PHYSICS

1. The physical quantity having the dimensions $\left[M^{-1}L^{-3}T^{+3}A^{2}\right]$ is

   (a) Resistance (b) Resistivity
   (c) Electrical conductivity (d) Electromotive force

2. The orbital velocity of a satellite close to the surface of the earth is v. if this satellite starts orbiting at an altitude of half the earth's radius, the orbital velocity will be

   (a) $\sqrt{\frac{2}{3}}v$ (b) $\sqrt{\frac{2}{5}}v$ (c) $\sqrt{\frac{2}{7}}v$ (d) $\sqrt{\frac{2}{9}}v$

3. A force 'F' acting on a body depends on its displacement 's' as $F \propto S^{-\frac{1}{3}}$. The power delivered by 'F' will depend on displacement as

   (a) $S^{2/3}$ (b) $S^{-3/2}$ (c) $S^{1/2}$ (d) S^{0}

4. A particle is projected from the ground with an initial speed of 'V' at an angle θ with the horizontal. Average velocity of the particle between its point of projection and highest point of the trajectory is

   (a) $\frac{V}{2}\sqrt{1+2\cos^2\theta}$ *(b)* $\frac{V}{2}\sqrt{1+\cos^2\theta}$ *(c)* $\frac{V}{2}\sqrt{1+3\cos^2\theta}$ (d) $V\cos\theta$

5. A block 'A' of mass 2 kg rests on another block B of mass 8 kg which rests on a horizontal floor. The coefficient of friction between A and B is 0.2. While that betweenB and floor is 0.5. When a horizontal force of 25 N is applied on the block B, the force offriction between A and B is

   (a) zero (b) 3.9 N (c) 5 N (d) 49 N

6. Temperature of the mixture of one mole of He and one mole of Hydrogen is increased from 0^0 C to 100^0C at constant pressure, the amount of heat delivered will be (R = 2 cal/mole – K)

   (a) 600 cal (b) 1200 cal (c) 1800 cal (d) 3600 cal

7. The nucleus $_{94}Pu^{242}$ decays to $_{82}Pu^{206}$ by emitting

   (a) 9α and 12β particle (b) 9α and 6β particle
   (c) 6α and 9β particle (d) 6α and 12β particle

8. In Huygen's eyepiece, the distance between the two lenses is 'P', the effective focal length is 'Q', the focal length of field lens is 'R' and focal length of eye lens is 'S' then

   (a) R > P > Q > S (b) P > Q > R > S (c) Q > R > S > P (d) R > S > P > Q

9. A wire of length L and 3 identical cells of negligible internal resistances are connected in series. Due to the current, the temperature of the wire is raised by ΔT in a time 't'. A number 'N' of similar cells is now connected in series with a wire of the same material and cross – section but of length 2 L. The temperature of the wire is raised by the same amount in the same time. The value of N is

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(a) 4 (b) 6 (c) 8 (d) 9

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10. The binding energy per nucleon for X^{200}, A^{110} and B^{90} are 7.4 MeV, 8.2 MeV and 8.2 MeV respectively. The energy released in the reaction $X^{200} \rightarrow A^{110} + B^{90} + energy$ is
(a) 200 MeV (b) 160 MeV (c) 110 MeV (d) 90 MeV

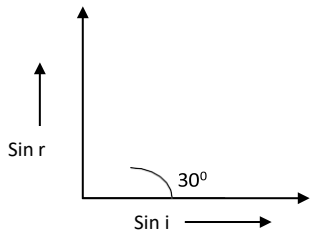
11. If the momentum of an electron is changed by ΔP, then the de Broglie wavelength associated with it changes by 0.5%. The possible initial momentum of the electrons will be
(a) $\frac{\Delta P}{200}$ (b) $\frac{\Delta P}{199}$ (c) $199\Delta P$ (d) $400\Delta P$

12. A wire of length 1 m and radius 1 mm is subjected to a load. The extension is 'x'. The wire is melted and then drawn into a wire of square cross-section of side 1 mm. The extension under the same load is
(a) $\pi^2 x$ (b) πx^2 *(c)* πx *(d)* π / x

13. Electric potential at any point is $V = 5x + 3y + \sqrt{15}\,z$, then the magnitude of intensity of electric field is
(a) $3\sqrt{2}\,units$ (b) $4\sqrt{2}\,units$ (c) $5\sqrt{2}\,units$ (d) 7 units

14. For a series L-C-R circuit $R = X_L = 2X_C$. The impedence of the circuit and phase difference alternating voltage of the circuit will be
(a) $\frac{5}{\sqrt{2}} R, Tan^{-1}(2)$ (b) $\frac{5R}{\sqrt{}}, Tan^{-1}(2)$ (c) $\frac{5}{\sqrt{2}} R, Tan^{-1}\left(\frac{1}{2}\right)$ (d) $\frac{5R}{\sqrt{}}, Tan^{-1}\left(\frac{1}{2}\right)$

15. When a light incident on a medium at an angle of incidence 'i' and refracted into a second medium at angle of refraction 'r', the graph of $\sin i$ and $\sin r$ is shown in the figure, then the critical angle for the two media is



(a) $\sin^{-1}\left(\sqrt{3}\right)$ (b) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (c) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (d) $\tan^{-1}\left(\frac{1}{2}\right)$

16. Three rods A, B and C of the same length and same cross-sectional area are joined in series. Their thermal conductivities are in the ratio 1 : 2 : 1.5. If the open ends of A and Care at 200^0C and 18^0C respectively, the temperature at the junction of A and B in equilibrium is
(a) 156^0C (b) 74^0C (c) 116^0C (d) 148^0C

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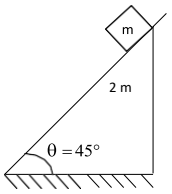
17. A simple pendulum has a time period T when it is at north pole. Its time period when it is at equator (R = radius of earth)

(a) $T\left[1+\frac{w^2R}{2g}\right]$ (b) $T\left[2+\frac{w^2R}{2g}\right]$ (c) T2wg (d) $2\pi\sqrt{\frac{R}{g}}$

18. A wedge of mass 2 m and a cube of mass 'm' are shown in figure. Between cube and wedge there is no friction. The minimum coefficient of friction between wedge and ground so that wedge does not move is



(a) 0.1 (b) 0.2 (c) 0.25 (d) 0.5

19. An object of mass 5 kg falls from rest through a vertical distance of 20 m and attains a velocity of 10 m/s. Then the work done by the resistance of the air on the object is ($g = 10\ ms^{-2}$)

(a) – 750 J (b) 750 J (c) 1000 J (d) – 1000 J

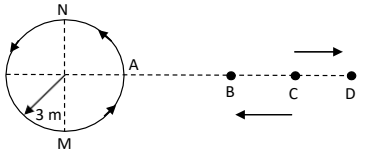
20. Three metal spheres P, Q and R of densities d, $\frac{d}{2}$ and 2d are falling down in a liquid of density $\frac{d}{4}$ with terminal velocities. The radii of the spheres are $\frac{r}{2}$, r and 2r respectively.

The ratio of terminal velocities of the spheres P, Q and R is

(a) 1 : 4 : 16 (b) 3 : 1 : 7 (c) 1 : 1 : 1 (d) 3 : 4 : 112

21. A source of sound is moving along a circular orbit of radius 3 m with an angular velocity of 10 rad/s. A sound detector located far away from the source is executing linear simple harmonic motion along the line BD with amplitude BC = CD = 6m. The frequency of oscillation of the detector is $\left(\frac{5}{\pi}\right)$ per sec. The source is at the point A when the detector is at the point B. If the source emits a continuous sound wave of frequency 340 Hz. The maximum and minimum frequencies recorded by the detector is

[Velocity of sound = 330 m/s]



(a) 255 Hz, 442 Hz (b) 442 Hz, 255 Hz (c) 295 Hz, 482 Hz (d) 482 Hz, 295 Hz

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22. Arrange the RMS current in ascending order for the following three sources of currents
(I) $X_0 \sin Wt$ (II) $X_0 \sin wt \cos wt$ (III) $X_0 \sin wt + X_0 \cos wt$

(a) II, I, III (b) I, II, III (c) III, II, I (d) III, I, II

23. The sky wave propagation is suitable for radio waves of frequency
(a) Upto 2 MHz (b) from 2 MHz to 20 MHz
(c) from 2 MHz to 30 MHz (d) above 30 MHz

24. A wire of mass 'm'; and length 'ℓ' is bent in the from of a quarter circle. The moment of inertia of this wire about an axis passing through the centre of the quarter circle and perpendicular to the plane of the quarter circle is approximately
(a) 0.6 ml^2 (b) ml^2 (c) 0.2 ml^2 (d) 0.4 ml^2

25. A metal cube of coefficient of linear expansion 'α' is floating in a beaker containing a liquid of coefficient of volume expansion γ. When the temperature is raised ΔT, the depth upto which the cube is submerged in the liquid remains unchanged. The relation between α and γ is (Ignore the expansion of the beaker)
(a) $\alpha = \gamma$ (b) $\alpha = \frac{\gamma}{3}$ (c) $\alpha = \frac{\gamma}{2}$ (d) $\alpha = 2\gamma$

26. A circular loop of radius 'r' carrying a current 'i' is held at the centre of another circular loop of radius R(>> r) carrying a current I. The plane of the smaller loop makes an angle of 30^0 with that of the larger loop. If the smaller loop is held fixed in this position by applying a single force at a point on its periphery, the minimum magnitude of this force is
(a) $\frac{\mu_0 \pi\, iIr}{4R}$ (b) $\frac{\mu_0 \pi\, iIr}{3R}$ (c) $\frac{\mu_0 \pi\, iIr}{2R}$ (d) $\frac{\mu_0 \pi\, iIr}{R}$

27. Two coils have self inductance $L_1 = 4mH$ and $L_2 = 1mH$ respectively. The currents in the two coils are increased at the same rate. At a certain instant of time both coils are given the same power. If I_1 and I_2 are the currents in the two cells at that instant of time respectively, then the value $\frac{I_1}{I_2}$ is
(a) $\frac{1}{8}$ (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1

28. Two chambers one containing 'm_1' gm of a gas at a pressure P_1 and other containing 'm_2' gm of a gas at a pressure P_2 are put in communication with each other. If temperature remains constant, the common pressure reached will be
(a) $\frac{P_1P_2(m_1+m_2)}{P_2m_1+P_1m_2}$ (b) $\frac{m_1m_2(P_1+P_2)}{P_2m_1+P_1m_2}$ (c) $\frac{P_1P_2m_1}{P_2m_1+P_1m_2}$ (d) $\frac{m_1m_2P_1}{P_2m_1+P_1m_2}$

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29. A vector $\vec{a}$ makes 30^0 and $\vec{b}$ makes 120^0 angle with the x-axis. The magnitude of these vectors are 3 unit and 4 unit respectively. The magnitude of resultant vector is
(a) 3 unit (b) 4 unit (c) 5 unit (d) 1 unit

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30. Match the logic gates in List – I to the output for the given input A and B in List – II

List – I	List – II
(A) AND gate	(I) $\overline{A+B}$
(B) OR gate	(II) $\overline{A \cdot B}$
(C) NAND gate	(III) A + B
(D) NOR gate	(IV) $A \cdot B$

(a) A-III, B-I, C-IV, D-II (b) A-I, B-III, C-II, D-IV
(c) A-II, B-I, C-IV, D-III (d) A-IV, B-III, C-II, D-I

31. Masses each 1 kg are placed at the vertices of an isosceles triangle ABC in which AC = BC = 5 cm and AB = 8 cm. The distance of centre of mass of the system from the vertex C is
(a) 2 cm (b) 1 cm (c) 1.5 cm (d) 3 cm

32. An – inelastic ball is dropped from a height of 100 m. Due to the earth, 20% of its energy is lost. To what height will the ball rise?
(a) 80 m (b) 40 m (c) 60 m (d) 20 m

33. A thermocouple of resistance 'r' has cold junction at t. It is in series with a galvanometer of resistance G. If thermocouple gives an emf of E volt/^{0}C. The hot junction temperature when the galvanometer reads V volt is
(a) $t+\frac{VG}{E(G+r)}$ *(b)* $t+\frac{EG}{V(G+r)}$ (c) $t+\frac{E(G+r)}{VG}$ (d) $t+\frac{V(G+r)}{EG}$

34. The same mass of copper is drawn into two wires 1 mm thick and 2 mm thick. Two wires are then connected in parallel and current is passed. The heat produced in the wires is in the ratio
(a) 16 : 1 (b) 1 : 1 (c) 1 : 16 (d) 1 : 4

35. The lower end of a glass capillary tube is dipped in water. Water rises to a height of 8 cm. The tube is then broken at a height of 6 cm. The height of water column and angle of contact will be
(a) $6\,m, \sin^{-1}\left(\frac{3}{4}\right)$ (b) $6\,m, \cos^{-1}\left(\frac{3}{4}\right)$ (c) $4\,m, \sin^{-1}\left(\frac{1}{2}\right)$ (d) $4\,m, \cos^{-1}\left(\frac{3}{4}\right)$

36. A central fringe of the interference produced by light of wavelength 6000A^0 is shifted to the position of 5th bright fringe by introducing a thin glass plate of refractive index 1.5. The thickness of the plate will be
(a) $6\times10^{-4}\,mm$ (b) $6\times10^{-4}\,m$ (c) $6\times10^{-4}\,cm$ (d) $6\times10^{-2}\,m$

37. A short magnet produces a deflection of 30^0 when placed at a certain distance in tan A position of magnetometer. If another magnet of double the length and thrice the pole strength is placed at the same distance in tan B position the deflection produced is
(a) 30^0 (b) 60^0 (c) 45^0 (d) 120^0

38. A variable capacitor is kept connected to a 10V battery. If the capacitance of the capacitor is changed from $7\mu F$ to $3\mu F$, the change in the energy of the capacitor is

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(a) $2\times10^{-4}\ J$ (b) $4\times10^{-4}\ J$ (c) $6\times10^{-4}\ J$ (d) $8\times10^{-4}\ J$

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39. Assertion (A): With the increase of target voltage, the energy of x-rays can be increased.
Reason (R): The short wavelength limit of continuous X-ray spectrum varies inversely as the target voltage.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is not the correct explanation of A
(c) A is true, R is false (d) A is false, R is true

40. The fundamental frequency of a sonometer wire of length 'ℓ' is f_0. A bridge is now introduced at a distance of $\Delta\ell$ from the centre of the wire $(\Delta\ell << \ell)$. The number of beats heard if both sides of the bridge are set into vibration in their fundamental modes are

(a) $\frac{8f_0\Delta\ell}{\ell}$ (b) $\frac{f_0\Delta\ell}{\ell}$ (c) $\frac{2f_0\Delta\ell}{\ell}$ (d) $\frac{4f_0\Delta\ell}{\ell}$

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