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Undergraduate Admission Test 2022: Physics Honours

Full Marks : 150 **Time : 2hours**

1. A ball is dropped onto a horizontal surface from a height of 36 cm. After bouncing several times it comes to rest covering a total distance of 100 cm measured in a vertical direction. The percentage loss in the kinetic energy after the first impact is
   a) 36
   b) 64
   c) 53
   d) 96

2. Two guns $A\ and\ B$ can fire bullets at speeds $1km/s$ and $2km/s$ respectively. From a point on a horizontal ground, they are fired in all possible directions. The ratio of maximum areas covered by the bullets fired by the two guns, on the ground is,

   a) 1:2
   b) 1:4
   c) 1:8
   d) 1:16

3. A ball is dropped on floor from a height H. Each collision of the ball with the floor reduces its speed by a factor of 50%. Elevation height of the ball after 2nd collision will be,

   a) $H/4$ b) $H/8$ c) $H/16$ d) $H/32$

4. Rain drops are falling vertically on earth with speed of 20m/s. Now wind start blowing horizontally with speed of 5m/s and a cyclist is moving with a speed of 35 m/s opposite to the wind. Then find the velocity of rain with which the rain is hitting the cyclist.

   a) $10\sqrt{5}$ m/s (b) $22\sqrt{5}$ m/s (c) $20\sqrt{5}$ m/s (d) $5\sqrt{22}$ m/s

5. If a wire is cut into two equal pieces keeping the applied force constant is
   (a) Young's modulus becomes half
   (b) Force constant becomes doubled
   (c) Force constant becomes half
   (d) Young's modulus becomes doubled

6. A particle is fired vertically upward from the earth's surface with a speed of 20 km/s. The speed of the particle in the interstellar space (very large distance from the earth) will be (Given : escape velocity = 11.2 km/s)

   (a) 8.8 km/sec
   (b) 11.2 km/sec
   (c) 16.5 km/sec
   (d) 10.0 km/sec

7. During an experiment it is observed that an ideal gas obeys an additional law $VP^2 = constant$. The gas is at an initial temperature T and volume V. When it is expanded to a volume $2V$, the temperature becomes;

   (a) T (b) 2T (c) $T\sqrt{2}$ (d) $T/2$

8. At a particular temperature the ratio of r.m.s velocity of oxygen molecules and that of hydrogen molecules is

   (a) 1:4
   (b) 4:1
   (c) 1:16
   (d) 16:1

9. Wind blows outside a house of roof area A. All the doors and windows are closed. If the velocity of wind is v and density ρ, the net force lifting the roof is
   a. $\frac{\rho A}{2v^2}$
   b. $\frac{\rho A}{v^2}$
   c. $\frac{\rho A v^2}{2}$
   d. $\frac{\rho A}{2v}$

10. The equation of a particle performing SHM is given by x = A sin(ωT + Φ). At t = 0, particle is at x = 2 unit and its velocity is 2ω unit, then find amplitude A:

    (a) $2\sqrt{2}$ unit (b) $5\sqrt{2}$ unit (c) $4\sqrt{2}$ unit (d) $6\sqrt{2}$ unit

11. A particle is released from a height H. At a certain height, its kinetic energy is two times its potential energy. Height and speed of the particle at that instant are,

(a) $\frac{H}{3}$ and $\sqrt{\frac{2gH}{3}}$
(b) $\frac{H}{3}$ and $\sqrt{\frac{4gH}{3}}$
(c) $\frac{2H}{3}$ and $\sqrt{\frac{2gH}{3}}$
(d) $\frac{H}{3}$ and $\sqrt{2gH}$

12. A particle of mass 1 kg is moving along the line $y = x + 2$ (x and y are measured in meter unit) with speed 2 m/s. The magnitude of angular momentum of the particle about the origin is;

(a) 4 kg m^2 s^{-1}
(b) $2\sqrt{2}$ kg m^2 s^{-1}
(c) $4\sqrt{2}$ kg m^2 s^{-1}
(d) Zero

13. If a body of mass m is taken from the earth surface to a height $h = R$, where R is the radius of the earth and if the acceleration due to gravity is g on the surface of earth then the amount of energy required is

(a) mgR (b) $\frac{1}{2}mgR$ (c) $\frac{1}{4}mgR$ (d) $2mgR$

14. A particle is projected from the earth's surface in vertically upward direction with escape velocity. The total mechanical energy of the particle is;
    (a) Negative
    (b) Positive
    (c) Zero
    (d) Undetermined

15. A cube of side 'a' is made from 6 identical sheets. If coefficient of linear expansion is α and temperature is now made T + ΔT from temperature T then find the change in volume

(a) $\Delta V = 3a^3\alpha\Delta T$ (b) $\Delta V = \frac{4}{3}\pi a^3\alpha\Delta T$ (c) $\Delta V = 4a^3\alpha\Delta T$ (d) $\Delta V = 6a^3\alpha\Delta T$

16. A hole is bored at a depth h on the side wall of a tank filled with water. The velocity of water coming out of the whole is proportional to,

(a) h
(b) h^2
(c) $\sqrt{h}$
(d) Independent of h

17. A bigger drop is broken into a large number of smaller drops. The process is
    (a) Exo-thermic
    (b) Endo-thermic
    (c) Neither exo-thermic nor endo-thermic
    (d) Cannot be said

18. 1 mole of an ideal gas undergoes adiabatic process, which increases the temperature from 27°C to 37°C. The gas is polyatomic and has 4 vibrational modes of freedom. (Given R=8.3 $Jmol^{-1}K^{-1}$). Find net work :

    (a) Work done on the gas 581 J
    (b) Work done by the gas 528 J
    (c) Work done on the gas 381 J
    (d) Work done by the gas 381 J

19. 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 $\frac{V_{rms}(He)}{V_{rms}(Ar)}$ is close to;

    (a) 3.16
    (b) 0.32
    (c) 0.45
    (d) 2.24

20. If 10^{22} gas molecules each of mass $10^{-26}kg$ collide with a surface (perpendicularly) elastically per second over an area $1m^2$ with a speed $10^6m/s$, the pressure exerted by the gas molecules will be of the order of;

(a) $10^4N/m^2$ (b) $10^3N/m^2$ (c) $10^2N/m^2$ (d) $10^8N/m^2$

21. A heat source at $T_1 = 10^3K$ is connected to another heat reservoir at $T_2 = 10^2K$ by a copper slab of length 1 $meter$. Given that the thermal conductivity of copper is 0.1 $WK^{-1}m^{-1}$, the energy flux through it in the steady state is;

a) $65Wm^{-2}$
(b) $90Wm^{-2}$
(c) $120Wm^{-2}$
(d) $200Wm^{-2}$

22. What is the percentage error involved in time period of oscillation of a simple pendulum if errors involved in length measurement is 1% and in gravitational acceleration it is 2%:

(a) 1.5% (b) 2% (c) 3% (d) 0.5%

23. The magnitude of displacement of a particle moving along a circular path of radius a with constant angular speed ω is given by;
(a)$2a\sin(\omega t)$
(b)$2a\sin\left(\frac{\omega t}{2}\right)$
(c)$2a\cos(\omega t)$
(d)$2a\cos\left(\frac{\omega t}{2}\right)$

24. Consider a body moving through air at a speed greater than that of sound. Out the following statements that one which is not connected with this event is

a) Sonic boom
b) Mach number
c) Conical wavefront
d) Ultrasonic

25. The time period of a simple pendulum in a lift descending with an acceleration a ($a < g$) is,

(a) $2\pi\sqrt{\frac{L}{g}}$

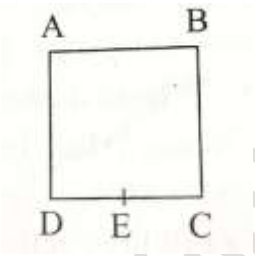
(b) $2\pi\sqrt{\frac{L}{g-a}}$

(c) $2\pi\sqrt{\frac{L}{g+a}}$

(d) $2\pi(L/(g^2+a^2))^{1/2}$

26. The electrostatic potential associated with the electric field $\vec{E} = (\hat{\imath}y + \hat{\jmath}x)$ is given by,
    a) $V = -xy + const$
    b) $V = -(x + y) + const$
    c) $V = (x - y) + const$
    d) $V = -\frac{x}{y} + const$

27. A wire of resistance R is bent to form a square $ABCD$ as shown in figure. The effective resistance between E and C is; (E is the middle point of arm CD)



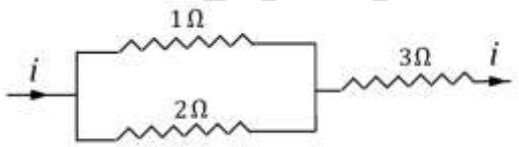
a) R

b) $\frac{7}{64}R$

c) $\frac{3}{4}R$

d) $\frac{1}{16}R$

28. In the circuit shown below, power dissipation at 1Ω , 2Ω and 3Ω resistors will be in the ratio of,



    a. 1:2:3
    b. 4:2:27
    c. 6:4:9
    d. 3:2:1

29. An electron is revolving in a circular orbit of radius 0.5 m, with a speed of 2.2×10^{-6} m/s. Find the equivalent current.
    (a) 2.15×10^{-25} A (b) 1.12×10^{-15} A
    (c) 2.15×10^{-13} A (d) 1.12×10^{-25} A

30. A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is;
    a. 2.0%
    b. 2.5%
    c. 1.0%
    d. 0.5%

31. A long solenoid having 1000 turns per unit length, relative permeability of medium inside it is 500, current flowing in the solenoid is 5A, then find the magnetic field (B) inside the solenoid ? [$\mu_0 = 4\ \pi$ x 10^{-7} N/A^2]

    (a) π x 10^{-2} T (b) π T (c) π x 10^{-3} T (d) 5 π T

32. Magnetic flux linked with a coil is $(1+2t+3t^2)$ Wb where t is in second. At an instant t=1 second, induced e.m.f in the coil is:

(a) 8V (b) 6V (c) 1V (d) 2V

33. A thin prism of 6^0 angle gives a deviation of 3^0 for a given monochromatic light. The refractive index of the material of the prism must be,

a. 1.75
b. 1.5
c. 1.25
d. 1.33

34. Two waves, whose intensities are of ratio 9:16 are made to interfere. The ratio of maximum and minimum intensities in the interference pattern is

(a) 49:16 (b) 49:1 (c) 7:1 (d) 4:3

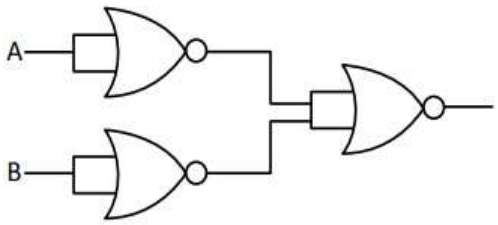
35. $^{238}_{92}$U changes to $^{210}_{85}$At by a series of α and β^- decays, number of α and β^- particles emission in this process is,

(a) 7 *and* 5
(b) 7 *and* 7
(c) 7 *and* 9
(d) 5 *and* 7

36. If V is the accelerating voltage, then the maximum frequency of X-ray emitted from a X-ray tube is

(a) $\frac{eh}{V}$ (b) $\frac{eV}{h}$ (c) $\frac{h}{eV}$ (d) $\frac{V}{eh}$

37. The circuit shown in the figure below represents which of the following gates.



(a) NAND (b) XOR (c) OR (d) AND

38. A p-type semiconductor is
    a) Positively charged b) Negatively charged c) Neutral d) Positively biased

39. When transistor is used as an amplifier, it is operated in,

    a) Saturation region b) Cut off region c) Active region d) Depletion region

40. For an amplitude modulated wave, the maximum amplitude is found to be 10V while minimum amplitude is 2V. Value of modulation index is

    a. 5
    b. 1/5
    c. 3/2
    d. 2/3

41. Three capacitors of capacitances 2μF, 3μF and 6μF are connected in series with a cell of emf 6V. Then charge on each capacitor is

    a) $1\mu C$ (b) $2\mu C$ (c) $6\mu C$ (d) $12\mu C$

42. A wire of uniform cross-section and resistance R is cut into ten equal pieces. If two such pieces are connected in parallel then equivalent resistance will be

    (a) R/5 (b) R/20 (c) R/10 (d) none of these

43. The instantaneous voltage across an impedance is 20 $\sin(200\pi t+60^0)$ V and the current flowing through it is 25 $\cos(200\pi t)$ A. The power factor must be

    (a) 0.5
    (b) 1
    (c) 0.866
    (d) 0.707

44. The best material for the core of transformer is

    (a) AlNiCo (b) Steel (c) Soft Iron (d) Copper

45. If an inductor having inductance L carries a current I then

    (a) Inductors magnetic field stores an energy ½ LI^2
    (b) Inductors electric field stores an energy ½ LI^2
    (c) Energy stored by the magnetic field is 1/3 L I^2
    (d) Inductors magnetic field stores an energy of $3LI^2$

46. Set of parallel monochromatic rays making an angle alpha with the principal axis fall on a thin convex lens. The emergent rays will

    (a) Converge to the focal point on the principal axis.
    (b) Diverge
    (c) Converge at a point on the focal plane of the lens away from the principal axis.
    (d) Remain parallel without making the same angle alpha with the principal axis.

47. Two coherent light sources may be obtained by

    (a) Division of amplitude
    (b) Division of wavefront
    (c) Both (a) and (b)
    (d) Using two separate light sources having same wavelength.

48. In Young's double slit experiment the distance between the two slits is halved while the distance of the screen from the source is doubled. The fringe width will

    (a) remain same
    (b) be doubled
    (c) become 4 times the initial value.
    (d) be halved.

49. The age of an organic material is usually determined by measuring its C^{14} content (carbon dating). The ratio of the number of stable to radioactive isotope of C^{14} present in the content is $3:1$. If the half-life of C^{14} atom is 5730 years, the age of the organic material under investigation is

    (a) 7944 years
    (b) 17190 years
    (c) 11460 years
    (d) 13972 years

50. A pn junction diode is connected in series with a battery of 5 V and a resistance of 100 ohm. If the diode is forward biased with a cut in voltage of 0.7 V, then the power dissipation across the diode must be
    a. 40.5 mW
    b. 35 mW
    c. 30.1 mW
    d. 25 mW

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