Sample Paper

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Physics

Q.No. 1 A stationary observer receives sound from two identical tuning forks, one of which approaches and the other one recedes with the same speed (much less than the speed of sound). The observer hears 2 beats/sec. The oscillation frequency of each tuning fork is v_0 = 1400 Hz and the velocity of sound in air is 350 m/s. The speed of each tuning fork is close to :

(A) ½ m/s

(B) 1 m/s

(C) ¼ m/s

(D) ⅛ m/s

Q.No. 2 A metal ball of mass 0.1 kg is heated upto 500°C and dropped into a vessel of heat capacity $800JK^{-1}$ and containing 0.5 kg water. The initial temperature of water and vessel is 30°C. What is the approximate percentage increment in the temperature of the water ? [Specific Heat Capacities of water and metal are, respectively, $4200Jkg^{-1}K^{-1}$ and $400Jkg^{-1}K^{-1}$J Jkg-IK-1]

(A) 30%

(B) 20 %

(C) 25 %

(D) 15%

Q.No. 3 Speed of a transverse wave on a straight wire (mass 6.0 g, length 60 cm and area of cross-section 1.0 mm^2 is 90 ms^{-1}. If the young's modulus of wire is 16 x 10^{11} Nm^{-2}, the extension of wire over its natural length is :

(A) 0.03 mm

(B) 0.02 mm

(C) 0.04 mm

(D) 0.01 mm

Q.No. 4 Visible light of wavelength 6000 X 10^{-8} cm falls normally on a single slit and produces a diffraction pattern. It is found that the second diffraction minimum is at 60° from the central maximum. If the first minimum is produced at θ_1 , then θ_1 is close to :

(A) 20°

(B) 30°

(C) 25°

(D) 45°

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Q.No. 5 A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to :

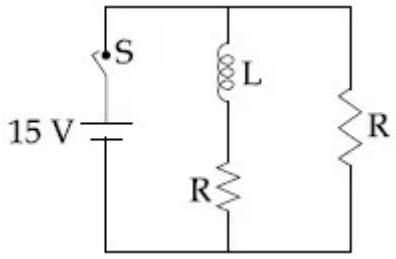
(A) 500 Hz

(B) 753 Hz

(C) 666 Hz

(D) 333 Hz

Q.No. 6 In the figure shown, a circuit contains two identical resistors with resistance R=5Ω and an inductance with L=2 mH. An ideal battery of 15 V is connected in the circuit. What will be the current



through the battery long after the switch is closed ?

(A) 3 A

(B) 5.5 A

(C) 7.5 A

(D) 6 A

Q.No. 7 Two rods A and B of identical dimensions are at temperature 30°C. If A is heated upto 180°C and B upto T°C, then the new lengths are the same. If the ratio of the coefficients of linear expansion of A and B is 4:3, then the value of T is :

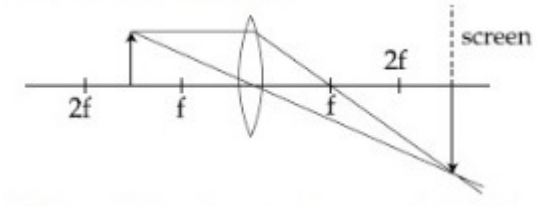
(A) 200°C

(B) 250°C

(C) 270°C

(D) 230°C

Q.No. 8 Formation of real image using a biconvex lens is shown below :



If the whole set up is immersed in water without disturbing the object and the screen positions, what will one observe on the screen?

(A) Image disappears

(B) Magnified image

(C) Erect real image

(D) No change

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Q.No. 9 A travelling harmonic wave is represented by the equation $y(x,t) = 10^{-3}\sin(50t + 2x)$,where x and y are in meter and t is in seconds. Which of the following is a correct statement about the wave?

(A) The wave is propagating along the positive x-axis with speed 25 ms^{-1}.

(B) The wave is propagating along the positive x-axis with speed 100 ms^{-1}..

(C) The wave is propagating along the negative x-axis with speed 25 ms^{-1}..

(D) The wave is propagating along the negative x-axis with speed 100 ms^{-1}.

Q.No. 10 A bar magnet is demagnetized by inserting it inside a solenoid of length 0.2 m, 100 turns, and carrying a current of 5.2 A. The coercivity of the bar magnet is

(A) 520 A/m

(B) 1200 A/m

(C) 2600 A/m

(D) 285 A/m

Q.No. 11 A capacitance of 2 μF is required in an electrical circuit across a potential difference of 1.0 kV. A large number of 1 μF capacitors are available which can with stand a potential difference of not more than 300 V. The minimum number of capacitors required to achieve this is :

(A) 2

(B) 16

(C) 24

(D) 32

Q.No. 12 An ideal fluid flows (laminar flow) through a pipe of non-uniform diameter. The maximum and minimum diameters of the pipes are 6.4 cm and 8 cm. respectively. The ratio of the minimum and the maximum velocities of fluid in this pipe

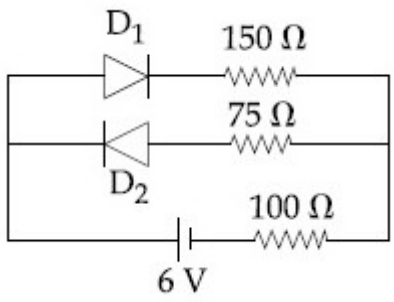
(A) 9/16

(B) (√3) /2

(C) 3/4

(D) 81/256

Q.No. 13 The circuit shown below contains two ideal diodes, each with a forward resistance of 50 Ω . If the battery voltage is 6 V, the current through the 100 Ω resistance(in Amperes) is :



(A) 0.027

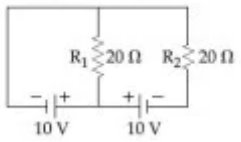
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(B) 0.030

(C) 0.036

(D) 0.020

Q.No. 14 In the given circuit the cells have zero internal resistance. The currents (in Amperes) passing through resistance R_1 and R_2 respectively, are :



(A) 0,1

(B) 1, 2

(C) 0.5, 0

(D) 2,2

Q.No. 15 Two Carnot engines A and B are operated in series. The first one, A, receives heat at T,(=600 K) and rejects to a reservoir at temperature T_2. The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at T3(=400 K). Calculate the temperature $T_3(= 400K)$ if the work outputs of the two engines are equal :

(A) 500 K

(B) 300 K

(C) 400 K

(D) 600 K

Q.No. 16 A thin lens made of glass (refractive index = 1.5) of focal length f = 16 cm is immersed in a liquid of refractive index 1.42. If its focal length in liquid is f_1, then the ratio f_1/ f is closest to the integer :

(A) 1

(B) 9

(C) 5

(D) 17

Q.No. 17 The time period of revolution of the electron in its ground state orbit in a hydrogen atom is 1.6 x 10^{-16} s. The frequency of revolution of the electron in its first excited state (in s^{-1}) is :

(A) 1.6 x 10^{14}

(B) 7.8 x 10^{14}

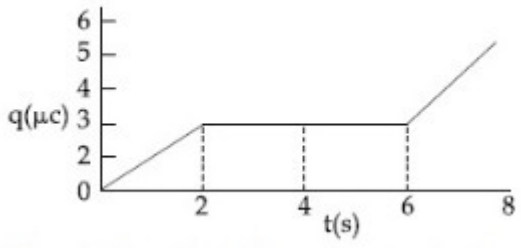
(C) 6.2 x 10^{15}

(D) 5.6 x 10^{12}

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Q.No. 18 The charge on a capacitor plate in a circuit, as a function of time, is shown in the figure:



What is the value of current at t = 4s ?

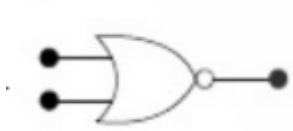
(A) 3μA

(B) zero

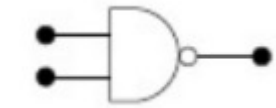
(C) 1.5 μA

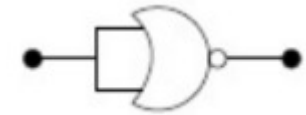
(D) 2 μA

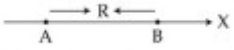
Q.No. 19 Which of the following gives a reversible operation ?

(A) 

(B) 

(C) 

(D) 

Q.No. 20 Two electric dipoles, A, B with respective dipole moments $\vec{d}_A = -4qa\hat{i}$ and $\vec{d}_B = -2qai$ are placed on the x-axis with a separation R, as shown in the figure 

The distance from Aat which both of them produce the same potential is :

(A) $\frac{\sqrt{2}R}{\sqrt{2}+1}$

(B) $\frac{\sqrt{2}R}{\sqrt{2}-1}$

(C) $\frac{R}{\sqrt{2}+1}$

(D) $\frac{R}{\sqrt{2}-1}$

Q.No. 21 A charge Q is distributed over three concentric spherical shells of radii a, b, c (a < b< c) such that their surface charge densities are equal to one another. The total potential at a point at a distance r from their common center, where r < a, would be.

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(A) $\frac{Q(a+b+c)}{4\pi\epsilon_0(a^2+b^2+c^2)}$

(B) $\frac{Q}{12\pi c_0}\frac{ab+bc+ca}{abc}$

(C) $\frac{Q(a^2+b^2+c^2)}{4\pi c_0(a^3+b^3+c^3)}$

(D) $\frac{Q}{4\pi\epsilon_0(a+b+c)}$

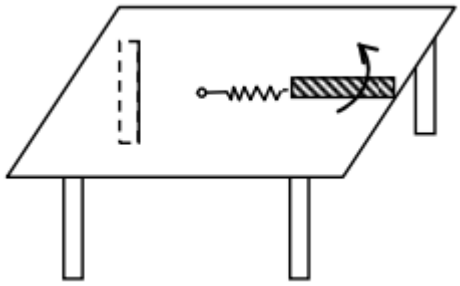
Q.No. 22 The region between y=0 and y=d contains a magnetic field $\vec{B} = Bz$. A particle of mass m and charge q enters the region with a velocity $\vec{v} = v\hat{i}$. If $d = \frac{mv}{2qB}$ the acceleration of the charged particle at the point of its emergence at the other side is :

(A) $\frac{qvB}{m}\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$

(B) $\frac{qvB}{m}\left(\frac{-\hat{j}+\hat{i}}{\sqrt{2}}\right)$

(C) $\frac{qvB}{m}\left(\frac{\sqrt{3}}{2}i + \frac{1}{2}i\right)$

(D) $\frac{qvB}{m}\left(\frac{1}{2}\hat{i} - \frac{\sqrt{3}}{2}\hat{j}\right)$



Q.No. 23 A metallic rod of length 'l' is tied to a string of length 2l and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is:

(A) $(3B\omega l^2)/2$

(B) $(4B\omega l^2)/2$

(C) $(5B\omega l^2)/2$

(D) $(2B\omega l^2)/2$

Q.No. 24 An ideal gas occupies a volume of 2 m^3 at a pressure of 3 x 10^6 Pa. The energy of the gas is :

(A) 9 x 10^6 J

(B) 3 x 10^2 J

(C) 6 x 10^4 J

(D) 10^8 J

Q.No. 25 The dimension of $\frac{B^2}{2\mu_0}$, where B is magnetic field and μ_0 is the magnetic permeability of vacuum, is

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(A) MLT^{-2}

(B) $MLT^{2}T^{-1}$

(C) $ML^{2}T^{-2}$

(D) $ML^{-1}T^{-2}$

Q.No. 26 At a given instant, say t=0, two radioactives substances A and B have equal activities. The ratio $\frac{R_B}{R_A}$ of their activities after time t itself decays with time t as e^{-3t}. If the half-life of A is In2, the half-life of B is:

(A) ln2/4

(B) In2/2

(C) 4ln2

(D) 2ln2

Q.No. 27 In In a process, temperature and volume of one mole of an ideal monoatomic gas are varied according to the relation VT =K. where K is a constant. In this process the temperature of the gas is increased by AT. The amount of heat absorbed by gas is (R is gas constant) :

(A) $\frac{1}{2}\mathrm{KR}\Delta\mathrm{T}$

(B) $\frac{3}{2}R\Delta T$

(C) $\frac{1}{2}R\Delta T$

(D) $\frac{2\mathrm{K}}{3}\Delta\mathrm{T}$

Q.No. 28 A carbon resistance has a following colour code. What is the value of the resistance ?



(A) $64\mathrm{k}\Omega \pm 10\%$

(B) $530\mathrm{k}\Omega \pm 5\%$

(C) $5.3\mathrm{M}\Omega \pm 5\%$

(D) $6.4\mathrm{M}\Omega \pm 5\%$

Q.No. 29 The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2 s. The period of oscillation of the same pendulum on the planet would be:

(A) $2\sqrt{3}\mathrm{s}$

(B) $\frac{\sqrt{3}}{2}s$

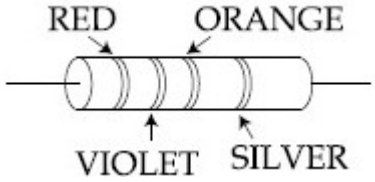
(C) $\frac{3}{2}s$

(D) $\frac{2}{\sqrt{3}}\mathrm{s}$

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Q.No. 30 A resistance is shown in the figure. Its value and tolerance are given respectively by :



(A) 27 kΩ, 20%

(B) 270 Ω, 10%

(C) 270 Ω,5%

(D) 27 kΩ, 10%

Q.No. 31 A mixture of 2 moles of helium gas (atomic mass=4u), and 1 mole of argon gas (atomic mass= 40u) is kept at 300 K in a container. The ratio of their rms speeds [$\frac{V_{\text{rms}}(\text{helium})}{V_{\text{rms}}(\text{argon})}$], is close to:

(A) 2.24

(B) 0.32

(C) 0.45

(D) 3.16

Q.No. 32 A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27°C. Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is about : (Take R=8.3J/K mole)

(A) 14 kJ

(B) 10 kJ

(C) 0.9 kJ

(D) 6 kJ

Q.No. 33 The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to :

(A) 9.6 m

(B) 6.0 m

(C) 2.9 m

(D) 4.8 m

Q.No. 34 Let l, r, c and v represent inductance, resistance, capacitance and voltage, respectively. The dimension of (l /rcv) in SI units will be:

(A) $\left[\mathrm{LA}^{-2}\right]$

(B) $\left[\mathrm{LT}^{2}\right]$

(C) $\left[A^{-1}\right]$

(D) [LTA]

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Q.No. 35 If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is :

(A) $25\ \nu_L$

(B) $16\ \nu_L$

(C) $\nu_L / 16$

(D) $\nu_L / 25$

Q.No. 36 To double the covering range of a TV transmission tower, its height should be multiplied by :

(A) $\frac{1}{\sqrt{2}}$

(B) 2

(C) 4

(D) $\sqrt{2}$

Q.No. 37 A magnetic needle of magnetic moment 6.7×10^{-2} Am^2 and moment of inertia 7.5×10^{-6} kg m^2 is performing simple harmonic oscillations in a magnetic field of 0.01 T. Time taken for 10 complete oscillations is :

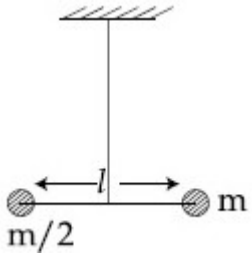
(A) 6.65 s

(B) 8.89 s

(C) 6.98 s

(D) 8.76 s

Q.No. 38 Two masses m and m/2 are connected at the two ends of a massless rigid rod of length l. The rod is suspended by a thin wire of torsional constant k at the centre of mass of the rod-mass system(see figure). Because of torsional constant k, the restoring torque is $\tau = k\theta$ for angular displacement θ. If the rod is rotated by θ_o, and released, the tension in it when it passes through its mean position will be:



(A) $K\theta_o^2 / 2l$

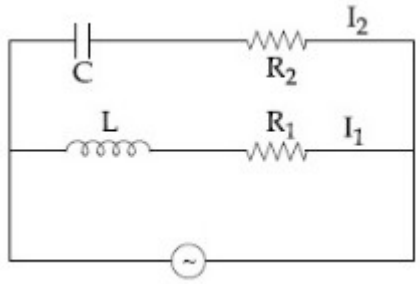
(B) $3K\theta_o^2 / l$

(C) $K\theta_o^2 / l$

(D) $2K\theta_o^2 / l$

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Q.No. 39 In the above circuit, $C = \frac{\sqrt{3}}{2}\mu F, R_2 = 20n$, $L = \frac{\sqrt{3}}{10}H$ and $R_1 = 10\Omega$. Current in L-R_1 path I_1 and in C-R_2 path it is I_2. The voltage of A.C source is given by, $V = 200\sqrt{2}\sin(100t)$ volts. The phase difference between I_1 and I_2 is :

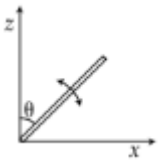
(A) 0º

(B) 30º

(C) 90º

(D) 60º

Q.No. 40 A slender uniform rod of mass M and length *l* is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. The angular acceleration of the rod when it makes an angle θ with the vertical is :



(A) 3g/2*l* sinθ

(B) 2g/3*l* sinθ

(C) 3g/2*l* cosθ

(D) 2g/3*l* cosθ

Answer Sheet

Q.No	Answer
Q.No. 1	(C)
Q.No. 2	(B)
Q.No. 3	(A)
Q.No. 4	(C)
Q.No. 5	(C)
Q.No. 6	(D)
Q.No. 7	(D)
Q.No. 8	(A)
Q.No. 9	(C)
Q.No. 10	(C)
Q.No. 11	(D)

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Q.No. 12	(A)
Q.No. 13	(D)
Q.No. 14	(C)
Q.No. 15	(A)
Q.No. 16	(B)
Q.No. 17	(B)
Q.No. 18	(B)
Q.No. 19	(D)
Q.No. 20	(B)
Q.No. 21	(A)
Q.No. 22	(D)
Q.No. 23	(C)
Q.No. 24	(A)
Q.No. 25	(D)
Q.No. 26	(A)
Q.No. 27	(C)
Q.No. 28	(B)
Q.No. 29	(A)
Q.No. 30	(D)
Q.No. 31	(D)
Q.No. 32	(B)
Q.No. 33	(D)
Q.No. 34	(C)
Q.No. 35	(D)
Q.No. 36	(C)
Q.No. 37	(A)
Q.No. 38	(C)
Q.No. 39	(D)
Q.No. 40	(A)

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