NEET ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 12th **PAPER CODE :- CWT-2**
CHAPTER :- CAPACITANCE

ANSWER KEY

1.	(C)	**2.**	(C)	**3.**	(B)	**4.**	(A)	**5.**	(B)	**6.**	(B)	**7.**	(B)
8.	(C)	**9.**	(C)	**10.**	(B)	**11.**	(D)	**12.**	(C)	**13.**	(A)	**14.**	(B)
15.	(C)	**16.**	(C)	**17.**	(B)	**18.**	(A)	**19.**	(A)	**20.**	(D)	**21.**	(C)
22.	(A)	**23.**	(B)	**24.**	(C)	**25.**	(D)	**26.**	(B)	**27.**	(C)	**28.**	(B)
29.	(B)	**30.**	(B)	**31.**	(B)	**32.**	(D)	**33.**	(A)	**34.**	(D)	**35.**	(C)
36.	(A)	**37.**	(D)	**38.**	(C)	**39.**	(B)	**40.**	(C)	**41.**	(C)	**42.**	(A)
43.	(D)	**44.**	(C)	**45.**	(A)	**46.**	(A)	**47.**	(B)	**48.**	(B)	**49.**	(B)
50.	(B)												

SOLUTIONS

SECTION-A

1. (C)

Sol. Battery in disconnected so Q will be constant as $C \propto K$. So with introduction of dielectric slab capacitance will increase using $Q = CV$, V will decrease and using $U = \frac{Q^2}{2C}$, energy will decrease.

2. (C)

3. (B)

Sol. $U = \int_0^V CV\,dV = \frac{1}{2}CV^2$

4. (A)

Sol. $U = \frac{1}{2}CV^2 = \frac{1}{2} \times 50 \times 10^{-6} \times (10)^2 = 2.5 \times 10^{-3}\,J$

5. (B)

6. (B)

Sol. $C_{medium} = K \times C_{air}$

7. (B)

Sol. By using $V_{big} = n^{2/3} v_{small}$

$\Rightarrow \frac{V_{Big}}{v_{small}} = (8)^{2/3} = \frac{4}{1}$

8. (C)

Sol. $W = \frac{Q^2}{2C} \Rightarrow W' = 4W$

9. (C)

Sol. Because the charges are produced due to induction and moreover the net charge of the condenser should be zero.

10. (B)

Sol. Initially $F = qE$ and $E = \frac{\sigma}{\varepsilon_0}$ $\therefore$ $F = \frac{q\sigma}{\varepsilon_0}$

If one plate is removed, then E becomes $\frac{\sigma}{2\varepsilon_0}$

So $F' = \frac{q\sigma}{2\varepsilon_0} = \frac{F}{2}$

11. (D)

12. (C)

Sol. In this process capacity increases, so battery supplies additional charge to capacitor.

13. (A)

Sol. Initially when key is closed, the capacitor acts as short-circuit, so bulb will light up. But finally the capacitor becomes fully charged, so it will act as open circuit, so bulb will not glow.

14. (B)

Sol. $C = \frac{K\varepsilon_0 A}{d}$; $\therefore$ $\frac{C_1}{C_2} = \frac{K_1}{K_2} \Rightarrow \frac{C}{C_2} = \frac{5}{20} \Rightarrow C_2 =$ 4C

15. (C)

Sol. $\Delta V = \frac{1}{2}\frac{C \times C}{(C+C)}|\,V-(-V)|^2 = CV^2$

16. (C)

Sol. Initially charge on the capacitor $Q = 10 \times 12 = 120\,\mu C$

Finally charge on the capacitor $Q' = (5 \times 10) \times 12 = 600\,\mu C$

So charge supplied by the battery later $= Q' - Q = 480\,\mu C$

17. (B)

Sol. (B) The energy stored $= \frac{1}{2}QV$

18. (A)

Sol. $U = \frac{1}{2}CV^2 = \frac{1}{2} \times 12 \times 10^{-12} \times (50)^2$

$= 1.5 \times 10^{-8} J$

19. (A)

Sol. $C = \frac{\varepsilon_0 KA}{d} \Rightarrow \frac{C_1}{C_2} = \frac{K_1}{K_2} \times \frac{d_2}{d_1}$

$\frac{2}{C_2} = \frac{1}{2.8} \times \frac{(0.4/2)}{(0.4)} \Rightarrow C_2 = 11.2\,\mu F$

20. (D)

21. (C)

Sol. $C \propto \frac{1}{d} \Rightarrow \frac{C_1}{C_2} = \frac{d_2}{d_1}$ so $\frac{C_2}{10} = \frac{8}{4} \Rightarrow C_2 = 20\,\mu F$

22. (A)

Sol. Energy density

$= \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0 \left(\frac{\sigma}{\varepsilon_0}\right)^2 = \frac{\sigma^2}{2\varepsilon_0} = \frac{q^2}{2\varepsilon_0 A^2}$

23. (B)

Sol. $U = \frac{Q^2}{2C} = \frac{(40 \times 10^{-6})^2}{2 \times 10^{-6} \times 10} = \frac{16 \times 10^{-10}}{2 \times 10^{-5}} = 8 \times 10^{-5} J$

$= 8 \times 10^{-5} \times 10^7 = 800\ erg$

24. (C)

Sol. Capacitance with dielectric $C_{medium} = \frac{K\varepsilon_0 A}{d}$

$\Rightarrow C_{medium} \propto \frac{K}{d}$

25. (D)

Sol. $U = \frac{1}{2}CV^2 = \frac{1}{2} 5 \times 10^{-6} \times (20 \times 10^3)^2 = 1kJ$

26. (B)

Sol. $U = \frac{1}{2}C_{eq}V^2 = \frac{1}{2}(nC)V^2$

27. (C)

Sol. $C = \frac{\varepsilon_0 A}{d} \Rightarrow \varepsilon_0 = \frac{Cd}{A} \Rightarrow \varepsilon_0 \rightarrow$

$\frac{Farad \times m}{m^2} \rightarrow \frac{F}{m}$

28. (B)

Sol. $V = n^{2/3}v = (8)^{2/3}v = 4v$ *i.e.* 4 times.

29. (B)

Sol. Power

$= \frac{\frac{1}{2}CV^2}{t} = \frac{1 \times 40 \times 10^{-6} \times (3000)^2}{2 \times 2 \times 10^{-3}} = 90\ kW$

30. (B)

31. (B)

Sol. In general electric field between the plates of a charged parallel plate capacitor is given by $E = \frac{\sigma}{\varepsilon_0 K}$

32. (D)

Sol. $Q_1 = 10^{-2}C$, $Q_2 = 5 \times 10^{-2}C$

Total charge of the system $Q = 6 \times 10^{-6}$ C

Charge on small sphere

$Q'_1 = \frac{Q r_1}{r_1 + r_2} = \frac{6 \times 10^{-2} \times 1}{1+2} = 2 \times 10^{-2} C$

33. (A)

Sol. When a lamp is connected to D.C. line with a capacitor. If will form an open circuit. Hence, the lamp will not glow.

34. (D)

Sol. $Q_1 = CV$ and $Q_2 = CV$

Applying charge conservation

$CV_1 + CV_2 = Q_1 + Q_2$

$CV_1 + CV_2 = 2CV \Rightarrow V_1 + V_2 = 2V$

35. (C)

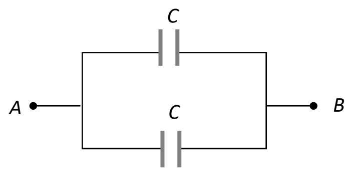
Sol. The given arrangement becomes an arrangement of $(n-1)$ capacitors connected in parallel. So $C_R = (n-1)C$

SECTION-B

36. (A)

Sol. The given circuit is equivalent to a parallel combination two identical capacitors

Hence equivalent capacitance between *A* and *B* is

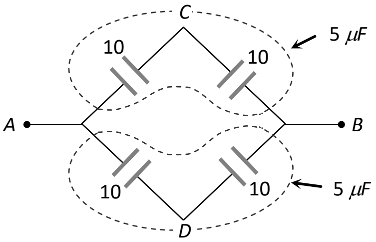


C = $\frac{\varepsilon_0 A}{d} + \frac{\varepsilon_0 A}{d}$

$= \frac{2\varepsilon_0 A}{d}$

37. (D)

Sol. In the given system, no current will flow through the branch *CD* so it can be removed



Effective capacitance of the system $= 5 + 5 = 10\,\mu F$

38. (C)

Sol. $C_R = C_1 + C_2 = \frac{k_1\varepsilon_0 A_1}{d} + \frac{k_2\varepsilon_0 A_2}{d}$

$$= \frac{2\times\varepsilon_0\frac{A}{2}}{d} + \frac{4\times\varepsilon_0\frac{A}{2}}{d} = 2\times\frac{10}{2} + 4\times\frac{10}{2} = 30\,\mu F$$

39. (B)

Sol. Total capacitance of given system

$C_{eq} = \frac{8}{5}\,\mu F$

$$U = \frac{1}{2}C_{eq}V^2 = \frac{1}{2}\times\frac{8}{5}\times 10^{-6}\times 225 = 180\times 10^{-6}\,J$$

$$= 180\times 10^{-6}\times 10^{7}\,erg = 1800\ erg$$

40. (C)

Sol. $\frac{1}{C_R} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

$\Rightarrow C_R = (C_1^{-1} + C_2^{-1} + C_3^{-1})^{-1}$

41. (C)

Sol. $C_1 = 2C$ and $C_2 = C/2$, so $C_1 / C_2 = 4:1$

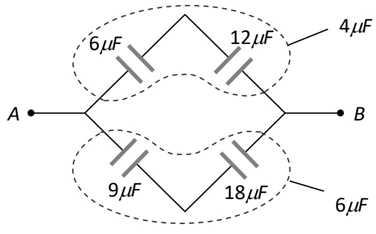
42. (A)

Sol. In parallel combination $V_1 = V_2$

or $\frac{q_1}{C_1} = \frac{q_2}{C_2} \Rightarrow \frac{q_1}{q_2} = \frac{C_1}{C_2}$

43. (D)

Sol. Given circuit can be drawn as follows. It is a balance whetstone bridge type network, hence 24 μF capacitor can be neglected



Equivalent capacitance between *A* and *B* = 4 + 6 = 10μF.

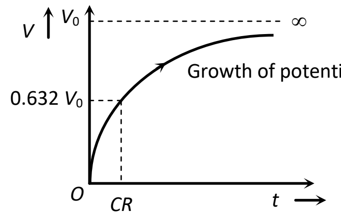
44. (C)

Sol. Equivalent capacitance of parallel combination is $C_p = C_1 + C_2 + C_3$.

45. (A)

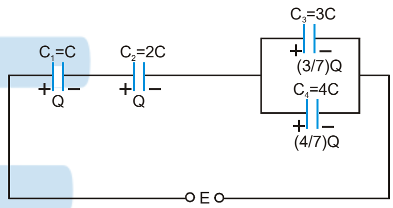
Sol. For charging of capacitor $q = q_0\left(1 - e^{-\frac{t}{CR}}\right)$

and potential difference $V = V_0\left(1 - e^{-\frac{t}{CR}}\right)$



46. (A)

Sol.



At C_1 = $V_1 = \frac{Q}{C}$ and $U_1 = \frac{Q^2}{2C}$

At C_2 = $V_2 = \frac{Q}{2C}$ and $U_2 = \frac{Q^2}{4C}$

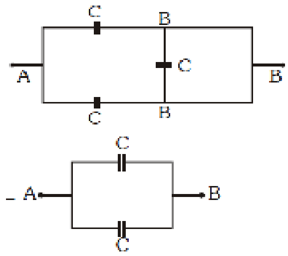
At C_3 = $V_3 = \frac{Q}{7C}$ and $U_3 = \frac{3Q^2}{98C}$

At C_4 = $V_4 = \frac{Q}{7C}$ and $U_4 = \frac{4Q^2}{98C}$

Therefore $V_{max} = V_1$ and $V_{min} = V_3 = V_4$ and $U_{max} = U_1$ and $U_{min} = U_3$

47. (B)

Sol.



(one capacitor gets short)

$\Rightarrow C_{eq} = C_1 + C_2$

$= C + C$

$= 2C$

48. (B)

49. (B)

Sol. Force between plates of parallel capacitor,

$$F = qE = q\left[\frac{\sigma}{2\varepsilon_0}\right]$$

∵ Surface charge density $\sigma = \frac{q}{A}$

$$\therefore\ F = q\left[\frac{q}{2A\varepsilon_0}\right] \Rightarrow F = \frac{q^2}{2A\varepsilon_0}$$

So, net charge across a capacitor, q = CV

$$F = \frac{C^2V^2}{2A\varepsilon_0}\left[C = \frac{A\varepsilon_0}{d}\right]$$

$$\Rightarrow \quad F = \frac{\left(\frac{A\varepsilon_0}{d}\right)\times CV^2}{2A\varepsilon_0} = \frac{CV^2}{2d}$$

50. (B)

Sol. Energy stored, in parallel plate capacitor is given by

$$U = \frac{1}{2}\frac{q^2}{C}$$

but $\sigma = \frac{q}{A}$ and $C = \frac{\varepsilon_0 A}{d}$

$$\therefore \quad U = \frac{1}{2}\frac{(\sigma A)^2}{\left(\frac{\varepsilon_0 A}{d}\right)}$$

or $= \frac{A\sigma^2 d}{2\varepsilon_0}$

or $= \frac{1}{2}\left(\frac{\sigma}{\varepsilon_0}\right)^2 \times \varepsilon_0 Ad$

or $U = \frac{1}{2}E^2\varepsilon_0 Ad$

Energy stored per unit volume i.e. energy density is thus given by

$$u = \frac{U}{V} = \frac{U}{Ad} = \frac{1}{2}\varepsilon_0 E^2$$

$$\Rightarrow \quad = \frac{1}{2}\varepsilon_0\left(\frac{V}{d}\right)^2 = \frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$$