Sample Paper

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Physics

Q.No. 1 A particle with charge Q coulomb, tied at the end of an inextensible string of length R meter, revolves in a vertical plane. At the centre of the circular trajectory there is a fixed charge of magnitude Q coulomb. The mass of the moving charge M is such that $\mathrm{Mg} = \frac{\mathrm{Q}^2}{4\pi e_0 \mathrm{R}^2}$. If at the highest position of the particle. the tension of the string just vanishes, the horizontal velocity at the lowest point has to be

(A) 0

(B) 2√gR

(C) √2gR

(D) √5gR

Q.No. 2 A block of mass m_2 is placed on a horizontal table and another block of mass m_1 is placed on top of it. An increasing horizontal force $\mathbf{F} = \alpha t$ is exerted on the upper block but the lower block never moves as a result. If the coefficient of friction between the blocks isμ_1 and that between the lower block and the table is μ_2, then what' is the maximum possible value of μ_1/μ_2? ?

(A) $\frac{\mathrm{m}_2}{\mathrm{m}_1}$

(B) $1 + \frac{\mathrm{m}_2}{\mathrm{m}_1}$

(C) $\frac{\mathrm{m}_1}{\mathrm{m}_2}$

(D) $1 + \frac{\mathrm{m}_1}{\mathrm{m}_2}$

Q.No. 3 Two black bodies A and B have equal surface areas and are maintained at temperatures 27° C and 177° C respectively. What will be the ratio of the thermal energy radiated per second by A to that by B?

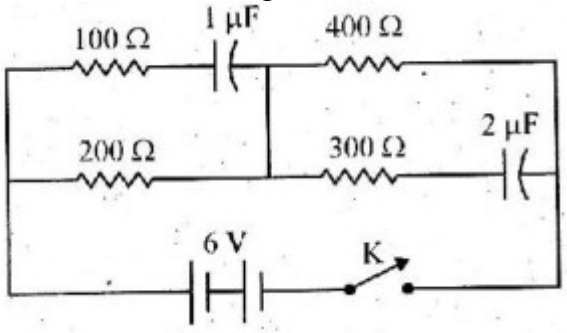
(A) 4:9

(B) 2:3

(C) 16:81

(D) 27:177

Q.No. 4 What will be current through the 200Ω resistor in the given circuit a long time after the switch 'K' is made on?



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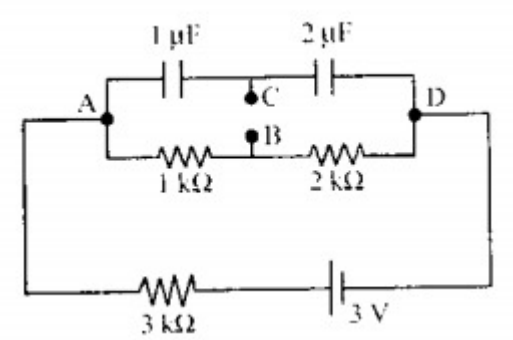
(A) *Zero*

(B) 100mA

(C) 10mA

(D) 1mA

Q.No. 5 Consider the circuit given here. The potential difference V_{BC} between the points Band C



(A) 1 V

(B) 0.5 V

(C) 0 V

(D) -4 V

Q.No. 6 A negative charge is placed at the midpoint between two fixed equal positive charges, separated by a distance 2d. If the negative charge is given a small displacement x (x << d) perpendicular to the line joining the positive charges, how the force (F) developed on it will approximately depend on x ?

(A) F ∝x

(B) F ∝ 1/x

(C) F ∝ x^2

(D) $F \propto \frac{1}{x^2}$

Q.No. 7 Let V_n, and E_n, be the respective speed and energy of an electron in the orbit of radius r,. in a hydrogen atom, as predicted by Bohr's model, Then

(A) plot of $E_n r_n E_1 r_1$ function of n is a straight line of slope 1.

(B) plot of $r_n r_n N_1 N_1$ a function of n is a straight line of slope 0.

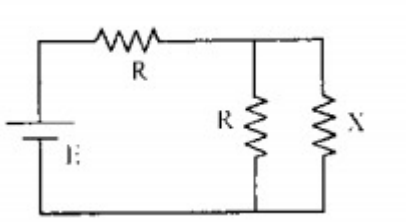
(C) plot of ln $\left(\frac{r_n}{r_1}\right)$ as a function of In (n) is a straight line of slope 3.

(D) plot of In ln $\left\{\frac{r_n E_1}{E_n r_1}\right\}$ as a function of ln(n) is a straight line of slope 4

Q.No. 8 Consider the circuit shown in the figure. The value of the resistance X for which the thermal power generated in it is practically independent of small variation of its resistance its resistance is

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(A) X =R

(B) X= R/3

(C) X =R/2

(D) X = 2R

Q.No. 9 A compressive force is applied to a uniform rod of rectangular cross-section so that its length decreases by 1%. If the Poisson's ratio for the material of the rod be 0.2, which of the following statements correct ? “The volume approximately .....

(A) decreases by 1%

(B) decreases by 0.8%

(C) decreases by 0.6%

(D) increases by 0.2%

Q.No. 10 A circular Imp of radius 'r' of conducting wire connected with a voltage source of zero internal resistance produces a magnetic field •B at its centre. If instead. a circular loop Of radius ‘2r’ made of same material, having the same cross section is' connected to the same voltage source, what will be the magnetic field at its centre ?

(A) $\frac{B}{2}$

(B) $\frac{\mathrm{B}}{4}$

(C) 2B

(D) B

Q.No. 11 A current ‘I’ is flowing along an infinite, straight wire, in the positive Z-direction and the same current is flowing along a similar parallel wire 5 m apati, in the negative Z- direction. A point P is at a perpendicular distance 3 m from the first wire and 4 m from the second. What will be magnitude of the magnetic field $\overrightarrow{\mathrm{B}}$ at P?

(A) $\frac{5}{12}(\mu_0 \mathrm{I})$

(B) $\frac{7}{24}(\mu_0 \mathrm{I})$

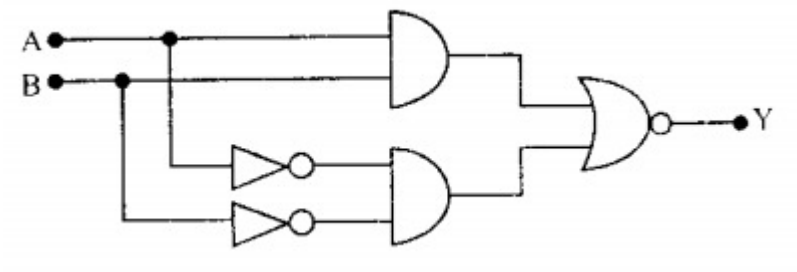
(C) $\frac{5}{24}(\mu_0 \mathrm{I})$

(D) $\frac{25}{288}(\mu_0 \mathrm{I})$

Q.No. 12 In the given circuit, the binary inputs at A and B are both 1 in one case and both 0 in the next case. The respective outputs at Y in these two cases will be :

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(A) 1,1

(B) 0,0

(C) 0,1

(D) 1,0

Q.No. 13 The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance r (r >> L)

(A) decreases as 1/r

(B) decreases as $\frac{1}{r^2}$

(C) decreases as $\frac{1}{r^3}$

(D) approaches a finite limit as r -->∞ .

Q.No. 14 A positive charge Q is situated at the centre of a cube. The electric flux through any face of the cube is (in SI units)

(A) $\frac{Q}{6\pi\varepsilon_0}$

(B) 4πQ

(C) $\frac{Q}{4\pi\varepsilon_0}$

(D) $\frac{Q}{6\pi\varepsilon_0}$

Q.No. 15 Three capacitors of capacitance 1.0, 2.0 and 5.0 μF are connected in series to a 10 V source. The potential difference across the 2.0 μF capacitor is

(A) 100/17 V

(B) 20/17 V

(C) 50/17 V

(D) 10 V

Q.No. 16 An electric bulb, a capacitor, a battery and a switch are all in series in a circuit. How does the intensity of light vary when the switch is turned on

(A) Continues to increase gradually.

(B) Gradually increases for some time and then becomes steady.

(C) Sharply rises initially and then gradually decreases.

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(D) Gradually increases for some time and then gradually decreases.

Q.No. 17 A body starts from rest, under the action of an engine working at a constant power and moves along a straight line. The displacement S is given as a function of time (t) as

(A) $S = at+bt^2$, a, b are constants

(B) $S = bt^2$, b is a constant

(C) $S = at^{3/2}$ a is a constant

(D) S = at, a is a constant

Q.No. 18 A solid rectangular sheet has two different coefficients of linear expansion α_1, and , α_1 along its length and breadth respectively, The coefficient of surface expansion is (for α_1, $t << 1$, $\alpha_2\ t << 1$)

(A) $\frac{a_1+a_2}{2}$

(B) $2(\alpha_1 + \alpha_1)$

(C) $\frac{4a_1\alpha_2}{\alpha_1+\alpha_2}$

(D) $\alpha_1 + \alpha_1$

Q.No. 19 To which of the following quantities, the radius of the circular path of a charged particle moving at right angles to a uniform magnetic field is directly proportional ?

(A) energy of the particle.

(B) magnetic field.

(C) charge of the particle.

(D) momentum of the particle.

Q.No. 20 An electron accelerated through a potential Of 10,000 V from rest has a de-BrogIie wavelength '·λ. What should bC thc accelerating potential so that the wavelength is doubled ?

(A) 20,000 V

(B) 40,000 V

(C) 5.000 V

(D) 2,500 V

Q.No. 21 The de Broglie wavelength of an electron is 0.4×10^{10} m when its kinetic energy is 1.0 keV. Its wavelength will be 1.0×10^{10} m. when its kinetic energy is

(A) 0.02 keV

(B) 0.8 keV

(C) 0.63 keV

(D) 0.16 keV

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Q.No. 22 Radon-222 has a half-life of 3.8 days. If one starts with 0.064 of Radon-222. the quantity of 19 days Will be

(A) 0.002kg

(B) 0.002kg

(C) 0.032kg

(D) 0.024kg

Q.No. 23 2 moles of an ideal monatomic gas is carried from a state (P_0. V_0) to a state ($2P_0$, $2V_0$) along a straight line path in a P-V diagram, The amount of heat absorbed by the gas in the process is given by

(A) $3P_0\ V_0$

(B) $9/2\ P_0\ V_0$

(C) $6P_0\ V_0$

(D) $3/2P_0\ V_0$

Q.No. 24 Six wires, cach of resistance r, are connected so as to form a tetrahedron. The equivalent resistance of the combination when current enters through one corner and leaves through some other corner is

(A) r

(B) 2r

(C) 5

(D) r/2

Q.No. 25 When light of frequency v_1, is incident on a metal with work function W (where hv_1, > W), the photocurrent falls to zero at a stopping potential of v_1, If the frequency of light is increased to V_1, the stopping potential changes to V_2. Therefore, the charge of an electron is given by

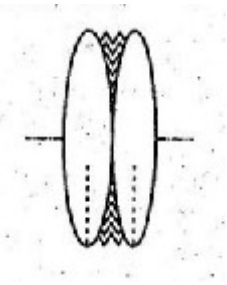
(A) $\frac{W(v_2+v_1)}{v_1V_2+v_2V_1}$

(B) $\frac{W(v_2+v_1)}{v_1V_1+v_2V_2}$

(C) $\frac{W(v_2-v_1)}{v_1V_2-v_2V_1}$

(D) $\frac{W(v_2-V_1)}{v_2V_2-v_1V_1}$

Q.No. 26 Two identical equiconvex len.qes, 'cach of focal 'length cw are placed side by side in contact with each other with a layer of water in between them as shown in the figure. If refractive index of the material Of



the lenses is gjcc.ter than that Of water, bow the combined focal I 'F' is related to ‘f‘?

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(A) $\mathrm{F} > \mathrm{f}$

(B) $\frac{f}{2} < F < f$

(C) $F < \frac{f}{2}$

(D) $\mathrm{F} = \mathrm{f}$

Q.No. 27 What will be the approximate terminal velocity of a raindrop or diameter 1.8×10^{-3}m When density Of rain water kgtn^{-}3 and the eo-efficient of viscosity of air 1.8 *10^{-5}Nsm^{-2}? (Neglect buoyancy Of air).

(A) $49\mathrm{ms}^{-1}$

(B) $98\mathrm{ms}^{-1}$

(C) $392\mathrm{ms}^{-1}$

(D) $980\mathrm{ms}^{-1}$

Q.No. 28 An alternating current is flowing through a series LCR circuit. It is found that the current reaches a value of I mA at both 200 Hz and 800 Hz frequency. What is the resonance of the circuit ?

(A) 600Hz

(B) 300Hz

(C) 500Hz

(D) 400Hz

Q.No. 29 A uniform capillary tube of length / and inner radius r with its upper end sealed is submerged vertically into water. The outside pressure is P_0, and surface tension of water is γ. When a length x of the capillary is submerged into water, it is found that water levels inside and outside the capillary coincide. The value of x is

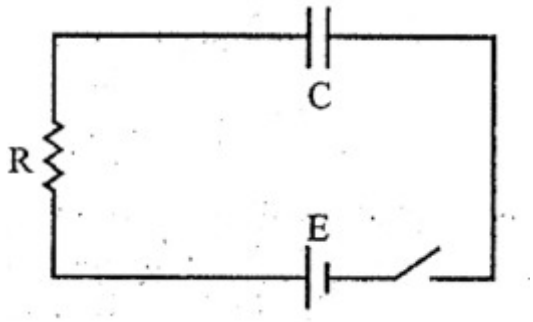
(A) $\frac{1}{\left(1+\frac{p_u^r}{4y}\right)}$

(B) $\mathrm{l}\left(1-\frac{p-r}{4\gamma}\right)$

(C) $\mathrm{l}\left(1-\frac{p-r}{2\gamma}\right)$

(D) $\frac{1}{\left(1+\frac{\mathrm{p-r}}{2\gamma}\right)}$

Q.No. 30 A capacitor of capacitance C is, connected in series with a resistance R and a DC source of emf E through a key. The capacitor-starts charging when the key is closed. By the time the capacitor has been fully



charged, what amount of energy is dissipated in the resistance R ?

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(A) ½ CE^2

(B) 0

(C) CE^2

(D) E^2/R

Q.No. 31 A parent nucleus X undergoes a-decay with a half-life of 75000 years. The daughter nucleus Y undergoes B-decay with a half-life of 9 months. In a particular sample, it is found that the rate of emission of B -particles is nearly constant (over several months) at 10^7/ hour. What will be the number of α-particles emitted in an hour ?

(A) 10^2

(B) 10^7

(C) 10^{12}

(D) 10^{14}

Q.No. 32 A charge of 0.8 coulomb is divided into two charges Q_1, and Q_2,. These are kept at a separation of 30 cm, The force on Q_1, is maximum when

(A) $Q_1 = Q_2 = 0.4$ C

(B) $Q_1 = 0.8$ C , Q_2 negligible

(C) Q_1 negligible $Q_2 = 0.8$ C

(D) $Q_1 = 0.2$C $Q_2 = 0.6$ C

Q.No. 33 A point object is: placed on the axis of a thin convex lens of focal length 0.05 m at a distance of 0.2 m from the lens and its image is formed on the axis. If the object is now made to oscillate along the axis with a small amplitude of A cm, then what is. the, amplitude of oscillation of the image ? [you may assume, $\frac{1}{1+x} = 1 - x$, where x << 1]

(A) $\frac{4A}{9} \times 10^{-2}$m

(B) $\frac{5A}{9} \times 10^{-2}$m

(C) $\frac{A}{3} \times 10^{-2}$m

(D) $\frac{A}{9} \times 10^{-2}$m

Q.No. 34 Three vectors $\vec{A} = a\vec{i} + \vec{j} + \vec{k} : \vec{B} = \vec{i} + b\vec{j} + \vec{k}$ and $\vec{C} = \vec{i} + \vec{j} + \vec{k}$ are mutually perpendicular $\vec{i}$ $\vec{j}$ and $\vec{k}$ are unit vectors along X. Y and Z axis respectively). The respective values of a, b and c are

(A) 0,0,0

(B) yy

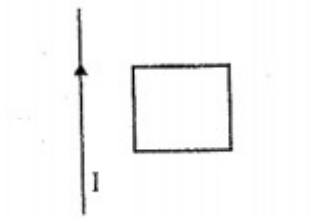
(C) 1,-1,1

(D) ½, ½, ½

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Q.No. 35 A square conducting loop is placed near an infinitely long current carrying wire with one edge parallel to the wire as shown in the figure. If the current in the straight wire is suddenly halved, which of the



following statements will be true ? "The loop will

(A) stay stationary.

(B) move towards the wire.

(C) move away from the wire.

(D) move parallel to the wire.

Q.No. 36 In Young's experiment for the interference of light, the separation between the slits is d and the distance of the screen from the slits is D. If D is increased by 0.5% and d is decreased by 0.3%, then for the light of a given wavelength, which one of the following is true ? "The fringe width....."

(A) increases by 0.8%

(B) decreases by 0.8%

(C) increases by 0.2%

(D) decreases by 0.2%

Q.No. 37 Tlic water equivalent of a calorimeter is 10 g and it contains 50 g of water at $15^{\circ}\mathrm{C}$ Some amount of ice. initially at $-10^{\circ}\mathrm{C}$ is dropped in it and half of the ice melts till equilibrium is reached. What was the initial amount of ice that was dropped (when specific heat of ice $= 0.5$ cal $gm^{-1} \cdot C^{-1}$, specific heat of water $= 1.0\mathrm{calgm}^{1}\mathrm{c}^{-1}$ and latent heat of melting of ice =$80\mathrm{calgm}^{-1}$)

(A) 10g

(B) 18 g

(C) 20g

(D) 30g

Q.No. 38 When the frequency of the AC voltage applied to a series LCR circuit is gradually increased from a low value, the impedance of the circuit

(A) monotonically increases

(B) first increases and then decreases

(C) first decreases and then increases

(D) monotonically dec

Q.No. 39 The dimension of the universal constült of gravitation. G. is

(A) $\left[\mathrm{ML}^{2}\mathrm{T}^{-\mathrm{l}}\right]$

(B) $\left[\mathrm{M}^{-1}\mathrm{L}^{3}\mathrm{T}^{-2}\right]$

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(C) $\left[\mathrm{M}^{-1}\mathrm{L}^{2}\mathrm{T}^{-2}\right]$

(D) $\left[\mathrm{ML}^{3}\mathrm{T}^{-2}\right]$

Q.No. 40 A proton and an electron initially at rest are accelerated by the same potential difference. Assuming that a proton is 2000 times heavier than an''electron, what will be the relation between the de Broglie wavelength of the proton (λ_p) and that of electron (λ_{e}) ?

(A) $\lambda_p = 2000\lambda_e$

(B) $\lambda_p = \frac{\lambda_e}{2000}$

(C) $\lambda_{\mathrm{p}} = 20\sqrt{5}\lambda_{\mathrm{e}}$

(D) $\lambda_p = \frac{\lambda_e}{20\sqrt{5}}$

Answer Sheet

Q.No	Answer
Q.No. 1	(B)
Q.No. 2	(B)
Q.No. 3	(C)
Q.No. 4	(C)
Q.No. 5	(B)
Q.No. 6	(A)
Q.No. 7	(D)
Q.No. 8	(C)
Q.No. 9	(C)
Q.No. 10	(B)
Q.No. 11	(C)
Q.No. 12	(B)
Q.No. 13	(B)
Q.No. 14	(A)
Q.No. 15	(C)
Q.No. 16	(C)
Q.No. 17	(C)
Q.No. 18	(D)
Q.No. 19	(D)
Q.No. 20	(D)
Q.No. 21	(D)
Q.No. 22	(A)
Q.No. 23	(C)
Q.No. 24	(D)

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Q.No. 25	(C)
Q.No. 26	(B)
Q.No. 27	(B)
Q.No. 28	(C)
Q.No. 29	(D)
Q.No. 30	(A)
Q.No. 31	(B)
Q.No. 32	(A)
Q.No. 33	(D)
Q.No. 34	(B)
Q.No. 35	(B)
Q.No. 36	(A)
Q.No. 37	(C)
Q.No. 38	(C)
Q.No. 39	(D)
Q.No. 40	(D)

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