Prachand NEET 2025

Physics

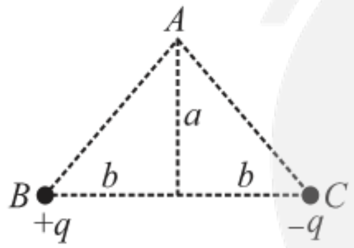
Electrostatic Potential and Capacitance

DPP 01

Q1 What is the electric potential at a distance of 9 cm from 3 nC?

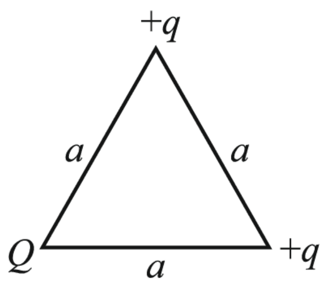
(A) 300 V
(B) 270 V
(C) 30 V
(D) 3 V

Q2 As shown in the figure, charges $+q$ and $-q$ are placed at the vertices B and C of an isosceles triangle. The potential at the vertex A is;



(A) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{2q}{\sqrt{a^2+b^2}}$
(B) Zero
(C) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{\sqrt{a^2+b^2}}$
(D) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{(-q)}{\sqrt{a^2+b^2}}$

Q3 Three charges are placed at the vertices of an equilateral triangle as shown in figure. For what value of Q the electrostatic potential energy of the system is zero?

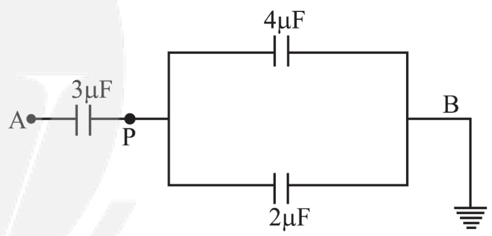


(A) $-q$
(B) $\frac{q}{2}$
(C) $-2q$
(D) $\frac{-q}{2}$

Q4 Four point charges $-Q$, $-q$, $2q$ and $2Q$ are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is

(A) $Q=-q$
(B) $Q=-\frac{1}{q}$
(C) $Q=q$
(D) $Q=\frac{1}{q}$

Q5 In the figure a potential of $+1200\ \mathrm{V}$ is given to point A and point B is earthed, what is the potential at the point P?



(A) $100\ \mathrm{V}$
(B) $200\ \mathrm{V}$
(C) $400\ \mathrm{V}$
(D) $600\ \mathrm{V}$

Q6 If 50 joule of work must be done to move an electric charge of $2\ \mathrm{C}$ from a point, where potential is -10 volt to another point, where potential is V volt, the value of V is

(A) 5
(B) -15
(C) $+15$
(D) $+10$

Q7 Potential energy of two equal negative point charges each of 2 μC held 1 m apart in air is;

(A) 2 J
(B) 2 eV
(C) 4 J
(D) 0.036 J

Q8 A charge q is placed at the centre of a cube of side length a. What is the electric potential at any corner of the square?

(A) kq/a

(B) $2\mathrm{kq}/\sqrt{3}a$

(C) kq/a^2

(D) $\sqrt{2\mathrm{kq}/a^2}$

Q9 Two identical capacitors are first connected in series and then in parallel. The ratio of equivalent capacitance is;

(A) 1:1 (B) 1:2

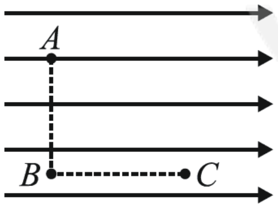
(C) 1:3 (D) 1:4

Q10 An electric dipole of dipole moment p is aligned parallel to a uniform electric field E. The energy required to rotate the dipole by 90° is

(A) pE^2 (B) p^2E

(C) pE (D) Infinity

Q11 Figure shows three points A, B and C in a region of uniform electric field $\vec{E}$. The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good ? (Where V_A, V_B and V_C represents the electric potential at points A, B and C respectively)



(A) $V_A = V_B = V_C$

(B) $V_A = V_B > V_C$

(C) $V_A = V_B < V_C$

(D) $V_A > V_B = V_C$

Q12 A capacitor having capacity of $1\mu F$ is charged to 100V. Calculate the energy stored in the capacitor.

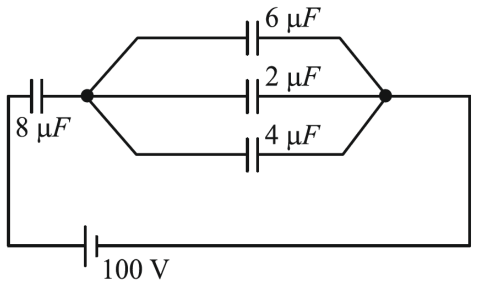
(A) $0.05\ J$

(B) $5\ \mu J$

(C) $10\ J$

(D) $5 \times 10^{-3}\ J$

Q13 Find the charge stored on $8\mu F$ capacitor in the given circuit.



(A) $480\ \mu\mathrm{C}$

(B) $200\ \mu\mathrm{C}$

(C) $400\ \mu C$

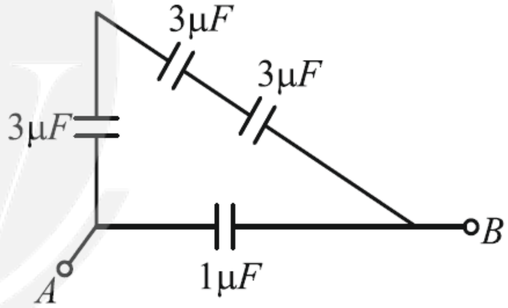
(D) $1200\ \mu C$

Q14 Angle between equipotential surface and lines of force is;

(A) zero (B) 180°

(C) 90° (D) 45°

Q15 In given figure, the equivalent capacitance between point A and B is;



(A) $1\ \mu F$ (B) $2\ \mu F$

(C) $3\ \mu F$ (D) $4\ \mu F$

Q16 Two charged spheres of radii $10\ \mathrm{cm}$ and $15\ \mathrm{cm}$ are connected by a thin wire. No current will flow, if they have;

(A) the same charge on each

(B) the same potential

(C) the same energy

(D) the same field on their surfaces

Q17 A short electric dipole has a dipole moment of 16 × 10^{-9} C-m. The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making an angle of 60° with the dipole axis is;

$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \mathrm{N\,m^2/C^2}\right)$

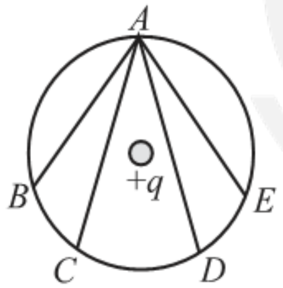
(A) 200 V (B) 400 V

(C) zero (D) 50 V

Q18 Twenty seven drops of same size are charged at $100 \mathrm{~V}$ each and they combined to form a bigger drop. Find the potential of the bigger drop.
(A) $200 \mathrm{~V}$
(B) $300 \mathrm{~V}$
(C) $600 \mathrm{~V}$
(D) $900 \mathrm{~V}$

Q19 A hollow metallic sphere of radius $10 \mathrm{~cm}$ is charged such that potential of its surface is $80 \mathrm{~V}$. The potential at the centre of the sphere would be
(A) $80 \mathrm{~V}$
(B) $800 \mathrm{~V}$
(C) Zero
(D) $8 \mathrm{~V}$

Q20 In the electric field of a point charge *q*, a certain charge is carried from point *A* to *B*, *C*, *D* and *E*. Then the work done by electric force is;



(A) least along the path *AB*
(B) least along the path *AD*
(C) zero along all the paths *AB*, *AC*, *AD* and *AE*
(D) least along *AE*

Q21 If electric field at any point is non-zero then potential at that point
(A) is always non-zero
(B) is always zero
(C) may be zero or non-zero
(D) infinite

Q22 **Assertion (A):** The potential due to a dipole depends only on *r* which is the distance of the point from the centre of the dipole.
Reason (R): At distances much larger than the size of the dipole, the electric potential of a dipole is then given by $V=\frac{1}{4 \pi \varepsilon_0} \frac{\vec{p} \cdot \hat{r}}{r^2}$
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).
(C) Assertion (A) is true and Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is true.

Q23 There is an air filled 1 pF parallel plate capacitor. When the plate separation is doubled and the space is filled with wax, the capacitance increases to 2 pF. The dielectric constant of wax is
(A) 2 (B) 4
(C) 6 (D) 8

Q24 The electric potential V at a point $P(x, y, z)$ in space is given by $V=4 x^2$ volt. Electric field at a point $(1 \mathrm{~m}, 0,2 \mathrm{~m})$ in V / m is
(A) 8 along -ve x-axis
(B) 8 along +ve x-axis
(C) 16 along -ve x-axis
(D) 16 along +ve x-axis

Q25 A capacitor of $30 \mu \mathrm{F}$ charged to $100 \mathrm{~V}$ is connected in parallel to capacitor of $20 \mu \mathrm{F}$ charged to 50 volt. The common potential is
(A) $75 \mathrm{~V}$
(B) $50 \mathrm{~V}$
(C) $150 \mathrm{~V}$
(D) $80 \mathrm{~V}$

Q26 In a certain region of space with volume 0.2 m^3, the electric potential is found to be 5 *V* throughout. The magnitude of electric field in this region is;
(A) 0.5 N/C (B) 1 N/C
(C) 5 N/C (D) zero

Q27 An isolated sphere has a capacitance of 50 *pF*. What would be the radius of the sphere?
(A) 90 m (B) 45 cm
(C) 11.50 cm (D) 5.75 cm

Q28 A parallel plate capacitor is charged and then isolated. What is the effect of increasing the plate separation on charge, potential, capacitance respectively?

(A) Remains constant, decreases, decreases
(B) Increases, decreases, decreases
(C) Remains constant, decreases, increases
(D) Remains constant, increases, decreases

Q29 Five identical capacitors connected in series have an equivalent capacitance of 4 μF. Now, all of them are connected in parallel across a 400 V source.

Considering the scenario mentioned, match quantities in List I with the correct magnitudes in List II.

List I		**List II**	
(a)	Capacitance of each capacitor (in μF)	(i)	400
(b)	Equivalent capacitance when they are connected in parallel (in μF)	(ii)	8
(c)	Potential across each capacitor when connected in parallel (in V)	(iii)	20
(d)	Total energy stored when the capacitors are connected in parallel(in J)	(iv)	100

Choose the correct answer from the options given below

(A) (a) - (iii), (b) - (ii), (c) - (iii), (d) - (iv)
(B) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
(C) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)
(D) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Q30 **Assertion :** Two adjacent conductors of unequal dimensions, carrying the same positive charge have a potential difference between them.

Reason : The potential of a conductor depends upon the charge given to it.

(A) Both assertion and reason are true and the reason is the correct explanation of the assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of the assertion
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false.

Answer Key

Q1	(A)
Q2	(B)
Q3	(D)
Q4	(A)
Q5	(C)
Q6	(C)
Q7	(D)
Q8	(B)
Q9	(D)
Q10	(C)
Q11	(B)
Q12	(D)
Q13	(A)
Q14	(C)
Q15	(B)
Q16	(B)
Q17	(A)
Q18	(D)
Q19	(A)
Q20	(C)
Q21	(C)
Q22	(D)
Q23	(B)
Q24	(A)
Q25	(D)
Q26	(D)
Q27	(B)
Q28	(D)
Q29	(B)
Q30	(B)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

(A)

$V=\frac{Kq}{r}=\frac{9\times10^{9}\times3\times10^{-9}}{9\times10^{-2}}$

$V=300\ V$

Video Solution:

Q2 Text Solution:

(B)

Potential at A = Potential due to $(+\mathrm{q})$ charge + Potential due to $(-q)$ charge

$$=\frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{\sqrt{a^2+b^2}}+\frac{1}{4\pi\varepsilon_0}\frac{(-q)}{\sqrt{a^2+b^2}}=0$$

Video Solution:

Q3 Text Solution:

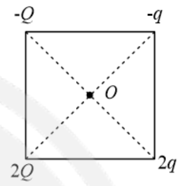
(D)

$$U=k\frac{qQ}{a}+k\frac{Qq}{a}+k\frac{q^2}{a}=0$$
$$2qQ=-q^2$$
$$2Q=-q$$
$$Q=\frac{-q}{2}$$

Video Solution:

Q4 Text Solution:

(A)



Let the side length of square be "a" then potential at centre O is;

$$V=\frac{K(-Q)}{\left(\frac{a}{\sqrt{2}}\right)}+\frac{k(-q)}{\frac{a}{\sqrt{2}}}+\frac{k(2q)}{\frac{a}{\sqrt{2}}}+\frac{k(2Q)}{\frac{a}{\sqrt{2}}}=0$$

$\Rightarrow -Q-q+2q+2Q=0$

$\Rightarrow Q+q=0$

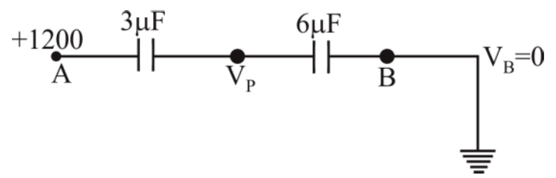
$\Rightarrow Q=-q$

Video Solution:

Q5 Text Solution:

(C)

Given circuit can be reduced as follows



In series combination charge on each capacitor remain same.

So using $\mathrm{Q}=\mathrm{CV}$

$$\Rightarrow \quad C_1V_1 = C_2V_2 \Rightarrow 3\,(1200 - V_p) = 6\,(V_p - V_B)$$
$$\Rightarrow \quad 1200 - V_p = 2V_p \quad (\because V_B = 0)$$
$$\Rightarrow \quad 3V_p = 1200 \Rightarrow V_p = 400 \text{ volt}$$

Video Solution:

Q6 Text Solution:

(C)

$$W = q\Delta V = q(V_2 - V_1)$$
$$50 = 2(V - (-10))$$
$$V = 15$$

Video Solution:

Q7 Text Solution:

(D)

$$U = k\frac{q_1q_2}{r} = 9 \times 10^9 \times \frac{(-2\times10^{-6})^2}{1}$$
$$\Rightarrow U = 36 \times 10^{-3} = 0.036\ J$$

Video Solution:

Q8 Text Solution:

(B)

Distance of corner from centre is $\frac{\sqrt{3}a}{2}$

$$V = \frac{kq}{\frac{\sqrt{3}a}{2}} = \frac{2kq}{\sqrt{3}a}$$

Video Solution:

Q9 Text Solution:

(D)

As, the capacitors are identical,

$\therefore C_1 = C_2 = C$

$$C_S = \frac{C_1C_2}{C_1 + C_2} = \frac{C \cdot C}{2C} = \frac{C}{2}$$
$$C_P = C + C = 2C$$
$$\therefore \frac{C_S}{C_P} = \frac{1}{4}$$

Video Solution:

Q10 Text Solution:

(C)

$$U = -pE\,(\cos\theta_2 - \cos\theta_1)$$
$$= -pE\,(\cos 90^\circ - \cos 0^\circ)$$
$$U = pE$$

Video Solution:

Q11 Text Solution:

(B)

Potential decreases in the direction of electric field. So $V_B > V_C$

Point A and B will have same potential.

So,

$$V_A = V_B > V_C$$

Video Solution:

Q12 Text Solution:

(D)

$U = \frac{1}{2}CV^2 = \frac{1}{2} \times 1 \times 10^{-6} \times (100)^2$

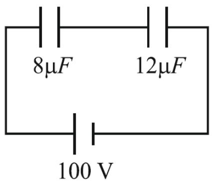
$\Rightarrow U = \frac{10^{-2}}{2} = 5 \times 10^{-3} J$

Video Solution:

Q13 Text Solution:

(A)

The equivalent circuit is



Charge on $8\mu F, q = C_{eq}V$

$$C_{eq} = \frac{C_1C_2}{C_1 + C_2} = \frac{8 \times 12}{8 + 12} = 4.8\ \mu\text{C}$$

Charge $= 4.8 \times 100 = 480\ \mu\text{C}$

Video Solution:

Q14 Text Solution:

(C)

Lines of force is perpendicular to the equipotential surface. Hence angle = 90°

Video Solution:

Q15 Text Solution:

(B)

Three $3\mu\text{F}$ capacitors are connected in series and their equivalent combination is in parallel to $1\mu\text{F}$ capacitor

So equivalent capacitance of capacitors connected in series :

$\frac{1}{C'} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3} = 1$

$\Rightarrow C' = 1\ \mu F$

Now this is in parallel with $1\ \mu F$ So,

$C_{\text{net}} = 1 + 1 = 2\ \mu\text{F}$

Video Solution:

Q16 Text Solution:

(B)

We know charge flows from higher potential to lower potential. If both are at the same potential, then no charge will flow and no current flows.

Video Solution:

Q17 Text Solution:

(A)

Potential due to dipole, $V = \frac{\vec{p} \cdot \vec{r}}{4\pi\varepsilon_0 r^3} = \frac{kp\ \cos\theta}{r^2}$

or $V = \frac{(9\times10^{9})(16\times10^{-9})\times\cos 60^{\circ}}{(0.6)^{2}} = 200 \text{ V}$

Video Solution:

Q18 Text Solution:

(D)

Electric potential due to a charged sphere is given by $V = \frac{kQ}{R}$

$k = 9 \times 10^{9} \text{ N} - \text{m}^2/\text{C}^2$

Q : charge on sphere

R : Radius of sphere

Let charge and radius of smaller drop is q and r respectively.

For smaller drop, $V = \frac{kq}{r} = 100 \text{ V}$

Let R be radius of bigger drop,

As volume remains the same

$$\left(\frac{4}{3}\pi r^{3}\right) \times 27 = \frac{4}{3}\pi R^{3}$$
$$\Rightarrow R = 3r$$

Now, using charge conservation,

$$\Rightarrow \quad Q = 27q$$
$$V_{\text{big drop}} = \frac{kQ}{R} = \frac{k(27q)}{3r} = 9\left(\frac{kq}{r}\right)$$
$$= 9 \times 100 = 900 \text{ V}$$

Video Solution:

Q19 Text Solution:

(A)

Potential at the surface and inside the conducting sphere is same.

So $V_s = 80 \text{ V} = V_c$

Video Solution:

Q20 Text Solution:

(C)

ABCDE is an equipotential surface and on equipotential surface no work is done in shifting a charge from one place to another as potential is same at every point.

$W_{AB} = q'(V_B - V_A) = 0 \quad [V_B = V_A]$

Similarly, $W_{AC} = W_{AD} = W_{AE} = 0$

Video Solution:

Q21 Text Solution:

(C)

$E = -\frac{dV}{dr}$

If electric field at any point is non-zero then potential at that point may be zero or non-zero.

Video Solution:

Q22 Text Solution:

(D)

The electric potential of a dipole at any point which is at a distance r from the dipole is given by

$V = \frac{1}{4\pi\varepsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}$

The potential due to a dipole depends on dipole moment p and *r* and also on the angle between dipole moment and position vector.
Assertion (A) is false and Reason (R) is true.

Video Solution:

Q23 Text Solution:

(B)

Capacitance of parallel plate capacitor with air as medium,

$C_a = \frac{\varepsilon_0 A}{d} \quad \ldots\ldots\ldots (1)$

When the space is filled with wax of dielectric constant K and distance between the plates is doubled then,

Capacitance of parallel plate capacitor with wax,

$C_W = \frac{K\varepsilon_0 A}{2d} \quad \ldots\ldots\ldots (2)$

(1) ÷ (2)

$\frac{C_a}{C_W} = \frac{2}{K}$

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

$\therefore K = 4$

Video Solution:

Q24 Text Solution:

(A)

$$E = -\frac{dV}{dr}$$
$$\because \quad V = 4x^2$$
$$E = -\frac{d}{dx}4x^2$$
$$E = -8x$$

At point $(1\ \mathrm{m}, 0, 2\ \mathrm{m})$

$$\vec{E} = -8 \times 1\hat{i}$$
$$\vec{E} = -8\hat{i}\ \mathrm{V/m}$$

Video Solution:

Q25 Text Solution:

(D)

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$
$$= \frac{30 \times 100 + 20 \times 50}{50}$$
$$= 80\ \mathrm{V}$$

Video Solution:

Q26 Text Solution:

(D)

Electric field in a region, $E = -\frac{dV}{dr}$

But here electric potential is constant. Therefore electric field will be zero.

Video Solution:

Q27 Text Solution:

(B)

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r}$$
$$C = \frac{Q}{V} = \frac{Q}{\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}}$$
$$C = 4\pi\varepsilon_0 r$$
$$r = \frac{C}{4\pi\varepsilon_0}$$
$$r = 9 \times 10^9 \times 50 \times 10^{-12}$$
$$= 450 \times 10^{-3} \text{ m}$$
$$r = 0.450 \text{ m}$$
$$r = 45 \text{ cm}$$

Video Solution:

Q28 **Text Solution:**

(D)

After charging, the capacitor is isolated, so the charge(Q) remains **constant**.

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

Capacitance **decreases** with increase in distance between the plates(d).

Now, $V = \frac{Q}{C}$

Potential **increases** with decrease in capacitance (C).

Video Solution:

Q29 **Text Solution:**

(B)

(a)

Let the capacitance of each capacitor be C

Given that when capacitors are connected in series, they have an equivalent capacitance of $4\ \mu F$

$$\frac{1}{C_S} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C} + \frac{1}{C} + \frac{1}{C} = \frac{5}{C}$$
$$\Rightarrow C = 5 \times C_S = 5 \times 4 = 20\ \mu F$$

(b)

Equivalent capacitance when they are connected in parallel

$$C_P = C + C + C + C + C = 5C$$
$$C_P = 5 \times 20 = 100\ \mu F$$

(c)

Potential across each capacitor when they are connected in parallel

$$V = 400\ V$$

(d)

Total energy stored when the capacitors are connected in parallel

$$U = \frac{1}{2} C_P V^2 = \frac{1}{2} \times 100 \times 10^{-6} \times (400)^2$$
$$\Rightarrow U = 8\ J$$

Video Solution:

Q30 **Text Solution:**

(B)

Let us cosider two spherical conductors of radius r_1 and r_2

Potential due to conductor having charge q and radius r is given by

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

$$V_1 = \frac{kq}{r_1} \neq V_2 = \frac{kq}{r_2}$$

So, they will have potential difference between them.

Yes, the potential of a conductor depends upon the charge given to it, so reason is true.

Both assertion and reason are true but reason is not the correct explanation of the assertion

Video Solution: