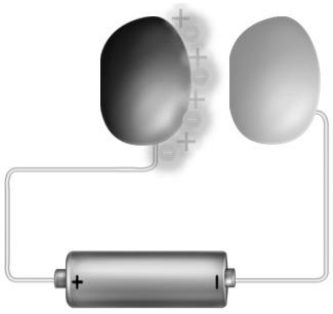
CHAPTER- 2

Capacitors

Exercise

Q.1 Two conductors of irregular shapes placed near each other are connected to the two terminals of a battery of50 V. It is observed that the charge on one of the conductors is2 μC. The capacitance of this arrangement is

(A) 2×10^{-8} F **(B)** 4×10^{-8} F **(C)** 10^{-8} F **(D)** $\times 10^{-6}$ F



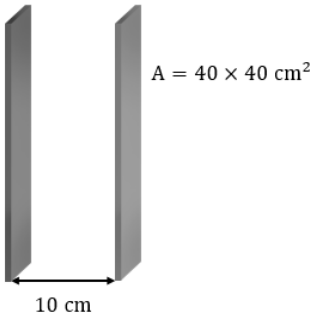
Q.2 Choose the correct dimensional formula of**5 CV**.(**C**Is capacitance and **V** is potential difference)

(A) $[M^{\circ}L^{\circ}T^{2}A^{1}]$ **(B)** $[M^{1}L^{0}T^{1}A^{1}]$ **(C)** $[M^{\circ}L^{\circ}T^{1}A^{1}]$ **(D)** $[M^{\circ}L^{2}T^{3}A^{2}]$

Q.3 What is the capacitance of a parallel plate capacitor having 40 cm × 40 cm square plates separated by the distance10 cm? (Take$\epsilon_{o} = 8.85 \times 10^{-12}$ F/m)

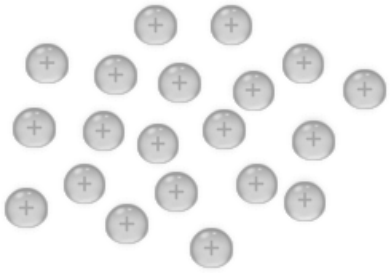
(A) 2.8×10^{-12} F **(B)** 1.4×10^{-11} F

(C) 2.8×10^{-11} F **(D)** 1.4×10^{-12} F



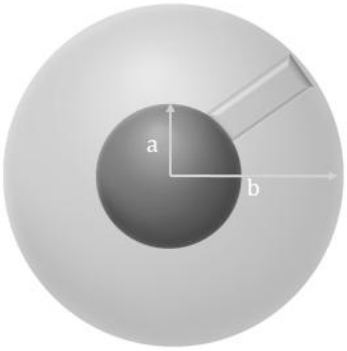
Q.4 1000 small water drops each of capacitance C are combined together to form one large spherical drop. The capacitance of the bigger drop is

(A) C **(B)** 10 C **(C)** 100 C **(D)** 1000 C



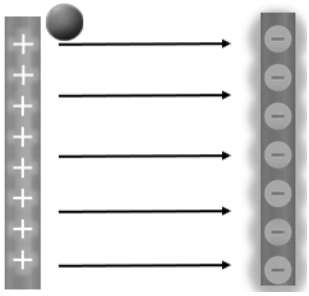
Q.5 The spheres shown in the figure are connected by a conductor. The capacitance of this setup will be

(A) $4\pi\epsilon_0 \frac{ab}{(b-a)}$ **(B)** $4\pi\epsilon_0 a$ **(C)** $4\pi\epsilon_0 b$ **(D)** $4\pi\epsilon_0 \frac{b^2}{(b-a)}$



Q.6 A parallel plate capacitor has a plate separation **d** and charge**Q**. A positive charge **q** of mass **m** is released from a point very near to the positive plate. The time taken by the charge to reach to the negative plate of capacitor is (Neglect gravity)

(A) $\sqrt{\frac{3dm\epsilon_0 A}{qQ}}$ **(B)** $\sqrt{\frac{4dm\epsilon_0 A}{qQ}}$ **(C)** $\sqrt{\frac{2dm\epsilon_0 A}{qQ}}$ **(D)** None of these

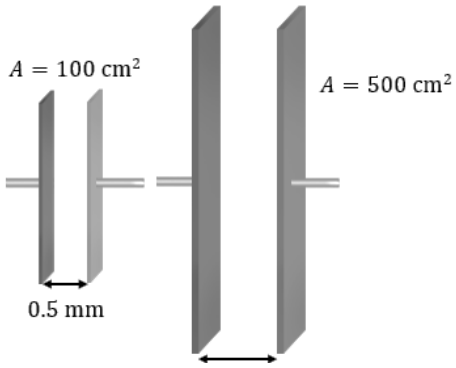


Q.7 A parallel plate air capacitor is charged to a potential difference of *V* Volts. After disconnecting the charging battery, the distance between the plates of the capacitor is increased using an insulating handle. As a result, the potential difference between the plates

(A) Decreases **(B)** Does not charge **(C)** Becomeszero **(D)** Increases

Q.8 Two parallel plate capacitors have their plate areas 100 cm2 and 500 cm2 respectively. If they have the same charge and potential difference, and the distance between the plates of first capacitor is 0.5 mm, then the distance between the plates of second capacitor is

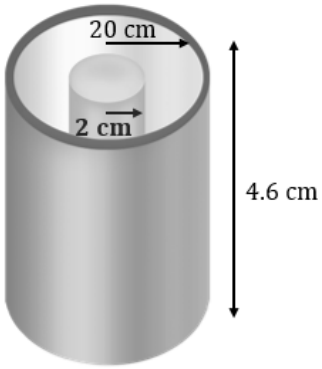
(A) 0.10 cm **(B)** 0.15 cm **(C)** 0.20 cm **(D)** 0.25 cm



Q.9 A cylindrical conductor of radius 2 cm is surrounded by another hollow cylindrical conductor of radius20 cm. If the length of both the cylinders is4.6 cm, then what is the capacitance of this system? (Ln10 = 2.3)

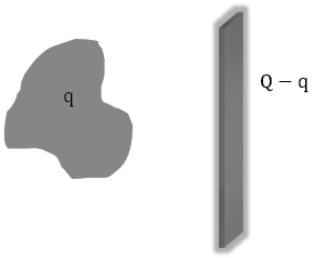
(A) 2.2×10^{-12} F **(B)** 1.1×10^{-11} F

(C) 2.2×10^{-11} F **(D)** 1.1×10^{-12} F



Q.10 A conductor initially free from charge is charged by repeated contacts with a plate which after each contact is replenished to a charge**Q**. If **q** is the charge on the conductor after first operation, then the maximum charge which can be given to the conductor in this way will be: (When 2 conductors are in contact, potential on them becomes equal)

(A) $\frac{3Qq}{2Q+q}$ **(B)** $\frac{2Qq}{Q+q}$ **(C)** $\frac{Qq}{Q+q}$ **(D)** $\frac{Qq}{Q-q}$

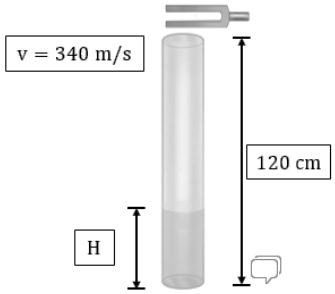


WORKSHEET

Resonance in Sound Waves

Q.1 A tuning fork of frequency 340 Hz is vibrated just above the tube of 120 cm height. Water is poured slowly in the tube. What is the minimum height of water necessary for the resonance? [Take speed of sound = 340 m/s]

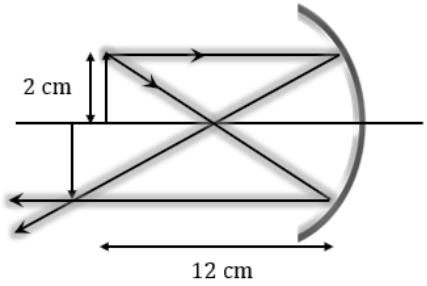
(A) 45 cm **(B)** 30 cm **(C)** 25 cm **(D)** 20 cm



Location of Image & Focal Length of the Mirror

Q.2 An object of height 2 cm is placed on the principal axis of a concave mirror at a distance of 12 cm from the pole. If the image is real, inverted and 5 cm high, then location of the image and the focal length of the mirror is

(A) 30 cm, 8.6 cm **(B)** 30 cm, 7.6 cm **(C)** 25 cm, 8.6 cm **(D)** 25 cm, 7.6 cm

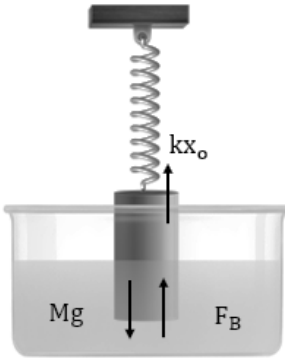


Buoyancy Force

Q.3 A uniform cylinder of length L and mass M having cross-sectional area A is suspended with its length vertical from a fixed point by a massless spring (spring constant k) such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_o of the spring when it is in equilibrium is:

(A) $\frac{Mg}{k}$ **(B)** $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$

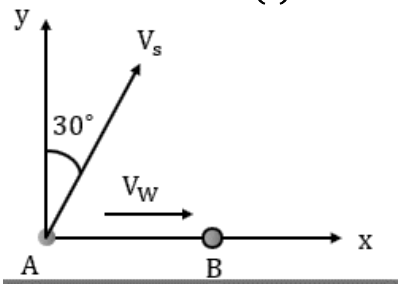
(C) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$ **(D)** $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$



Apparent Frequency: Source Moving

Q.4 In the figure shown, a source of sound at A having frequency 510 Hzmoves with constant velocity $v_s = 20$ m/s in the direction shown. The wind is blowing at a constant velocity $v_w = 20$ m/s towards an observer who is at rest at pointB. Frequency detected by the observer corresponding to the sound emitted by the source at initial position A will be(speed of sound relative to air $= 330$ m/s)

(A)485 Hz **(B)**500 Hz **(C)**512 Hz **(D)**525 Hz



Terminal Velocity

Q.5 Two spherical rain drops with radii in the ratio 1: 2 fall from a great height through the atmosphere. The ratio of their momenta after they have attained terminal velocity is:

(A)1: 8 **(B)**2: 1 **(C)**1: 32 **(D)**1: 2

Moving Object Velocity

Q.6 A point object is performing SHM starting from mean position at $t = 0$ along the principal axis of a concave mirror at rest. The image velocity will

(A) Be in the same phase with respect to object velocity.

(B) Have phase difference of 90° with respect to object velocity.

(C) Have a phase difference of 180° with respect to object velocity.

(D) Have phase difference of 45° with respect to object velocity.

Longitudinal Strain

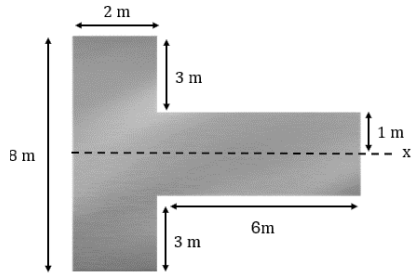
Q.7 A wire of cross-section area 2 mm^2 is stretched by 0.1 mm by a certain force. How far (length) will the wire of same material and length but area 8 mm^2 stretch under the action of the same force?

(A)0.25 mm **(B)**0.005 mm **(C)**0.025 mm **(D)**0.05 mm

COM of Solid Bodies

Q.8 If mass is uniformly distributed, find the distance (in m) of the centre of mass of the T-shaped plate from pointO.

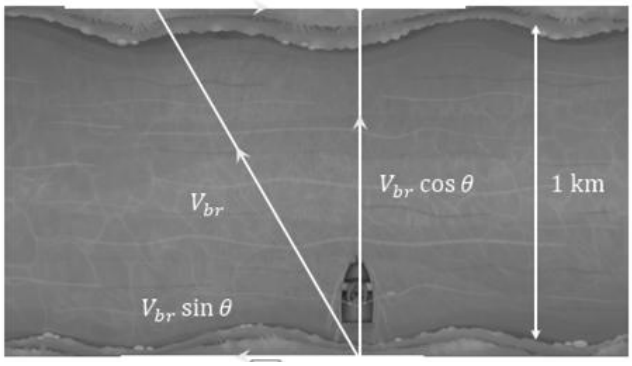
(A)$\frac{19}{7}$ **(B)**$\frac{9}{7}$ **(C)** $\frac{7}{9}$ **(D)**$\frac{7}{19}$



Relative Velocity

Q.9 A boat that has a speed of 5 km/hr in still water crosses a river of width 1 km along the shortest possible path in 20 minutes. The velocity of the river water in (km/hr) is

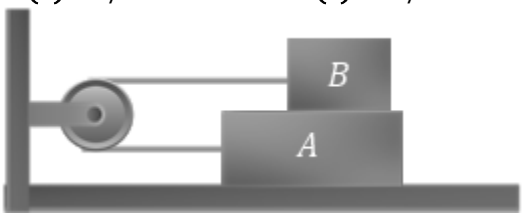
(A)1 **(B)** 3 **(C)** 4 **(D)**4.5



Relative Acceleration

Q.10 A system consists of blocks A and B of same mass 5 kg and connected to the pulley as shown in figure. Find the minimum relative acceleration with which they will move?(Take$g = 10$ m/s^2)

(A)8 m/s^2 **(B)**5 m/s^2 **(C)** 4 m/s^2 **(D)**16 m/s^2



About Capacitor

Q.11 A capacitor cannot be used as a battery because

(A) It cannot store a large amount of charge

(B) It produces too much heat

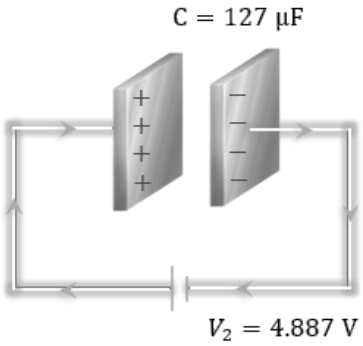
(C) It gets discharged very rapidly

(D) It is very costly as compared to a battery

More about Q=CV

Q.12 The voltage across a parallel plate capacitor of capacitance 127 μF is increased from 3.887 V to 4.887 V. The extra charge that flows through the battery is

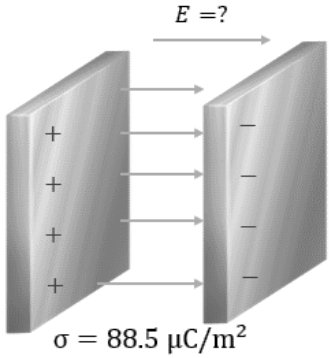
(A)63.5 μC **(B)**254 μC **(C)** 508 μC **(D)**127 μC



Charges on Large and Parallel Conducting Plates

Q.13 Magnitude of surface charge density on each plate of a parallel plate capacitor is88.5 $\mu C/m^2$. What is the magnitude of the electric field in the region between the plates?(Takeϵ_o 8.8510^{-12} C^2/Nm^2)

(A) 2×10^7 N/C **(B)** 10^7 N/C **(C)** 10^6 N/C **(D)** 4×10^7 N/C

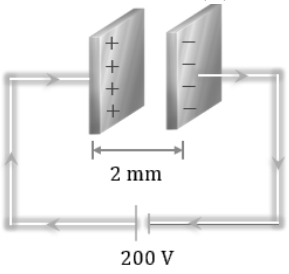


Capacitance of Parallel Plate Capacitor

Q.14 A parallel plate capacitor has rectangular plates of area 400 cm^2 and separated by 2 mm with air as a medium. What is the magnitude of charge on each plate if the applied potential difference is200 Volts? (Take$\epsilon_o = 8.85 \times 10^{-12}$ F/m)

(A) 3.54×10^{-6} C **(B)** 3.54×10^{-8} C

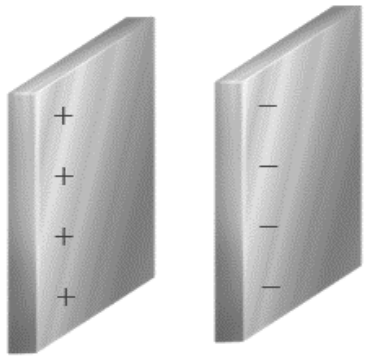
(C) 1770.8×10^{-9} C **(D)** 1770.8×10^{-13} C



Capacitance of Parallel Plate Capacitor

Q.15 Charges 2q and $-3q$ are given to two identical metal plates of cross-sectional areaA. The distance between the plates isd. The capacitance of system and potential difference between plates respectively will be:

(A) $\frac{2A\epsilon_0}{d}$, $\frac{qd}{2\epsilon_0 A}$ **(B)** $\frac{A\epsilon_0}{d}$, $\frac{2.5qd}{\epsilon_0 A}$ **(C)** $\frac{A\epsilon_0}{2d}$, $\frac{2.5\ qd}{\epsilon_0 A}$ **(D)** $\frac{A\epsilon_0}{d}$, $\frac{5qd}{\epsilon_0 A}$

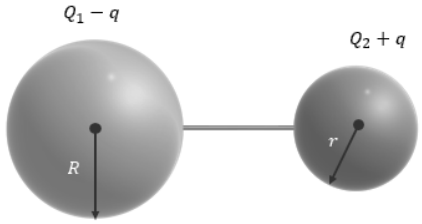


Charge vs Potential in Spherical Conductor

Q.16 Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C respectively. If these are connected by a conducting wire (potential on them becomes equal), the final charge on bigger sphere is

(A) 2×10^{-2} C **(B)** 3×10^{-2} C

(C) 4×10^{-2} C **(D)** 1×10^{-2} C

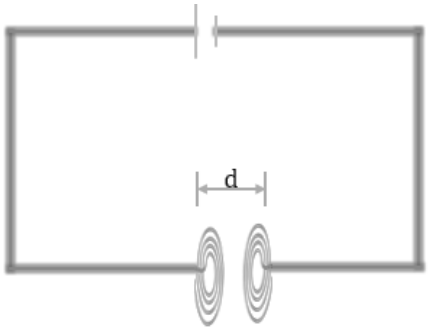


Capacitance of Parallel Plate Capacitor

Q.17 Two identical sheets of the same metallic foil of the area A are separated by a distanced, and charged by a battery of emfE. Keeping the charge constant, the separation is increased byl. Then, the new capacitance and potential difference will be

(A) $\frac{\epsilon_0 A}{d}$, E **(B)** $\frac{\epsilon_0 A}{(d+l)}$, E

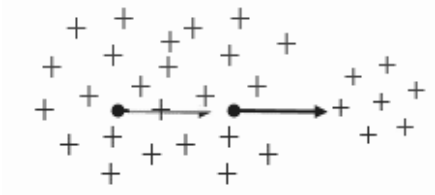
(C) $\frac{\epsilon_0 A}{(d+l)}$, $\left[1+\frac{l}{d}\right]$E **(D)** $\frac{\epsilon_0 A}{d}$, $\left[1+\frac{l}{d}\right]$E



Charge vs Potential in Spherical Conductor

Q.18 A large conducting sphere of radiusr, having a charge Q is placed in contact with a small neutral conducting sphere of radius r′ and is then separated. The charge on smaller sphere will now be:

(A) $\frac{Q(r+r')}{r}$ **(B)** $\frac{Q(r-r')}{r'}$ **(C)** $\frac{Qr}{r'+r}$ **(D)** $\frac{Qr'}{r'+r}$



Energy of a Capacitor

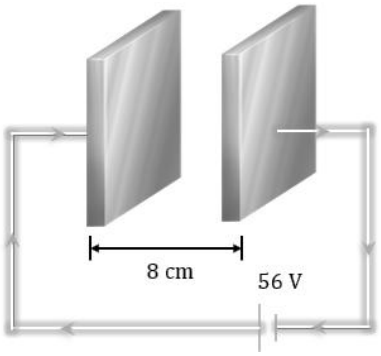
Q.19 The energy of a 100 μF capacitor charged to 6 kV is used to lift a 50 kgmass (by powering a motor by energy of capacitor) without incurring any losses. What would be the greatest vertical height through which mass could be raised?(Takeg = 10 m/s^2)

(A)0.6 mm **(B)**3.6 m **(C)** 1.6 m **(D)**1.2 mm

Capacitance of Parallel Plate Capacitor

Q.20 Two plates of a capacitor of the area 100 cm^2 are separated by a distance of8 cm, and charged by a battery of emf56 V. If the separation is increased by8.5 mm, then the new capacitance will be

(A)10^{-13} F **(B)**10^{-11} F **(C)**10^{-14} F **(D)**10^{-12} F



ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(A)	(B)	(D)	(C)	(A)	(D)	(C)	(D)	(B,C)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(B)	(D)	(B)	(D)	(A)	(D)	(A)	(C)	(C)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(C)	(A)	(A)	(A)	(C)	(B)	(C)	(D)	(C)	(B,D)
Q.	21									
Sol.	(C,D)									