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Undergraduate Admission Test : Physics Honours

Full Marks : 75 **Time : 1 hour**

1. If $\vec{A}$ and $\vec{B}$ are three dimensional vectors and $\hat{e}_B$ is unit vector along $\vec{B}$, then $[\vec{A} - (\vec{A}.\hat{e}_B)\,\hat{e}_B].\vec{B}$ must be equal to

(a) 0 (b) 1 (c) $\vec{A}.\vec{B}$ (d) $\vec{A}.\hat{e}_B$

2. A random sample of size ***r*** without replacement is taken from a population of ***n*** distinct elements. The probability for any fixed element of the population to be included must be

(a) $\frac{1}{2}$ (b) $\frac{{}^{n}C_r}{n^r}$ (c) $\frac{r}{n}$ (d) $\frac{{}^{n-1}C_r}{{}^{n}C_r}$

3. The average velocity of a particle falling freely under gravity in vacuum between 3 sec and 3.25 sec must be

(a) 30.6 m/sec (b) 35 m/sec (c) 30 m/sec (d) 31.25 m/sec

4. An object moves at a constant speed along a circular path in a horizontal xy plane, with the centre at the origin. When the object is at x = -2m, its velocity is –(4 m/s)$\hat{j}$. The object's velocity and acceleration when it is at y=2 meter must be

(a) –(4 m/s)$\hat{\imath}$, –(4 m/s^2)$\hat{j}$ (b) (4 m/s)$\hat{j}$, (4 m/s^2)$\hat{\imath}$ (c) –(4 m/s)$\hat{\imath}$, –(8 m/s^2)$\hat{j}$

(d) –(4 m/s)$\hat{\imath}$, (8 m/s^2)$\hat{j}$

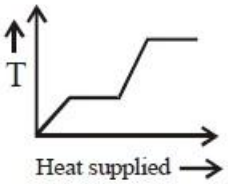
5. A spherical liquid drop of radius R is divided into n^3 equal droplets. If surface tension is S then work done will be

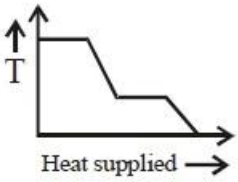
(a) $4\pi R^2S$ (b) $4\pi R^2S(n-1)$ (c) $4\pi R^2S(n^2-1)$ (d) $4\pi R^2S(n^3-1)$

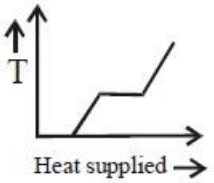
6. If a wire is cut into two equal pieces then

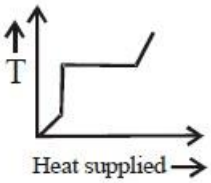
(a) Young's modulus becomes half
(b) Force constant becomes doubled
(c) Force constant becomes half
(d) Young's modulus becomes doubled

7. A block of ice at -10^0 C is slowly heated and converted to steam at 100^0 C. Which of the following curve represents the phenomenon qualitatively?

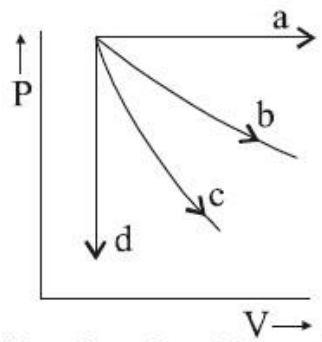
(a) 

(b) 

(c) 

(d) 

8. The given Pressure (P) vs Volume (V) diagram shows four processes i.e., isochoric, isobaric, isothermal and adiabatic. The correct assignment of the process in the same order is given by:



(a) a d b c (b) d a c b (c) a d c b (d) d a b c

9. The temperature at which the root mean square velocity of Hydrogen molecules equals their escape velocity from the earth, is closest to:
[Boltzmann Constant = $1.38\text{x}10^{-23}$ J/K, Universal Gas constant(R)= 8.31 $\text{J.mol}^{-1}.\text{K}^{-1}$, Molar mass of Hydrogen= $2\text{x}10^{-3}$ kg/mol, Radius of the Earth = $6.4\text{x}10^{6}$ m, acceleration due to gravity (g) = 9.8 m/s^2]

a) 800 K b) $3\text{x}10^{5}$ K c) 10^{4} K d) 650 K

10. The time period of a mass suspended from a spring is *T*. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then new time period will be,

(a) T (b) T/2 (c) 2T (d) none of these

11. A tuning fork produces 4 beats per second when vibrated with sonometer wire of length 48 cm and also of 50 cm. The frequency of the tuning fork is,

(a) 196 Hz (b) 284 Hz (c) 375 Hz (d) 460 Hz

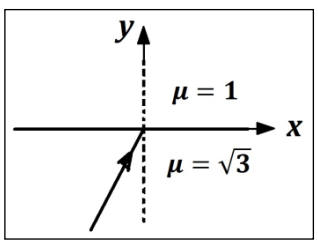
12. A stationary wave is represented by y = A sin(100πt) cos(πx/100) where x is in metre and t is in second. The velocity of the wave is

(a) 1 ms^{-1} (b) 10^{2} ms^{-1} (c) 10^{4} ms^{-1} (d) 10^{-2} ms^{-1}

13. Consider refraction of light ray at an interface separating two homogeneous media. Suppose, $\hat{a}, \hat{b}$ and $\hat{n}$ denotes the directions of incident ray, refracted ray and surface normal respectively. Then, which of the following options is correct?

(a) $\hat{a} + \hat{b} + \hat{n} = 0$
(b) $\hat{a} - \hat{b} = \hat{n}$
(c) $\hat{a} \times (\hat{b} \times \hat{n}) = 0$
(d) $\hat{a} \cdot (\hat{b} \times \hat{n}) = 0$

14. A light ray is crossing an interface from refractive index $\mu = \sqrt{3}$ to $\mu = 1$ as shown in the figure. The incident ray is defined by the



unit vector: $\hat{n} = (\hat{x} + \sqrt{3}\hat{y})/2$. Then, the refracted ray unit vector will be

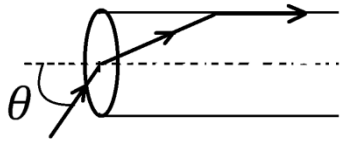
(a) $(\hat{x} + \sqrt{3}\hat{y})/4$

(b) $(\hat{x} - \sqrt{3}\hat{y})/2$

(c) $(\sqrt{3}\hat{x} + \hat{y})/2$

(d) $(\hat{x} + \hat{y})/2$

15. A very narrow beam of light is incident at the axial point of a cylindrical transparent tube as depicted in the figure. Refractive index of the material of the tube is $\mu = 2/\sqrt{3}$. The angle of incidence θ is such that the final emergent ray is directed as shown in the figure. Assuming the surrounding medium is air, the value of θ is,



(a) $\theta = \sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

(b) $\theta = \sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(c) $\theta = \sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(d) $\theta = \sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$

16. If ϵ_0 be the permittivity of free space, L the length, $\Delta V and \Delta t$ are the potential difference and the time interval respectively, then the dimensional formula for the quantity $\epsilon_0 L^{-1}\frac{\Delta V}{\Delta t}$ corresponds to,

(a) Current density

(b) Resistivity

(c) Surface charge density

(d) Electric field

17. An electron is travelling along the X-direction. It encounters a magnetic field in the Y-direction. Its subsequent motion will be

(a) Straight line along the X-direction

(b) A circle in the XZ-plane

(c) A circle in the YZ-plane

(d) A circle in the XY-plane

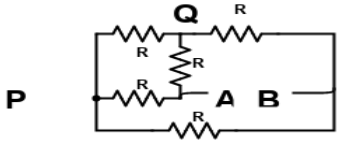
18. Find the equivalent resistance between the point A and B in the given figure.

(a) R

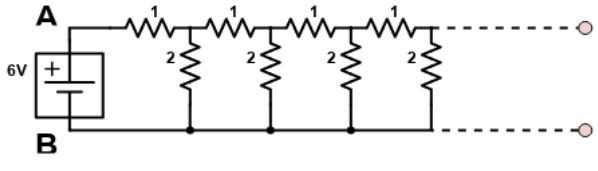
(b) 2R

(c) R/2

(d) R/4



19. 1Ω and 2Ω resistances are connected in an imaginary circuit in an infinitly repeating manner as shown in the figure below and the whole system is connected to a $6V$ battery source. What is the current through 2Ω resistor nearest to the battery in the following picture?



(a) 1A
(b) 2A
(c) 3A
(d) 4A

20. Curie temperature is the temperature above which :

(a) A ferromagnetic material becomes paramagnetic
(b) A paramagnetic material becomes diamagnetic
(c) A ferromagnetic material becomes diamagnetic
(d) A paramagnetic material becomes ferromagnetic

21. A deuteron is a stable particle composed of a neutron and a proton. A proton and a deuteron having same kinetic energies enter a region of uniform magnetic field **B** , moving perpendicular to **B**. The ratio of the radius r_d of deuteron path to the radius r_p of the proton path is:

a) 1:2
b) 1:1
c) $\sqrt{2}:1$
d) $1:\sqrt{2}$

22. An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then:

a) The electron will experience a force at 45^0 to the axis and execute a helical path.
b) The electron will be accelerated along the axis.
c) The electron path will be circular about the axis
d) The electron will continue to move with uniform velocity along the axis of the solenoid.

23. When Uranium is bombarded with neutrons, it undergoes fission. The fission reaction can be written as:

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3x + Q(energy)$$

Where three particles named x are produced and Q amount of energy is released. What is the name of the particle x ?

(a) Electron
(b) α – particle
(c) Neutron
(d) Neutrino

24. If radius of the $^{27}_{13}Al$ nucleus is estimated to be 3.6 fermi then the radius of $^{125}_{52}Te$ nucleus be nearly

a) $8\ fermi$
b) $6 fermi$
c) $5\ fermi$
d) $4\ fermi$

25. Sodium and Copper have work functions 2.3 $eV and$ 4.5 eV respectively. Then the ratio of the wavelengths is nearest to

a) 1: 2
b) 4: 1

c) 2:1
d) 1: 4