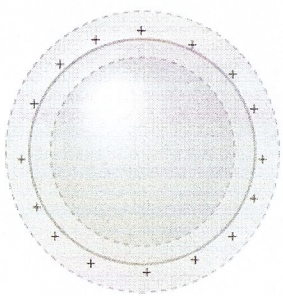
Student 8
Average 26.1 / 50
Best 46 / 50

12th Physics (2017 – 18)

(3rdQ, #2Mini Test)

Class	No.	Name Solutions



In calculation problems, describe equations clearly and systematically enough to show how to solve the problems. If not enough, you won't get any point.

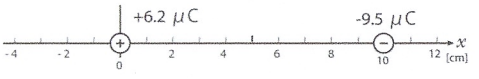
Gravitational acceleration rate	$g = 9.80\ m/s^2$
Universal Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Elementary Charge	$e = 1.60 \times 10^{-19}\ C$
Electron Mass	$m_e = 9.11 \times 10^{-31}\ kg$
Proton Mass	$m_p = 1.673 \times 10^{-27}\ kg$
Coulomb's Law Constant	$k = 8.99 \times 10^{9}\ N \cdot m^2/C^2$
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/(N \cdot m^2)$
Magnetic Permeability of Free Space	$\mu_0 = 4\pi \times 10^{-7}\ T \cdot m/A$
Avogadro's Number	$N_A = 6.022 \times 10^{23}\ mol^{-1}$
Inch	1 in = 25.4 mm

4 pt/question x 13 questions = 52 pt Max 50 pt

/[Total 50 pt]

12thPhysics(2017-18) 3rdQ Quiz-2 *

(1) Two point charges lie on the x axis. A charge of +6.2 μ C is at the origin, and a charge of – 9.5 μ C is at x = 10.0 cm. What is the net electric field at x = – 4.0 cm.



(Equations)

$$E_A = k\frac{|8_A|}{r_A^2} = k\frac{6.2\times10^{-6}}{(4.0\times10^{-2})^2}$$

$$E_B = k\frac{|8_B|}{r_B^2} = k\frac{9.5\times10^{-6}}{(14.0\times10^{-2})^2}$$

$$E_x = -E_A + E_B$$

$$= -k\frac{6.2\times10^{-6}}{16\times10^{-4}} + k\frac{9.5\times10^{-6}}{196\times10^{-4}}$$

$$= \frac{(-6.2\times196 + 9.5\times16)\times10^{-6}}{16\times196\times10^{-4}} \times 8.99\times10^{9}$$

$$= -0.3390\times10^{-2}\times8.99\times10^{9}$$

$$= -3.048\times10^{-3}$$

$$\rightarrow -3.0\times10^{-3}$$

(1) Answer

Direction To the negative x axis (48%)

Magnitude 3.0×10^{7} N/C

(2) Find the amount of positive electric charge in one mole of lithium atoms.

(Equations)

^{3}Li

$$Q = 3\times N_A\times e$$

$$= 3\times6.022\times10^{23}\times1.60\times10^{-19}$$

$$= 28.91\times10^{4}$$

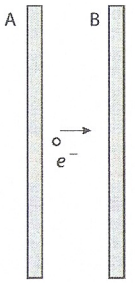
$$= 2.891\times10^{5} \rightarrow 2.89\times10^{5}$$

(2) Answer

2.89×10^{5} C (31%)

12thPhysics(2017-18) 3rdQ Quiz-2 *

(3) An electron starts from one plate A of a charged closely spaced parallel plate arrangement with an initial velocity of 1.63 x 104 m/s to the right. Its speed on reaching the other plate B B, 2.10 cm away is 4.15 x104 m/s.
(3-a) What type of charge is on each plate?
(3-b) What is the direction of the electric field between the plates?
(3-c) If the plates are square with an edge length of 25.4 cm, determine the charge on each.
(Equations)



$Q = \sigma A$ — ①

Gauss' Law $E = \frac{\sigma}{\varepsilon_0}$ — ②

$\Delta V = E/d$ — ③

$e\Delta V = \Delta K = \frac{me}{2}(v_B^2 - v_A^2)$ — ④

$Q = \sigma A$

$= A\varepsilon_0 E$

$= A\varepsilon_0 d\Delta V$

$= \frac{A\varepsilon_0 d\, me}{2e}(v_B^2 - v_A^2)$

$= \frac{(25.4\times10^{-2})^2 \times 8.85\times10^{-12} \times 2.10\times10^{-2} \times 9.11\times10^{-31}}{2\times 1.60\times 10^{-19}} (4.15^2 - 1.63^2)\times10^8$

$= 4.972\times10^{5} \times 10^{-4-12-2-31+8+19}$

$= 4.972\times10^{-17} \rightarrow 4.97\times10^{-17}$ (C)

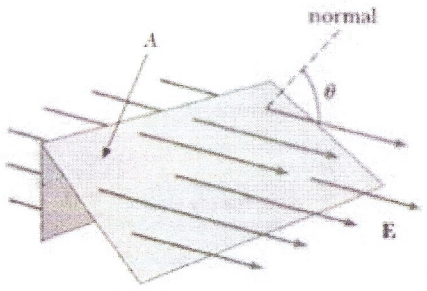
(3-a) Answer
A: negative
B: positive

(3-b) Answer
From B to A

(3-c) Answer
4.97×10^{-17} C

(48%)

(4) A flat sheet of paper of area 0.250 m2 is oriented so that the normal to the sheet at an angle of 60.0° to a uniform electric field of magnitude of 14.0 N/C. Find the magnitude of the electric flux through the sheet. (Equations)



$\Phi = EA\cos\theta$

$= 14.0 \times 0.250 \times \cos 60.0^\circ$

$= 1.750 \rightarrow 1.75$

(4) Answer

1.75 N·m²/C (59%)

(5) Rank the Gaussian surfaces shown in the figure in order of increasing electric flux, using the signs, <, = and >.

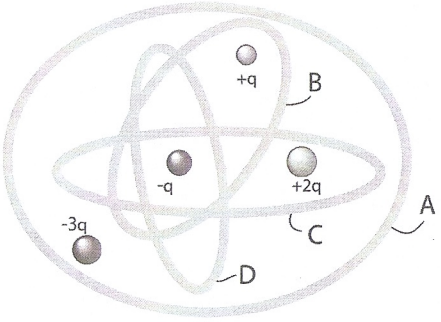
A : $-3 + 2 + 1 - 1 = -1$

B : $1 - 1 = 0$

C : $+2 - 1 = 1$

D : -1

$\Phi = \frac{\text{enclosed charge}}{\varepsilon_0}$

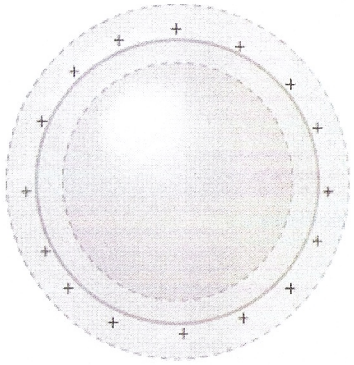


(5) Answer

A = D < B < C (81%)

12thPhysics(2017-18) 3rdQ Quiz-2 *

(6,7) A solid metal sphere of radius 0.450m carries a net charge of 0.250nC.
(6) Find the magnitude of the electric field at a point 0.100 m outside the surface of the sphere.
(7) Find the magnitude of the electric field at a point inside the sphere, 0.100m below the surface.
(Equations)



(6) $\Phi = EA$

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

$\therefore E = \frac{q}{A\varepsilon_0} = \frac{q}{4\pi r^2 \cdot \varepsilon_0}$

$= \frac{0.250 \times 10^{-9}}{8.85 \times 10^{-12} \times 4\pi \times (0.450 + 0.100)^2}$

$= 7.430 \times 10^{-3} \times 10^{-9+12}$

$= 7.430 \times 10^{-3+3} \longrightarrow 7.43$

7.43

(7) $\Phi = EA = \frac{q}{\varepsilon_0}$, $q = 0$

$\therefore E = 0$

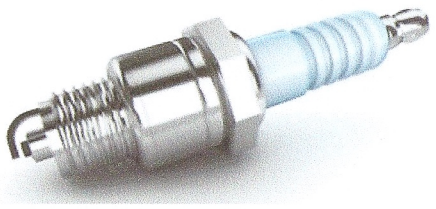
(6) Answer

7.43 N/C (58%)

(7) Answer

0 (38%)

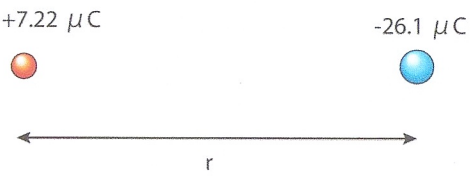
(8) A spark plug in a car has electrodes separated by a gap of 0.025 in. To create a spark and ignite the air-fuel mixture in the engine, an electric field of 3.0×10^6 N/C is required in the gap. What potential difference must be applied to the spark plug to initiate a spark?
(Equations)



$$\Delta V = Ed$$
$$= 3.0 \times 10^6 \times 0.025 \times 25.4 \times 10^{-3}$$
$$= 1.905 \times 10^3 \ (V)$$
$$= 1.905 \ kV$$
$$\longrightarrow 1.9 \ kV$$

(8) Answer: 1.9 kV (66%)

(9) How far must the point charges $q_1 = +7.22 \ \mu C$ and $q_2 = -26.1 \ \mu C$ be separated for the electric potential energy of the system to be -126 J?
(Equations)



$$U = q_0 V = k \frac{q \, q_0}{r}$$
$$\rightarrow r = \frac{k \, q \, q_0}{U}$$
$$= \frac{8.99 \times 10^9 \times 7.22 \times 10^{-6} \times (-26.1) \times 10^{-6}}{-126}$$
$$= 13.45 \times 10^{-3}$$
$$= 1.345 \times 10^{-2} \ (m)$$
$$= 1.345 \ (cm)$$
$$\rightarrow 1.34 \ cm$$

(9) Answer: 1.34 cm (44%)

12thPhysics(2017-18) 3rdQ Quiz-2 *

(10) Consider a region in space where a uniform electric field E = 6500 N/C points in the negative x direction.
(10-a) What is the orientation of the equipotential surface?
(10-b) If you move in the positive x direction, does the electric potential increase or decrease?
(10-c) What is the distance between the + 14-V and the + 16-V equipotentials?
(Equations)

$E = 6500\ N/C = 6500\ V/m$

$$\frac{6500\ V}{1\ m} = \frac{(16-14)\ V}{x}$$

$$x = \frac{2}{6500}\ (m)$$

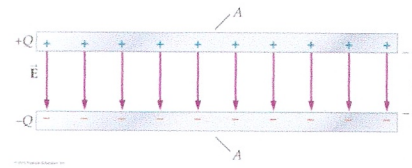
$$= 0.308\ (mm)$$

$$\longrightarrow 0.31\ mm$$

(10-a) Answer Perpendicular to the x axis
(10-b) Answer Increase
(10-c) Answer 0.31 mm

(53%)

(11~13)A parallel-plate capacitor is constructed with plates of area 0.0590 m^2 and separation 0.550 mm.



(11) Find the magnitude of the charge on each plate of this capacitor when the potential difference between the plates is 32.8 V.

(12) What is the magnitude of the electric field between the plates of the capacitor?

(13) Next, the space between the plates is filled with a dielectric with relative permittivity ε_r (= κ). When the capacitor is connected to a 32.8 V battery, each of the plates has a charge of magnitude 2.11 x 10^{-7} C. What is the value of the ε_r?

(Equations)

(11) $E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$, $E = \frac{V}{d}$

$\therefore Q = \frac{V}{d} \cdot \frac{\varepsilon_0 A}{1}$

$= \frac{32.8 \times 8.85 \times 10^{-12} \times 0.0590}{0.550 \times 10^{-3}}$

$= 31.14 \times 10^{-12+3} = 31.14 \times 10^{-9} = 3.114 \times 10^{-8} \rightarrow 3.11 \times 10^{-8}$

(12) $E = \frac{V}{d} = \frac{32.8}{0.550 \times 10^{-3}} = 59.64 \times 10^{3}$ (N/e) $= 5.963 \times 10^{4}$

$\rightarrow 5.96 \times 10^{4}$

(13)

$C' = \varepsilon_r C$

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

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

$\therefore \varepsilon_r = \frac{C'}{C} = \frac{\frac{Q'}{V}}{\varepsilon_0 \frac{A}{d}} = \frac{Q' d}{\varepsilon_0 A V}$

$= \frac{2.11 \times 10^{-7} \times 0.550 \times 10^{-3}}{8.85 \times 10^{-12} \times 0.0590 \times 32.8}$

$= 0.06778 \times 10^{-10+12} = 6.778$

$\rightarrow 6.78$

(11) Answer: 3.11×10^{-8} C (50%)

(12) Answer: 5.96×10^{4} V/m (48%)

(13) Answer: 6.78 (36%)