

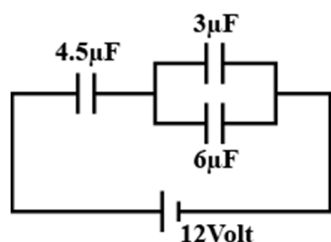


Max Marks: 60

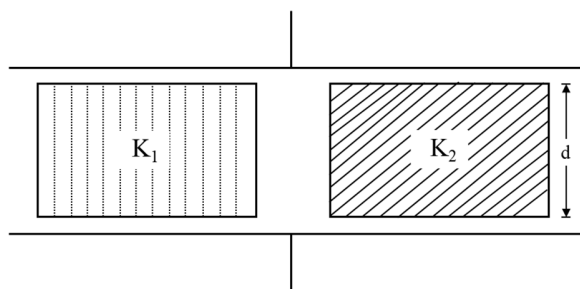
Date: 06.08.2022

ARJUNA BATCH
PHYSICS : DCT
Topic: Capacitor

1. In the circuit shown in the figure, the potential difference across the $4.5 \mu\text{F}$ capacitor is



- (a) $8/3$ volt (b) 4 volt (c) 6 volt (d) 8 volt
2. Two dielectrics of dielectric constants K_1 and K_2 are filled in the gap of parallel plate capacitor as shown in figure. The capacitor has plate each of area A and separation d . The capacitance of the capacitor is



- (a) $\frac{\epsilon_0 A (K_1 + K_2)}{2d}$ (b) $\frac{\epsilon_0 A}{2d} \left(\frac{K_1 + K_2}{K_1 K_2} \right)$ (c) $\frac{\epsilon_0 A}{d} \left(\frac{K_1 K_2}{K_1 + K_2} \right)$ (d) $\frac{2\epsilon_0 A}{d} \left(\frac{K_1 K_2}{K_1 + K_2} \right)$

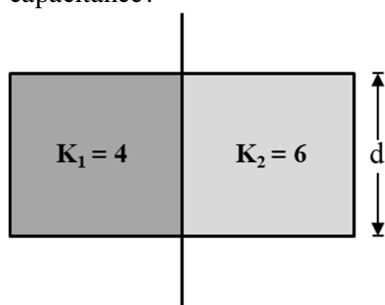
Space for Rough Work



3. Across each of two capacitors of capacitance $1\ \mu\text{F}$ and $4\ \mu\text{F}$, a potential difference of $10\ \text{V}$ is applied. Then positive plate of one is connected to the negative plate of the other, and negative plate of one is connected to the positive plate of the other. After contact,

- (a) charge of each is zero (b) charge on each is same but non-zero
(c) charge on each is different but non-zero (d) none of these

4. A capacitor of capacitance $1\ \mu\text{F}$ is filled with two dielectrics of dielectric constant 4 and 6. What is the new capacitance?

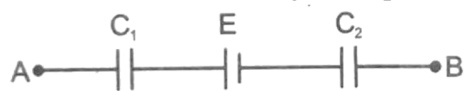


- (a) $10\ \mu\text{F}$ (b) $5\ \mu\text{F}$ (c) $4\ \mu\text{F}$ (d) $7\ \mu\text{F}$

5. A capacitor is charged by connecting a battery across its plates. It stores energy u . now the battery disconnected and another identical capacitor is connected across it, then the energy stored by both capacitors of the system will be

- (a) u (b) $\frac{u}{2}$ (c) $2u$ (d) $\frac{3}{2}u$

6. For section AB of a circuit shown in figure, $C_1 = 1\ \mu\text{F}$, $C_2 = 2\ \mu\text{F}$, $E = 10\ \text{V}$, and the potential difference $V_A - V_B = -10\ \text{V}$. Charge on capacitor C_1 is

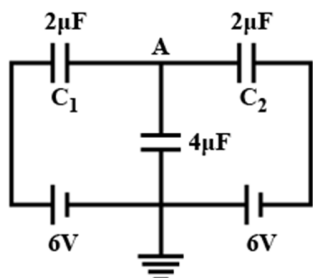


- (a) $0\ \mu\text{C}$ (b) $20/3\ \mu\text{C}$ (c) $-40/3\ \mu\text{C}$ (d) None of these

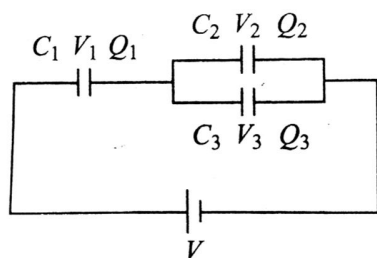
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7. Three capacitors are connected as shown in figure. Then, the charge on capacitor C_1 is



- (a) $6 \mu\text{C}$ (b) $12 \mu\text{C}$ (c) $18 \mu\text{C}$ (d) $24 \mu\text{C}$
8. In figure, three capacitors C_1 , C_2 and C_3 are joined to a battery. With symbols having their usual meaning, the correct conditions will be

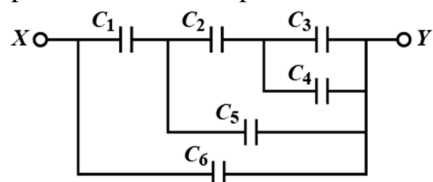


- (a) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V_3 + V$ (b) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2 + V_3$
 (c) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$ (d) $Q_2 = Q_3$ and $V_2 = V_3$
9. Two identical parallel plate capacitors are connected in series and then joined in series with a battery of 100 V. A slab of dielectric constant $K = 3$ is inserted between the plates of the first capacitor. Then, the potential difference across the capacitors will be, respectively.
- (a) 25 V, 75 V (b) 75 V, 25 V (c) 20 V, 80 V (d) 50 V, 50 V

Space for Rough Work

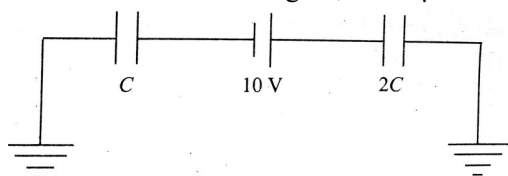


10. In the given network of capacitors as shown in figure, given that $C_1 = C_2 = C_3 = 400 \text{ pF}$ and $C_4 = C_5 = C_6 = 200 \text{ pF}$. The effective capacitance of the circuit between X and Y is



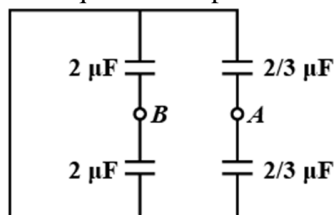
- (a) 810 pF (b) 205 pF (c) 600 pF (d) 410 pF

11. In the circuit shown in figure, $C = 6 \text{ }\mu\text{F}$. The charge stored in the capacitor of capacity C is



- (a) zero (b) $90 \text{ }\mu\text{C}$ (c) $40 \text{ }\mu\text{C}$ (d) $60 \text{ }\mu\text{C}$

12. The equivalent capacitance of the circuit across the terminals A and B is equal to

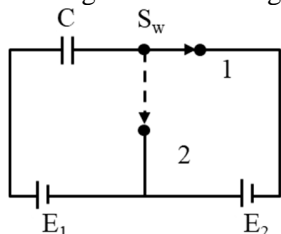


- (a) $0.5 \text{ }\mu\text{F}$ (b) $2 \text{ }\mu\text{F}$ (c) $1 \text{ }\mu\text{F}$ (d) None of these

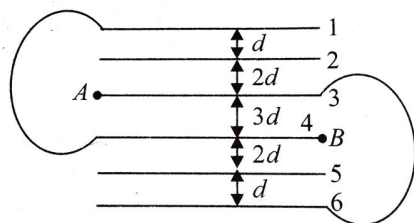
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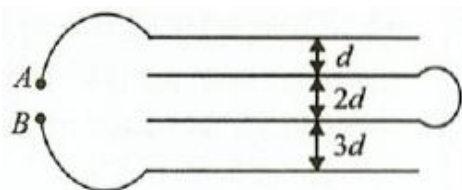
13. In the given circuit diagram (figure), switch S_w is shifted from position 1 to position 2. Then



- (a) a charge of amount CE_2 will be supplied to battery E_1
 (b) heat generated in the circuit is $CE_2^2 / 2$
 (c) a charge of amount CE_2 will be supplied by battery E_1
 (d) heat generated in the circuit is $CE_1E_2/2$
14. Six plates of equal area A and plate separation as shown (figure) are arranged. The equivalent capacitance between A and B is



- (a) $\frac{\epsilon_0 A}{d}$ (b) $\frac{2\epsilon_0 d}{d}$ (c) $\frac{3\epsilon_0 A}{d}$ (d) $\frac{\epsilon_0 A}{4d}$
15. If area of each plate is A and the successive separations are d , $2d$, and $3d$, then the equivalent capacitance across A and B is



- (a) $\frac{\epsilon_0 A}{6d}$ (b) $\frac{\epsilon_0 A}{4d}$ (c) $\frac{3\epsilon_0 A}{4d}$ (d) $\frac{\epsilon_0 A}{3d}$

Space for Rough Work



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SECTION-I
[SINGLE CORRECT CHOICE TYPE]

Q.1 to Q.8 has four choices (A), (B), (C), (D) out of which **ONLY ONE** is correct.

- Q.1 The equation of the tangent to the curve $y = x + \frac{4}{x^2}$, that is parallel to the x-axis, is
(A) $y = 3$ (B) $y = 0$ (C) $y = 1$ (D) $y = 2$
- Q.2 The shortest distance between the line $y - x = 1$ and the curve $x = y^2$ is -
(A) $\frac{3\sqrt{2}}{8}$ (B) $\frac{2\sqrt{3}}{8}$ (C) $\frac{3\sqrt{2}}{5}$ (D) $\frac{\sqrt{3}}{4}$
- Q.3 A man saves Rs. 200 in each of the first three months of his service. In each of the subsequent months of his service. In each of the subsequent months his saving increases by Rs. 40 more than the saving of immediately previous month. His total saving from the start of service will be Rs. 11040 after.
(A) 18 months (B) 19 months (C) 20 months (D) 21 months
- Q.4 A spherical balloon is filled with 4500π cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of 72π cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is
(A) $\frac{2}{9}$ (B) $\frac{9}{2}$ (C) $\frac{4}{7}$ (D) $\frac{7}{9}$



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- Q.5 The intercepts on x-axis made by tangents to the curve, $y = \int_0^x |t| dt$, $x \in \mathbb{R}$, which are parallel to the line $y = 2x$ are equal to
(A) ± 2 (B) ± 3 (C) ± 4 (D) ± 1
- Q.6 The normal to the curve, $x^2 + 2xy - 3y^2 = 0$, at $(1, 1)$
(A) meets the curve again in the third quadrant. (B) meets the curve again in the fourth quadrant.
(C) does not meet the curve again. (D) meets the curve again in the second quadrant.
- Q.7 Consider $f(x) = \tan^{-1}\left(\sqrt{\frac{1+\sin x}{1-\sin x}}\right)$, $x \in \left(0, \frac{\pi}{2}\right)$. A normal to $y = f(x)$ at $x = \frac{\pi}{6}$ also passes through the point
[JEE (Main) 2016]
(A) $\left(\frac{\pi}{4}, 0\right)$ (B) $(0, 0)$ (C) $\left(0, \frac{2\pi}{3}\right)$ (D) $\left(\frac{\pi}{6}, 0\right)$
- Q.8 The normal to the curve $y(x-2)(x-3) = x+6$ at the point where the curve intersects the y-axis passes through the point
(A) $\left(\frac{-1}{2}, \frac{-1}{2}\right)$ (B) $\left(\frac{1}{2}, \frac{1}{2}\right)$ (C) $\left(\frac{1}{2}, \frac{-1}{3}\right)$ (D) $\left(\frac{1}{2}, \frac{1}{3}\right)$



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SECTION-II [MULTIPLE CORRECT CHOICE TYPE]

Q.9 to Q.15 has four choices (A), (B), (C), (D) out of which **MORE THAN ONE** may be correct.

Q.9 Equation of a tangent to the curve $y \cot x = y^3 \tan x$ at the point where the abscissa is $\frac{\pi}{4}$ is

- (A) $4x + 2y = \pi + 2$ (B) $4x - 2y = \pi + 2$ (C) $x = 0$ (D) $y = 0$

Q.10 Equation of a line which is tangent to both the curves $y = x^2 + 1$ and $y = -x^2$ is

(A) $y = \sqrt{2}x + \frac{1}{2}$ (B) $y = \sqrt{2}x - \frac{1}{2}$

(C) $y = -\sqrt{2}x + \frac{1}{2}$ (D) $y = -\sqrt{2}x - \frac{1}{2}$

Q.11 If $y = mx + 5$ is a tangent to the curve $x^3 y^3 = ax^3 + by^3$ at P (1, 2), then

- (A) $a + b = \frac{18}{5}$ (B) $a > b$ (C) $a < b$ (D) $a + b = \frac{19}{5}$

Q.12 Let $y = f(x)$ be a function such that $f'(x) = x^3$ and the line $x + y = 0$ is tangent to the graph of $f(x)$ then which of the following alternative(s) is/are correct?

- (A) $f(0) = -\frac{3}{4}$ (B) $f(1) = 1$ (C) $f(-1) = 1$ (D) $f(3) = 21$



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- Q.13 If the line $aX + bY + c = 0$ is a normal to the curve $xy = 1$. Then
(A) $a > 0, b > 0$ (B) $a > 0, b < 0$ (C) $a < 0, b > 0$ (D) $a < 0, b < 0$
- Q.14 The curves $y = \cos x$ and $y = \tan x$ intersect at a point P in the first quadrant whose x-coordinate is α . Then
(A) $\sin \alpha = 2 \sin 18^\circ$ (B) $\sec^2 \alpha = 2 \cos 36^\circ$
(C) The curves are orthogonal at P (D) $\sec \alpha \cdot \tan \alpha = 1$
- Q.15 Which of the following pair(s) of curves touch each other?
(A) $y^2 = 4x$ and $x^2 + y^2 = 6x - 1$ (B) $xy = 4$ and $x^2 + y^2 = 8$
(C) $y = 2x - 3$ and $y = x^3 - x + 1$ (D) $y = 6 + x - x^2$ and $y = \frac{x+2}{x-2}$



Max Marks: 60

Date: 06.08.2022

**ARJUNA BATCH
PHYSICS : DCT ANSWER KEY
Topic: Capacitor**

1.	(d)	2.	(a)	3.	(c)	4.	(b)	5.	(b)
6.	(c)	7.	(a)	8.	(c)	9.	(a)	10.	(d)
11.	(c)	12.	(c)	13.	(c)	14.	(a)	15.	(b)

Max Marks: 60

Date: 06.08.2022

**ARJUNA BATCH
MATHEMATICS : DCT ANSWER KEY
Topic: Tangent Normal**

1.	(a)	2.	(a)	3.	(a)	4.	(a)	5.	(d)
6.	(b)	7.	(c)	8.	(b)	9.	(a, b, d)	10.	(a, c)
11.	(b, d)	12.	(b, c, d)	13.	(b, c)	14.	(a, b, c, d)	15.	(a, b)