the y axis?

$\lambda = 2\times10^{-9} \times 9\times10^{9}$



$dE_y = dE\sin\theta$

$= \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2}\frac{y}{r}$

$= \frac{y}{4\pi\varepsilon_0}\frac{\lambda\,dx}{r^3}$

[✓ a.] $\int_0^3 \frac{72dx}{(16+x^2)^{3/2}}$

b. $\int_0^3 \frac{18dx}{(16+x^2)^{3/2}}$

c. $\int_0^3 \frac{72dx}{16+x^2}$

d. $\int_3^0 \frac{18dx}{16+x^2}$

e. none of these

$r = \sqrt{x^2+16}$

$E_y = \frac{4\lambda}{4\pi\varepsilon_0}\int_0^3 \frac{dx}{(x^2+16)^{3/2}} = \int_0^3 \frac{72\,dx}{(x^2+16)^{3/2}}$

$V_2 = 0 + 20\times3 = 60$

$ma = qE$

$a = \frac{Eq}{m} = \frac{2.5\times 40\times10^{-3}}{5\times10^{-3}} = 20$ (8)

$V_2 = V_1 + at$

$V_{2y} = 50 + 0 =$

$V_{2y} = 50$

5. A particle (mass = 5.0 g, charge = 40 mC) moves in a region of space where the electric field is uniform and is given by $E_x = 2.5$ N/C, $E_y = E_z = 0$. If the velocity of the particle at $t = 0$ is given by $v_y = 50$ m/s, $v_x = v_z = 0$, what is the speed of the particle at $t = 3.0$ s?

a. 94 m/s

[✓ b.] 78 m/s

c. 64 m/s

d. 112 m/s

e. 25 m/s

$E_x = 2.5$ N/C	$E_y = 0$	$E_z = 0$
$F_x = 0.1$ N.	$F_y = 0$	$F_z = 0$
$a_x = 20$ m/s².	$a_y = 0$	$a_z = 0$.
$V_2 = V_1 + at$	$V_y = 50$ m/s	$V_z = 0$
$V_2 = 0 + (20)(3) = 60$ m/s.		

$V = \sqrt{V_x^2 + V_y^2}$.

6. A proton moving at 3×10^4 m/s is projected at an angle of 30° above a horizontal plane. If an electric field of 400 N/C is directed downwards, how long does it take the proton to return to the horizontal plane? (HINT: Ignore gravity) [$m_{PROTON} = 1.67\times10^{-27}$ kg, $q_{PROTON} = +1.6\times10^{-19}$ C.]

↓ E = 400 N/C

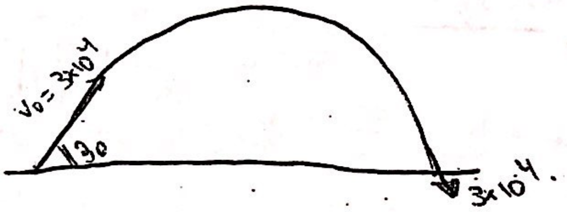
a. 1.56×10^{-6} s

b. 6.2×10^{-7} s

c. 6.4×10^{-6} s

[✓ d.] 7.8×10^{-7} s

e. None of these



$E = 400\hat{j}$ N/C

$F = -6.4\times10^{-17}\hat{j}$ N. → $a = -3.8\times10^{10}$ m/s²

$V_{1y} = 1.5\times10^4$ m/s.

$V_{2y} = -1.5\times10^4$ m/s.

$V_{2y} = V_{1y} + at$

$-1.5\times10^4 = +1.5\times10^4 + -3.8\times10^{10}\,t$ $t = 7.8\times10^{-7}$ s.

7. Charge of uniform surface density (4.0 nC/m^2) is distributed on a spherical surface (radius = 3.0 cm). What is the total electric flux through a concentric spherical surface with a radius of 10.0 cm?

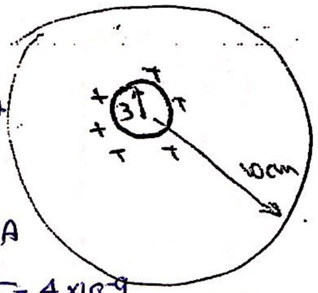
$\Phi = \int E.A$

$= \int 40.6\, dA$

$\sigma = \frac{q}{S}$

$\sigma 4\pi r^2 =$

$= 40.6 \times A$



$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

$q = 4\pi r^2 \sigma = 4.52 \times 10^{-11}$

$\vec{E} = 40.67$ N/c.

- a. 14.1 N · m^2/C
- b. 20.3 N · m^2/C
- c. 2.3 N · m^2/C
- [✓ d.] 5.1 N · m^2/C
- e. 9.1 N · m^2/C

$\sigma = 4 \times 10^{-9}$

$E = \frac{\cancel{\Phi}\sigma A}{A \epsilon_0}$

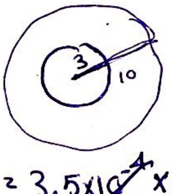
$E = \frac{\sigma \; \cancel{4\pi}(3)^2}{\cancel{4\pi}\epsilon_0 (10)^2}$

$= \frac{4 \times 10^{-9} \times 9}{\epsilon_0\; 100}$

$\int \vec{E} . dA = \frac{q_{enc}}{\epsilon_0}$

$\Phi = \frac{q_{enc}}{} =$

$EA = \frac{q_{enc}}{\epsilon_0} \Rightarrow E = \frac{4 \times 10^{-9}}{4\pi\epsilon_0\; 100 \times 10^{-4}} = 3.5 \frac{\times 10^{-4} \times 10^{-9}}{\times 10^{-4}}$



$\phi = \int \vec{E} . d\vec{A}$

$= \int 40\, dA \cos 0$

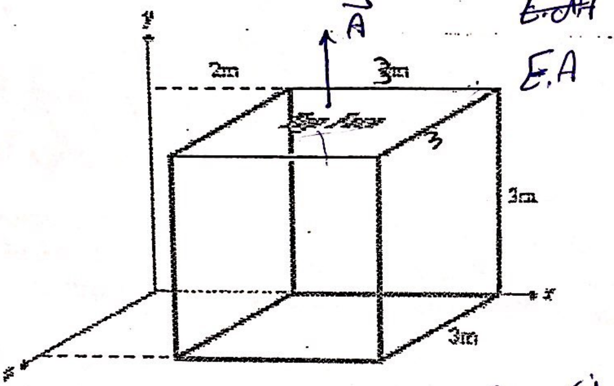
$= (40)(4\pi r^2)$

$= 5.1$ N · m²/c.

8. The electric field in the region of space shown is given by $E = (8\mathbf{i} + 2y\mathbf{j})$ N/C where y is in m. What is the magnitude of the electric flux through the top face of the cube shown?

$E = \frac{\sigma \cancel{S} r^2}{\cancel{4\pi} r^2 \epsilon_0}$

$= 40.6$



$\cancel{E.dA}$

$E.A$

$dA = dA\, \hat{j}$

$E = 8\hat{i} + 4\hat{j}.$

$\phi = \int E . dA$

$= \int 4\, dA$

$= (4)(3)(3) =$

36

54

$\Phi = \int E . dA$

$\cancel{\int 8i + 2y\hat{j}}$

- a. 72 N · m^2/C
- b. 60 N · m^2/C
- [✓ c.] 54 N · m^2/C
- d. zero N · m^2/C
- e. None of these

$\int_0^3 2y . dA$

$2 \times 3 \quad 9$

$E.A$

$(8\hat{i} + 2y\hat{j}) . | 9\hat{j} |$

$2 \times 9 \times y$

$2 \times$

$\rho = 5\times10^{-9}$

$E = \frac{5\times10^{-9}\times\cancel{\pi}\times(12)^2\times\cancel{13}\times10^{-2}}{\epsilon_0\, 2\cancel{\pi}\, 6\times\cancel{E}}$

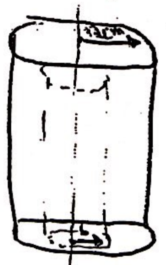
$\int E\,dA = \frac{q_{enc}}{\epsilon_0} \Rightarrow$ ~~$EA = \frac{q}{\epsilon_0} \Rightarrow E = \frac{q}{A\epsilon_0}$~~ $=$

$EA = \frac{\rho\times V}{\epsilon_0}$ $E =$

? 9. A long nonconducting cylinder (radius = 12 cm) has a charge of uniform density (5.0 nC/m³) distributed throughout its ~~column~~ volume. Determine the magnitude of the electric field 6.0 cm from the axis of the cylinder.

don't we put 12×10^{-6} instead of r.

- [✓ a.] 16.9 N/C
- b. 20 N/C
- c. 14 N/C
- d. 22.5 N/C
- e. 28.1 N/C



$\rho = 5\times10^{-9}\ C/m^3$. $\epsilon_0 \oint E\cdot dA = q_{en}$.

$\epsilon_0 E 2\pi(6\times10^{-2})\cancel{l} = \pi(6\times10^{-2})^2\cancel{l}\,\rho$

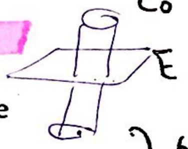
$E = \frac{6\times10^{-2}\,\rho}{2\epsilon_0} = 16.9$

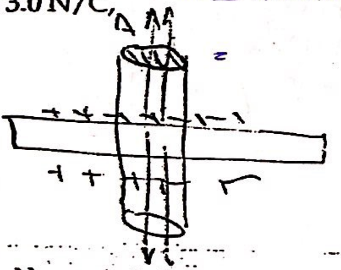
$EA = \frac{\rho\times V}{\epsilon_0}$

$E\, 2\cancel{\pi} r \cancel{L} = \frac{\rho\times\cancel{\pi} r^2 \cancel{L}}{\epsilon_0} \Rightarrow E = \frac{5\times10^{-9}\times12^2\times10^{-4}}{\epsilon_0\, 2\times6\times10^{-2}}$

10. If the electric field just outside a thin conducting sheet is equal to 3.0 N/C, determine the surface charge density on the conductor.

- a. 53.4 pC/m²
- b. 44.5 pC/m²
- [✓ c.] 26.7 pC/m²
- d. 13 pC/m²
- [illegible] None of these





$\epsilon_0 \oint E\cdot da = q_{enc}$.

$\epsilon_0 E \cancel{2A} = (\cancel{2A}\,\sigma)$

$E = \frac{\sigma}{\epsilon_0} \to \sigma = E\epsilon_0$

2.655×10^{-11} ~~$= 2.655\times10^{-11}$~~

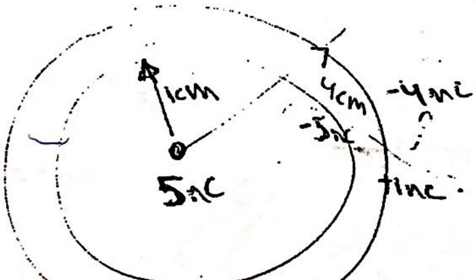
$EA = \frac{q_{enc}}{\epsilon_0}$

$EA = \frac{\sigma \cancel{A}}{\epsilon_0} \Rightarrow E = \frac{\sigma}{\epsilon_0}$

11. A point charge of 5.0 nC is placed at the center of a hollow spherical conductor (inner radius = 1.0 cm, outer radius = 4.0 cm) which has a net charge of −4.0 nC. Determine the resulting charge density on the inner surface of the conducting sphere.

$-5 + q = -4$

- a. +6.4 μC/m²
- b. −4.8 μC/m²
- [✓ c.] −4.0 μC/m²
- d. Zero C/m²
- e. −8.0 μC/m²



$\sigma = -3.9\times10^{-6}$

$S = 4\pi r^2$

$= 4\pi(1\times10^{-2})^2 = 1.256\times10^{-3}\ m^2$.

$q = -5nc. = -5\times10^{-9}\ c$.

$\sigma = \frac{q}{s} = -3.9\times10^{-6}$

$\approx -4\times10^{-6}\ C/m^2$

$-4\ \mu C/m^2$.

$q = -5nc$.

$S = 4\pi r^2 = 1.256\times10^{-3}$

$\boxed{\sigma = 3.98\times10^{-6}}$

$- 6y\ yz^3 + - 3x^2z^3 + - 3z^2\ 3x^2y$

12. The electric potential at points in an xyz space is given by :

$V = 3x^2yz^3$ V/m³ . The electric field at the point $p(\overset{x}{1},\overset{y}{2},\overset{z}{1})$ is

$E = -3yz^3(2x)\hat{i} + -3x^2z^3\hat{j} + -3z^2(3x^2y)$

$= (-3)(2)(1)(2)(1) + (-3)(1)(1) + (-3)(1)(3)(1)(1)$

$= -12\hat{i} + -3\hat{j} + -18\hat{k}$

[✓ a.] E = -12 i – 3 j - 18 k N/C

b. E = – 96 j N/C

c. E = 0

d. E = -12 i - 12 j - 36 k N/C

e. None of these

13. The electric field in a certain region of space is given by:

E = 4 x i + 9 y² j N/C , given that the potential at the origin (0,0) is zero, the potential in this region is given by V=

$E = 4x\hat{i} + 9y^2\hat{j}$. $(0,0)$ $V=0$.

$V = -\int_0^r E \cdot ds$.

$V_x = -\int_0^x 4x\hat{i} \cdot dx\hat{i} = -\int_0^x 4x\,dx = \frac{\cancel{4}^{2}x^2}{\cancel{2}}\Big|_0^x = -2x$

$V_y = -\int_0^y (9y^2\hat{j}) \cdot (dy)\hat{j} = -\int_0^y 9y^2\,dy = -\frac{\cancel{9}^{3}y^3}{\cancel{3}}$

$V = -2x^2 - 3y^3$

a. - 2x² + y³

b. - 2x² + 2y³

c. 2 + 12y

[✓ d.] - 2x² - 3y³

e. None of these

14. The work in joules required to carry a 9.0-C charge from a 15.0-V equipotential surface to a 6.0-V equipotential surface and then to a 25.0-V surface is:

$W = -\Delta U = -(U_f - U_i)$

$= U_i - U_f = V_i q - V_f q$

$= (15)(9) - (25)(9) = -90$ J

a. zero

b. -45 J

[✓ c.] 90 J

d. -63 J

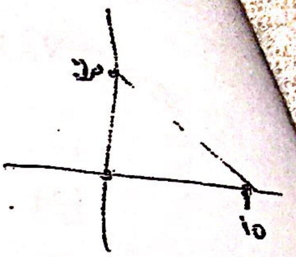
e. None of these

15. A 5 x10-8 C charge is fixed at the origin. A -4 x10-8 C charge is moved from x = 10 cm on the x axis to y = 20 cm on the y axis. The change in potential energy is:

$\Delta U = U_f - U_i$

$= \frac{q_1 q_2}{4\pi\varepsilon_0}\left[\frac{1}{20\times10^{-2}} - \frac{1}{(10\times10^{-2})}\right]$

=



a. -1.8 x10-4 J

b. None of these

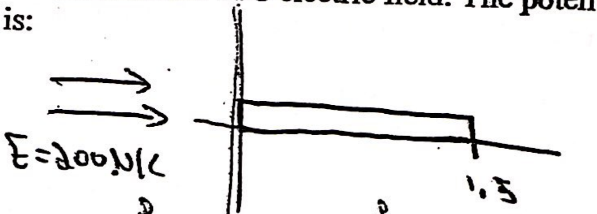
c. 1.8 x10-4 J

[✓ d.] 9.0 x10-5 J

e. zero

16. A 1.5-meter rod is parallel to a uniform 200 N/C electric field. The potential difference between its ends is:

[✓ a.] 300 V
b. 150 V
c. 120 V
d. zero
e. None of these



$E = 200\hat{i}$

$ds = |ds|\hat{i}$

$V = -\int_i^f E\cdot ds = -\int_i^f (200\hat{i})\cdot ds\hat{i} = -\int_i^f 200\, ds$

$= -200 \times \int_i^f ds = -200 \times 1.5 = -300$

17. A 5-cm radius conducting sphere has a charge density of 3 x10^{-6} C/m2 on its surface. Its electric potential at its surface is:

a. 4.5 x10^4 V 45000V
b. 2.8 x10^4 V 28000V
[✓ c.] 1.7 x10^4 V 17000V
d. 2.3 x10^5 V
e. None of these 230000V

~~$\rho = 3\times10^{-6}\ C/m^2$~~

~~$r = 5cm$~~

~~$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = 282.4V$~~

~~$q = \rho(V) = \rho(\frac{4}{3}\pi r^3) = (3\times10^{-6})(\frac{4}{3})(\pi)(5\times10^{-2})^3 = 1.57$~~

$q = \sigma(S) = (0.0314)\sigma = 9.42\times10^{-8}C$ ~~$\times10^{-9}$~~ C.

16949.15

17000

10

جامعة بيرزيت

BIRZEIT UNIVERSITY

-Physics Department-

-physics 132-

1st Hour Exam
Time: 80 Minutes

Summer Semester 2013-2014
20/7/2014

Student Name:[redacted]
Student Number:[redacted]

ضع علامة (X) هنا	Instructor Name	Section No.
X	غسان عباس	1L
	وفاء خاطر	2L
	غسان عباس	3L
	عزيز شوابكة	4L

Answer Sheet

Q#	A	B	C	D	E
1	✓				
2				✓	
3		✓			
4		✓			
5			✓		
6			✓		
7		✓			
8	✓				
9		✓			
10					✓
11					✓
12					✓
13		✓			
14			✓		
15		✓			
16				✓	

$e = 1.6 \times 10^{-19}C$
$\mu_o = 4\pi \times 10^{-7}$ T.m/A

$M_e = 9.11\times10^{-31}kg$
$M_p = 1.67\times10^{-27}kg$

$\epsilon_o = 8.85\times10^{-12}$ $C^2/N.m^2$
$1\ eV = 1.6\times10^{-19}J$

q

$$= 2\times10^{-8}\left(\frac{9\times10^{9}\times1\times10^{-8}}{7\times10^{-2}}\right) + -3\times10^{-8}\left(\frac{9\times10^{9}\times}{2\times10^{-2}}\right)$$

$$+\left(\frac{9\times10^{9}\times2\times10^{-8}}{1\times10^{-2}}\right)$$

Name: ____________________ Class: __________________ Date: _________ ID:

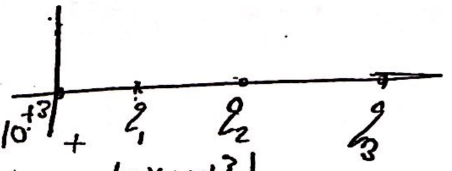
phys132-first

$$U = 0 + q_2\left(\frac{q_1}{4\pi\epsilon_0 r}\right) + q_3\left(\frac{q_1}{} + q_2\right)$$

Multiple Choice

Identify the choice that best completes the statement or answers the question.

____ 1. Three particles lie on the x axis: particle 1, with a charge of 1×10^{-8} C is at $x = 1$ cm, particle 2, with a charge of 2×10^{-8} C is at $x = 2$ cm, and particle 3, with a charge of -3×10^{-8} C, is at $x = 3$ cm. The potential energy of this arrangement, relative to the potential energy for infinite separation, is:



$= 18\times10^{+3\,-5}$

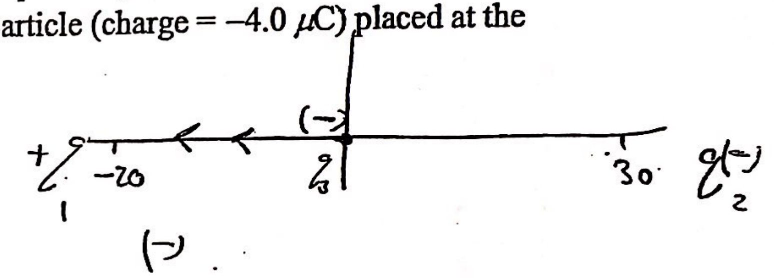
$+ -3\times10^{-8}\left(4.5\times10^{+3} + 18\times10^{+3}\right)$

$= 18 - 67.5$

$\boxed{-49.5}\times10^{-5}$

[✓ a.] -5×10^{-4} J
b. $+9\times10^{-4}$ J
c. -9×10^{-4} J
d. zero
e. $+5\times10^{-4}$ J

____ 2. A particle (charge q_1 = +40 μC) is located on the x axis at the point $x = -20$ cm, and a second particle (charge q_2 = −50 μC) is placed on the x axis at $x = +30$ cm. What is total electrostatic force on a third particle (charge = −4.0 μC) placed at the origin ($x = 0$)?



a. -36**i** N
b. 56**i** N
c. 36**i** N
[✓ d.] -56**i** N
e. 16**i** N

____ 3. Charge of uniform linear density (4.0 nC/m) is distributed along an infinite thin wire placed on the x-axis. Determine the magnitude of the electric field on the y axis at $y = 2.5$ m.

$$F_{31} = \frac{9\times10^{9}\times4.0\times10^{-6}\times40\times10^{-6}}{(-20)^2\ 10^{-4}}$$

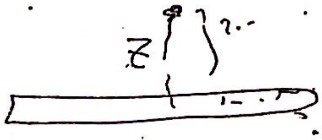
$= 3.6\ \text{N}\times10$

a. 36 N/C
b. 58 N/C
c. 50 N/C
d. 29 N/C
e. 43 N/C

$$E = \frac{1}{4\pi\epsilon_0}\frac{}{R}$$

$$F_{32} = \frac{9\times10^{9}\times4.0\times10^{-6}\times50\times10^{-6}}{(30\times10^{-2})^2}$$

$$\lambda = \frac{q}{L}$$



$= 2\times10 = 20$

$= 36+20$

$F = qE$

$ma = qE$

$20 \times 10^{-3} \times a = 3 \times 10^{-3} \times 80$

$a = \frac{240}{20}$

$a = 12$

Name: ____________________ **ID:** B

4. A particle (q = 3.0 mC, m = 20 g) has a speed of 20 m/s when it enters a region where the electric field has a constant magnitude of 80 N/C and a direction which is the same as the velocity of the particle. What is the speed of the particle 3.0 s after it enters this region?

$V = V + (at)$

$V = 20 + 12 \times 3$

$V = 20 + 36$

$\boxed{V = 56}$

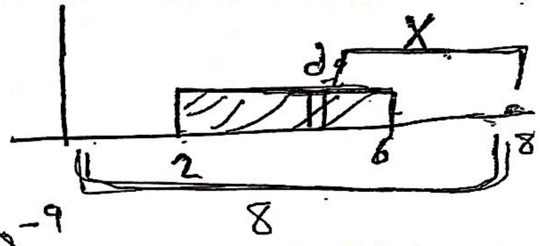
- a. 41 m/s
- [✓ b.] 56 m/s
- c. 80 m/s
- d. 68 m/s
- e. 36 m/s

5. A 24nC charge is distributed uniformly along the x axis from $x = 2$ m to $x = 6$ m. Which of the following integrals is correct for the magnitude (in N/C) of the electric field at $x = +8$ m on the x axis?

$dE = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r^2}$

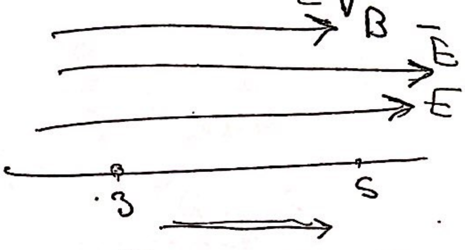
$E = \frac{\lambda}{4\pi\epsilon_0} \int \frac{x}{x^2}$

$E = \cancel{9 \times 10^{9} \times 24 \times 10^{-9}}$



- a. $\int_2^6 \frac{54dx}{x^2}$
- ✗ b. $\int_2^6 \frac{54dx}{(8-x)^2}$
- [✓ c.] $\int_2^6 \frac{216dx}{x^2}$
- ✗ d. $\int_2^6 \frac{216dx}{(8-x)^2}$
- ✗ e. $\int_0^8 54dx/(8-x)^2$

6. The electric field in a region of space is given by $E_x = (3.0x)$ N/C, $E_y = E_z = 0$, where x is in m. Points A and B are on the x axis at x_A = ~~3.0 m and~~ x_B = 5.0 m. Determine the potential difference $V_B - V_A$.



$V_B - V_A = -\int_3^5 E\, ds$

$= (-) E\, (d) \cos\theta$

$= \cancel{3 \times 3.0 \times d}$

$= \cancel{3x}$

$= -\int_3^5 3x$

- a. −18 V
- b. +24 V
- [✓ c.] −24 V
- d. +30 V
- e. −6.0 V

$= (-)3 \left[\frac{x^2}{2} \right]_3^5$

$= (-)3 \left[\left(\frac{(5)^2}{2} \right) - \left(\frac{(3)^2}{2} \right) \right]$

$= (-3)\,(12.5 - 4.5)$

8

$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2} + \frac{1}{4\pi\epsilon_0}\frac{R}{16}\left[\frac{1}{4\pi\epsilon_0}\frac{q}{r}\left(1\right.\right.$

ID:

Name: $\frac{1}{4} + \frac{16}{4}$ ~~$\frac{4}{4}$~~ $+ \frac{16}{4}$

a 7. Charge Q is distributed uniformly throughout an insulating sphere of radius R. The magnitude of the electric field at a point $R/4$ from the center is:

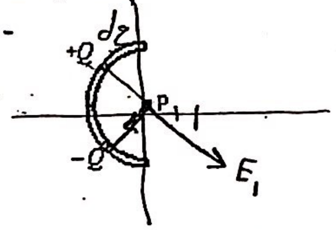
~~$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$~~

~~$= \frac{1}{4\pi\epsilon_0}\frac{q}{\left(\frac{R}{4}\right)^2}$ 16~~

~~$= \frac{16}{4}$~~ $\frac{R}{16}$

a. $3Q/4\pi\epsilon_0 R^2$
[✓ b.] $Q/4\pi\epsilon_0 R^2$
c. $Q/\pi\epsilon_0 R^2$
d. $Q/16\pi\epsilon_0 R^2$
e. $Q/8\pi\epsilon_0 R^2$

8. Positive charge $+Q$ is uniformly distributed on the upper half of a semicircular rod and negative charge $-Q$ is uniformly distributed on the lower half. What is the direction of the electric field at point P, the center of the semicircle?



$\boxed{\downarrow}$

[✓ a.] ↓
b. ↗
c. ↑
d. ←
e. →

9. A conducting sphere of radius 5 cm has a charge density of 2×10^{-6} C/m² on its surface. Its electric potential is:

$\sigma = \frac{q}{4\pi R^2}$

a. 2.3×10^5 V
[✓ b.] 1.1×10^4 V
c. 2.2×10^4 V
d. 7.2×10^6 V
e. 3.6×10^5 V

$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$

$= \frac{\sigma 4\pi R^2}{4\pi\epsilon_0 R} = \frac{\sigma R}{\epsilon_0}$

$= \frac{2\times10^{-6} \times 5\times10^{-2}}{8.8\times10^{-12}}$

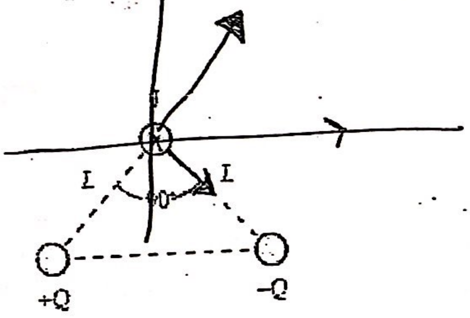
$V = 1.1 \times 10^4$ V

Name: ____________________ **ID:**

___ 10. A particle with a charge of 5×10^{-6} C and a mass of 20 g moves uniformly with a speed of 7 m/s in a circular orbit around a stationary particle with a charge of -5×10^{-6} C. The radius of the orbit is:

a. 0.62 m
b. 0
c. 1.6 m
d. 4.4 m
[✓ e.] 0.23 m

___ 11. If $Q = 25\ \mu$C, $q = 10\ \mu$C, and $L = 40$ cm in the figure, what is the electrostatic force on q?

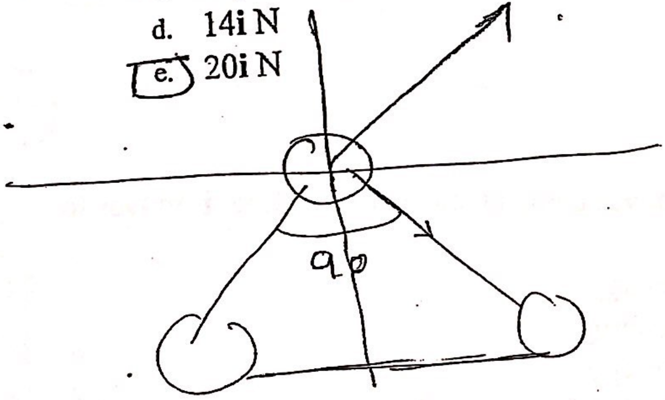


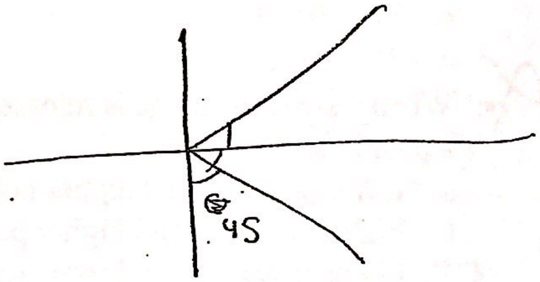
$$F_{2q_1} = \frac{q_1 q_2}{4\pi\epsilon_0 R^2}$$

$$9\times10^9 = \frac{25 \times 10 \times 10^{-6} \times 10^{-6}}{(40\times10^{-2})^2}$$

$= 1.4 \quad = 14\ N$

a. -22**i** N
b. zero
c. 28**j** N
d. 14**i** N
[✓ e.] 20**i** N





$= 2 \times 14 \ \cos\theta 45$

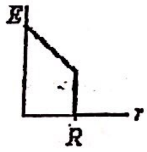
$= 28$ (19.8)

$= \boxed{19.7}$

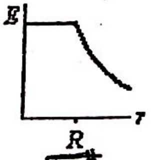
ID:

Name: ____________________

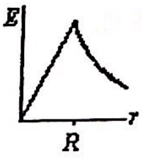
____ 12. Which of the following graphs represents the magnitude of the electric field as a function of the distance from the center of a solid charged conducting sphere of radius *R*?



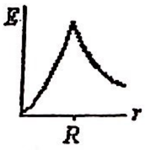
A



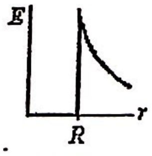
[✓ B]



C



D



E

a. E
b. C
c. D
d. A
[✓ e.] B

____ 13. The dipole moment of a dipole in a 300N/C electric field is initially perpendicular to the field, but it rotates so it is in the same direction as the field. If the moment has a magnitude of 2×10^{-9} C · m the work done by the field is:

$U = -P \cdot E$

$Z = P \times E$

a. -12×10^{-7} J
[✓ b.] -6×10^{-7} J
c. 6×10^{-7} J
d. 12×10^{-7} J
e. 0

____ 14. When a positive charge is released and moves along an electric field line, it moves to a position of
a. lower potential and higher potential energy.
b. higher potential and higher potential energy.
[✓ c.] higher potential and lower potential energy.
d. lower potential and lower potential energy.
e. greater magnitude of the electric field.

ID:

Name: ____________________

___ 15. The electric potential at any point in space is given by $V=3xy^2z$,the electric field at any point in space is given by:

- a. $-6yj$
- [✓ b.] $-3y^2zi-6xyzj-3xy^2k$
- c. $3y^2zi+6xyzj+3xy^2k$
- d. $-3xi-6yj-3zk$
- e. $-6xyzk$

___ 16. The flux of the electric field $(24\ \text{N/C})\hat{i}+(30\ \text{N/C})\hat{j}+(16\ \text{N/C})\hat{k}$ through a 2.0 m² portion of the xy plane is:

K

$\boxed{2 \times 16}$

- a. 48 N · m²/C
- b. 60 N · m²/C
- c. 34 N · m²/C
- [✓ d.] 32 N · m²/C
- e. 42 N · m²/C

$$V = 3xy^2z$$

$$E_x = (-)3y^2z$$

$$E_y = (-)3x\,2y\,z$$

$$E_z = (-)3xy^2$$

$$= -3y^2z\,\hat{i} - 6xyz\,\hat{j} - 3xy^2\,\hat{k}$$

$C = \frac{\epsilon_0 A}{d}$

(1) [illegible]

BIRZEIT UNIVERSITY

PHYSICS DEPARTMENT

10

Student name: QUIZ3 student number:

Mohaned Shweiki 1121252

1) A parallel-plate capacitor has a plate area of 0.2 m^2 and a plate separation of 0.1 mm. To obtain an electric field of 4.0×10^6 V/m between the plates, the magnitude of the charge on each plate should be:

A) 8.9×10^{-7}C
B) 1.8×10^{-6}C
C) 3.5×10^{-6}C
[✓ D)] 7.1×10^{-6}C
E) 1.4×10^{-5}C

$\Rightarrow q = C V_c$

$C = \frac{\epsilon A}{d}$

$C = \frac{8.85 \times 10^{-12} \times 0.2}{0.1 \times 10^{-3}}$

$= \frac{1.77 \times 10^{-12}}{0.1 \times 10^{-3}}$

$= 17.7 \times 10^{-9}$

$\Rightarrow E = \frac{V}{d}$

$4.0 \times 10^{6} = \frac{V}{0.1 \times 10^{-3}}$

$V = 0.4 \times 10^{3}$

$q = C.V$

$= 17.7 \times 10^{-9} \times 0.4 \times 10^{3}$

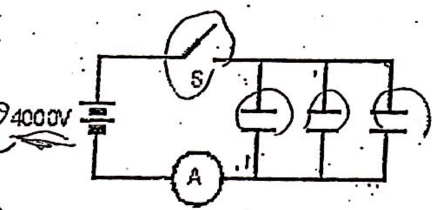
$= 7.08$

$= 7.1 \times 10^{-6}$

2) Each of the three 50μF capacitors shown is initially uncharged. How many coulombs of charge pass through the ammeter A after the switch S is closed?

q $V_1 = V_2 = V$

$q = C V_c \quad q_1 + q_2 + q_3 = q$



A) 0.10 C $150 \times 10^{-6} \times 4000$
B) 0.20 C
[✓ C)] 0.6 C
D) 0.05 C
E) 0.30 C

~~$q_{قبل} = q_{بعد}$~~

~~$0.2 =$~~

~~$q = C.V$~~

~~$q = 4000 \times 50 \times 10^{-6}$~~

~~$q_1 = 0.2$~~

$q = C V$

$= 150 \times 10^{-6} \times 4000$

$= 0.6$ C

$C_{eq} = C_1 + C_2 + C_3$

$= 50 + 50 + 50$

$= 150 \times 10^{-6}$

$C_{eq} = C_1 + C_2 + C_3$

$= 50 + 50 +$

$= 150 \times 50$

14

جامعة بيرزيت

BIRZEIT UNIVERSITY

-Physics Department-

Physics 132

1st hour exam
Time: 80:00 min

2nd Semester 2012/2013
Date:24 /3/2013

Coordinator Ghassan Abbas

Student Name: [redacted] **Student NO:.** [redacted]

ضع علامة (X) هنا	Instructor Name	Section No.	
X	تيسير عاروري	1,2D	S 12:00
	غاده دوشق	3,4,5,6D	
	وفاء خاطر	7,9,10D	
	غسان عباس	8D	

Answer Sheet:

Q#	A	B	C	D	E
1				X	
2	X				
3					X
4		X			
5					X
6				X	
7					X
8					X
9			X		
10		X			
11	X				
12				X	
13				X	
14	X				
15		X			
16			X		
17			X		

$e = 1.6 \times 10^{-19} C$

$Me = 9.11 \times 10^{-31} kg$

$\epsilon_o = 8.85 \times 10^{-12}\ C^2/N.m^2$

$\mu_o = 4\pi \times 10^{-7}\ T.m/A$

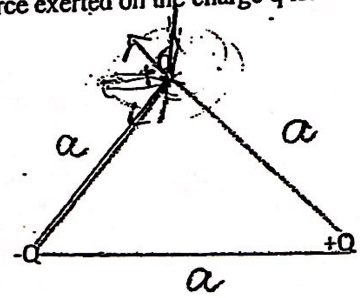
ID: A

Name: ____________________ **Class:** ____________________ **Date:** __________

phys13212013

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Charges Q, -Q and q are placed at the vertices(رؤوس) of an equilateral triangle (مثلث متساوي الاضلاع) of length 'a' the total force exerted on the charge q is:



$$F_x = \frac{qQ}{4\pi\epsilon_0 a^2} \cos\theta$$

$$F_+ = \frac{qQ}{4\pi\epsilon_0 a^2}$$

$$F_- = \frac{qQ}{4\pi\epsilon_0 a^2} \quad \frac{1}{2}$$

$$\left(\frac{qQ}{4\pi\epsilon a^2}\right)^2 + (\quad)^2$$

$$\sqrt{2(\quad)^2}$$

a. $\frac{1}{4\pi\epsilon_0}\frac{Qq}{a^2}(\hat{\imath}+\hat{\jmath})$

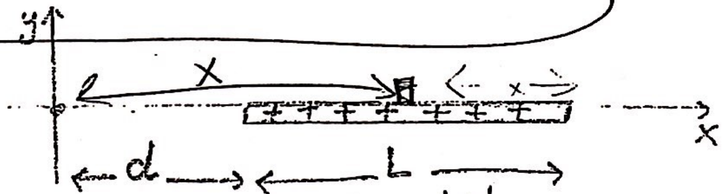
b. $\frac{1}{4\pi\epsilon_0}\frac{Qq}{a^2}(\hat{\imath})$

c. $\frac{0.87}{4\pi\epsilon_0}\frac{Qq}{a^2}(\hat{\jmath})$

[✓ d.] $\frac{1}{4\pi\epsilon_0}\frac{Qq}{a^2}(-\hat{\imath})$

[✓ e.] $\frac{2}{4\pi\epsilon_0}\frac{Qq}{a^2}(-\hat{\imath})$ ✓

____ 2. A rod of length L has a uniform positive charge per unit length λ. The electric field at the origin, a distance d from one end equal to:



[✓ a.] $\frac{\lambda}{4\pi\epsilon_0}\left[\frac{1}{d}-\frac{1}{L+d}\right]$

b. $\frac{\lambda}{4\pi\epsilon_0}\left[\frac{1}{d+L}-\frac{1}{d}\right]$

c. $\frac{1}{4\pi\epsilon_0}[\ln(L+d)-\ln d]$ ✗

d. $\frac{1}{4\pi\epsilon_0}\ln\left[\frac{d}{d+L}\right]$

[✓ e.] $\frac{\lambda}{2\pi\epsilon_0 d}$

$$E = \frac{d}{2\pi\epsilon_0 d} \qquad \int_d^{L+d}$$

$$V = \frac{1}{4\pi\epsilon_0} \ln\left(\frac{L+d}{d}\right)$$

$$E = \frac{\frac{q}{L}}{2\pi\epsilon_0}$$

$$\frac{-L}{dL+d^2}$$

$$\frac{1}{4\pi\epsilon_0}\left(\frac{\frac{d-(L+d)}{d^2}}{\frac{L+d}{d}}\right) \quad 1$$

$$E = \frac{q}{2\pi\epsilon_0 L d}$$

$$\frac{-L}{d(L+d)}$$

$$\frac{d-L+d}{d} \times \frac{1}{1}$$

$$\frac{d-L-d}{-L}$$

Name: ____________________ **ID: A**

الشحنة الي ذوتهم مساوية في المقدار A
4.5 // 4.5

3. A charge of 9 µC is to be split into two parts that ar then separated by 3mm . The maximum possible magnitude of the electrostatic force between those two parts is:
   - a. 2×10^4N
   - b. 8×10^3N
   - c. 2.4×10^3N
   - d. 61N
   - [✓ e.] 0 e

$F = \frac{9 \times 10^{-6} \times 9 \times 10^{9}}{(9 \times 10^{-6})}$ $= \frac{(9-Q)\,Q \;\; 9\times10^{9}}{9\times10^{-6}}$

$9Q - Q^2 = 0$

$Q(9 - Q)$

$\frac{9Q - Q^2}{} \cdot 10^{15}$

4. An electron moves in a circular path around a proton of radius 5.29×10^{-11}m.The proton is at rest at the centerof the circle,the kinetic energy of the circulating electron is :

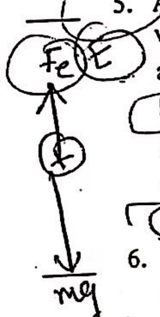
   r $V_0 = 0$
   - a. 4.4×10^{-18}J
   - [✓ b.] 2.18×10^{-18}J
   - c. 8.7×10^{-18}J
   - d. 8.2×10^{-18}J
   - e. -4.4×10^{-18}J

$F = m\frac{v^2}{r}$

$K_i U_t$

$\frac{9\times10^{9} \times 1.6\times1.6\times10^{-12}}{(5.29\times10^{-11})^2} = \frac{9.11\times10^{-31} \times v^2}{(5.29\times10^{-11})}$

5. An alpha particle has a mass of 6.64×10^{-27}kg and a charge of +2e .The electric field tht will balance the weight of the alpha particle is :
   - a. 2.1×10^{-7}N/C downward
   - [✓ b.] 2.1×10^{-7}N/C upward
   - c. 4.2×10^{-7}N/C downward
   - d. 4.2×10^{-7}N/C upward
   - [✓ e.] 2.1×10^{-7}N/C in any direction



E

$F = Eq = mg$

→ 6.64 × 10

a0

E

6. The dipole moment of a dipole in a 300-N/C electric field is initially perpendicular to the field, but it rotates so it is in the same direction as the field. If the moment has a magnitude of 2×10^{-9} C· m the work done bv the field is:

   - a. -12×10^{-7} J
   - b. -6×10^{-7} J
   - c. ~~0~~
   - [✓ d.] 6×10^{-7} J
   - e. 12×10^{-7} J

زاوية بين صفر 0

$W = -\Delta U$ $\quad -W = -\Delta U = -P.E\cos\theta$

$= -300\times2\times10^{-9}$

$(-PE\cos\theta_f) - (-PE\cos\theta_i)$ to

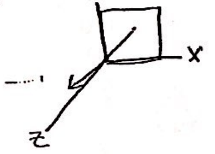
0 =

7. The flux of the electric field 24î+12j+36k through a 5.0 m² portion of the xy plane is:
   - a. 48Nm²/C
   - b. 60Nm²/C
   - c. 72Nm²/C
   - d. 120Nm²/C
   - [✓ e.] 180Nm²/C

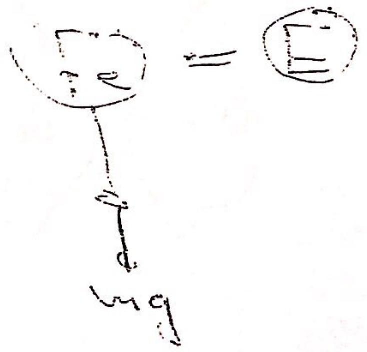
$\Phi = E \cdot A$

$\Phi = E \cdot dA$

$= 36.5 = 180 N.m^2/C$



③ ~~$F = k\frac{q(Q-q)}{3}$~~



Name: ____________________

___ 8. A point particle with charge q is placed inside a cube but not at its center. The electric flux through any one side of the cube:

$\phi = \frac{q}{\epsilon_0}$

a. is zero
b. is q/ε
c. is $q/4\varepsilon_0$
d. is $q/6\varepsilon_0$
[✓ e. cannot be computed using Gauss' law]

___ 9. Charge is distributed uniformly on the surface of a large flat plate. The electric field 2 cm from the plate is 30 N/C. The electric field 4 cm from the plate is:

$E = \frac{\sigma}{2\epsilon_0} = \frac{q}{}$

$\frac{q}{R^2}$ 30

$E = \frac{\sigma A}{2\epsilon_0}$

$\frac{\sigma}{2\epsilon_0}$

$= \frac{kq}{R^2}$

a. 120 N/C
b. 80 N/C
[✓ c. 30 N/C]
d. 15 N/C
e. 7.5 N/C

___ 10. Charge Q is distributed uniformly throughout an insulating sphere of radius R. The magnitude of the electric field at a point $R/2$ from the center is:

$E = \frac{q}{4\pi\epsilon_0 r^2}$

$\frac{q}{4\pi\epsilon_0 \frac{R^2}{4}}$

$E = \frac{q}{4\pi\epsilon_0}$

a. $Q/4\pi\varepsilon_0 R^2$
[✓ b. $Q/\pi\varepsilon_0 R^2$]
c. $3Q/4\pi\varepsilon_0 R^2$
d. $Q/8\pi\varepsilon_0 R^2$
e. none of these

___ 11. A spherical conducting shell has charge Q. A particle with charge q is placed at the center of the cavity. The charge on the inner surface of the shell and the charge on the outer surface of the shell, respectively, are:

a. [✓ $-q, Q+q$]
b. $0, Q$
c. $q, Q-q$
d. $Q, 0$
e. $-q, 0$

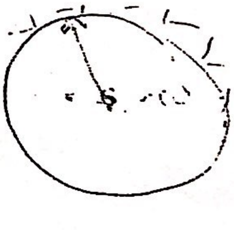
___ 12. A conducting sphere with radius R is charged until the magnitude of the electric field just outside its surface is E. The electric potential at thecenter of sphere:

$V = \frac{q}{4\pi\epsilon_0 r}$

a. zero
b. E/R
c. E/R^2
[✓ d. ER]
e. ER^2

~~$E = \frac{Q}{4\pi\epsilon_0 (\frac{R^2}{2})}$~~

~~$E = \frac{Q}{\pi\epsilon_0 R^2}$~~



BIRZEIT UNIVERSITY
Physics Department
phys 132

First Hour Exam
Time: 75 minutes

2nd Summer term 2012
Date: 21.07.2012

Student name: [redacted]

Student #: [redacted]

Answer Sheet

Q. #	A	B	C	D	E	
1			X		X	X
2	X		X			X
3		X				✓
4	X					
5		X				
6				X		
7					X	
8	X					
9			X			
10					X	
11	X					
12		X		X		X

Do NOT write below this line

For Instructor:

Part I	9 /12
Part II	9 /11
Total Grade	18 /23

Best of Luck 100%

4. The electric potential in a certain region is given by $V = 7x - 3x^2y + 2yz^2$. The electric field over this region is given by:

A) $\mathbf{E} = (6xy - 7)\mathbf{i} + (3x^2 - 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$
B) 0
C) $\mathbf{E} = -(6xy - 7)\mathbf{i} - (3x^2 - 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$
D) $\mathbf{E} = (6xy - 7)\mathbf{i} - (3x^2 - 2z^2)\mathbf{j} + 4yz\,\mathbf{k}$
E) $\mathbf{E} = -(6xy - 7)\mathbf{i} - (3x^2 + 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$

$E_x = -(7 - 6xy) = 6xy - 7$

$E_y = -(-3x^2 + 2z^2) = 3x^2 - 2z^2$

$E_z = -(4yz) = -4yz$

5. τ An electric dipole has a dipole moment of $\overset{p}{2 \times 10^{-9}}$ C.m in the negative x-direction $\leftarrow$. A torque of 3.5×10^{-7} N.m in the positive z-direction is exerted on the dipole when it is in a uniform electric field. The magnitude and direction of the electric field is:

A) 5.7×10^{-3} N/C, positive y-axis
B) 175 N/C, negative y-axis
C) 175 N/C, negative z-axis
D) 175 N/C, negative x-axis
E) 175 N/C, positive y-axis

$\tau = p \times E$

$\tau = pE \sin\theta$

$\frac{\tau}{p} =$

$\frac{3.5 \times 10^{-7}}{2 \times 10^{-3}} = 175$

6. Five positive charges are placed in a box. The first charge has a magnitude q. The second charge has a magnitude which is $\overset{2q}{\text{twice the}}$ first charge. The third charge has a magnitude which is twice the $\overset{4q}{\text{second}}$ charge. The fourth charge has a magnitude which is twice the third $\overset{8q}{\text{charge}}$. The fifth charge has a magnitude which is twice the $\overset{16q}{\text{fourth}}$ charge. The net electric flux through the box is $\underset{\phi}{6.8 \times 10^7}$ N.m²/C. The magnitude of the charge q is:

A) 425 μC B) 1.6×10^{-19} C C) 47.2 μC D) 19.4 μC E) 16.6 μC

$\phi = \frac{32q}{\varepsilon_0}$

$q = \frac{6.8 \times 10^7 \times 8.85 \times 1}{37}$

1.94 x1

1.94 x1

7. Charge is distributed uniformly on the surface of a large flat plate. The electric field at 2 mm from the plate is 35 N/C. The electric field at 4 mm from the plate is:

A) 16.5 N/C B) 37 V/m C) 66 N/C D) 8.25 V/m E) 35 V/m

$E = 35$ N/C

~~$\frac{kq}{r^2}$~~

~~$\frac{kq}{(2r)^2}$~~

~~$\frac{kq}{4r^2}$~~

$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N.m^2$ $e = 1.6 \times 10^{-19}\ C$

Part I: Multiple-Choice Problems. 1 Point Each

$F = ma$

$a = \frac{F}{m}$

1. A "free" electron and a "free" proton are placed in an identical electric field. Which of the following is the CORRECT statement?
   - A) The magnitude of the electrostatic force acting on the proton is greater than that acting on the electron
   - B) The direction of the electrostatic force acting on the proton is the same as that acting on the electron
   - [✓ C)] The magnitude of the acceleration of the proton is less than that of the electron
   - D) The magnitude of the acceleration of the proton is greater than that of the electron
   - [✓ E)] The magnitude of the acceleration of the proton is equal to that of the electron

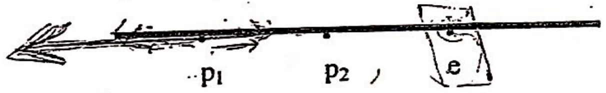
$$F_e = Eq$$

$$- \cancel{\boxed{\frac{ma}{q} = \frac{F}{E}}}\ q$$

2. A positively charged glass rod attracts an object suspended by a nonconducting thread. This means that:
   - ~~A) The object is definitely negatively charged~~
   - [✓ B)] The object is possibly positively charged
   - [✓ C)] The object is possibly negatively charged
   - D) The object is definitely positively charged

F

3. Two protons (p_1 and p_2) and an electron e lie on a straight line as shown. The directions of the electrostatic force from p_2 on p_1, the force from e on p_1 and the total force on p_1, respectively, are:



A) →, ←, 0 ~~B) ←, →, ←~~ [✓ C) ←, →, 0] D) →, →, → E) ←, ←, →

$\frac{a^2+a^2}{\sqrt{2a^2}}$

6) For the electric dipole shown in the figure, the electric field on the positive y-axis, at y = a , is given by:

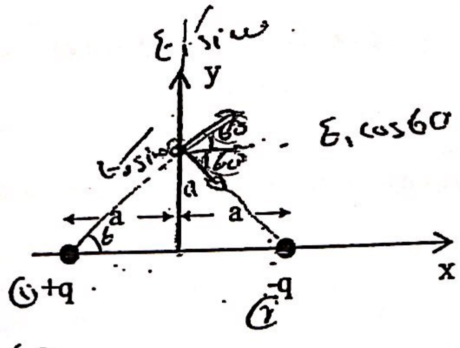
[✓ A) $\frac{1}{4\pi\varepsilon_0}\frac{q}{\sqrt{2}\,a^2}\hat{i}$]

B) $\frac{1}{4\pi\varepsilon_0}\frac{q}{\sqrt{2}\,a^2}\hat{j}$

C) $\frac{1}{4\pi\varepsilon_0}\frac{q}{a^2}\hat{i}$

D) $\frac{-1}{4\pi\varepsilon_0}\frac{q}{\sqrt{2}\,a^2}\hat{i}$

E) zero



$= E_1 \cos 60 + E_2 \cos 60$

$= \frac{Kq}{\sqrt{2a^2}} .5 + \frac{Kq}{\sqrt{2a^2}} .5$

$E_1 \cos 60 \quad E_2 \cos 60$

$\frac{.5Kq}{\sqrt{2a^2}} + \frac{.5qk}{\sqrt{2a^2}}$

$\frac{Kq}{\sqrt{2a^2}}\left(\frac{1}{1}\right.$

2E cos60

7) The magnitude of the force exerted by a 400 N/C electric field on a 0.2 μC point charge is:

A) 0.08 N

B) 8.0×10^{-3} N

[✓ C) 8.0×10^{-5} N]

D) 8.0 N

E) 2.0×10^{11} N

$F = E \times q$

$\frac{F}{q} = E \quad F = qE$

$400 \times 0.2 \times 10^{-6}$

$= .2 \times 10^{-6} \times 400$

=

8) At the center of a uniformly charged ring, choose the correct statement regarding the electric field E and the electric potential V:

??

A) E = 0 and V = 0 ✗

B) E ≠ 0 and V = 0 ✗

C) E ≠ 0 and V ≠ 0

D) E = 0 and V ≠ 0 ✗

[✓ E) E = 0 only if the ring is conductor and V ≠ 0]

9) Two thin spherical shells, one of radius R and the other of radius 2R, surround an isolated point charge. The ratio (نسبة) of the electric flux through the large sphere to the electric flux through the small one is:

A) 1/2

B) 1/4

C) 4

D) 2

[✓ E) 1]

$\Phi =$

$\Phi = \frac{q}{\varepsilon_0}$

$\frac{4\pi r^2}{2\pi r}$

$\Phi = \cancel{EA}$

C U

8. The energy stored in a 12-μF capacitor is 130 μJ. The charge on the capacitor is:
[✓ A) 56 μC] B) 65 μC C) 312 μC D) 60 μC E) 47 μC

$U = \frac{q^2}{2C}$

$U \times 2C = q^2$ $q = 5.6 \times$

9. A parallel-plate capacitor having air between its plates is charged to 38.5 V. The capacitor is then isolated from the charging source and the space between the plates filled with Plexiglas (κ = 3.12). The new potential difference across the capacitor is:
A) 38.5 V B) 15.5 V [✓ C) 12.3 V] D) 95 V E) 14.5 V

$C = \frac{\varepsilon_0 A}{d}$

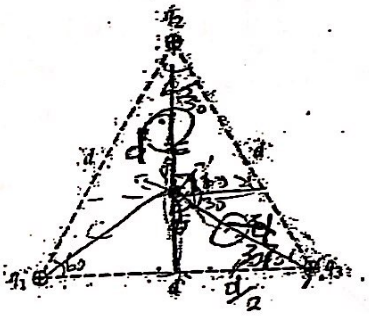
$\frac{\sqrt{3} \times q}{a}$

$K \frac{\varepsilon_0 A}{d}$

$C = 3.12 \times$

$\varepsilon =$

Three equal positive charges of magnitude q each are placed at the corners of an equilateral triangle of sides d as shown in the figure. Answer the following three questions:



10. The magnitude of the electric potential at the center (the point p) of the triangle is:
A) 3 $q/(4\pi\varepsilon_0 d^2)$
B) 0
C) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d^2)$
D) $3\ q^2/(4\pi\varepsilon_0 d)$
[✓ E) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d)$]

$V = \frac{Kq_1}{\sqrt{3} d} +$

$V = \frac{Kq}{r}$

$= \frac{\sqrt{3}Kq}{d} + \frac{\sqrt{3}Kq}{d}$ $\cos 30 = \frac{d/2}{x}$ $\frac{\sqrt{3}}{2} = \frac{d/2}{x}$

$2\sqrt{3}Kq$

$x^2 + (\frac{d}{2})^2 = d^2$

$x^2 = \frac{4d^2}{4} - \frac{d^2}{4}$ =

$U = \frac{q d}{A\varepsilon_0}$

$= \frac{1}{K} \frac{qd}{A\varepsilon_0}$

$= \frac{1}{3.12} \times 3$

11. The magnitude of the electric field at the center (the point p) of the triangle is:
[✓ A) 0]
B) $3\ q^2/(4\pi\varepsilon_0 d)$
C) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d^2)$
D) $3\ q/(4\pi\varepsilon_0 d^2)$
E) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d)$

$\frac{3\sqrt{3}\ q}{4\pi\varepsilon_0 d}$ $2E \cos 45$ $\frac{2Kq}{(\frac{d}{2})^2 +}$

$\frac{d}{2} \times \frac{1}{x}$ $\frac{1}{x} = \frac{d}{2x}$ $x = d$

$x = \sqrt{\frac{3}{4}} d$ $\frac{x}{2} = \sqrt{\frac{3}{4}} d$

$x^2 = \frac{3}{4} d^2$ $x = \frac{\frac{\sqrt{3}}{2} d}{2}$

$\frac{3}{16} d^2 + \frac{d^2}{4} = x^2$ $\frac{\sqrt{3}}{4} d -$

$x^2 + \frac{d^2}{4}$ $x^2 = \frac{3d}{4}$ $\frac{3}{2}$

12. The electric potential energy stored in the system of the three charges is:
A) $3\ q/(4\pi\varepsilon_0 d^2)$
B) $3\ q^2/(4\pi\varepsilon_0 d)$
C) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d^2)$
[✓ D) 0]
E) $3\sqrt{3}\ q/(4\pi\varepsilon_0 d)$

$U = -p \cdot E$

$\frac{3d^2 + 4d^2}{16} = x^2$ $\frac{3}{16} d^2 + \frac{4d^2}{16} = x^2$

$\frac{\sqrt{3}}{2} = \frac{d}{2x}$ $U = q \Delta V$

$\frac{7d^2}{16} = x^2$ $\frac{7 d^2}{16} = x^2$

$x = \frac{d}{\sqrt{3}}$ $q =$ $E = \frac{\sqrt{3}Kq}{d}$

0.75d

0.5d

$\frac{\sqrt{7}d}{4}$ $\frac{\sqrt{7}\ d}{4}$

$\frac{3\sqrt{3}Kq}{d} - \frac{\sqrt{3}Kq}{d}$

$\sqrt{3}\sqrt{3}$

$\sqrt{3}$

$\frac{\sqrt{3}Kq}{d^2} \frac{\sqrt{3}}{2} = \boxed{\frac{3\sqrt{3}Kq}{d}}$

$\frac{4Kq_1}{\sqrt{7}d} + \frac{4Kq_3}{\sqrt{7}d} + \frac{4Kq_2}{\sqrt{3}d}$

$\frac{3Kq}{d^2} \frac{1}{2} - \frac{3Kq}{d^2} =$

$\sqrt{7}\sqrt{3}\ d$

$\frac{c}{m^3}$

Part II:

Essay Problem 1:

A nonconducting solid sphere of radius R has a nonuniform volume charge density $\rho(r) = A/r + Br^2$ with the radial distance r is measured from the sphere's center and A and B are constants.

a) What are the SI units of the constant A? (2 points)

~~SI unit of A is $\frac{c}{m^2}$~~ ②

$\frac{c}{m^3} = \frac{A}{m} + $

$\frac{m^2 A + B}{m^3}$

R

$\int \rho \, dv$

b) What are the SI units of the constant B? (2 points)

$\frac{1}{R} * \frac{C}{m^3} = B\frac{m^2}{m}$ SI unit of B is ~~$\frac{c}{m^5}$~~

$\frac{c}{m^5}$ B

$\frac{c}{m^5}$ ①

$= \frac{4\pi r}{3}$

c) What is total charge on the sphere? (4 points)

$V = \frac{4}{3}\pi r^3$

$dv = 4\pi r^2 dr$

$q = \int \rho \, 4\pi r^2 dr$ $= \int^R \left(\frac{A}{r} + Br^2\right) 4\pi r^2 dr$ ③

$4\pi \int_0^R (Ar + Br^4)\, dr$ ok

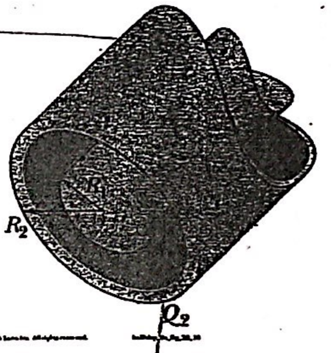
$4\pi \left(\frac{Ar^2}{2} + \frac{Br^5}{5}\right]_0^R = 4\pi\left(\frac{AR^2}{2} + \frac{BR^5}{5}\right)$

$\frac{C}{m^3} = \frac{A}{m}$

$A = Cm^2$

Essay Problem 2:

The figure shows a section of a conducting rod of radius R_1 and length L inside a thin coaxial conducting cylindrical shell with radius R_2 and length L. The net charge on the rod $Q_1 = +3\ \mu C$. The net charge on the shell $Q_2 = -6\ Q_1$.



a) What is the charge on the interior surface of the shell? (2 points)

-3

~~$q = Zero$~~ NO! ①

-3

-3

b) What is the charge on the exterior surface of the shell? (2 points)

$Q_2 + Q_1 = (-6\times3) + 3 = -18 + 3 = -15C$ ②

$Q + q$

$(-6\times3) + 3 = -18 + 3 = -15C$

13

جامعة بيرزيت
BIRZEIT UNIVERSITY
Physics Department

Physics 132

First Hour Exam
Time: 1.5 Hours

First Summer, 2010/2011
Date: 21/06/2011

Student Name: [redacted] **Student NO.:** [redacted]

ضع علامة (X) مقابل شعبتك	Instructor Name	Section No.
~~X~~	عدنان جودة	1 (ENG334)
X	عدنان جودة	2 (SCI234)
	نضال دويكات	3 (SCI214)

Answer Sheet

Q No.	A	B	C	D	E
A 1	✓				
2		✓			
3		✓			
4			✓		
5					✓
6	✓				
7			✓		
8					✓
9					✓
10				✓	
11					✓
12		✓			
13	✓				
14			✓		
15			✓		
16					✓
17		✓			
18	✓				

$U = \frac{Q^2}{2C}$

1) Let Q denote the charge on a capacitor, ΔV the potential difference between its plates and U the energy stored in it. Capacitors connected in parallel must have the same:

[✓ A)] Q
B) U
C) ΔV and U
D) Q and U
E) ΔV

2) If a charged conductor is in electrostatic equilibrium, which of the following statements is always true?

A) The electric field just outside the conductor is perpendicular to the surface
[✓ B)] The charge is distributed uniformly on the surface of the conductor
C) The magnitude of the electric field just outside the conductor is constant X
D) The electric potential at the surface of the conductor is higher than the electric potential inside the conductor
E) The charge is distributed uniformly throughout the conductor volume X

3) An air-filled parallel-plate capacitor has a capacitance of 1 pF. The plate separation is then doubled and a wax dielectric is inserted, completely filling the space between the plates. As a result, the capacitance remains 1 pF. The dielectric constant of the wax is:

$\boxed{C = KC_0}$

$\frac{K\epsilon_0 A}{2d}$ $K\boxed{\frac{\epsilon_0 A}{d}}$

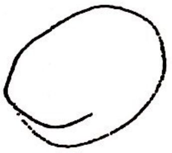
$\frac{1\times10^{-12}}{1\times10^{-12}} = K\,1\times10^{-12}$

$\frac{2\times1\times10^{-12}}{1} = K\frac{1\times10^{-12}}{2}\times2$

$\frac{2\times10^{-12}}{1\times10^{-12}} = \frac{K\epsilon_0 A}{2d}\times1 = K\frac{\epsilon_0 A}{2d}\times2 \quad K\frac{\epsilon_0 A}{2d} = \left(K\frac{\epsilon_0 A}{d}\right)$

A) 0.25
[✓ B)] 2.0
C) 0.5
D) 4.0
E) 8.0

4) A charge of 10 C is placed on a spherical conducting shell and a point charge of 2 C is placed at the center of the shell. The net charge on the outer surface of the shell is:



$q_{in} = (q_{shell} + q_{outer}$

$\boxed{12} = 2 + 10$

$\textcircled{2}$ 10

A) 5 C
[✓ B)] 12 C
C) 8 C
D) 10 C
E) 0 C

5) A charged capacitor stores a charge of 0.1 C when connected to 40 V battery. The stored energy in the capacitor is:

$\frac{(.1)^2}{800}$ $\frac{Q^2}{2C}$ $Q = C\Delta V$ 400 $\frac{1}{2}$

$\frac{.1}{40} = \frac{.1\times40}{40}$

$Q = 4.0$

$\frac{}{5\times10^{-3}}$ $\frac{(.1)^2}{2}$ $\frac{Q^2}{2C}$ $\frac{Q}{\Delta V} = C\Delta V$

$\frac{(8.16}{2\times.1}$ $\frac{1.}{40}$

$\frac{1}{2}Q\Delta V$

$\boxed{20}$ $\frac{1}{2}\times.1\times\frac{20}{40}$ $\boxed{2.5\times10^{-3}}$

A) 400 J
B) 4 J
C) 0.2 J
D) 2.5 J
[✓ E)] 2 J

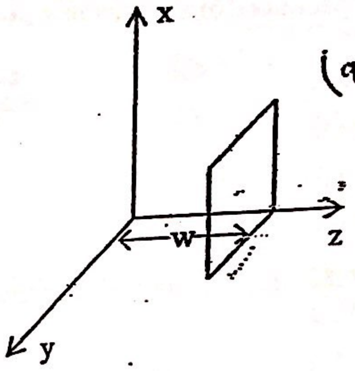
10) An electric field is given by: $\vec{E} = ax^2\hat{i} + by^2\hat{j} + cz^3\hat{k}$, where a, b and c are constants. The electric flux through a square surface of edge length L, located in the xy-plane at z = w as shown is:

$\phi = \boxed{\vec{E}.\vec{A}}$

$(ax^2\hat{i} \rightarrow bj y^2) L^2 z$

$\boxed{cz^3L^2}$

A) awL
B) aw^2L^2
C) bw^2L^2
[✓ D)] cw^3L^2
E) zero



$cz^3 L^2$

11) A particle with a charge of 1.0 μC is fixed at the origin (x,y) = (0,0). A second particle with a charge of −1.0 μC is moved from x = 6.0 cm on the x-axis to y = 5.0 cm on the y-axis. The change in potential energy of the two-particle system is:

50
+1x10^-6
6- 1x10^-6

$\Delta U = U_f - U_i$

$\frac{Kq_1q_2}{.06 \times 5} - \frac{Kq_1q_2 \cdot 5}{.06 \times 5}$

$\frac{-.054 - .045}{30}$

$-\frac{5.4 \times 10^{-4} - 4.5 \times 10^{-4}}{3 \times 10^{-3}}$

$-\frac{.099}{.3}$

3.3×10^{-3}

.0033

.033

3.3 x

A) −0.06 J
B) 0.03 J
C) 0
D) 0.06 J
[✓ E)] −0.03 J

12) An electric field is in the positive x direction and has a magnitude given by, $E = cx^2$, where c is constant. The electric potential V at a point x (relative to V = 0 at x = 0) is given by:

$\Delta V = -\int E d$

$-cx^3$

$-\int cx^3$

$\frac{3cx^3}{3}$

$V_x - V_0 = -\int_0^x cx^2$

$V_{x-0} =$

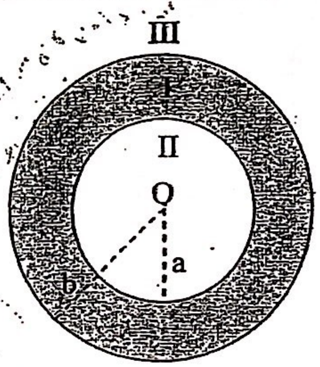
$\frac{cx^3}{3}$

$\frac{x^3}{3}$ x^{2+1}

A) 2cx
[✓ B)] $-cx^3/3$
C) $-2cx$
D) $-3cx^3$
E) $cx^3/3$

13) The shown conducting shell has an inner radius a and an outer radius b. If a positive point charge Q is placed at the center of the shell, the electric field is zero in region:

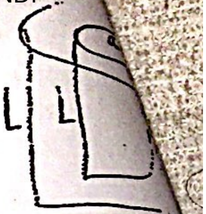
[✓ A)] I
B) II
C) III
D) II and III
E) None of the above



$E\,2\pi r4 = \frac{2Q}{\varepsilon_0}$ $\frac{KQ}{r}$ $-\frac{\lambda}{\varepsilon_0 2\pi}\int \frac{dr}{r}$ $V_{2a} - V_a =$ $C\frac{2\pi\varepsilon_0}{2\pi r} = \frac{\lambda L}{\varepsilon_0 2\pi r}$

$-\int E\cdot ds$ $\frac{K\lambda 2}{2\pi r\varepsilon_0} \div r$ $+\frac{\lambda}{\varepsilon_0 2\pi}\ln\left|\frac{2a}{a}\right| +$ $\underline{\ln 2}$

E



14) A cylindrical conductor consists of a cylindrical conducting shell of radius 2a and length L, concentric with a smaller cylindrical conducting shell of radius a and length L. The capacitance of this device ([illegible]) is:

$C = \frac{Q}{\Delta V}$

A) $\frac{2\pi\varepsilon_0 L}{\ln(a)}$

B) $\frac{4\pi\varepsilon_0 L}{\ln(2)}$

[✓ C)] $\frac{2\pi\varepsilon_0 L}{\ln(2)}$

D) $\frac{2\pi\varepsilon_0}{\ln(a/L)}$

E) $\frac{2\pi\varepsilon_0 L}{L^2 - a^2}$

$\frac{Q\,2\pi\varepsilon_0 L}{Q\ln|2|}\div\frac{Q}{L}$

$\frac{\lambda}{2\pi\varepsilon_0}\ln\left|\frac{2a}{a}\right|$

$2\pi\varepsilon_0 L \cdot$ $Q \div \frac{\frac{Q}{L}\ln|2|}{1}$ $\lambda \ln|2.$

$\frac{\frac{Q}{L}\ln|2|}{2\pi\varepsilon_0}$

$F = \frac{KQQ}{d}$

15) Two charges $q_1 = Q$ and $q_2 = Q/4$ are separated by a distance d. If the magnitude of the force exerted on q_1 by q_2 is F, then the magnitude of the force exerted on q_2 by q_1 is:

A) 4F

B) F/4

[✓ C) F]

D) 2F

E) F/2

$F_{21} = F$

16) A rod of length L has a uniform charge per unit length λ as shown. The magnitude of the electric field at point P, located at a distance d from one end, equals:

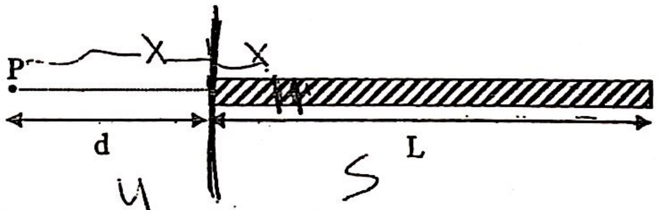
A) $\frac{\lambda}{4\pi\varepsilon_0}\left[\frac{1}{L} - \frac{1}{d}\right]$

B) $\frac{\lambda}{4\pi\varepsilon_0}[\ln(L+d) - \ln(d)]$

C) $\frac{\lambda}{4\pi\varepsilon_0}\ln\left[\frac{d}{L+d}\right]$

D) $\frac{\lambda}{2\pi\varepsilon_0 d}$

[✓ E)] $\frac{\lambda}{4\pi\varepsilon_0}\left[\frac{1}{d} - \frac{1}{L+d}\right]$



$S - 4$

①

$\underline{\underline{L-d}}$

$\frac{K_e\lambda\,dx}{x^2}$

$K_e\lambda\int\frac{dx}{x^2}$ $\int_d^L$ x^{-2} $\boxed{\frac{-1}{x}}$

$\frac{-1}{x}\Big|_{L-d}^{L}$

$\frac{-1}{L-d} + \frac{1}{L}$

$\frac{-L}{L^2 - Ld} + \frac{L-d}{L^2 - Ld}$ $\frac{-1}{L-d} + \frac{+1}{L}\,L-d$

$\frac{-d}{L(L-d)}$ $\frac{-d}{L^2 - Ld}$

E

17) At a certain distance from a point charge, the magnitude of the electric field is 500 V/m and the electric potential is – 1.5 kV. The point charge equals:

A) 2 μC
[✓ B) – 0.5 μC]
C) 4 μC
D) – 2 μC
E) – 4 μC

$\Delta V = -Ed$

$\frac{+1.5\times10^3}{500} = \frac{+500d}{500}$

$3 = d$

$500 = \frac{KQ}{q}$

<4500

5

e

18) An electron is accelerated from rest through a potential difference ΔV. Its final kinetic energy is proportional to:

$V_i = 0$

$\Delta K = \Delta U$

[✓ A) $\sqrt{\Delta V}$]
B) $1/\Delta V$
C) $1/\sqrt{\Delta V}$
D) ΔV
E) ΔV^2

$\frac{1}{2}mV_f^2 = \sqrt{\frac{q\Delta V\times2}{m}}$

$\frac{1.5\times10^3}{5\times10^2} = \frac{500\times d}{500}$

$\boxed{3 = d}$

$-1.5\times10^3 = \frac{9\times10^9\times Q}{3}$

Elementary charge: $e = 1.60\times10^{-19}$ C

Electron mass: $m_e = 9.11\times10^{-31}$ kg

Proton mass: $m_p = 1.67\times10^{-27}$ kg

Permittivity constant: $\varepsilon_0 = 8.85\times10^{-12}$ F/m

Permeability constant: $\mu_0 = 4\pi\times10^{-7}$ H/m

Good Luck

جامعة بيرزيت

BIRZEIT UNIVERSITY

Physics Department
phys 132

First Hour Exam
Time: 75 minutes

2nd Summer term 2012
date: 21.07.2012

Student name: [redacted] **Student #:** [redacted]

Answer Sheet

Q. #	A	B	C	D	E
1				✓	
2		✓			
3				✓	
4				✓	
5					✓
6				✓	
7					✓
8		✓			
9			✓		
10			✓		
11					✓
12				✓	

Do NOT write below this line

For Instructor:

Part I	12 /12
Part II	9 /11
Total Grade	21 /23

Best of Luck 100%

$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N.m^2$ $\quad e = 1.6 \times 10^{-19}\ C$

Part I: Multiple-Choice Problems. 1 Point Each

1. A "free" electron and a "free" proton are placed in an identical electric field. Which of the following is the INCORRECT statement?
   - A) The magnitude of the electrostatic force acting on the proton is equal to that acting on the electron
   - B) The direction of the electrostatic force acting on the proton is opposite to that acting on the electron
   - C) The magnitude of the acceleration of the proton is less than that of the electron
   - [✓ D)] The magnitude of the acceleration of the proton is equal to that of the electron
   - E) The charge of the proton is equal to the charge of the electron but differs in sign

* 2. A negatively charged glass rod attracts an object suspended by a nonconducting thread. This means that:
   - A) The object is definitely negatively charged
   - B) The object is possibly positively charged
   - C) The object is possibly negatively charged
   - [✓ D)] The object is definitely positively charged

3. Two protons (p_1 and p_2) and an electron e lie on a straight line as shown. The directions of the electrostatic force from p_1 on p_2, the force from e on p_2 and the total force on p_2, respectively, are:

A) →, ←, 0 B) ←, →, ← C) ←, →, 0 [✓ D)] →, →, → E) ←, ←, →

* 4. Charge is distributed uniformly on the surface of a large flat plate. The electric field at 2 mm from the plate is 37 N/C. The electric field at 4 mm from the plate is:

A) 16.5 N/C B) 33 V/m C) 8.25 N/C [✓ D)] 37 V/m E) 35 V/m

$\frac{\sigma}{\varepsilon_0}$

N/C

V = U

$\frac{kg\ m^2}{s^2\ C} \cdot q$

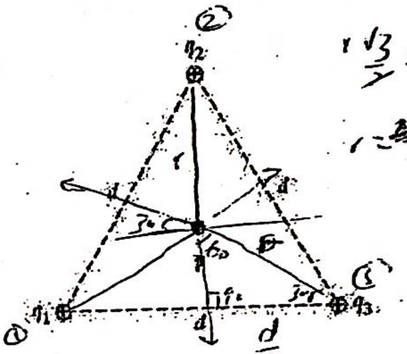
$\vec{\tau} = \vec{P} \times \vec{E}$ $P = 2\times10^{-9}$

5. An electric dipole has a dipole moment of 2×10^{-9} C.m in the negative x-direction. A torque of 3.5×10^{-7}.N.m in the negative z-direction is exerted on the dipole when it is in a uniform electric field. The magnitude and direction of the electric field is:

A) 5.7×10^{-3} N/C, positive y-axis
B) 175 N/C, negative x-axis
C) 175 N/C, negative z-axis
D) ~~175 N/C, negative y-axis~~
[✓ E) 175 N/C, positive y-axis]

$\frac{Kq}{\frac{d^2}{3}}$

Three equal positive charges of magnitude q each are placed on the corners of an equilateral triangle of sides d as shown in the figure. Answer the following three questions:



$r\frac{\sqrt3}{2} = \frac{d}{2}$

$r = \frac{2d}{\sqrt3}$

$\frac{d}{2r} = \frac{\sqrt3}{2}$

$\boxed{d = \sqrt3 r}$

$r = \frac{d}{\sqrt3}$

6. The magnitude of the electric field at the center (the point p) of the triangle is:
A) ~~3 $q/(4\pi\varepsilon_0 d^2)$~~
B) 3 $q^2/(4\pi\varepsilon_0 d)$
C) $3\sqrt3$ $q/(4\pi\varepsilon_0 d^2)$
[✓ D) 0]
E) $3\sqrt3$ $q/(4\pi\varepsilon_0 d)$

$2\frac{Kq}{\frac{d^2}{3}}\sin 30$

$\frac{3Kq}{d^2} = \frac{3q}{4\pi\varepsilon_0 d^2}$

7. The magnitude of the electric potential at the center (the point p) of the triangle is:
A) 3 $q/(4\pi\varepsilon_0 d^2)$
B) 0
C) $3\sqrt3$ $q/(4\pi\varepsilon_0 d^2)$
D) 3 $q^2/(4\pi\varepsilon_0 d)$
[✓ E) $3\sqrt3$ $q/(4\pi\varepsilon_0 d)$]

$3\frac{Kq}{r}$ $r = \frac{d}{\sqrt3}$

$\frac{3\sqrt3 q}{4\pi\varepsilon_0 d}$

8. The electric potential energy stored in the system of the three charges is:
A) 3 $q/(4\pi\varepsilon_0 d^2)$
[✓ B) 3 $q^2/(4\pi\varepsilon_0 d)$]
C) $3\sqrt3$ $q/(4\pi\varepsilon_0 d^2)$
D) 0
E) $3\sqrt3$ $q/(4\pi\varepsilon_0 d)$

$U_{12} + U_{13} + U_{23}$

$\frac{Kq^2}{d} + \frac{Kq^2}{d} + \frac{Kq^2}{d}$

$\frac{3q^2}{4\pi\varepsilon_0 d}$

9. Five positive charges are placed in a box. The first charge has a magnitude q. The second charge has a magnitude which is twice the first $\overset{2q}{\text{charge}}$. The third charge has a magnitude which is twice the second $\overset{4q}{\text{charge}}$. The fourth charge has a magnitude which is twice the third $\overset{8q}{\text{charge}}$. The fifth charge has a magnitude which is twice the fourth $\overset{16q}{\text{charge}}$. The net electric flux through the box is 5.8×10^7 N.m²/C. The magnitude of the charge q is:

A) 425 μC B) 1.6×10^{-19} C [✓ C) 16.6 μC] D) 47.2 μC. E) 19.4 μC

$$\int \vec{E} . d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$$

$$5.8 \times 10^7 = \frac{f}{\varepsilon_0}$$

10. The electric potential in a certain region is given by $V = 8x - 3x^2y + 2yz^2$. The electric field over this region is given by:

A) 0
B) $\mathbf{E} = -(6xy - 8)\mathbf{i} - (3x^2 - 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$
[✓ C) $\mathbf{E} = (6xy - 8)\mathbf{i} + (3x^2 - 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$]
D) $\mathbf{E} = -(6xy - 8)\mathbf{i} - (3x^2 + 2z^2)\mathbf{j} - 4yz\,\mathbf{k}$
E) $\mathbf{E} = (6xy - 8)\mathbf{i} - (3x^2 - 2z^2)\mathbf{j} + 4yz\,\mathbf{k}$

~~8 - 3x~~

$-(8 - 6xy + \cancel{2yz})$

$(6xy - 8)\,\hat{i}$ [illegible] $\hat{i}$

v_y [illegible] $(+3x^2\cancel{y} - 2z^2)\,\hat{j}$

$v_z =$ ~~8x~~ $(\cancel{\ } - 4yz)\,\hat{k}$

11. A parallel-plate capacitor having air between its plates is charged to 48.5 V. The capacitor is then isolated from the charging source and the space between the plates filled with Plexiglas (κ = 3.12). The new potential difference across the capacitor is:

A) 48.5 V B) 12.3 V C) 95 V D) 14.5 V [✓ E) 15.5 V]

$q = CV$

$C_1V_1 = C_2V_2$

$q = cv$

$\frac{\cancel{\varepsilon_0 A} V_1}{\cancel{d}} = k\frac{\cancel{\varepsilon_0 A}}{\cancel{d}} V_2 \cdot kV_2 = V_1$

12. The energy stored in a 12-μF capacitor is 150 μJ. The charge on the capacitor is:

A) 65 μC B) 56 μC C) 312 μC [✓ D) 60 μC] E) 47 μC

$150 \times 10^{-6} = \frac{1}{2} c v^2$

$V = 5 \quad q = cv$

Part II:

Essay Problem 1:

A nonconducting solid sphere of radius R. has a nonuniform volume charge density $\rho(r) = Ar^2 + B/r$ with the radial distance r is measured from the sphere's center and A and B are constants.

$\rho = C/m^3$

a) What are the SI units of the constant A? **(2 points)**

②

$A = \frac{C}{m^5}$

b) What are the SI units of the constant B? **(2 points)**

②

$B = \frac{C}{m^2}$

c) What is total charge on the sphere? **(3 points)**

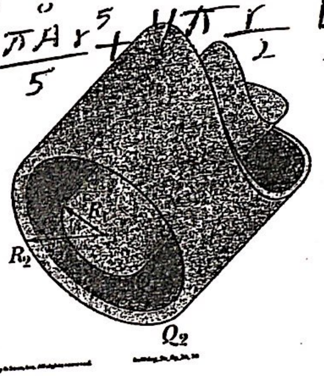
$q = \int \rho . dv = \int_0^R \left(Ar^2 + \frac{B}{r}\right) dr \rightarrow dv = 4\pi r^2 dr$

$= \int_0^R \left(Ar^2 + \frac{B}{r}\right)(4\pi r^2 dr) = A\int_0^{} 4\pi r^4 dr + \int 4\pi r B dr$

$q = \left(\frac{4\pi A r^5}{5} + 4\pi \frac{r^2}{2} B\right)\Big]_{r=0}^{r=R}$ *

Essay Problem 2:

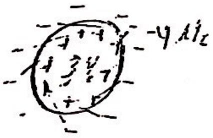
The figure shows a section of a conducting rod of radius R_1 and length L inside a thin coaxial conducting cylindrical shell with radius R_2 and length L. The net charge on the rod $Q_1 = +3\ \mu C$. The net charge on the shell $Q_2 = -4\ Q_1$.



a) What is the charge on the interior surface of the shell? **(2 points)**

~~q = 0 Coulomb~~ NO!

①



b) What is the charge on the exterior surface of the shell? **(2 points)**

~~q = -4 μC~~ NO!!

ok

③

②

$q = \left(\frac{4\pi A R^5}{5} + \frac{4\pi R^2 B}{2}\right)$ *

physics
132

Forget

جامعة بيرزيت
BIRZEIT UNIVERSITY
(Physics 132)
Coordinator: Tayseer AROURI

1st H. EXAM
TIME: 80 min

2nd. Sem. 2011
27/2/2011

Student Name: [redacted]

Student No.: [redacted]

ضع إشارة (X) في كل من المربع المقابل لمدرس شعبتك ودائرة على رقم الشعبة.

	المدرس	الشعبة		المدرس	الشعبة
☐	تيسير عاروري	1 , 6	☐	يعقوب عنيني	4, 10
☐	.غسان عباس	3	☐	رائد حسن	7 ,9
☒	وفاء خاطر	2, 8	☐	عدنان جوده	5

تعليمات:

(1) لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
(2) اكتب اسمك ورقمك في أعلى هذه الصفحة
(3) اختر الجواب الأكثر قربا للجواب الصحيح وانقله على هذه الصفحة، وذلك بوضع إشارة (X) في الخانة المناسبة.
(4) السؤال الذي له أكثر من إجابة يعطى علامة صفر.
(5) يجب إعادة أوراق الامتحان كاملة.
(6) عدد الأسئلة 17 سؤالا.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A								X	X								
B	X									X					X		
C		X		X		X	X						X	X			X
D			X		X						X	X					
E																X	

On the Way

2 11 13 15 16

1. The electric potential at points in an xyz space is given by : x y z
$V = 3x^2y - 3y^2z + 4xz^2$ V/m³ . The electric field at the point p(1,0,2) is

$E_x = 6xy + 4xz^2 = 16\hat{i}$ A

$E_y = 3x^2 + 6yz = 3\hat{j}$

$E_z = -3y^2 + 8xz = 16\hat{k}$

A) E = -16i + 12j + 3k N/C
[✓ B)] None of these
C) E = -12i - 3j + 12k N/C
D) E = 0
[✓ E)] E = -16i - 3j - 16k N/C

$V = \frac{Kq}{r}$

2. A 5-cm radius conducting sphere has a charge density of 6 x10⁻⁶ C/m² on its surface. Its electric potential at its surface, is:

$V = \frac{kq}{r}$ $V = \frac{6}{\varepsilon_0} = \frac{6 \times 10^{-6}}{9 \times 10^{-12}}$ $q = 6$

8.85×10^{-12}

A) 5.1 x10⁴ V
B) 2.3 x10⁴ V
[✓ C)] None of these
D) 3.4 x10⁴ V
E) 7.3 x10⁵ V

q_1 $V =$ $k =$ $m =$

3. A particle with a charge of 5x10⁻⁶ C and a mass of 40 g moves uniformly with a speed of 12 m/s in a circular orbit around a stationary particle with a charge of -48x10⁻⁶ C. The radius of the orbit is:

$\frac{1}{2}mv^2 = k\frac{qq}{r}$

$\frac{1}{2}mv^2 = k\frac{qq}{r}$

$r = \frac{2kqq}{mv^2}$

$$\frac{q_1 q_2}{4\pi\varepsilon_0 r^2} = \frac{mv^2}{r}$$

A) 0.25 m
B) 3.00 m
C) None of these
[✓ D)] 0.75 m
E) 0.38 m

q_2

4. An alpha particle has a mass of 6.64 x 10⁻²⁷ kg and a charge +2e is released from rest in a uniform electric field of magnitude 5.00x10⁴ N/C. The acceleration of the particle in m/s² is:

E

$qa = \frac{2q}{mE}$

$a = \frac{2E}{m}$ $a = \frac{2mE}{q} = \frac{2qm}{E}$ $a = \frac{2E}{qm}$

$qE = ma$

$a = \frac{2mE}{q}$ $\frac{2E}{mq}$

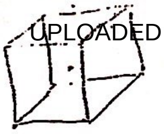
A) 1.45 x 10¹²
B) None of these
C) 0.48 x 10¹²
D) 3.86 x 10¹²
[✓ E)] 2.41 x 10¹²

$a = \frac{Eq}{m}$

$a = \frac{2mE}{q} = \frac{2q}{mE}$

$a = \frac{2E}{mq}$

2. $\Phi = E \cdot d$



5. An 15.0-μC point charge is placed at the center of a cube. The electric flux in N $\cdot$m^2/C through one side of the cube is:

$\Phi = \cancel{\frac{\Sigma E \cdot d}{q_0}} = \cancel{\frac{kq}{r}}$

- A) None of these
- B) 0
- C) 4.7 x10^5
- [✓ D) 2.8 x10^5]
- E) 1.5 x10^5

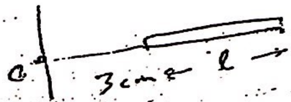
$\Phi = \frac{q}{6\varepsilon_0}$

6. A long straight wire has a linear charge density of 2.8x10^{-9} C/m. The electric field 3cm from the wire is:

$E = k\int \frac{dq}{r^2} = k \ldots = k\frac{q}{r^2}$

$= 10000$

- A) 2.52 x10^3 N/C
- B) 1.26 x10^3 N/C
- [✓ C) None of these]
- D) 1.68 x10^3 N/C
- E) 3.36 x10^{-8} N/C



$E = k\int \frac{dq}{r^2} = k\int \ldots$

$= \frac{2k(d+l-d)}{r^2}$

7. Two small charged objects repel each other with a force F when separated by a distance d. If the charge on each object is reduced to one-fifth of its original value and the distance between them is reduced to d/3, the force becomes:

$F_1 = k\frac{q_1 q_2}{d^2}$

$F_2 = k\frac{\frac{q_1 q_2}{25}}{\frac{d^2}{9}} = \frac{9}{25}$

- A) 9F/16
- B) None of these
- [✓ C) 9F/25]
- D) F/8
- E) 9F/4

8. A charged oil drop with a mass of 6.0x10^{-3} kg is held suspended by an downward electric field of 300 N/C. The charge on the drop is:

m=

↓E=

$F = mg$

$F = qE$

E=

- [✓ A) +2 x10^{-4} C]
- B) none of these
- C) +2.5 x10^{-4} C
- D) -2 x10^{-4} C
- E) +1.5 x10^{-4} C

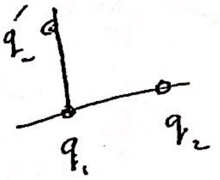
9. A 5 x10-8 C charge is fixed at the origin. A -8 x10-8 C charge is moved from x = 10 cm on the x axis to y = 20 cm on the y axis. The change in potential energy is:

$q_1 =$ $q_2 =$

$\Delta U = U_f - U_i$

$= k\frac{q_1 q_2}{r_1} - k\frac{q_1 q_2}{r_2}$

$= k(5\times10^{-8} \times -8\times10^{-8} - 5$



[✓ A) zero]
B) 9.0 x10-5 J
C) 1.8 x10-4 J
D) None of these
[✓ E) -1.8 x10-4 J]

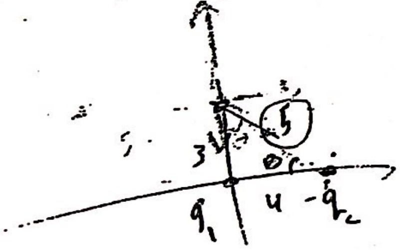
10. The flux of the electric field (4î + 5j + 6k) N/C through a 4.0 m² portion of the yz plane is:

$\vec{E}\cdot\vec{A}$

$(4\hat{i}+5\hat{j}+6\hat{k})\cdot 4\hat{i}$

A) 60 N·m²/C
[✓ B) 16 N·m²/C]
C) 24 N·m²/C
D) None of these
E) 20 N·m²/C

11. Two point charges q_1 = 27x10-9 C is located at (0,0) m, and q_2 = -250x10-9 C is located at (4,0) m. The electric field at point P(0,3)m is:

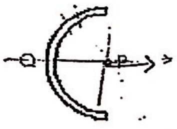


A) 27i N/C
B) 108i - 54j N/C
[✓ C) 72i - 27j N/C]
D) None of these
E) 36i N/C

$E_1 = k\frac{q_1}{9} = 27\hat{j}$

$E_2 = k\frac{q_2}{25} = -90 = 72$

12. Negative charge Q is uniformly distributed on a semicircular rod. What is the magnitude and direction of the electric field at point P, the center of the semicircle?



$$E = k \int_0^{90} \frac{dq}{r^2} \cos\theta \, d\theta$$

$$= \frac{kq}{r^2} \int_0^{90} \cos\theta \, d\theta$$

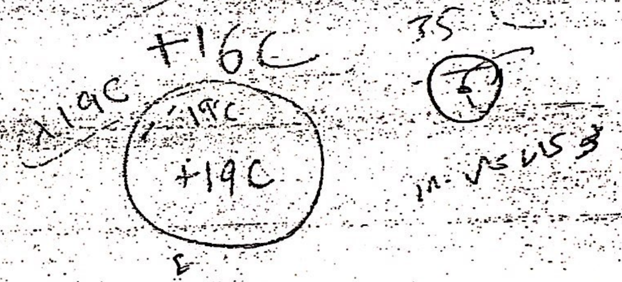
$$= \frac{kq}{r^2} \sin\theta \Big|_0^{90}$$

$$= \frac{kq}{r^2}(1-0)$$

A) $Q/8\pi^2\varepsilon_0R^2$ →
B) $Q/4\varepsilon_0R^2$ ↓
C) $Q/16\pi\varepsilon_0R^2$ ←
[✓ D) $Q/2\pi^2\varepsilon_0R^2$ →]
E) $Q/2\pi^2\varepsilon_0R^2$ ←

13. 16 C of charge are placed on a spherical conducting shell. A 19 C-point charge is placed at the center of the cavity (تجويف). The net charge in coulombs on the outer surface of the shell is:

A) +25 C
B) +7 C
[✓ C) +35 C]
D) +16 C
E) 0 C

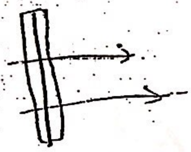


14. A 0.8-meter rope is parallel to a uniform 300 N/C electric field. The potential difference between its ends is:

A) 320 V
B) 160 V
[✓ C) 240 V]
D) 0
E) None of these

$\int \vec{E} \cdot d\vec{s}$ $\Delta V =$

$-300 \cdot 1.8$



15. The electric field in a certain region of space is given by:
$\mathbf{E} = 4\,x\,\mathbf{i} - 3\,y^2\,\mathbf{j}$ N/C , given that the potential at the origin (0,0) is zero, the potential in this region is given by V=

A) $-2x^2 + 2y^3$
[✓ B) $-2x^2 + y^3$]
C) $-2x^2 - 3y^3$
D) None of these
E) $2 + 12y$

$V = \int dE$ $\quad -2x^2 + y^3 + c$

$E_x = 4x$

$E_y = +6y\,\bar{j} = 4$

$y = \frac{4}{6}$

16. The work in joules required to carry a 9.0-C charge from a 15.0-V equipotential surface to a 6.0-V equipotential surface and then to a 20.0-V surface is:

A) 45 J
B) None of these
C) 27 J
D) zero
[✓ E) -45 J]

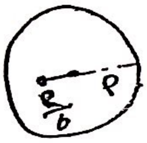
$W = qV$
$= 9\times 6 + 9\times 5$
$= (9\times 15 - 9\times 6) = 81$

$W = -\Delta V = -(9-15) = 6$
$= -(15-20) = 5$

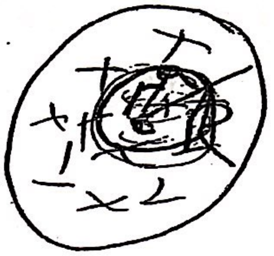
17. Charge Q is distributed uniformly throughout an insulating sphere of radius R. The magnitude of the electric field at a point R/6 from the center is:

A) $Q/32\pi\varepsilon_0 R^2$
B) none of these
C) $Q/4\pi\varepsilon_0 R^2$
[✓ D) $Q/24\pi\varepsilon_0 R^2$]
E) $Q/16\pi\varepsilon_0 R^2$

$E = \frac{kQ}{\frac{R^2}{36}}$



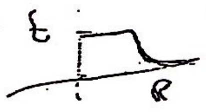
$\rho = \frac{Q}{\frac{4}{3}\pi R^3}$



$\oint \vec{E}\cdot d\vec{A} = \frac{q_{en}}{\epsilon_0}$

$E\,4\pi r^2 = \rho\,\frac{4}{3}\pi r^3$

$E_{inside} = \frac{\rho r}{3\epsilon_0} = \frac{\frac{Q}{4/3\pi R^3}\,r}{3\epsilon_0}$



$= \left(\frac{Q}{\frac{4}{3}\pi R^3}\right)\frac{r}{3\epsilon_0}$

$= \frac{Q}{4\pi\epsilon_0 R^3}\,r$