Chapter 1

Electrostatics

Exercise

Q.1 In chromatic aberration of a convex lens
(A)the image of straight object becomes wavy.
(B)the image of white object becomes coloured and blurred.
(C) both (a) and (b)
(D) none of the above.

Q.2 The focal length of a convex lens made of flint glass is 15 cm. To remove its chromatic aberration, it is placed in contact with a concave lens made of crown glass. Find the focal length of the concave lens. The ratio of dispersive powers of flint glass lens to the crown glass lens is 1.5.
(A)5CM **(B)**20CM **(C)**30CM **(D)** 10CM

Q.3 Which of the following quantity related to a lens depends upon the wavelength or wavelengths of incident light?
(A) Power **(B)**Chromatic aberration **(C)** Focal length **(D)** All of the above

Q.4 Consider a coaxial system of two thin convex lenses of focal length f each separated by a distance d. The left column of the table below gives different possible conditions between d and f, and the right column represents the nature of the lens combination. Choose the correct alternative.

Conditions	Nature
(1) $d < f$	(p) convex
(2) $d = 2f$	(Q) Plane glass slab
(3) $d > 2f$	(R) Concave

(A) $1-P, 2-R, 3-Q$ **(B)** $1-R, 2-P, 3-Q$
(C) $1-P, 2-Q, 3-R$ **(D)** $1-Q, 2-P, 3-R$

Q.5 A metallic sphere A is given positive charge whereas another identical metallic sphere B of exactly same mass as of A is given an equal amount of negative charge then,
(A) Mass of A and mass of B will remain equal **(B)**Chromatic aberration
(C) Focal length **(D)** All of the above

Q.6 A soap bubble is given a small negative charge. The radius of the soap bubble will
(A) Decrease **(B)**increases
(C) remains constant **(D)** first increase then decrease

Q.7 What is the amount of charge possessed by 1 kg of electrons?
(A) 1.76×10^{11} C **(B)** 1.76×10^{-9} C **(C)** 1.76×10^{-7} C **(D)** 1.76×10^{-5} C

Q.8 What is the amount of charge possessed by 1 kg of electrons?
$10^{12}\alpha -$ particles (nuclei of helium) accumulate every second on a neutral conductor. Calculate the amount of time (in sec) in which the sphere gets charged by 1.6 μC.
(A) 2 **(B)**3 **(C)** 4 **(D)** 5

Q.9 A body has 80 μC of negative charge. The number of excess electrons in the body will be:
(A) 8×10^{-5} **(B)** 80×10^{-17} **(C)** 5×10^{14} **(D)** 1.28×10^{-17}

Q.10 A body has 80 μC of negative charge. The number of excess electrons in the body will be:
An electron at rest has a charge of 1.6×10^{-19} C. It starts moving with a velocity $v = \frac{c}{2}$,

where c is the speed of light, then the new charge on it is

(A) 1.6×10^{-19} C

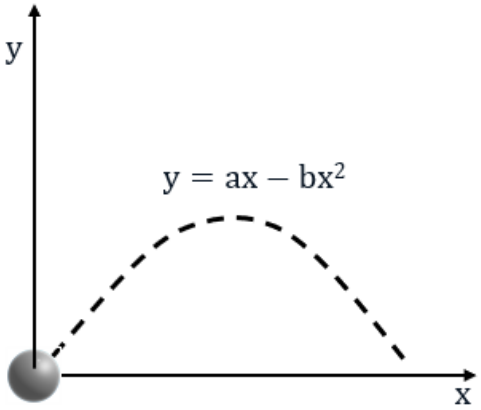
(B) $1.6 \times 10^{-19}\sqrt{\left(\frac{2}{1}\right)^2 - 1}$ C

(C) $1.6 \times 10^{-19}\sqrt{1 - \left(\frac{1}{2}\right)^2}$ C

(D) $\frac{1.6\times10^{-19}}{\sqrt{1-\left(\frac{1}{2}\right)^2}}$ C

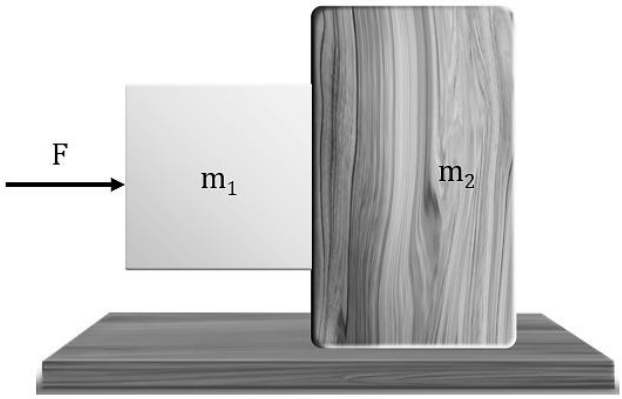
WORK SHEET

Q.1 The trajectory of a projectile in a vertical plane is $y = ax - bx2$, where a and b are constants and x and y are horizontal and vertical distances respectively of the projectile from the point of projection. The maximum height attained by the particle and the angle of projection from the horizontal are:



(A) $\frac{b^2}{2a}, \tan^{-1}(a)$ **(B)** $\frac{a^2}{b}, \tan^{-1}(2a)$ **(C)** $\frac{a^2}{4a}, \tan^{-1}(a)$ **(D)** $\frac{2a^2}{b}, \tan^{-1}(a)$

Q.2 In the given figure, the coefficient of friction between the two blocks is μ, and all other surfaces are smooth. Find the minimum value of F which will prevent slipping.

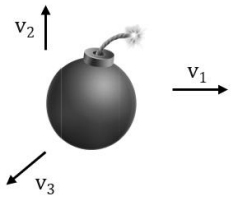


(A) $\frac{(m_1+m_2)m_1g}{\mu m_2}$ **(B)** $\frac{(m_1+m_2)m_2g}{\mu m_1}$ **(C)** $\frac{(m_1+m_2)g}{\mu}$ **(D)** $\frac{(m_1+m_2)m_1g}{m_2}$

Q.3 A particle of mass m is moving in a circular path of constant radius r such that centripetal acceleration is varying with time t as $k^2 rt^2$, where k is a constant. The power delivered to the particle by the force acting on it is

(A) $m^2k^2r^2t^2$ **(B)** $m^2k^2r^2t$ **(C)** mk^2rt^2 **(D)** mkr^2t

Q.4 A bomb bursts into three fragments, in which two fragments of equal masses of 1 kg each are moving with speed v at right angles to each other, while third fragment has mass twice that of either mass. If kinetic energy of system (all masses) increases by 96 J after bursting then find out the correct statement about third fragment:



(A) Will move with speed 4 m/s at angle of 135° to either

(B) Will move with speed $4\sqrt{2}$ m/s at angle of 135° to either

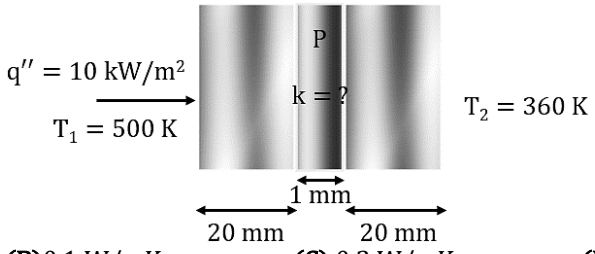
(C) Will move with speed $4\sqrt{2}$ m/s at angle of 45° to either

(D) Will move with speed 4 m/s at angle of 45° to either

Q.5 A gas has molar heat capacity C = 37.35 $Jmol^{-1}K^{-1}$ in the process PT =constant. Find the number of degrees of freedom of molecules in the gas.

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

Q.6 A material P of thickness 1 mm is sandwiched between two steel slabs, as shown in the figure below. A heat flux 10 $kW/m^2$is supplied to one of the steel slabs as shown. The boundary temperatures of the slabs are indicated in the figure. Assume thermal conductivity of this steel as 10 W/mK. Considering one-dimensional steady state heat conduction for the configuration, the thermal conductivity k (in W/mK) of material P is



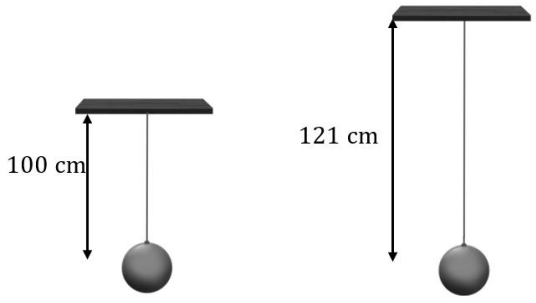
(A) 0.1 W/mK **(B)**0.1 W/mK **(C)** 0.2 W/mK **(D)** 0.4 W/mK

Q.7 A 100 W electric bulb was switched on in a 2.5 m × 3 m × 3 m size thermally insulated room having a temperature of 200 C. The room temperature at the end of 24 hours will be (Assume, air to be ideal in nature)

[Data required: specific heat of air at constant volume cv = 0.717 kJ/kgK and density of air, ρ = 1.2 kg/m3]

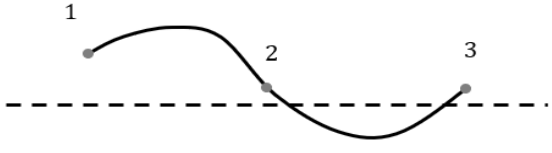
(A) 321^0C **(B)** 341^0C **(C)** 341^0C **(D)** 341^0C

Q.8 Two simple pendulums whose lengths are 100 cm and 121 cm are suspended side by side. Their bobs are pulled together and then released. After how many minimum oscillations of the longer pendulum, will the two be in phase again



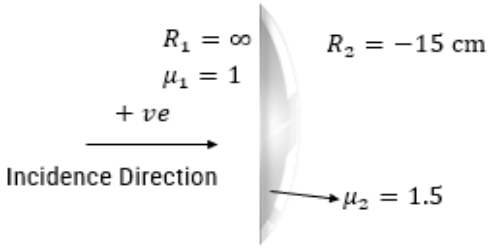
(A)11 **(B)** 10 **(C)**21 **(D)** 20

Q.9 The diagram shows an instantaneous position of a string as a transverse progressive wave travels along it from left to right. Which one of the following correctly shows the direction of velocity of points 1,2 and 3 on the string?



(A) $\overset{123}{\uparrow\downarrow\downarrow}$ **(B)** $\overset{123}{\uparrow\downarrow\uparrow}$ **(C)** $\overset{123}{\downarrow\downarrow\downarrow}$ **(D)** $\overset{123}{\downarrow\uparrow\downarrow}$

Q.10 The radius of curvature of curved surface of a plano-convex lens is 15 cm. The refractive index of the lens material is 1.5. The focal length of plano-convex lens is (surroundings is air)



(A) 20 cm **(B)** –40 cm **(C)** 30 cm **(D)** 25 cm

Q.11 Chromatic aberration produced by a concave mirror and a convex lens of same focal length will be

(A) Chromatic aberration is produced by convex lens as well as concave mirror

(B) Chromatic aberration produced by concave mirror is equal to chromatic aberration produced by convex lens

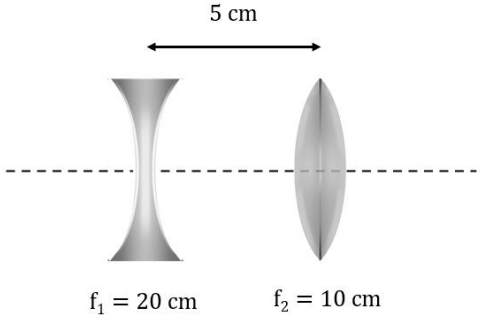
(C) Concave mirror will not produce chromatic aberration

(D) None of the above

Q.12 A convex lens of focal length 5 cm is used in the combination with a concave lens of unknown focal length to form an achromatic combination. If the dispersive powers of the lenses are in the ratio 2 : 3 respectively. Then the value of focal length of concave lens will be:

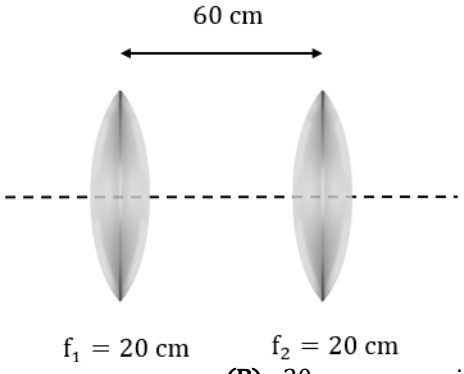
(A) $\frac{15}{2}$ cm **(B)** $\frac{10}{3}$ cm **(C)** $\frac{6}{2}$ cm **(D)** $\frac{7}{2}$ cm

Q.13 If a concave lens of focal length 20 cm is kept at a distance of 5 cm from a convex lens of focal length 10 cm. The equivalent focal length and nature of this combination is:



(A) $\frac{10}{3}$ cm, concave **(B)** $\frac{10}{3}$ cm, convex **(C)** $\frac{40}{3}$ cm, convex **(D)** $\frac{40}{3}$ cm, concave

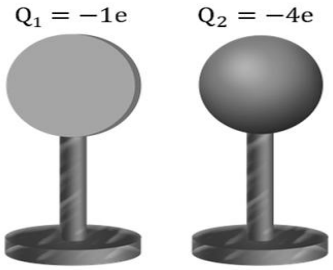
Q.14 Two convex lenses of focal length 20 cm each are placed coaxially with a separation of 60 cm between them. Find the equivalent focal length of the combination and also comment on the nature of lens.



(A) -20 cm, diverging **(B)** -20 cm, converging
(C) $+20$ cm, converging **(D)** -30 cm, diverging

Q.15 Which of the following is a wrong statement?
(A) the charges on a body are quantized always.
(B) Charge on proton has a positive sign and charge on electron has a negative sign.
(C) The net charge of an isolated system is always conserved.
(D) The net charge of an object connected to ground through earthing is always constant.

Q.16 A metal disc with a charge $Q_1 = -1e$ is placed near a metal sphere that has a charge $Q_2 = -4e$. If the disc touched the sphere, what is the possible final charge on each object?

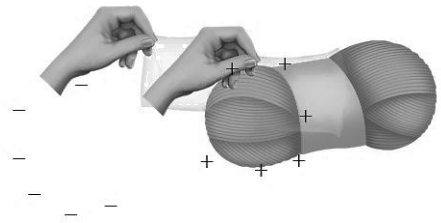


(A) $Q_1 = -2e,\ Q_2 = -3e$ **(B)** $Q_1 = -3e,\ Q_2 = -3e$
(C) $Q_1 = -1e,\ Q_2 = +7e$ **(D)** $Q_1 = -2e,\ Q_2 = -2e$

Q.17 When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it becomes
(A) -1.6 C **(B)** $+1.6$ C **(C)** 10^{+19}C **(D)** 10^{-19} C

Q.18 Calculate the number of electrons that constitute one coulomb of charge.
(A) 120×10^{14} electrons **(B)** 625×10^{16} electrons
(C) 500×10^{16} electrons **(D)** 425×10^{16} electrons

Q.19 A polythene piece rubbed with wool is found to have a negative charge of 3×10^{-7} C. The number of electrons transferred between the materials is:

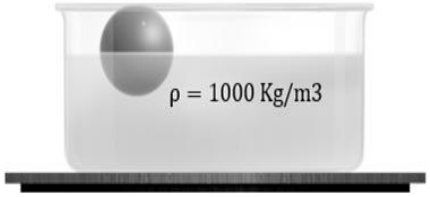


(A) 1.875×10^{12} electrons from wool to polyethene
(B) 3×10^{-7} electrons from polythene to wool
(C) 3×10^{-7}electrons from wool to polythene

(D) It is not possible to have 3×10^{-7} C charges

Q.20 The loss in mass for 1 mole of potassium cation in the saltK_2SO_4 will be: ($K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$)
(A)5.48×10^{-7} kg **(B)**7.48×10^{-9} kg **(C)**4.50×10^{-5} kg **(D)**30.96×10^{-7} kg

Q.21 A hollow spherical ball of radius 20 cm floats in still water, with half of its volume submerged. Taking the density of water as 1000 kg/m3, and the acceleration due to gravity as 10 m/s2, the natural frequency of small oscillations of the ball, normal to the water surface is (roundoff to 2 decimal places).



Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(D)	(D)	(C)	(D)	(B)	(A)	(D)	(C)	(A)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(A)	(B)	(B)	(B)	(A)	(D)	(B)	(D)	(C)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(C)	(A)	(C)	(A)	(D)	(A)	(B)	(B)	(A)	(A)
Q.	21	22	23							
Sol.	(C)	(A)	(D)							

(A)5.66 rad/s **(B)**4.86 rad/s **(C)**8.66 rad/s **(D)** 9.66 rad/s

Q.22 A cubical block is floating in a liquid with one fourth of its volume immersed in the liquid. If the whole of the system accelerates upwards with acceleration $g/4$, the fraction of volume immersed in the liquid will be

(A)$\frac{1}{4}$ **(B)**$\frac{1}{2}$ **(C)**$\frac{3}{4}$ **(D)**$\frac{2}{3}$

Q.23 In a process, when two bodies are charged by rubbing against each other, one becomes positively charged while the other becomes negatively charged. Then
(A) Mass of each body remains unchanged
(B) Mass of positively charged body slightly increases
(C) Mass of negatively charged body slightly decreases
(D) Mass of each body changes slightly but the total mass of system remains the same

ANSWER KEY