Physics : Section-A (Q. No. 1 to 35)

1 The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is :

(1) 5 : 3 (2) 2 : 5

(3) 5 : 2 (4) 3 : 5

2 The work functions of Caesium (Cs), Potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(1) Both Na and K

(2) K only

(3) Na only

(4) Cs only

3 The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly : (surface tension of soap solution = 0.03 N m^{-1})

(1) 5.06×10^{-4}J (2) 3.01×10^{-4}J

(3) 50.1×10^{-4}J (4) 30.16×10^{-4}J

4 Resistance of a carbon resistor determined from colour codes is $(22000\pm5\%)\,\Omega$. The colour of third band must be :

(1) Green (2) Orange

(3) Yellow (4) Red

5 In a series LCR circuit, the inductance L is 10 mH, capacitance C is 1 μF and resistance R is 100 Ω. The frequency at which resonance occurs is :

(1) 15.9 kHz (2) 1.59 rad/s

(3) 1.59 kHz (4) 15.9 rad/s

6 In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. Then the amplitude of oscillating magnetic field is : (Speed of light in free space = 3×10^{8} m s^{-1})

(1) 1.6×10^{-8}T (2) 1.6×10^{-7}T

(3) 1.6×10^{-6}T (4) 1.6×10^{-9}T

7 Given below are two statements:

Statement I : Photovoltaic devices can convert optical radiation into electricity.

Statement II : Zener diode is designed to operate under reverse bias in breakdown region.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below :

(1) Both **Statement I** and **Statement II** are incorrect.

(2) **Statement I** is correct but **Statement II** is incorrect.

(3) **Statement I** is incorrect but **Statement II** is correct.

(4) Both **Statement I** and **Statement II** are correct.

8 The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are :

(1) Personal errors

(2) Least count errors

(3) Random errors

(4) Instrumental errors

9 If $\oint_S \vec{E}\cdot\vec{dS}=0$ over a surface, then :

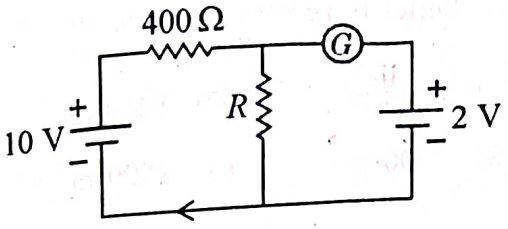
(1) the magnitude of electric field on the surface is constant.

(2) all the charges must necessarily be inside the surface.

(3) the electric field inside the surface is necessarily uniform.

(4) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

10 If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by :



(1) 50 Ω (2) 100 Ω
(3) 400 Ω (4) 200 Ω

11 An ac source is connected to a capacitor C. Due to decrease in its operating frequency :
(1) displacement current increases.
(2) displacement current decreases.
(3) capacitive reactance remains constant
(4) capacitive reactance decreases.

12 The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to:

(1) $\frac{1}{V}$ (2) $\frac{1}{\sqrt{V}}$
(3) V^2 (4) $\sqrt{V}$

13 The venturi-meter works on :
(1) Bernoulli's principle
(2) The principle of parallel axes
(3) The principle of perpendicular axes
(4) Huygen's principle

14 A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?
(1) p-n junction diodes
(2) Capacitor
(3) Load resistance
(4) A centre-tapped transformer

15 A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be:
(1) 1.3% (2) 1.6%
(3) 1.4% (4) 1.2%

16 For Young's double slit experiment, two statements are given below:
Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.
Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.
In the light of the above statements, choose the *correct* answer from the options given below:
(1) Both **Statement I** and **Statement II** are false.
(2) **Statement I** is true but **Statement II** is false.
(3) **Statement I** is false but **Statement II** is true.
(4) Both **Statement I** and **Statement II** are true.

17 The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be :
(1) 4U (2) 8U
(3) 16U (4) 2U

18 Light travels a distance x in time t_1 in air and $10x$ in time t_2 in another denser medium. What is the critical angle for this medium?

(1) $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$ (2) $\sin^{-1}\left(\frac{t_1}{10t_2}\right)$
(3) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$ (4) $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

19 A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(1) 2.7 A (2) 3.7 A

(3) 0.37 A (4) 0.27 A

20 A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is :

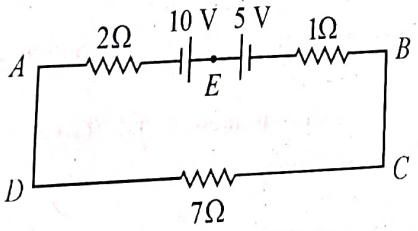
(1) along northward

(2) along north-east

(3) along south-west

(4) along eastward

21 The magnitude and direction of the current in the following circuit is



(1) 0.5 A from A to B through E

(2) $\frac{5}{9}$ A from A to B through E

(3) 1.5 A from B to A through E

(4) 0.2 A from B to A through E

22 The angular acceleration of a body, moving along the circumference of a circle, is :

(1) along the radius towards the centre

(2) along the tangent to its position

(3) along the axis of rotation

(4) along the radius, away from centre

23 A bullet is fired from a gun at the speed o 280 m s^{-1} in the direction 30° above th horizontal. The maximum height attained b the bullet is $\left(g = 9.8\ m\ s^{-2}, \sin 30° = 0.5\right)$:

(1) 2000 m (2) 1000 m

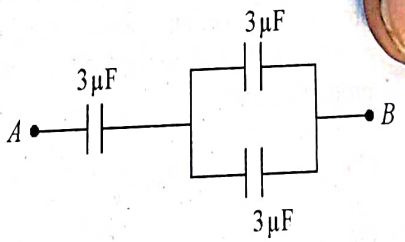
(3) 3000 m (4) 2800 m

24 The net magnetic flux through any close surface is :

(1) Positive (2) Infinity

(3) Negative (4) Zero

25 The equivalent capacitance of the system shown in the following circuit is :



(1) 3 μF (2) 6 μF

(3) 9 μF (4) 2 μF

26 A vehicle travels half the distance with speed ϑ and the remaining distance with speed 2ϑ. Its average speed is:

(1) $\frac{2\vartheta}{3}$ (2) $\frac{4\vartheta}{3}$

(3) $\frac{3\vartheta}{4}$ (4) $\frac{\vartheta}{3}$

27 The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{16}\right)^{th}$ of its initial value?

(1) 40 minutes (2) 60 minutes

(3) 80 minutes (4) 20 minutes

28 The temperature of a gas is –50° C. To what temperature the gas should be heated so that the rms speed is increased by 3 times?

(1) 3295° C (2) 3097 K

(3) 223 K (4) 669° C

29 A Carnot engine has an efficiency of 50% when its source is at a temperature 327° C. The temperature of the sink is :

(1) 15° C (2) 100° C

(3) 200° C (4) 27° C

30 The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is :

(1) 4 mJ (2) 8 mJ

(3) 8 μJ (4) 4 μJ

31 Let a wire be suspended from the ceiling (rigid support) and stretched by a weight W attached at its free end. The longitudinal stress at any point of cross-sectional area A of the wire is :

(1) W/A (2) $W/2A$

(3) Zero (4) $2W/A$

32 An electric dipole is placed at an angle of 30° with an electric field of intensity $2\times10^5\,N\,C^{-1}$. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(1) 6 mC (2) 4 mC

(3) 2 mC (4) 8 mC

33 In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series is :

(1) 4λ (2) 9λ

(3) 16λ (4) 2λ

34 The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is :

(1) 2 : 1 (2) 1 : 3

(3) 3 : 1 (4) 1 : 2

35 Two bodies of mass m and $9m$ are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (G = gravitational constant) :

(1) $-\frac{12\,Gm}{R}$ (2) $-\frac{16\,Gm}{R}$

(3) $-\frac{20\,Gm}{R}$ (4) $-\frac{8\,Gm}{R}$

Physics : Section-B (Q. No. 36 to 50)

36 A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is :

(1) 24 cm (2) 28 cm
(3) 30 cm (4) 27 cm

37 The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom?

(1) 1.06 Å (2) 1.59 Å
(3) 4.77 Å (4) 0.53 Å

38 Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 ($g = 10\ m\ s^{-2}$).

(1) $150\ m\ s^{-2}$ (2) $1.5\ m\ s^{-2}$
(3) $50\ m\ s^{-2}$ (4) $1.2\ m\ s^{-2}$

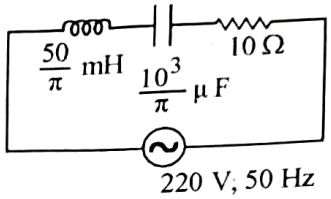
39 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is :

(1) 100 (2) 1
(3) 1000 (4) 10

40 A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity $4\ m\ s^{-1}$. The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take $g = 10\ m\ s^{-2}$) :

(1) 60 m (2) 64 m
(3) 68 m (4) 56 m

41 The net impedance of circuit (as show figure) will be :



(1) 15 Ω (2) $5\sqrt{5}\ \Omega$
(3) 25 Ω (4) $10\sqrt{2}\ \Omega$

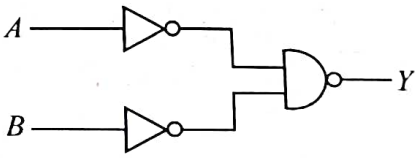
42 A satellite is orbiting just above the su of the earth with period T. If d is the de of the earth and G is the universal con of gravitation, the quantity $\frac{3\pi}{Gd}$ represe

(1) T^2 (2) T^3
(3) $\sqrt{T}$ (4) T

43 Two thin lenses are of same focal len (f), but one is convex and the other concave. When they are placed in with each other, the equivalent foc of the combination will be :

(1) $f/4$ (2) $f/2$
(3) Infinite (4) Zero

44 For the following logic circuit, the truth is:



(1)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(2)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

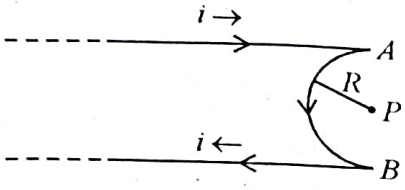
(3)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(4)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

45 A very long conducting wire is bent in a semi-circular shape from A to B as shown in figure. The magnetic field at point P for steady current configuration is given by :



(1) $\frac{\mu_0 i}{4R}$ pointed away from the page

(2) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed away from page

(3) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed into the page

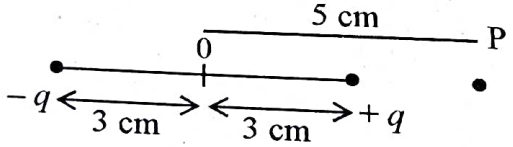
(4) $\frac{\mu_0 i}{4R}$ pointed into the page

46 The resistance of platinum wire at 0°C is 2Ω and 6.8Ω at 80°C. The temperature coefficient of resistance of the wire is :

(1) 3×10^{-3} °C^{-1} (2) 3×10^{-2} °C^{-1}

(3) 3×10^{-1} °C^{-1} (4) 3×10^{-4} °C^{-1}

47 An electric dipole is placed as shown in the figure.

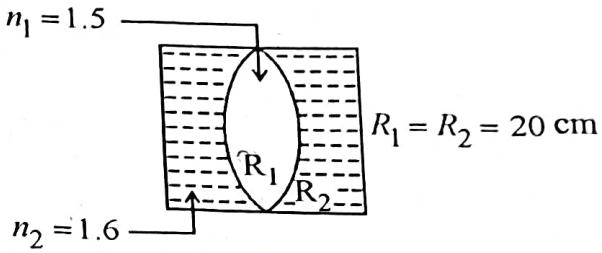


The electric potential (in 10^2 V) at point P due to the dipole is (ϵ_0 = permittivity of free space and $\frac{1}{4\pi\epsilon_0} = K$):

(1) $\left(\frac{5}{8}\right)qK$ (2) $\left(\frac{8}{5}\right)qK$

(3) $\left(\frac{8}{3}\right)qK$ (4) $\left(\frac{3}{8}\right)qK$

48 In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin)?



(1) − 40 cm (2) − 100 cm

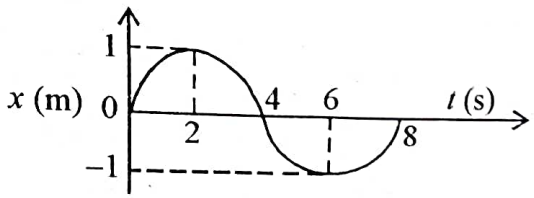
(3) − 50 cm (4) 40 cm

49 A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})$ T. The magnitude of the magnetic force acting on the wire is :

(1) $\sqrt{5}\,IL$ (2) $5\,IL$

(3) $\sqrt{3}\,IL$ (4) $3\,IL$

50 The x-t graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at $t = 2$ s is :



(1) $-\frac{\pi^2}{8}$ m s^{-2} (2) $\frac{\pi^2}{16}$ m s^{-2}

(3) $-\frac{\pi^2}{16}$ m s^{-2} (4) $\frac{\pi^2}{8}$ m s^{-2}