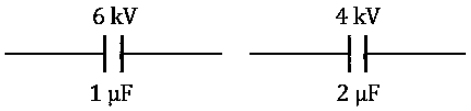
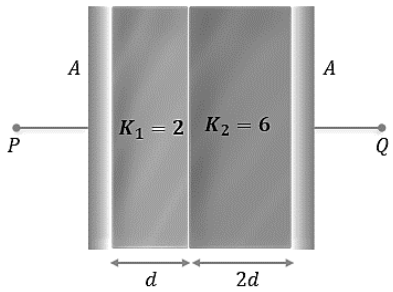
Q.1 A capacitor of capacitance **1 μF** can withstand a maximum voltage of**6 kV**. Another capacitor of capacitance **2 μF** can withstand a maximum voltage of**4 kV**. If the capacitors are connected in series, the combination can withstand a maximum voltage of

(A)10 kV **(B)**9 kV **(C)**8 kV **(D)**6 KV



Q.2 Equivalent capacitance of the given capacitor will be

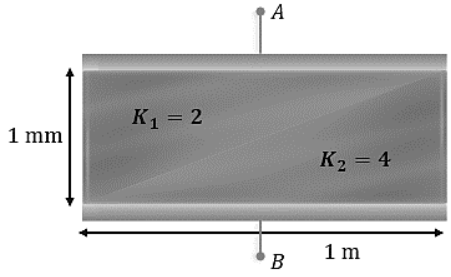
(A) $\frac{6}{5}\frac{\epsilon_o A}{d}$ **(B)** $\frac{5}{6}\frac{\epsilon_o A}{d}$ **(C)** $\frac{2}{3}\frac{\epsilon_o A}{d}$ **(D)** $\frac{3}{2}\frac{\epsilon_o A}{d}$



Q.3 A capacitor is formed by two square metal plates of edge**1 m**, separated by a distance**1 mm**. Dielectrics of dielectric constant $\mathbf{K_1}$ and $\mathbf{K_2}$ are filled in the gap as shown in figure. The new capacitance is

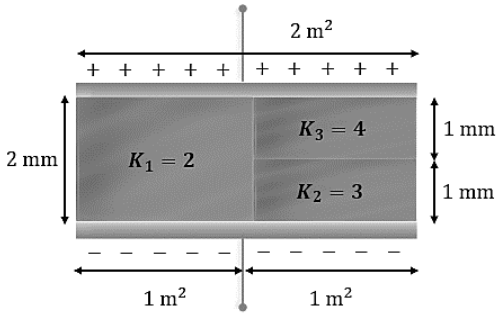
[Take ln$\mathbf{2 = 0.7}$]

(A)10 Nf **(B)**15 nF **(C)**20 nF **(D)**25 nF



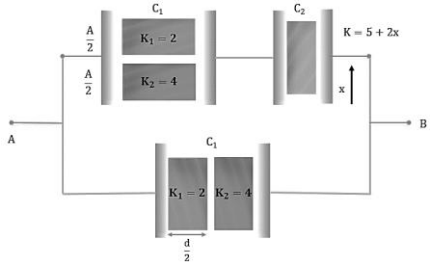
Q.4 Capacitance of the capacitor shown in the figure is

(A)24 nF **(B)**20 nF **(C)**15 nF **(D)**10 nF



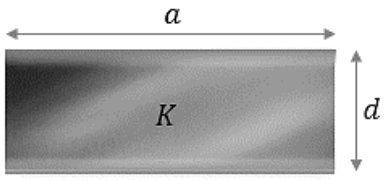
Q.5 For all the capacitors in the figure, plates are square in shape with area, $A = 100\ m^2$ and separation, $d = 11.5$ mm. In the capacitor C_2 , dielectric constant depends upon x as $K = 5 + 2x$. Find the equivalent capacitance across AB

(A) 39.8 μF **(B)** 3.98 μF **(C)**0.398 μF **(D)**398 μF



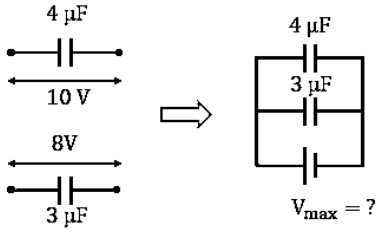
Q.6 Figure shows a parallel plate capacitor having square plates of edge length a and separation d. The gap between the plates is filled with a dielectric of dielectric constant K which varies parallel to an edge as,$\mathbf{K = K_o + \alpha x}$where, K and α are constants and x is the distance from the left end. Calculate the capacitance of system.

(A) $\frac{\epsilon_o a^2 K_o}{d}$ **(B)** $\frac{\epsilon_o a^2}{d}\left(K_o + \frac{a\alpha}{2}\right)$ **(C)** $\frac{\epsilon_o a\, K_o \alpha}{2d}$ **(D)** $\frac{\epsilon_o a^2 (K_o + a\alpha)}{2}$



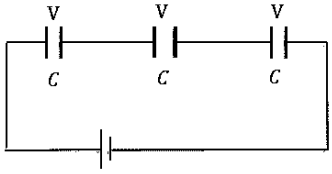
Q.7 A capacitor of capacitance 4 μF can withstand a maximum voltage of**10 V**. Another capacitor of capacitance **3 μF** can withstand a maximum voltage of**8 V**. If the capacitors are connected in parallel, the combination can withstand a maximum voltage of

(A)10 V **(B)**8 V **(C)**4 V **(D)**5 V



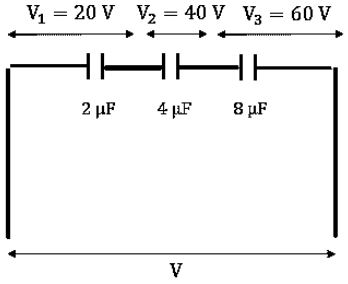
Q.8 In a lab experiment, three capacitors each of capacitance **C** and of breakdown voltage **V** are joined in series. Then capacitance and breakdown voltage of the combination will be?

(A) $\frac{C}{3}$, 3V **(B)**3C, 3V **(C)** $\frac{C}{3}, \frac{V}{3}$ **(D)** $\frac{C}{3}$, 1.5 V



Q.9 For three capacitors of capacitance **2 μF**, **4 μF**, **8 μF** connected parallel to each other having applied voltages **20 V**, **40 V**, **60 V** respectively. Then the equivalent breakdown voltage of the combination is?

(A) 11.4 V **(B)** 20 V **(C)** 40 V **(D)** 60 V



Q.10 Which of the following statements is correct?

(A) Leakage of current results in charging of capacitor

(B) For a good capacitor resistance should be low

(C) Leakage of current results in discharging of capacitor

(D) A charged capacitor is equivalent to a LC circuit.

WORKSHEET

Longitudinal Strain

Q.1 Choose the correct option.

Statement1: Hooke's law is obeyed only for small values of strain.

Statement2: The permanent deformation beyond elastic limit is called plasticity.

(A) Statement 1 is correct but statement 2 is wrong

(B) Statement 1 is wrong but statement 2 is correct

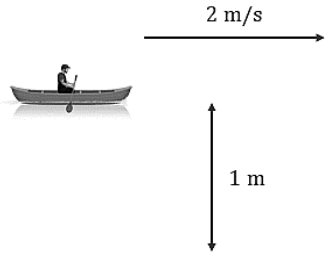
(C) Both statement 1 and statement 2 are correct

(D) Both statement 1 and statement 2 are wrong

Coefficient of Viscosity

Q.2 A boat of area $\mathbf{10\ m^2}$ floating on the surface of a river is made to move horizontally with a speed of $\mathbf{2\ m/s}$ by applying a tangential force. If the river is $\mathbf{1\ m}$ deep and the water in contact with the bed is stationary, find the tangential force needed to keep the boat moving with the same velocity. (Assume the viscosity of water as0.01 poise).

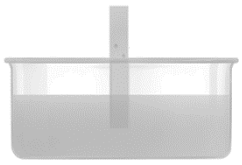
(A)0.02 N **(B)**0.03 N **(C)**0.04 N **(D)**0.05 N



Capillary Action

Q.3 If a capillary tube is dipped into liquid and the level of the liquid inside and outside are same, then the angle of contact is

(A)0° **(B)**90° **(C)**45° **(D)**30°

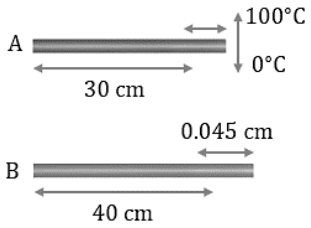


Thermal Expansion

Q.4 A metal rod of $\mathbf{30\ cm}$ length expands by $\mathbf{0.075\ cm}$ when its temperature is raised from $\mathbf{0^\circ C}$ to $\mathbf{100^\circ C}$. Another rod of different metal of length $\mathbf{45\ cm}$ expands by $\mathbf{0.045\ cm}$ for the same rise in temperature. A composite rod **C** made by joining **A** and **B** end to end expands by $\mathbf{0.040\ cm}$ when its length is $\mathbf{45\ cm}$ and it is heated from $\mathbf{0^\circ C}$ to$\mathbf{50^\circ C}$. Find the length of each portion of the composite rod.

(A) $l_A = 23.3$ cm, $l_B = 23.3$ cm **(B)** $l_A = 23.3$ cm, $l_B = 21.7$ cm

(C) $l_A = 21.7$ cm, $l_B = 23.3$ cm **(D)** $l_A = 25$ cm, $l_B = 20$ cm



Ideal Gas Equation from KTG

Q.5 Find the ratio of specific gas constant for H_2 to the specific gas constant for O_2?

(A)16:1 **(B)**1:16 **(C)**1:1 **(D)**1:8

Heat Capacity

Q.6 Which of the following gases possesses the largest internal energy?

(A)2 Moles of helium occupying 1 m^3 at 300 K

(B)56 g Of nitrogen at 10^7 Nm^{-2} and 300 K

(C)8 g Of oxygen at 8 atm and 300 K

(D)6×10^{26} Molecules of argon occupying 40 m^3 at 900 K

Friction and Horizontal Circular Motion

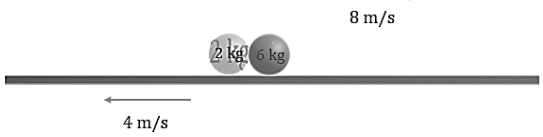
Q.7 A car travelling on a level road with a curve of radius$\mathbf{32\ m}$. The coefficient of static friction between the road and tire of car is$\mathbf{0.2}$. What speed will put the car on verge of sliding? ($\mathbf{g = 10\ m/s^2}$)

(A)10 m/s **(B)** 8 m/s **(C)**13 m/s **(D)**6 m/s

Velocity of COM

Q.8 Two spheres of mass **2 kg** and **6 kg** are moving with velocities **4 m/s** and **8 m/s** away from each other along the same line. The ball of mass **2 kg** is moving towards the left. The velocity of the center of mass is

(A)4 m/s **(B)**7 m/s **(C)**5 m/s **(D)**3 m/s



Elastic Collisions

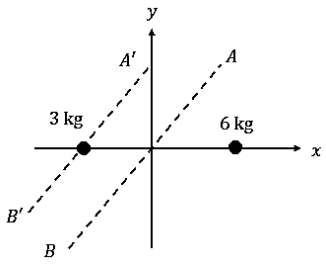
Q.9 A ball is thrown horizontally at a heavy wall with a velocity of$\mathbf{15\ m/s}$. The wall is moving in the same direction as the ball with a velocity of$\mathbf{8\ m/s}$. Assuming that the collision is elastic, what is the velocity of the ball after the collision?

(A)1 m/s **(B)**2 m/s **(C)**7 m/s **(D)**8 m/s

Moment of Inertia of Solid Bodies

Q.10 Two particles having masses **3 kg** and **6 kg** are situated in a plane perpendicular to line **AB** at a perpendicular distance of **2 m** and **4 m** respectively as shown in figure. Find the moment of inertia about an axis $\mathbf{A'B'}$ parallel to**AB**.

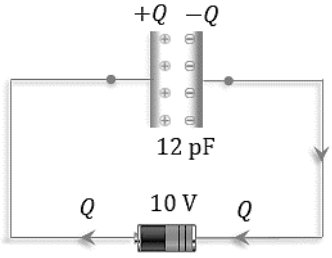
(A)216 $kg - m^2$ **(B)**108 $kg - m^2$ **(C)**300 $kg - m^2$ **(D)**200 $kg - m^2$



Energy of a Capacitor

Q.11 A parallel plate capacitor having capacitance **12 pF** is charged by a battery to a potential difference of **10 V** between its plates. The charging battery is now disconnected and a porcelain slab of dielectric constant **6. 5** is placed between the plates. The work done by the capacitor on the slab is:

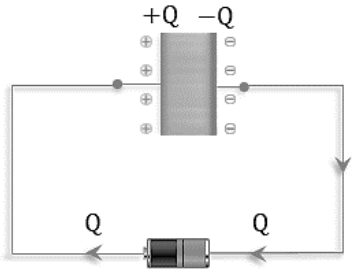
(A)560 pJ **(B)** 508 pJ **(C)**692 pJ **(D)**600 PJ



Energy of a Capacitor

Q.12 An air filled capacitor with a dielectric slab inside it is completely charged up to energy **U** and disconnected from battery. If the dielectric slab between the plates is removed slowly by an external agent, the work done by the external agent is**3 U**. The dielectric constant of the slab is: (Assume the process to be ideal & no energy is lost)

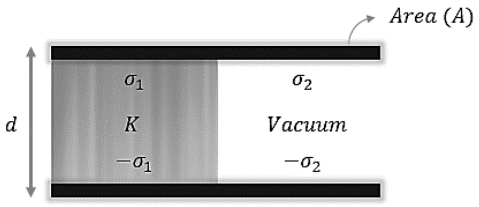
(A)5 **(B)**4 **(C)**3 **(D)**1.5



Breaking a Capacitor into Combinations

Q.13 A parallel plate capacitor of area **A** and separation **d** is fully charged to potential difference **V** and then removed from the charging source. A dielectric slab of dielectric constant**K = 2**, thickness **d** and area **A/2** is inserted as shown in figure. Let $\boldsymbol{\sigma_1}$ be the free charge density at the conductor-dielectric surface, $\boldsymbol{\sigma_2}$ be the charge density at the conductor- vacuum surface. The value of new capacitance and potential difference respectively are

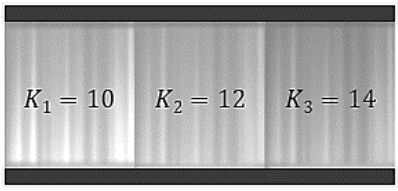
(A) $\frac{3A\epsilon_0}{2d}, \frac{2}{3}V$ **(B)** $\frac{A\epsilon_0}{2d}, \frac{V}{2}$ **(C)** $\frac{3A\epsilon_0}{d}, \frac{V}{3}$ **(D)** $\frac{2A\epsilon_0}{3d}, \frac{4}{3}V$



Parallel and Series Combination of Capacitors

Q.14 A parallel plate capacitor has area **6 cm^2** and separation**3 mm**. The gap between the plates is filled with three dielectric materials of equal thickness as shown. The equivalent dielectric constant of a material which would give the same capacitance when fully inserted in the capacitor, would be

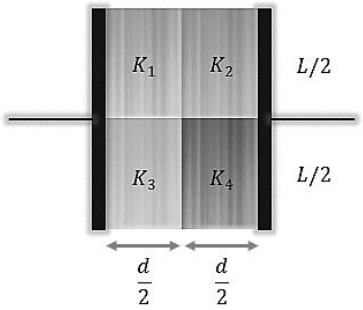
(A)4 **(B)**36 **(C)**12 **(D)**14



Parallel and Series Combination of Capacitors

Q.15 A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants $\mathbf{K_1 = 2}$, $\mathbf{K_2 = 4}$, $\mathbf{K_3 = 6}$ and $\mathbf{K_4 = 8}$ arranged as shown in the figure. The effective dielectric constant will be

(A)3.8 **(B)**4.8 **(C)**1.8 **(D)**2.8



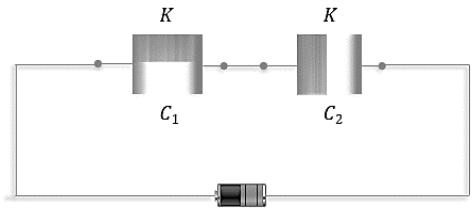
New Capacitance in Dielectric

Q.16 Two identical sized capacitors $\mathbf{C_1}$ and $\mathbf{C_2}$ are connected to a battery in series. A dielectric slab of dielectric constant $\mathbf{K = 2}$ is filled in the half region of both the capacitors as shown in figure.
($\mathbf{C}$ → Capacitance, $\mathbf{q}$ → charge stored, $\mathbf{U}$ → energy stored)
Match the following column:

Column I	**Column II**
(A) $\frac{C1}{C2}$	(p) 8/9
(B) $\frac{q1}{q2}$	(q) 4/9
	(r) 9/8

(C) $\frac{U1}{U2}$	(s) None of these

(A) A → r, B → p, C → s **(B)** A → r, B → s, C → p
(C) A → s, B → s, C → s **(D)** A → p, B → r, C → q



New Capacitance in Dielectric

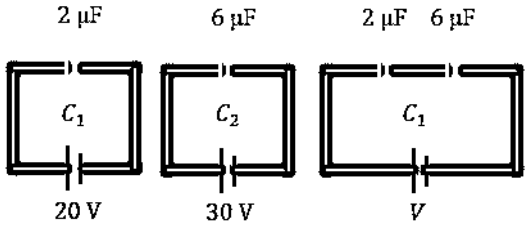
Q.17 Which of the following is true in case of a dielectric strength, when the thickness of the material increases?

(A) Increases **(B)** Remains same **(C)** Decreases **(D)** Becomes zero

More about Q=CV

Q.18 Calculate the breakdown voltage of a series combination of two capacitors having capacitance **2 μF** and **6 μF** as shown in the figure.

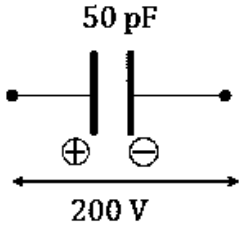
(A) 30 V **(B)** 20 V **(C)** 17 V **(D)** 27 V



More about Q=CV

Q.19 If a parallel plate capacitor of capacitance **50 pF** has a breakdown voltage of **200 V**, when an electric field of **500 N/C** is applied. Calculate the area of the plates in this case which can store the required charges.

(A) 3.36 m^2 **(B)** 2.26 m^2 **(C)** 1.26 m^2 **(D)** 0.26 m^2



ANSWER KEY

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