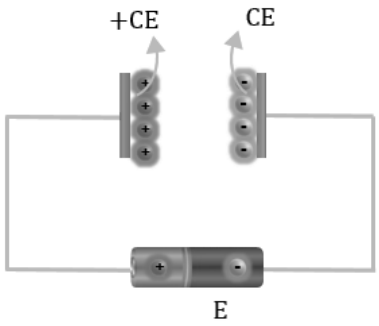
Q.1 A capacitor of capacitance C carrying a charge Q is connected to an emf source of emfE. Finally, the charge on the capacitor is

(A) Q **(B)** $Q + CE$ **(C)** CE **(D)** $Q - CE$



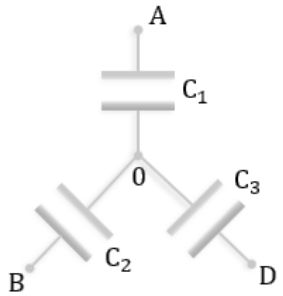
Q.2 A capacitor of 4 μF charged at 50 V is connected with another capacitor of 2 μF charged at100 V, in such a way that plates with similar charges are connected together. Before joining and after joining the total energy will be

(A) 1.5×10^{-2} J & 1.33×10^{-2} J **(B)** 1.33×10^{-2} J & 1.5×10^{-2} J

(C) 1.5×10^{-2} J & 2.67×10^{-2} J **(D)** 2.67×10^{-2} J & 1.5×10^{-2} J

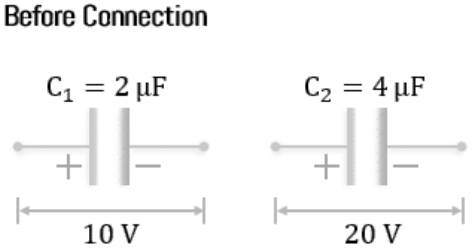
Q.3 Three uncharged capacitors of capacitance $C_1 = 1$ μF, $C_2 = 2$ μF and $C_3 = 3$ μF are connected as shown in figure. If potential at shown points are $V_A = 10$ V; $V_B = 25$ V and $V_D = 20$ V. The potential at point O will be

(A) 20 V **(B)** 10 V **(C)** 30 V **(D)** 40 V



Q.4 A 2 μF capacitor is charged to a potential difference of10 V. Another 4 μF capacitor is charged to a potential difference of20 V. The two capacitors are then connected in a single loop, with the positive plate of one connected with negative plate of another. What is the amount of heat dissipated in the circuit?

(A) 300 μJ **(B)** 600 μJ **(C)** 900 μJ **(D)** 450 μJ

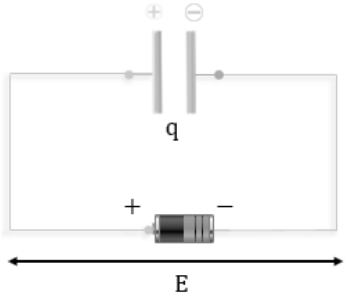


Q.5 An uncharged capacitor of $\mathbf{50\ \mu F}$ is connected to a battery of $\mathbf{10\ V}$. What amount of energy supplied by the battery is lost as heat while charging the capacitor?

(A) 5 mJ **(B)** 2.5 mJ **(C)** 1.25 mJ **(D)** 10 mJ

Q.6 A capacitor of capacitance **C** is charged by connecting it to a battery of emf **E**. The capacitor is now disconnected and reconnected to the battery with the polarity reversed. The heat developed in the connecting wires is:

(A) $2CE^2$ **(B)** $\frac{CE^2}{4}$ **(C)** CE^2 **(D)** $\frac{3}{2}CE^2$



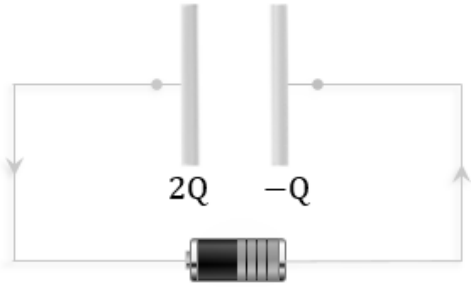
Q.7 In the figure shown, the plates of a parallel plate capacitor have unequal charges. Its capacitance is **C**. The distance between the plates of cross-sectional area **A** is **d**.Consider the following statements:

1. The energy stored in the electric field region between plates is $\frac{\mathbf{9Q^2}}{\mathbf{8C}}$
2. Force exerted by one plate on theanother one is $\frac{\mathbf{Q^2}}{\mathbf{4A\epsilon_0}}$
3. The potential difference between the plates will be $\frac{\mathbf{3Q}}{\mathbf{2C}}$
4. Force exerted by one plate on the another one is $\frac{\mathbf{Q^2}}{\mathbf{A\epsilon_0}}$

Choose the correct option, which represents a set of true statements:

(A) (1), (2), (3) Only **(B)** (1), (3), (4) only

(C) (2) & (3) Only **(D)** (3) only



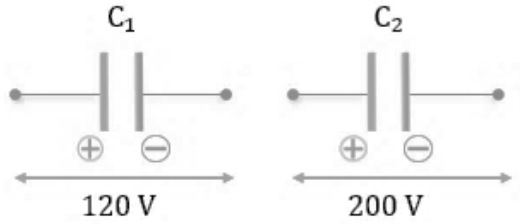
Q.8 A parallel plate capacitor of capacitance C is connected to a battery and is charged to a voltageV. Another capacitor of capacitance2C is similarly charged to a voltage2V. The batteries are disconnected and the capacitors are connected in parallel to each other in such a way that the positive terminal of one is connected to the negative terminal of the other capacitor. The final energy of the configuration is

(A) 0 **(B)** $\frac{3CV^2}{2}$ **(C)** $\frac{25CV^2}{6}$ **(D)** $\frac{9CV^2}{2}$

Q.9 Two capacitors $\boldsymbol{C_1}$ and $\boldsymbol{C_2}$ are charged to **120 V** and **200 V** respectively. It is found that by connecting them together, the potential difference on each one can be made zero. Then:

(A) $5C_1 = 3C_2$ **(B)** $3C_1 = 5C_2$

(C) $3C_1 + 5C_2 = 0$ **(D)** $9C_1 = 4C_2$



Q.10 A parallel plate capacitor is charged by a battery and after charging the battery is removed. Now the distance between the plates is reduced. Choose the correct statement

(A) Electric field is not constant **(B)** Potential difference is increased

(C) Capacitance is decreased **(D)** Electrostatic potential energy is decrease

WORKSHEET

Potential Energy

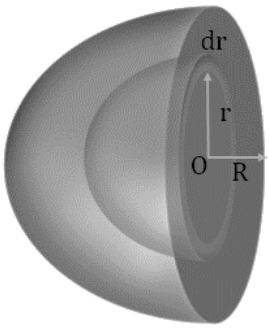
Q.1 An object of mass 2 kg is moved from infinity to a pointP. Initially the object was at rest but on reaching P its speed became2 m/s. If the work done in moving that object is-4 J, then find the ratio of potential energy to mass at point P (inJ/kg) is

(A)8 **(B)**-8 **(C)** 4 **(D)**-4

Gravitational Potential of a Solid Sphere

Q.2 The potential at the centre of the base of a solid hemisphere of mass m and radius R is

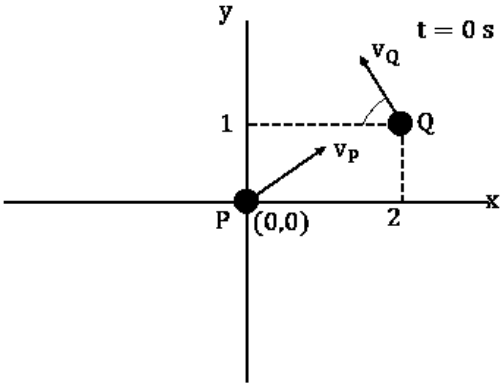
(A)$\frac{-Gm}{2R}$ **(B)**$\frac{3Gm}{2R}$ **(C)** $\frac{-3Gm}{2R}$ **(D)**$\frac{-2Gm}{R}$



Position Vector

Q.3 Two particles P and Q are moving with velocities of $(\hat{\imath}+\hat{\jmath})$ and $(-\hat{\imath}+2\hat{\jmath})$ respectively. At time $t=0$, P is at origin and Q is at point with position vector$(2\hat{\imath}+\hat{\jmath})$. The equation of the path of Q with respect to Pis$x+2y=c$. Find the value of **c**

(A) 1 **(B)**3 **(C)**4 **(D)** 6

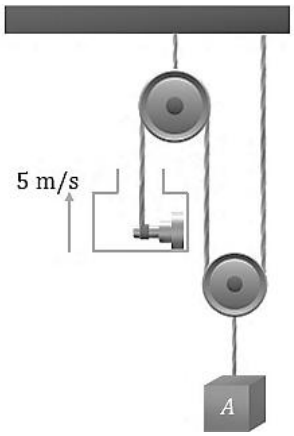


Velocity of Block

Q.4 A motor is fixed inside a box which is moving upwards with velocity5 m/s. String is winding at the rate 3 m/s around the motor shaft. Then the velocity of block *A* will be

(A)2.5 m/s Downwards **(B)**5 m/s downwards

(C) 1 m/s Downwards **(D)**2 m/s downwards



Frames of Reference

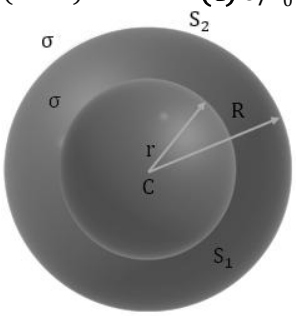
Q.5 From a lift moving upward with a uniform acceleration a, a man throws a ball vertically upwards with a velocity v relative to the lift. The ball comes back to the man after time$t$. Which relation is correct?

(A) $a + g = 2v/t$ **(B)** $a + g = v/t$ **(C)** $a + g = \frac{3v}{t}$ **(D)** $a + g = 4v/t$

Electric Potential at the Center of Solid Sphere

Q.6 Two concentric spherical shells of radii R and r have similar charges with equal surface charge densities (σ).What is the electric potential at their common centre?

(A) $\sigma R/\epsilon_0$ **(B)** $\sigma/\epsilon_0(R - r)$ **(C)** $\sigma/\epsilon_0(R + r)$ **(D)** None of these



Thermal Expansion

Q.7 The coefficient of linear expansion of steel and brass are $11 \times 10^{-6}/°C$ and $19 \times 10^{-6}/°C$, respectively. If their differences in lengths at all temperatures has to kept constant at 30 cm, their lengths at 0°C should be

(A)71.25 cm and 41.25 cm **(B)**82 cm and 52 cm
(C) 92 cm and 62 cm **(D)**62.25 cm and 32.25 cm

Molar Heat Capacity

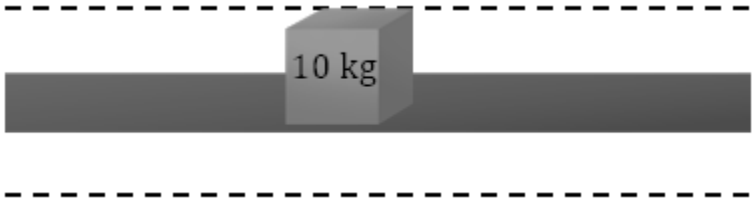
Q.8 Two moles of helium (He) are mixed with four moles of hydrogen(H_2). The molar heat capacity of the mixture at constant pressure is

(A)$\frac{19R}{6}$ **(B)**$\frac{17R}{6}$ **(C)** $\frac{15R}{6}$ **(D)**$\frac{3R}{2}$

SHM expression

Q.9 A large horizontal surface is in SHM with an amplitude of 1 cm. A mass of 10 kg is kept gently on it when it is at mean position. For the mass to always remain in contact with the surface, the maximum frequency of SHM will be

(A)5 Hz **(B)**6 Hz **(C)** 7 Hz **(D)**8 Hz



Dimensional Analysis

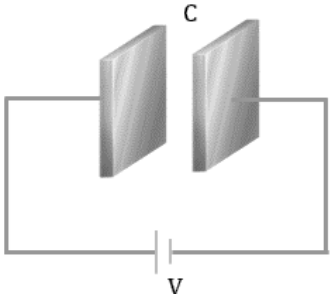
Q.10 If the velocity of water wave v depends upon the wavelengthλ, the density of water ρ and the acceleration due to gravityg, then which of the following options depicts the correct relation dimensionally?

(A)$v^2 \propto \lambda g^{-1}\rho^{-1}$ **(B)**$v^2 \propto g\lambda\rho$ **(C)** $v^2 \propto g\lambda$ **(D)**$v^2 \propto g^{-1}\lambda^{-3}$

Energy of a Capacitor

Q.11 A parallel plate capacitor of 20 μF is connected to a battery of emf8.85 V. If the plate area of each plate is2 cm^2, with what magnitude of force the positively charged plate attracts the negative one?

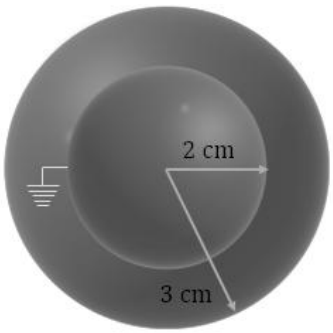
(A)4.425×10^6 N **(B)**17.7×10^6 N **(C)** 8.85×10^6 N **(D** 2.21×10^6 N



Capacitance of a Spherical Capacitor

Q.12 The figure shows a spherical capacitor with an inner sphere earthed. If $a = 2$ cmand$b = 3$ cm, then the capacitance of the system is (Take$k = 9 \times 10^9$ Nm^2/C^2)

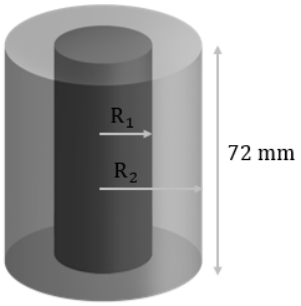
(A)40 pF **(B)**20 pF **(C)** 5 pF **(D)**10 pF



Capacitance of a Cylindrical Capacitor

Q.13 The capacitance of a cylindrical capacitor of length 72 mmis 2 pF. If the ratio of radii of its outer cylindrical conductor to that of its inner cylindrical conductor is e^x, then x is

(A) 4 **(B)** 2 **(C)** 3 **(D)** 5



More about Q=CV

Q.14 Two insulated conductors are charged by transferring electrons from one conductor to the other. A potential difference of 100 V was produced by transferring 6.25×10^{15} electrons from one conductor to the other. The capacitance of the system will be

(A) 20 μF **(B)** 10 μF **(C)** 40 μF **(D)** 5 μF

Energy of a Capacitor

Q.15 Energy per unit volume for a capacitor having area A and separation d kept at potential difference V is given by

(A) $\frac{1}{2}\frac{\epsilon_0 V^2}{d^2}$ **(B)** $\frac{\epsilon_0 V^2}{2d^2}$ **(C)** $\frac{1}{2}CV^2$ **(D)** $\frac{Q^2}{2C}$

Final Charge on Capacitors

Q.16 Two spherical conductors of capacitance 3 μF and 5 μF are charged to potentials of 300 Volt and 500 Volt. The spheres are then connected, then the final charge on 3 μF and 5 μF capacitors respectively will be:

(A) 900 μC, 2500 μC **(B)** 1200 μC, 2200 μC
(C) 1275 μC, 2125 μC **(D)** 1000 μC, 2400 μC

More about Q=CV

Q.17 Two metal spheres of capacitance C_1 and C_2 carry some charges. They are put in contact and then separated. The final charge Q_1 and Q_2 on them will satisfy

(A) $\frac{C_1}{C_2} > \frac{Q_1}{Q_2}$ **(B)** $\frac{C_1}{C_2} < \frac{Q_1}{Q_2}$ **(C)** $\frac{C_1}{C_2} = \frac{Q_1}{Q_2}$ **(D)** $\frac{C_1}{C_2} = \frac{Q_2}{Q_1}$

Energy of a Capacitor

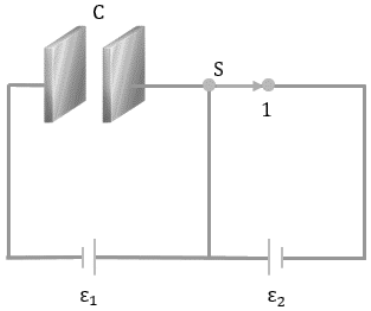
Q.18 A 40 μF capacitor in the defibrillator is charged to3000 V. The energy stored in the capacitor is sent through a patient during a pulse of duration2 ms. The power delivered to the patient is

(A)45 kW **(B)**90 kW **(C)** 180 kW **(D)**360 kW

Energy of a Capacitor

Q.19 What amount of heat will be generated in the circuit shown in figure, after the switch 'S' is shifted from position '1' to position '2' ?

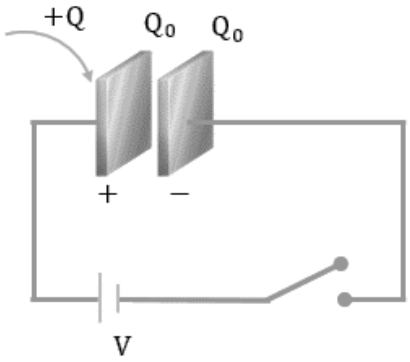
(A) $\frac{1}{2}C\varepsilon_2^2$ **(B)** $\frac{1}{2}C[\varepsilon_1^2 - \varepsilon_2^2]$ **(C)** $\frac{1}{2}C[\varepsilon_1^2 + \varepsilon_2^2]$ **(D)** $\frac{1}{2}C\varepsilon_2\varepsilon_1^2$



Potential Difference across the Capacitor

Q.20 A capacitor of capacitance C is charged to a potential difference V from a cell and then disconnected from it. A charge +Q is now given to its positive plate. The potential difference across the capacitor is now

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



ANSWER KEY

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