*Code: Phy/ EM-1/Cap/003*

# Electromagnetism: Capacitors – Typical Questions (Set 1)

**No of Questions: 94** **Time Allotted: 9-1/2 Hours (in 3 parts)**

**<u>All questions are compulsory</u>**

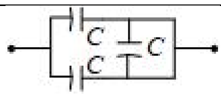
**[<u>Note: a</u>.** Figures are conceptual only and not to the scale**]**

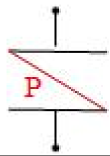
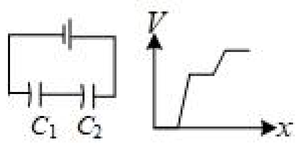
**[<u>b</u>.** Solutions may be taken up in Three parts as, Part I: 1 to 30 of Three Hours;**]**

**[** Part II: 31 to 60 of Three Hours; and Part III: 61 to 94 of Three and Half Hours**]**

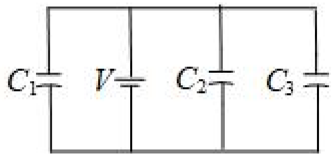
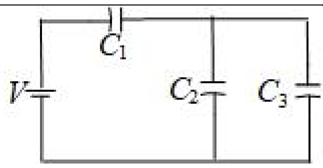
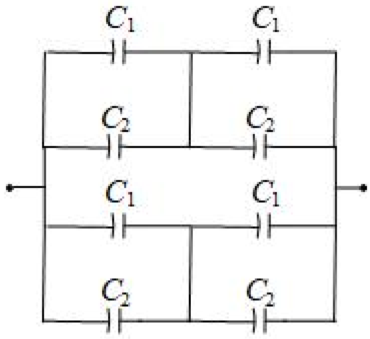
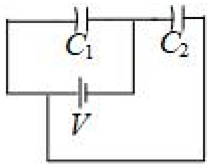
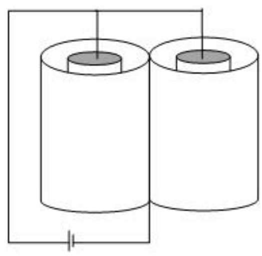
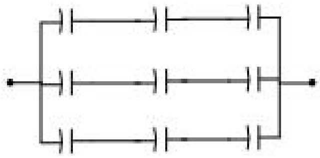
**[<u>c</u>.** It is advised to attempt question under examination conditions**]**

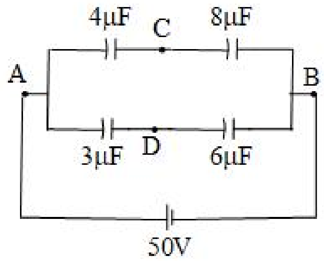
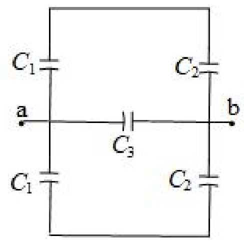
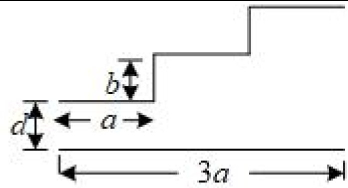
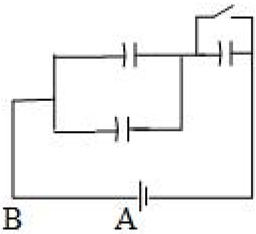
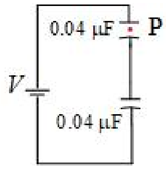
**Important Note:** Capacitors are implementation aspect of concepts of electrostatics. The capacitors are integral part of any electrical system or circuit and any kind of application of electricity.

| | |
|---|---|
| Q-1 | Suppose a charge $+Q_1$ is given to the positive plate and $-Q_2$ is given to the negative plate of a capacitor. What is the charge on the capacitor. |
| Q-2 | As $C = \left(\frac{1}{V}\right) Q$, can you say that the capacitance $C$ is proportional to the charge Q? |
| Q-3 | A hollow metal sphere and a solid metal sphere of equal radii are given equal charges. Which of the two will have higher potential? |
| Q-4 | The plates of a parallel plate capacitor are given positive charges. What will be the potential difference between the plates? What will be the charge on the facing surfaces and on the outer surfaces? |
| Q-5 | A capacitor has capacitance C. Is this information sufficient to know what maximum charge the capacitor can contain? If yes, what is the charge? If no, what other information is needed? |
| Q-6 | The dielectric constant decreases if temperature is increased. Explain this in terms of polarization of the material. |
| Q-7 | When a dielectric slab is gradually inserted between the plates of an isolated parallel-plate capacitor, the energy of the system decreases. What can you conclude about the force on the slab exerted by the electric field? |
| Q-8 | A capacitor of capacitance $C$ is charged to a potential V. The electric flux of the electric field through a closed surface enclosing the capacitor is<br>(a) $\frac{CV}{\varepsilon_0}$ (b) $\frac{CV}{\varepsilon_0}$ (c) $\frac{CV}{2\varepsilon_0}$ (d) Zero |
| Q-9 | Two capacitors each having capacitance $C$ and breakdown voltage $V$ are joined in series. The capacitance and breakdown voltage of the combination will be<br>(a) $2C$ and $2V$ (b) $C/2$ and $V/2$ (c) $2C$ and $V/2$ (d) $C/2$ and $2V$ |
| Q-10 | Two capacitors each having capacitance $C$ and breakdown voltage $V$ are joined in parallel. The capacitance and breakdown voltage of the combination will be<br>$2C$ and $2V$ (b) $C$ and $2V$ (c) $2C$ and $V$ (d) $C$ and $V$ |
| Q-11 | The equivalent capacitance of the combination shown in the figure is <br>(a) $C$ (b) $2C$ (c) $C/2$ (d) None of these |

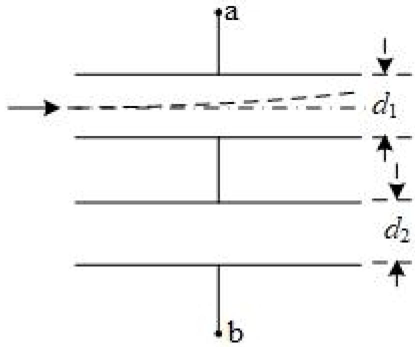
| | |
|---|---|
| Q-12 | A dielectric slab is inserted between plates of an isolated capacitor. The force between the plates will<br>(a) Increase (b) Decrease (c) Remain unchanged (d) Become zero |
| Q-13 | The energy density in the electric field created by a point charge falls off with the distance from the point charge as<br>(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$ (c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$ |
| Q-14 | A parallel-plate capacitor has plates of unequal area. The larger plate is connected to the positive terminal of the battery and smaller plate is connected to the negative terminal. Let $Q_+$ and $Q_-$ be the charges appearing on the positive and negative plates respectively.<br>(a) $Q_+ > Q_-$ (b) $Q_+ = Q_-$ (c) $Q_+ < Q_-$<br>(d) The information is no sufficient to decide relation between $Q_+$ and $Q_-$. |
| Q-15 | A thin metal plate P is inserted between the plates of a capacitor of capacitance $C$ in such a way that its edges touch the two plates as shown in the figure. The capacitance now becomes<br>(a) $C/2$ (b) $2C$ (c) $0$ (d) $\infty$<br> |
| Q-16 | Figure shows two capacitors connected in series and joined to a battery. The graph shows the variation I potential as one moves from left to the right on the branch containing capacitor.<br><br>(a) $C_1 > C_2$ (b) $C_1 = C_2$ (c) $C_1 < C_2$<br>(d) The information is not sufficient to decide the relation between $C_1$ and $C_2$ |
| Q-17 | Two metal plates having charges $Q, -Q$ face each other at some separation and are dipped into an oil tank. If the oil is pumped out, the electric field between the two plates will<br>(a) Increase (b) Decrease (c) Remain the same (d) Become Zero |
| Q-18 | Two metal spheres of capacitance $C_1$ and $C_2$ carry some charges. They are put in contact and then separated. The final charges $Q$ and $Q_2$ on them will satisfy<br>(a) $\frac{Q_1}{Q_2} < \frac{C_1}{C_2}$ (b) $\frac{Q_1}{Q_2} = \frac{C_1}{C_2}$ (c) $\frac{Q_1}{Q_2} > \frac{C_1}{C_2}$ (d) $\frac{Q_1}{Q_2} < \frac{C_2}{C_1}$ |
| Q-19 | Three capacitors of capacitances 6 μF each are available. The minimum and maximum capacitances, which may be obtained are<br>(a) 6 μF and 18 μF (b) 3 μF and 12 μF (c) 2 μF and 12 μF (d) 2 μF and 18 μF |
| Q-20 | The capacitance of a capacitor does not depend on<br>(a) Shape of the plates<br>(b) Size of plates<br>(c) Charges on the plates<br>(d) Separation between the plates |
| Q-21 | A dielectric slab is inserted between the plates of an isolated charged capacitor. Which of the following quantities will remain the same<br>(a) Electric field in the capacitor<br>(b) Charge on the capacitor<br>(c) Potential difference between the plates<br>(d) Energy stored in the capacitor |
| Q-22 | A dielectric slab is inserted between the plates of a capacitor. The charge on the capacitor is $Q$ and magnitude of the induced charge on the each surface of the dielectric is $Q_p$<br>(a) $Q_p$ may be larger than $Q$<br>(b) $Q_p$ must be larger than $Q$<br>(c) $Q_p$ may be equal to $Q$ |

| | |
|---|---|
| | (d) $Q_p$ must be smaller than $Q$ |
| Q-23 | Each plate of a parallel plate capacitor has a charge $q$ on it. The capacitor is now connected to a battery. Now<br>(a) The facing surfaces of the capacitor have equal and opposite charges<br>(b) The two plates of the capacitor have equal and opposite charges<br>(c) The battery supplies equal and opposite charges to the two plates<br>(d) The outer surfaces of the plates have equal charges |
| Q-24 | The separation between the two plates of a charged parallel-plate capacitor is increased. Which of the following quantities will change?<br>(a) Charge on the capacitor<br>(b) Potential difference across the capacitor<br>(c) Energy on the capacitor<br>(d) Energy density between the plates |
| Q-25 | A parallel-plate capacitor is connected to a battery. A metal sheet of negligible thickness is placed between the plates. The sheet remains parallel to the plates of the capacitor.<br>(a) The battery will supply more charge<br>(b) The capacitance will increase<br>(c) The potential difference between the plates will increase<br>(d) Equal and opposite charges will appear on two faces of the metal sheet |
| Q-26 | Following operations can be performed on a capacitor.<br>X—Connected the capacitor to a battery of emf $E$<br>Y- Disconnect the battery<br>Z – Connect the battery with polarity reversed<br>W- Insert a dielectric slab in the capacitor<br>(a) In operations X, Y and Z sequentially the electric energy stored in the capacitor remains unchanged.<br>(b) The charge appearing on the capacitor is greater after X,W and Y than after X,Y and W<br>(c) The electric energy stored in the capacitor is greater after W, X and Y than after X, Y and W.<br>(d) The electric field in the capacitor after X and W is same as that after W and X. |
| Q-27 | When $1.0 \times 10^{12}$ electrons are transferred from one conductor to another, a potential difference of 10 V appears between the two conductors. Calculate the capacitance of the two-conductor system. |
| Q-28 | The plates of a parallel-plate capacitor are made of circular discs of radii 5.0 cm each. If separation between the plates is 1.00 mm, what is the capacitance? |
| Q-29 | Suppose, one wishes to construct a 1.0 farad capacitor using circular discs. If the separation between the discs be kept 1.0mm, what would be the radius of the discs? |
| Q-30 | A parallel-plate capacitor having plate area 25 $cm^2$ and separation 1.0 mm is connected to a battery of 6.0 V. Calculate the charge flown through the battery. How much work has been done by the battery during the process? |
| Q-31 | A parallel-plate capacitor has plate area 25.0 $cm^2$ and separation 2.00 mm between the plates. The capacitor is connected to a battery of 12.0 V.<br>(a) Find the charge on the capacitor\<br>(b) The plate separation is decreased to 1.00 mm. Find the extra charge given by the battery to the positive plate. |

| | |
|---|---|
| Q-32 | Find the charges on the three capacitors connected to a battery as shown in the figure. Take $C_1 = 2.0$ μF, $C_2 = 4.0$ μF, $C_3 = 6.0$ μF and $V = 12$ volts.   |
| Q-33 | Three capacitors having capacitances $C_1 = 20$ μF, $C_2 = 30$ μF, $C_3 = 40$ μF are connected in series to a 12 V battery. Find the charge on each of the capacitor. How much work has been done by the battery in charging the capacitors? |
| Q-34 | Find the charge appearing on each of the three capacitors shown in the figure. Given that $C_1 = 8$ μF, $C_2 = 4$ μF, $C_3 = 4$ μF and $V = 12$ V.   |
| Q-35 | Take $C_1 = 4.0$ μF and $C_2 = 6.0$ μF in the figure. Calculate the equivalent capacitance of the combination between the points indicated.   (b) |
| Q-36 | Find the charge supplied by the battery of $V = 10$ V in the arrangement of capacitors shown in the figure. Take $C_1 = 5.0$ μF and $C_2 = 6.0$ μF.   |
| Q-37 | The outer cylinder of two cylindrical capacitors of capacitances 2.2 μF each, are kept in contact and the inner cylinder are connected through a wire. A battery of emf 10 V is connected as shown in the figure. Find the total charge supplied by the battery to the inner cylinder.  |
| Q-38 | Two conducting spheres of radii $R_1$ and $R_2$ are kept widely separated from each other. What are their individual capacitances? If the sphere are connected by a metal wire, what will be the capacitance of the combination? Think in terms of series-parallel combination. |
| Q-39 | Each of the capacitance in the figure has a capacitance 2 μF. Find the equivalent capacitance of the assembly between the points A and B. Suppose a battery of emf 60 volts is connected between A and B. Find the potential difference appearing on the individual capacitors.  |
| Q-40 | It is required to construct a 10 μF capacitor which can be connected across 200 V battery. Capacitors of capacitance 10 μF are available but they can withstand only 50 V. Design a combination which can yield the desired result. |

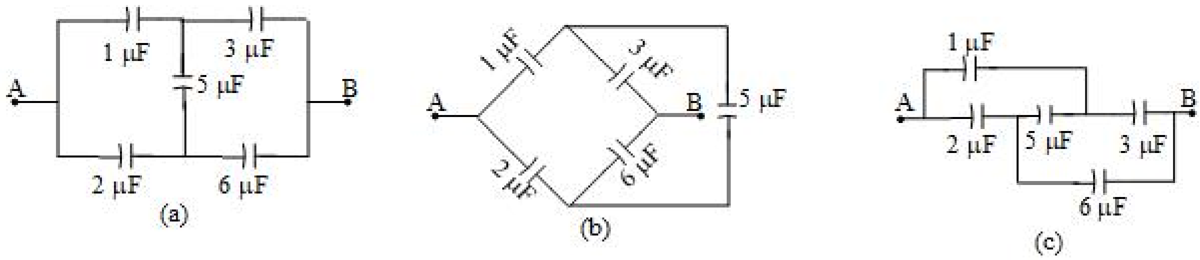
| | |
|---|---|
| Q-41 | Take the potential of the point B in the figure to be zero.<br>(a) Find the potential at points C and D<br>(b) If a capacitor is connected between C and D, what charge will appear on it.<br> |
| Q-42 | Find equivalent capacitance of system shown in the figure. Between a and b.<br> |
| Q-43 | A capacitor is made of a flat sheet of area $A$ and a second plate having a stair-like structure as shown in the figure. The width of each star is $a$ and height $b$. Find capacitance of the assembly.<br> |
| Q-44 | A cylindrical capacitor is constructed using two coaxial cylinders of same length 10 cm and radii 2 mm and 4 mm.<br>(a) Calculate the capacitance.<br>(b) Another capacitor of the same length is constructed with cylinders of radii 4 mm and 8 mm. Calculate the capacitance |
| Q-45 | A 100 μF capacitor is charged to a potential difference of 24 V. It is connected to an uncharged capacitor of capacitance 20 μF. What will be the new potential difference across 100 μF capacitor? |
| Q-46 | Each of the capacitor shown in the figure has a capacitance 5.0 μF. The emf of the batter is 50 V. How much charge will flow through AB if the switch is closed?<br> |
| Q-47 | The particle P shown in the figure has a mass of 10 mg and a charge -0.01 μC. Each plate has a surface area 100 $cm^2$ on one side. What potential difference $V$ should be applied to the combination to hold the particle in equilibrium?<br> |

**Q-48** Both the capacitors shown in the figure are made of square plates of edge $a$. The separation between the plates of the capacitors are $d_1$ and $d_2$ as shown in the figure. A potential difference $V$ is applied between points a and b. An electron is projected between the plates of the upper capacitor along its central line. With what minimum speed should the electron be projected so that it does not collide with any plate? Consider only the electric forces.

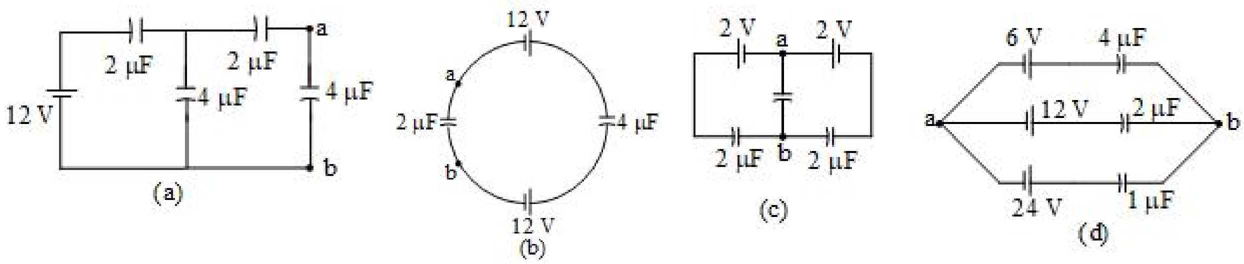



**Q-49** The plates of a capacitor are 2.00 cm apart. An electron-proton pair is released somewhere in the gap between the plates and it is found that the proton reaches the negative plate at the same time as electron reaches the positive plate. At what distance from the negative plate was the pair released?

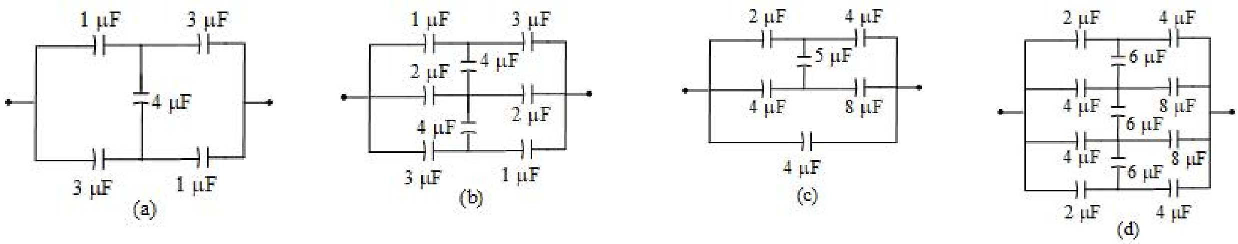
**Q-50** Convince yourself that parts (a), (b) an (c) of figure are electrically identical. Find capacitance between points A and B of the assembly.



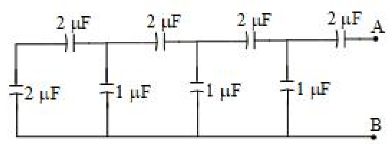

**Q-51** Find the potential difference $V_a - V_b$, between the points a and b shown in each part of the figure.

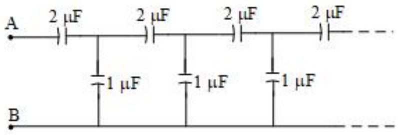
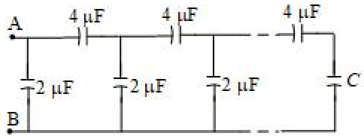
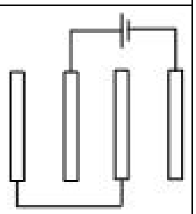
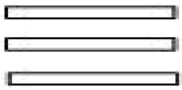
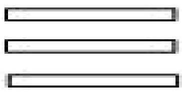
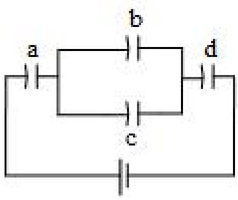
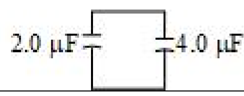


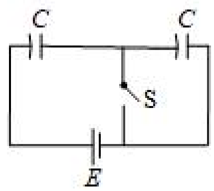

**Q-52** Find the equivalent capacitance of the combination shown in each part of the figures between the indicated points.

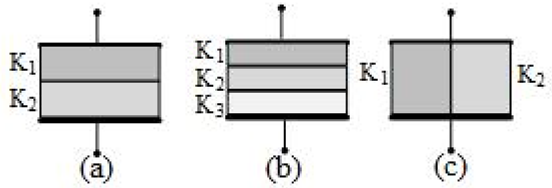
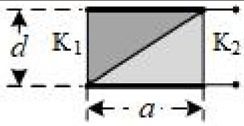
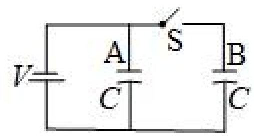


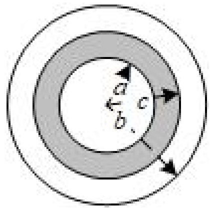
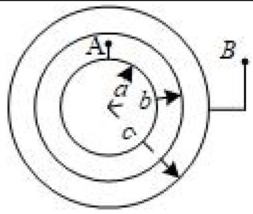
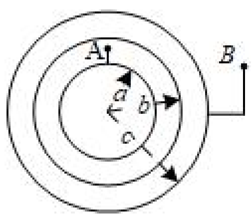
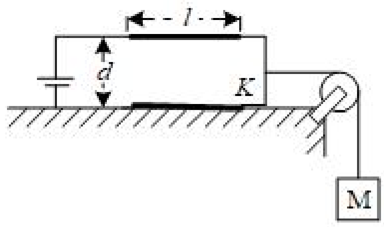
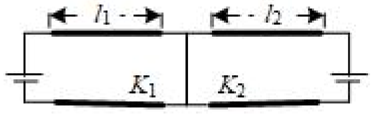

**Q-53** Find the capacitance of the combination shown in the figure between A and B.

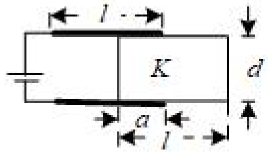


| | |
|---|---|
| Q-54 | Find equivalent capacitance of infinite ladder shown in the figure between points A and B  |
| Q-55 | A finite ladder is constructed by connecting several sections of 2 μF and 4 μF capacitors as shown in the figure. It is terminated by a capacitor of capacitance *C*. What value should be chosen for *C*, such that the equivalent of the ladder between points A and B becomes independent of the number of sections in between?  |
| Q-56 | A charge of $+2.0 \times 10^{-8}$ C is placed on the positive plate and a charge $-1.0 \times 10^{-8}$ C on the negative plate of a parallel plate capacitor of capacitance $1.2 \times 10^{-3}$μF. Calculate potential difference developed between the plates. |
| Q-57 | A charge of 20 μC is placed on the positive plate of an isolated parallel-plate capacitor of capacitance 10 μF. Calculate the potential difference developed between the plates. |
| Q-58 | A charge of 1 μC is given to one plate of a parallel-plate capacitor of capacitance 0.1 μF and a charge 2 μC is given to the other plate. Find potential difference developed between the plates. |
| Q-59 | Each of the plates shown in the figure has surface area $\left(\frac{96}{\varepsilon_0} \times 10^{-12}\right)$ Fm on one side and separation between the consecutive plates is 4.00 mm. The emf of the battery connected is 10 Volts. Find magnitude of charge supplied by the battery to each of the plates connected to it.  |
| Q-60 | Capacitance between the adjacent plates shown in figure is 50 nF. A charge of 1.0 μC is placed on the middle plate.<br>(a) What will be the charge on outer surface of the upper plate?<br>(b) Find the potential difference developed between the upper and the middle plates.  |
| Q-61 | Capacitance between the adjacent plates shown in figure is 50 nF. A charge of 1.0 μC is placed on the upper plate, what will be the potential difference between -<br>(a) The upper and middle plates?<br>(b) The middle and lower plates?  |
| Q-62 | Two capacitors of capacitances 20.0 pF and 50.0 pF are connected in series with a 6.00 V battery. Find –<br>(a) The potential difference across each capacitor<br>(b) The energy supplied by the battery. |
| Q-63 | Two capacitors of capacitances 4.0 μF and 6.0 μF are connected in series with a 20 V battery. Find the energy supplied by the battery. |
| Q-64 | Each capacitor in the figure has a capacitance of 10 μF. The emf of the battery is 100 V. Find energy stored in each of the four capacitors.  |
| Q-65 | A capacitor with stored energy 4.0 J is connected with an identical capacitor with no electric field in between. Find the total energy stored in two capacitors. |
| Q-66 | A capacitor of capacitance 2.0 μF is charged to a potential difference of 12 V. It is then connected to an uncharged capacitor of capacitance 4.0 μF as shown in the figure. Find –<br>(a) The charge on each of the capacitors after the connection.  |

| | |
|---|---|
| | (b) The electrostatic energy stored in each of the two capacitors<br>(c) The heat produced during the charge transfer from one capacitor to the other. |
| Q-67 | A point charge $Q$ is placed at the origin. Find the electrostatic energy stored in an outside sphere of radius $R$ centered at the origin. |
| Q-68 | A metal sphere of radius $R$ is charged to a potential $V$.<br>(a) Find the electrostatic energy stored in the electric field within a concentric sphere of radius $2R$<br>(b) Show that the electrostatic field energy stored outside the sphere of radius 2R equals that stored within it. |
| Q-69 | A large conducting plane has a surface charge density $1.0 \times 10^{-4}$ C/m$^2$. Find the electrostatic energy stored in a cubical volume of edge 1.0 cm in front of the plane. |
| Q-70 | A parallel-plate capacitor having plate area 20 cm$^2$ and separation between the plates 1.00 mm is connected to a battery of 12.0 V. The plates are pulled apart to increase the separation to 2.00 mm.<br>(a) Calculate the charge flown through the circuit during the process.<br>(b) How much energy is absorbed by the battery during the process?<br>(c) Calculate the stored energy in the electric field before and after the process.<br>(d) Using the expression for the force between the plates, find the work done by the person pulling the plates apart.<br>(e) Show and justify that no heat is produced during the transfer of charge as separation is increased. |
| Q-71 | A capacitor having a capacitance 100 μF is charged to a potential difference of 24 V. The charging battery is disconnected and the capacitor is connected to another battery of 12 V with the positive plate of the capacitor joined with the positive terminal of the battery.<br>(a) Find the charge on the capacitor before and after the reconnection.<br>(b) Find the charge flown through the 12 V battery.<br>(c) Is work done by the battery or is it done on the battery? Find the magnitude.<br>(d) Find the decrease in electrostatic field energy.<br>(e) Find the heat developed during the flow of charge after reconnection. |
| Q-72 | Consider the situation shown in the figure. The switch S is open for a long time and then closed.<br>(a) Find the charge flown through the battery when the switch S is closed.<br>(b) Find the work done by the battery.<br>(c) Find the change in energy stored in the capacitor.<br>(d) Find the heat developed in the system.<br> |
| Q-73 | A capacitor of capacitance 5.00 μF is charged to 24.0 V and another capacitor of capacitance 6.00 μF is charged to 12.0 V.<br>(a) Find the energy stored in each capacitor.<br>(b) The positive plate of the first capacitor is connected to the negative plate of the second and vice versa. Find the new charges on the capacitors.<br>(c) Find the loss of electrostatic energy during the process.<br>(d) Where does this energy go? |
| Q-74 | A capacitor of capacitance 5.0 μF is charged to 12 V. The positive plate of this capacitor is now connected to the negative terminal of a 12 V battery and vice versa. Calculate the heat developed in the connecting wires. |
| Q-75 | The two square faces of a rectangular dielectric slab (dielectric constant 4.0) of dimensions 20 cm x 20 cm x 1.0 mm are metal coated. Find the capacitance between the coated surface. |
| Q-76 | The two square faces of a rectangular dielectric slab (dielectric constant 4.0) of dimensions 20 cm x 20 cm x 1.0 mm are metal coated. Find the capacitance between the coated surface. The coated plates are connected across a 6.0 V battery. Find –<br>(a) The charge supplied by the battery, |

| | |
|---|---|
| | (b) The induced charge on the dielectric, and<br>(c) The net charge appearing on one of the coated surfaces. |
| Q-77 | The separation between the plates of a parallel-plate capacitor is 0.500 cm and its plate area is 100 $cm^2$. A 0.400 cm thick metal sheet is inserted into the gap with its faces parallel to the plates. Show that the capacitance of the assembly is independent of the position of the metal plate within the gap and its value. |
| Q-78 | A capacitor stores 50 μC of charge when connected across a battery. When the gap between the plates is filled with a dielectric, a charge of 100 μC flows through the battery. Find the dielectric constant of the material inserted. |
| Q-79 | A parallel-plate capacitor of 5 μF is connected to a battery of emf 6 V. The separation between the plates is 2 mm.<br>(a) Find charge on the positive plate of the capacitor.<br>(b) Find the electric field between the plates.<br>(c) A dielectric slab of thickness 1mm and dielectric constant 5 is inserted into the gap to occupy the lower half of it. Find the capacitance of the new combination.<br>(d) How much charge has flown through the battery after the slab is inserted? |
| Q-80 | A parallel-plate capacitor has plate area 100 $cm^2$ and separation 1.00 cm. A glass plate (dielectric constant 6.0) of thickness 6.0 mm and an ebonite plate dielectric constant 4.0) are inserted one over the other to fill the space between the plates of the capacitor. Find the new capacitance. |
| Q-81 | A parallel-plate capacitor has plate area 400 $cm^2$ and plate separation between the plates 1.0 mm connected to a power supply of 100 V. A dielectric slab of thickness 0.5 mm and dielectric constant 5.0 is inserted into the gap.<br>(a) Find the increase in the electrostatic energy.<br>(b) If the power supply is now disconnected and the slab is taken out, find the further increase in energy.<br>(c) Why does the energy increase in inserting the slab as well as in taking it out? |
| Q-82 | Find the capacitances of the capacitors shown in the figure. The plate area is *A* and separation between the plates is *d*. Different dielectric slabs in a particular part of the figure are of the same thickness and entire gap between the plates is filled with the dielectric slabs.   |
| Q-83 | A capacitor is formed by two square metal-plates of edge *a*, separated by a distance *d*. Dielectric of dielectric constant $K_1$ and $K_2$ are filled in the gaps as shown in the figure. Find the capacitance.   |
| Q-84 | Figure shows two identical parallel-plate capacitors connected to a battery through a switch S. Initially, the switch is closed so that the capacitors are completely charged. The switch is now opened and free space between the plates of the capacitors is filled with dielectric of dielectric constant 3. Find the ratio of the initial total energy stored in the capacitors to the final total energy stored.   |
| Q-85 | A parallel-plate capacitor of plate area *A* and plate separation *d* is charged to a potential difference *V* and then the battery is disconnected. A slab of dielectric constant *K* is then inserted between the plates of the capacitor so as to fill the space between the plates. Find the work done on the system in the process of inserting the slab. |
| I-85 | Given is a capacitor having plate area *A* and separation *d* is charged to a potential difference *V*. In this state energy stored in the capacitor is $E' = \frac{QV}{2} = \frac{(CV)V}{2} \Rightarrow E' = \frac{CV^2}{2}$.<br>Next battery is disconnected and a dielectric slab of dielectric constant *K* is then inserted to fill space between the plates of the capacitor. In this state charge on the capacitor stays at $Q = CV$, but capacitance changes to $C' = CK$. Accordingly, in this new state energy stored in the system is $E'' = \frac{Q}{2}\left(\frac{Q}{C'}\right) \Rightarrow E'' = \frac{Q^2}{2C'} \Rightarrow E'' = \frac{(CV)^2}{2CK}$. |

| | |
|---|---|
| | It leads to $E'' = \frac{CV^2}{2K}$. Thus change in energy stored in the capacitor is $\Delta E' = E'' - E' \Rightarrow \Delta E' = \frac{CV^2}{2K} - \frac{CV^2}{2}$.<br>Using $C = \frac{\varepsilon_0 A}{d}$, we get $\Delta E' = \left(\frac{\varepsilon_0 A}{d}\right)\frac{V^2}{2}\left(\frac{1}{K} - 1\right) \Rightarrow \Delta E' = \frac{\boldsymbol{\varepsilon_0 A V^2}}{\boldsymbol{2d}}\left(\frac{\boldsymbol{1}}{\boldsymbol{K}} - \boldsymbol{1}\right)$ **is the answer**. |
| Q-86 | A capacitor having a capacitance of 100 μF is charged to a potential difference of 50 V.<br>(a) What is the magnitude of the charges on each plate?<br>(b) The charging battery is disconnected and a dielectric of dielectric constant 2.5 is inserted. Calculate the new potential difference between the plates.<br>(c) What charge would have produced this potential difference in absence of the dielectric slab?<br>(d) Find the charge induced at a surface of the dielectric slab. |
| Q-87 | Q-61, HCV-II, Ch-31, Ex, pp. 169-170 |
| Q-87 | A spherical capacitor is made of two conducting spherical shells of radii *a* and *b*. The space between the shells is filled with a dielectric of dielectric constant *K* upto radius *c* as shown in the figure. Calculate the capacitance.   |
| Q-88 | Consider an assembly of three conducting spherical shells of radii *a*, *b* and *c* as shown in the figure. Find capacitance of the assembly between points A and B.   |
| Q-89 | Suppose the space between the two inner shells as shown in the figure filled with a dielectric of dielectric constant *K*. Find capacitance of the system between points A and B.   |
| Q-90 | An air filled parallel plate capacitor is to constructed which can store 12 μC of charge when operated at 1200 V. What can be the minimum plate area of the capacitor? The dielectric strength of air is $3 \times 10^6$ V/m. |
| Q-91 | A parallel-plate capacitor with the plates area 100 $cm^2$ and separation between the plates is 1.0 cm is connected across a battery of emf 24 volts. Find the force of attraction between the plates. |
| Q-92 | Consider the situation shown in the figure. The width of each plate is b. The capacitor plates are rigidly clamped in the laboratory and connected to a battery of emf E. All surfaces are frictionless. Calculate the value of M for which the dielectric slab will stay in equilibrium.   |
| Q-93 | Figure shows two parallel plate capacitors with fixed plates and connected to two batteries. The separation between the plates is the same for the two capacitors. The plates are rectangular in shape with width b and length $l_1$ and $l_2$. The left half of the dielectric slab has a dielectric constant $K_1$ and the right half $K_2$. Neglecting friction, find the ratio of the emf of the left battery to that of the right battery for which the dielectric slab may remain in equilibrium.   |

| | |
|---|---|
| Q-94 | Consider the situation shown in the figure. The plates of the capacitor have plate area A and are clamped in the laboratory. The dielectric slab is released from rest with a length a inside the capacitor. Neglecting any effect of friction or gravity, show that the slab will execute periodic motion and find its time3 period.  |

**—00—**