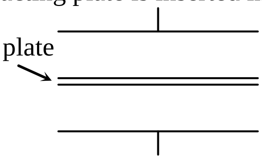
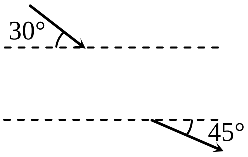
1. A thin conducting plate is inserted in half way between the plates of a parallel plates capacitor of capacitance C.



What does the value of capacitance, if both the plate of capacitor is shortened?

(a) C (b) 2C (c) 3C (d) 4C

2. An electron with a kinetic energy of 100 eV enters the space between the plates of plane capacitor made of two dense metal grids at an angle of 30^0 with the plates of capacitor and leaves this space at an angle of 45^0 with the plates. What is the potential difference of the capacitor –



(a) 100 V (b) 50 V (c) 150 V (d) 200 V

3. A capacitor (without dielectric) is discharging through a resistor. At same instant a dielectric is inserted between the plates, then-

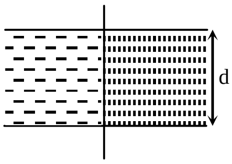
(a) Just after the insertion of the dielectric, current will increase

(b) Just after the insertion of the dielectric charge on capacitor will increase

(c) Just after the insertion of the dielectric, energy stored in the capacitor will increase

(d) After the insertion of the dielectric, time constant will increase

4. A capacitor of capacitance 1 μF is filled with two dielectrics of dielectric constants 4 and 6. What is the new capacitance?



(a) 10 μF (b) 5 μF (c) 4 μF (d) None of these

5. A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

(a) 1 (b) 2

(c) 1/4 (d) ½

6. n identical condenser are joined in parallel and are charged to potential V. Now they are separated and joined in series. Then the total energy and potential difference of the combination will be-

(a) Energy and potential difference remain same

(b) Energy remains same and potential difference is nV

(c) Energy increases n times and potentials differences is nV

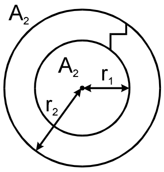
(d) Energy increases n times and potential difference remains same

7. Conducting sphere of radius R_1 is covered by concentric sphere of radius R_2. Capacity of this combination is proportional to-

(a) $\frac{R_2 - R_1}{R_1 R_2}$ (b) $\frac{R_2 + R_1}{R_1 R_2}$

(c) $\frac{R_1 R_2}{R_1 + R_2}$ (d) $\frac{R_1 R_2}{R_2 - R_1}$

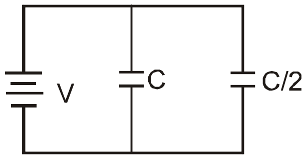
8. Two spherical conductors A_1 and A_2 of radii r_1 and r_2 are placed concentrically in air. The two are connected by a copper wire as shown in figure. Then the equivalent capacitance of the system is



(a) $\frac{4\pi\varepsilon_0 k\, r_1.r_2}{r_2 - r_1}$ (b) $4\pi\in_0 (r_1 + r_2)$

(c) $4\pi\in_0 r_2$ (d) $4\pi\in_0 r_1$

9. Two condensers, one of capacity C and the other of capacity $\frac{C}{2}$, are connected to a V volt battery, as shown.



The work doen in charging fully both the condensers is

(a) $2CV^2$ (b) $\frac{1}{4}$ CV^2

(c) $\frac{3}{2}$ CV^2 (d) $\frac{1}{2}$ CV^2

10. A parallel capacitor of capacitance C is charged and disconnected from the battery. The energy stored in it is E. If a dielectric slab of dielectric constant 6 is ineserted between the plates of the capacitor then energy and capacitance will become

(a) 6E, 6C (b) E, C

(c) $\frac{E}{6}, 6C$ (d) E, 6C

11. A parallel plate air capacitor is charged by connecting its plates to a battery. Without disconnecting the battery, a dielectric is introduced between its plates. As a result-

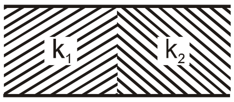
(a) P.D. between the plates increases
(b) Charge on the plates decreases
(c) Capacitance of the capacitor decreases
(d) None of the above

12. A parallel plate capacitor is filled by copper plate of thickness b. The new capacity will be-

(a) $\frac{\varepsilon_0 A}{2d - b}$ (b) $\frac{\varepsilon_0 A}{d - b}$

(c) $\frac{\varepsilon_0 A}{d - b/2}$ (d) $\frac{\varepsilon_0 A}{d}$

13. Two materials of dielectric constant k_1 and k_2 are filled between two parallel plates of a capacitor as shown in figrue. The capacity of the capacitor is :



(a) $\frac{A \epsilon_0 (k_1 + k_2)}{2d}$ (b) $\frac{2A \epsilon_0}{d}\left(\frac{k_1 k_2}{k_1 + k_2}\right)$

(c) $\frac{A \epsilon_0}{d}\left(\frac{k_1 k_2}{k_1 + k_2}\right)$ (d) $\frac{A \epsilon_0}{2d}\left(\frac{k_1 + k_2}{k_1 k_2}\right)$

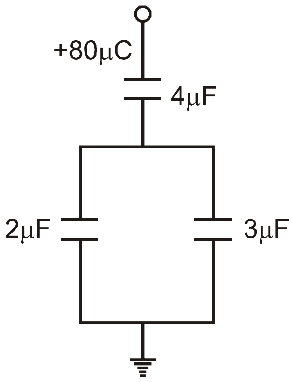
14. The electric field between two parallel plates of a capacitor is 2.1×10^{-5}. If a medium is inserted between the plates than the electric field becomes 1.0×10^{-5}. Now, the value of dielectric will be

(a) 2 (b) 3
(c) 4 (d) 5

15. Three capacitors of same capacitance are connected in parallel. When they are connected to a cell of 2 volt, total charge of 1.8μC is accumulated on them. Now they are connected in series and then charged by the same cell. The total charge stored in them will be

(a) 1.8μC (b) 0.9μC
(c) 0.6μC (d) 0.2μC

16. In the given circuit, a charge of +80 μC is given to the upper plate of the 4μF capacitor. Then in the steady state, the charge on the upper plate of the 3μF capacitor is :



(a) +32 μC (b) +40 μC
(c) +48 μC (d) +80 μC

17. If a slab of insulating material $4 \times 10^{-3} m$ thick is introduced between the plates of a parallel plate capacitor, the separation between plates has to be increased by $3.5 \times 10^{-3} m$ to restore the capacity to original value. The dielectric constant of the material will be

(a) 6 (b) 8
(c) 10 (d) 12

18. Two insulated metallic spheres of $3 \mu F$ and $5 \mu F$ capacitances are charged to 300 V and 500V respectively. The energy loss, when they are connected by a wire is

(a) 0.012 J (b) 0.0218 J
(c) 0.0375 J (d) 3.75 J

19. The electric field between the plates of a parallel plate capacitor when connected to a certain battery is E_0 . If the space between the plates of the capacitor is filled by introducing a material of dielectric constant K without disturbing the battery connections, the field between the plates shall be

(a) KE_0 (b) E_0

(c) $\frac{E_0}{K}$ (d) None of the above

20. A condenser has a capacity $2\mu F$ and is charged to a voltage of 50 *V*. The energy stored is

(a) 25×10^5 *Joule* (b) 25 *Joule*

(c) 25×10 *erg* (d) 25×10^3 *erg*

21. The unit of electric permittivity is

(a) *Volt/m*^{2} (b) *Joule/coulomb*

(c) *Farad/m* (d) *Henry/m*

22. $2\mu F$ capacitance has potential difference across its two terminals $200\ volts$. It is disconnected with battery and then another uncharged capacitance is connected in parallel to it, then P.D. becomes $20\ volts$. Then the capacity of another capacitance will be

(a) $2\mu F$ (b) $4\mu F$

(c) $18\mu F$ (d) $10\mu F$

23. Three capacitors of $2.0, 3.0$ and $6.0\ \mu F$ are connected in series to a $10\,V$ source. The charge on the $3.0\mu F$ capacitor is

(a) $5\mu C$ (b) $10\mu C$

(c) $12\mu C$ (d) $15\mu C$

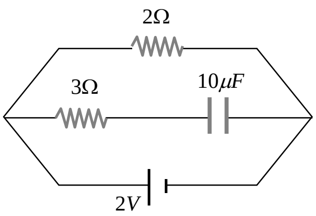
24. The charge on a capacitor of capacitance $10\mu F$ connected as shown in the figure is

(a) $20\mu C$

(b) $15\mu C$

(c) $10\mu C$

(d) Zero



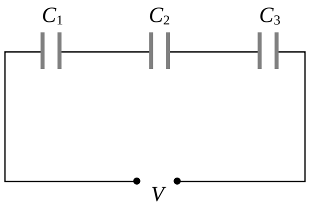
25. In the figure, three capacitors each of capacitance 6 pF are connected in series. The total capacitance of the combination will be

(a) $9 \times 10^{-12}\ F$

(b) $6 \times 10^{-12}\ F$

(c) $3 \times 10^{-12}\ F$

(d) $2 \times 10^{-12}\ F$



26. A parallel plate capacitor has capacitance C. If it is equally filled with parallel layers of materials of dielectric constants K_1 and K_2 its capacity becomes C_1. The ratio of C_1 to C is

(a) $K_1 + K_2$ (b) $\frac{K_1K_2}{K_1 - K_2}$

(c) $\frac{K_1 + K_2}{K_1 K_2}$ (d) $\frac{2K_1 K_2}{K_1 + K_2}$

27. Two identical capacitors, have the same capacitance *C*. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is

(a) $\frac{1}{4}C(V_1^2 - V_2^2)$ (b) $\frac{1}{4}C(V_1^2 + V_2^2)$

(c) $\frac{1}{4}C(V_1 - V_2)^2$ (d) $\frac{1}{4}C(V_1 + V_2)^2$

28. Three capacitors each of capacity $4\mu F$ are to be connected in such a way that the effective capacitance is $6\mu F$. This can be done by

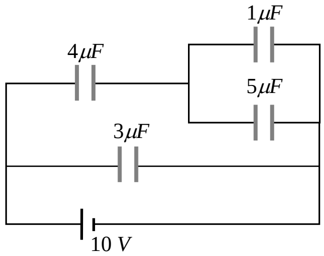
(a) Connecting them in parallel

(b) Connecting two in series and one in parallel

(c) Connecting two in parallel and one in series

(d) Connecting all of them in series

29. The charge on 4 μF capacitor in the given circuit is .... in μC



(a) 12

(b) 24

(c) 36

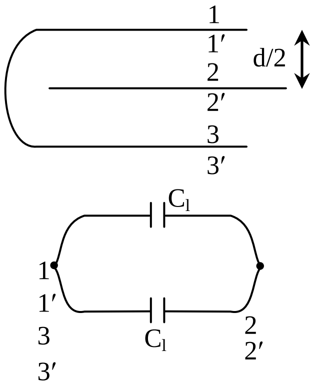
(d) 32

30. A 10 μF capacitor is charged to a potential difference of 1000 *V*. The terminals of the charged capacitor are disconnected from the power supply and connected to the terminals of an uncharged 6μF capacitor. What is the final potential difference across each capacitor

(a) 167 *V* (b) 100 *V*

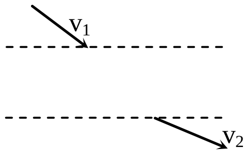
(c) 625 *V* (d) 250 *V*

1. (d)



$= 2 \times \frac{(\epsilon_0 A) \times 2}{d} = 4 \cdot \frac{\epsilon_0 A}{d} = 4C$

2. (b)



Horizontal velocity is constant

$v_1 \cos 30^0 = v_2 \cos 45^0$

$v_1 \frac{\sqrt{3}}{2} = v_2 \times \frac{1}{\sqrt{2}}$

$\frac{3v_1^2}{4} = \frac{v_2^2}{2}$

$\frac{3}{2} \times \frac{1}{2} mv_1^2 = \frac{1}{2} mv_2^2$

$KE_f = \frac{3}{2} \times KE_i$

$= 1.5 \times 100 = 150$ eV

P.d. $= \frac{\Delta KE}{e} = \frac{(150 - 100)eV}{e} = 50$ V

3. (d)

Let the capacitance before insertion of dielectric be C and the resistance be R.

$\therefore q = q_0 \ e^{\frac{t}{RC}}$ and $i = \frac{q/C}{R} = \frac{q}{RC}$

Just after insertion of dielectric the capacitance increases.

The charge just after insertion of dielectric remains same, but the current decreases ⇒ (A) and (B) are false.

The energy stored in capacitor is $\frac{q^2}{2C}$, hence energy decreases.

⇒ (C) is false.

The time constant is RC and hence increases.

⇒ (D) is true.`

4. (b)

$C_{eq} = \left(\frac{\in r_1 + \in r_2}{2}\right) C$

$= \left(\frac{4+6}{2}\right)(1\mu F) = 5\mu F$

5. (d)Work done by battery $= (CV)\,V = CV^2$

Energy stored in capacitor $= CV^2$

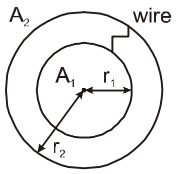
$$\frac{\text{Energy stored in capacitor}}{\text{Work done by battery}} = \frac{\frac{1}{2}CV^2}{CV^2} = \frac{1}{2}$$

Correct choice is (d)

6. (b)

7. (d)

8. (c)



All given charge of A_1 goes to A_2

Therefore $C = 4\pi\epsilon_0 r_2$

9. (c)The two condensers in the circuit are in parallel order, hence

$$C' = C + \frac{C}{2} = \frac{3C}{2}$$

the work done in charging the equivalent capacitor is stored in the form of potential energy.

Hence, $W = U = \frac{1}{2}\ C'\ V^2 \frac{1}{2}\left(\frac{3C}{2}\right) = V^2 = \frac{3}{4}\ CV^2$

10. (c)

11. (d)

12. (b)

13. (a)

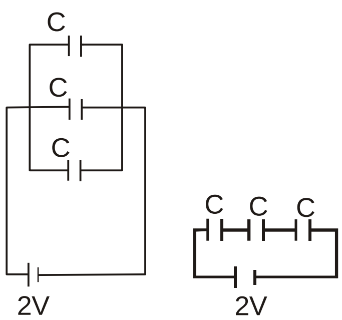
14. (a)$E = \frac{\sigma}{\varepsilon_0} = 2.1 \times 10^{-5}$

$E' = \frac{\sigma}{\varepsilon_0 K} = 1 \times 10^{-5}$

$\therefore \quad \frac{E}{E'} = \frac{\sigma}{\varepsilon_0} \times \frac{\varepsilon_0 K}{\sigma} = \frac{2.1\times10^{-5}}{1\times10^{-5}}$

or $\quad K = 2.1 \approx 2$

15. (d)



$q_1 + q_2 + q_3 + = 1.8\ \mu C = (3C)2 = 1.8\ \mu C$

$C = 0.3\mu F$

$C_{eq} = \frac{C}{3} = 0.1\ \mu F$

$Q = C_{eq}V = 0.1 \times 2 = 0.2\ \mu C$

16. (c) $q_3 = \frac{C_3}{C_2 + C_3}.Q$

$q_3 = \frac{3}{3+2} \times 80 = \frac{3}{5} \times 80 = 48\ \mu C$

17. (b) $K = \frac{t}{t - d'} = \frac{4 \times 10^{-3}}{4 \times 10^{-3} - 3.5 \times 10^{-3}} = 8$

18. (c) $\Delta U = \frac{1}{2}\frac{C_1C_2(V_2 - V_1)^2}{(C_1 + C_2)} = \frac{(3 \times 5) \times 10^{-12} \times (500 - 300)^2}{(3+5) \times 10^{-6}}$

$= \frac{15 \times 10^{-12} \times 4 \times 10^4}{8 \times 10^{-6}} = 0.0375\ J$

19. (b) In the presence of battery potential difference remains constant. Also $E = \frac{V}{d}$, so E remains same.

20. (d) $U = \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 10^{-6} \times (50)^2 = 25 \times 10^{-4}\ J$

$= 25 \times 10^3\ erg$

21. (c) $C = \frac{\varepsilon_0 A}{d} \Rightarrow \varepsilon_0 = \frac{Cd}{A} \Rightarrow \varepsilon_0 \rightarrow \frac{Farad \times m}{m^2} \rightarrow \frac{F}{m}$

22. (c) By using, common potential $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$\Rightarrow 20 = \frac{2 \times 200 + C_2 \times 0}{2 + C_2} \Rightarrow C_2 = 18\ \mu F$

23. (b) Net capacitance $= \frac{1}{\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{6}\right)} = 1\ \mu F$

Total charge $= CV = 1\ \mu F \times 10\ V = 10\ \mu C$

Total charge on every capacitor in series system is same. So charge on 3 μF is 10 μC.

24. (a) In steady state potential difference a cross capacitor = $2V$.
So charge on capacitor $Q = 10 \times 2 = 20\ \mu C$

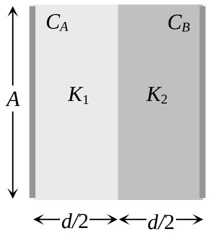
25. (d) $C' = C/n = \frac{6 \times 10^{-12}}{3} = 2 \times 10^{-12}\ F$

26. (d) $C_A = \frac{K_1\varepsilon_0 A}{d/2}, C_B = \frac{K_2\varepsilon_0 A}{d/2}$

$\therefore\ C_{eq} = \frac{C_1}{C_2} = \frac{2K_1K_2}{K_1+K_2}$

$= \frac{C_AC_B}{C_A+C_B} = \left(\frac{2K_1K_2}{K_1+K_2}\right)\frac{\varepsilon_0 A}{d}$

$\left(\because\ C = \frac{\varepsilon_0 A}{d}\right)$



27. (c) Initial energy of the system

$U_i = \frac{1}{2}CV_1^2 + \frac{1}{2}CV_2^2$

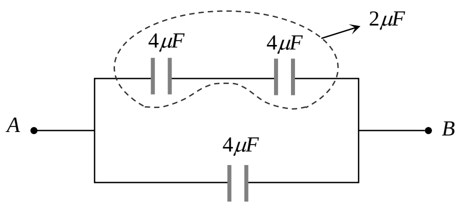
When the capacitors are joined, common potential $V = \frac{CV_1 + CV_2}{2C} = \frac{V_1+V_2}{2}$

Final energy of the system

$U_f = \frac{1}{2}(2C)V^2 = \frac{1}{2}2C\left(\frac{V_1+V_2}{2}\right)^2 = \frac{1}{4}C(V_1+V_2)^2$

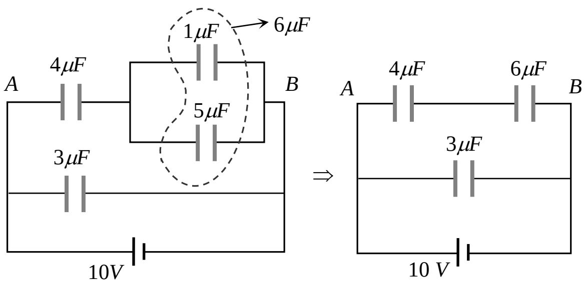
Decrease in energy = $U_i - U_f = \frac{1}{4}C(V_1 - V_2)^2$

28. (b) The given circuit can be drawn as follows



$\Rightarrow C_{AB} = 2+4 = 6\mu F$

29. (b) Equivalent capacity between A and B $= \frac{6\times 4}{10} = 2.4\ \mu F$



Hence charge across $4\mu F$ (Since in series combination charge remains constant) or 6 $\mu F = 2.4 \times 10 = 24\ \mu C$

30. (c) After charging, total charge on the capacitor $Q = CV$

$= 10 \times 10^{-6}\ F \times 1000\ V = 10^{-2}\ C.$

Common potential $V = \frac{C_1V_1}{C_1 + C_2} = \frac{10^{-2}}{16 \times 10^{-6}} = 625V.$