2007-PH

EE24BTECH11060 - sruthi bijili

18) The energy levels of a particle of mass m in a potential of the form $v(x)=\begin{cases} \infty, x \leq 0 \\ \frac{1}{2}m\omega^2 x^2, x>0 \end{cases}$ are given in terms of quantum numbers $n = 0, 1, 2, 3 \ldots, n$ by
    a) $\left(n + \frac{1}{2}\right)h\omega$
    b) $\left(2n + \frac{1}{2}\right)h\omega$
    c) $\left(2n + \frac{3}{2}\right)h\omega$
    d) $\left(n + \frac{3}{2}\right)h\omega$
19) The electromagnetic field due to a point charge must be described by lienard-weichart potentials when
    a) the point charge is highly accelerated.
    b) the electric and magnetic fields are not perpendicular.
    c) the point charge is moving with velocity close to that of light.
    d) the calculation is done for the radiation zone,i.e.far away from the charge.
20) The strangeness quantum number is conserved in
    a) strong,weak and electromagnetic interactions.
    b) weak and electromagnetic interactions only.
    c) strong and weak interactions only.
    d) strong and electromagnetic interactions only.
21) The eigenvalues and eigenvectors of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ are
    a) $6, 1$ and $\begin{bmatrix} 4 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}$
    b) $2, 5$ and $\begin{bmatrix} 4 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}$
    c) $6, 1$ and $\begin{bmatrix} 1 \\ 4 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}$
    d) $2, 5$ and $\begin{bmatrix} 1 \\ 4 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}$
22) A vector field is defined everywhere as $\mathbf{F}=\frac{y^2}{L}\hat{\imath} + z\hat{k}$.The net flux of $\mathbf{F}$ associated with a cube of side L,with one vector at the origin and sides along the positive X, Y and Z axes,is
    a) $2L^3$
    b) $4L^3$
    c) $8L^3$

d) $10L^3$

23) $\mathbf{r} = x\hat{i} + y\hat{j}$,then

a) $\nabla.\mathbf{r} = 0$ and $\nabla|\mathbf{r}| = \mathbf{r}$
b) $\nabla.\mathbf{r} = 2$ and $\nabla|\mathbf{r}| = \hat{r}$
c) $\nabla.\mathbf{r} = 2$ and $\nabla|\mathbf{r}| = \frac{\hat{r}}{r}$
d) $\nabla.\mathbf{r} = 3$ and $\nabla|\mathbf{r}| = \frac{\hat{r}}{r}$

24) Consider a vector $\mathbf{p} = 2\hat{i}+2\hat{j}+2\hat{k}$ in the coordinate system $\left(\hat{i}, \hat{j}, \hat{k}\right)$.The axes are rotated anti-clockwise about Y axis by an angle $60°$.The vector $\mathbf{p}$ in the rotated coordinate system $\left(\hat{i}', \hat{j}', \hat{k}'\right)$ is

a) $\left(1 + \sqrt{3}\right)\hat{i}' + 3\hat{j}' + \left(1 - \sqrt{3}\right)\hat{k}'$
b) $\left(1 - \sqrt{3}\right)\hat{i}' + 3\hat{j}' + \left(1 + \sqrt{3}\right)\hat{k}'$
c) $\left(1 - \sqrt{3}\right)\hat{i}' + \left(3 + \sqrt{3}\right)\hat{j}' + 2\hat{k}'$
d) $\left(1 - \sqrt{3}\right)\hat{i}' + \left(3 - \sqrt{3}\right)\hat{j}' + 2\hat{k}'$

25) the counter integral $\oint \frac{1}{z^4+a^4}dz$ is to be evaluated on a circle of radius $2a$ centered at the origin .It will have contributions only from the points

a) $\frac{1+i}{\sqrt{2}}a$ and $-\frac{1+i}{\sqrt{2}}a$
b) ia and $-ia$
c) $ia, -ia, \frac{1-i}{\sqrt{2}}a$ and $-\frac{1-i}{\sqrt{2}}a$
d) $\frac{1+i}{\sqrt{2}}a, -\frac{1+i}{\sqrt{2}}a, \frac{1-i}{\sqrt{2}}a$ and $-\frac{1-i}{\sqrt{2}}a$

26) Inverse Laplace transform of $\frac{s+1}{s^2-4}$ is

a) $\cos 2x + \frac{1}{2}\sin 2x$
b) $\cos x + \frac{1}{2}\sin x$
c) $\cosh x + \frac{1}{2}\sinh x$
d) $\cosh 2x + \frac{1}{2}\sinh 2x$

27) The points,where the series solution of the Legendre differential equation $\left(1 - x^2\right)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + \frac{3}{2}\left(\frac{3}{2} + 1\right)y = 0$ will diverge, are located at

a) 0 and 1
b) 0 and -1
c) -1 and 1
d) $\frac{3}{2}$ and $\frac{5}{2}$

28) Solution of differential equation $x\frac{dy}{dx} + y = x^4$, with the boundary condition that $Y = 1$,at $x = 1$,is

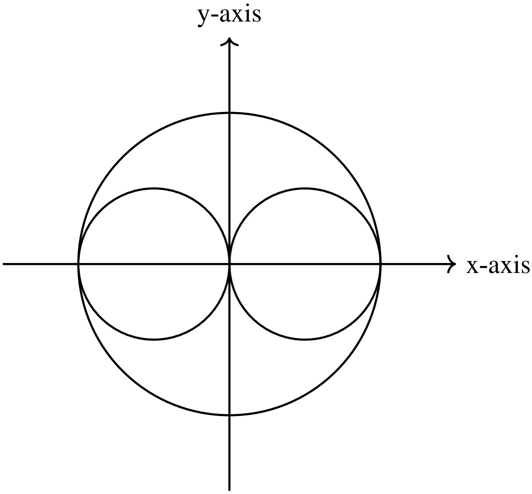
a) $y = 5x^4 - 4$
b) $y = \frac{x^4}{5} + \frac{4x}{5}$
c) $y = \frac{4x^4}{5} + \frac{1}{5x}$
d) $y = \frac{x^4}{5} + \frac{4}{5x}$

29) Match the following

Column 1	Column 2
(A) rest mass	(p) timelike vector
(B) charge	(q) Lorentz invariant
(C) four-momentum	(r) tensor of rank 2
(D) electromagnetic field	(s) conserved and Lorentz invariant

a) $P-2, Q-4, R-3, S-1$
b) $P-4, Q-2, R-1, S-3$
c) $P-2, Q-4, R-1, S-3$
d) $P-4, Q-2, R-3, S-1$

30) The moment of inertia of a uniform sphere of radius r about an axis passing through its centreis given by $\frac{2}{5}\left(\frac{4\pi}{3}r^5\rho\right)$.A rigid sphere of uniform mass density ρ and radius R has two smaller spheres of $\frac{R}{2}$ hollowed out of it,as shown in the figure. The moment of inertia of the resulting body about the Y axis is



a) $\frac{\pi\rho R^5}{4}$
b) $\frac{5\pi\rho R^5}{12}$
c) $\frac{7\pi\rho R^5}{12}$
d) $\frac{3\pi\rho R^5}{4}$

31) The Lagrangian of a particle of mass m is $L = \frac{m}{2}\left[\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2\right] - \frac{V}{2}\left(x^2+y^2\right) + W\sin\omega t$,where $V, W and \omega$ are constants.The conserved quantities are

a) energy and z-component of linear momentum only.
b) energy and z-component of angular momentum only.
c) z-component of both linear and angular momenta only.
d) energy z-component of both linear and angular momenta.

32) Three particles of mass m each situated at $x_1(t), x_2(t) and x_3(t)$ respectively are connected by two springs of spring constant k and un-streched length l.The system

is free to oscillate only in one dimension along the straight line joning all the three particles.The Lagrangian of the system is

a) $L = \frac{m}{2}\left[\left(\frac{dx_1}{dt}\right)^2 + \left(\frac{dx_2}{dt}\right)^2 + \left(\frac{dx_3}{dt}\right)^2\right] - \frac{k}{2}(x_1 - x_2 - l)^2 + \frac{k}{2}(x_3 - x_2 - l)^2$

b) $L = \frac{m}{2}\left[\left(\frac{dx_1}{dt}\right)^2 + \left(\frac{dx_2}{dt}\right)^2 + \left(\frac{dx_3}{dt}\right)^2\right] - \frac{k}{2}(x_1 - x_3 - l)^2 + \frac{k}{2}(x_3 - x_2 - l)^2$

c) $L = \frac{m}{2}\left[\left(\frac{dx_1}{dt}\right)^2 + \left(\frac{dx_2}{dt}\right)^2 + \left(\frac{dx_3}{dt}\right)^2\right] - \frac{k}{2}(x_1 - x_2 + l)^2 - \frac{k}{2}(x_3 - x_2 - l)^2$

d) $L = \frac{m}{2}\left[\left(\frac{dx_1}{dt}\right)^2 + \left(\frac{dx_2}{dt}\right)^2 + \left(\frac{dx_3}{dt}\right)^2\right] - \frac{k}{2}(x_1 - x_2 - l)^2 - \frac{k}{2}(x_3 - x_2 - l)^2$

33) The Hamiltonian of a particle is $H = \frac{p^2}{2m} + pq$,where q is the generalized coordinate and p is the corresponding canonical momentum.The Lagrangian is

a) $\frac{m}{2}\left(\frac{dq}{dt} + q\right)^2$

b) $\frac{m}{2}\left(\frac{dq}{dt} - q\right)^2$

c) $\frac{m}{2}\left[\left(\frac{dq}{dt}\right)^2 + q\frac{dq}{dt} - q^2\right]$

d) $\frac{m}{2}\left[\left(\frac{dq}{dt}\right)^2 - q\frac{dq}{dt} + q^2\right]$

34) A toroidal coil has N closely-wounded turns.Assume the current through the coil to be I and the toroid is filled with a magnetic material of relative permittivity μ_r.The magnitude of magnetic induction **B** is inside the toroid,at a radial distance r from the axis,is given by

a) $\mu_r\mu_0 NIr$

b) $\frac{\mu_r\mu_0 NI}{r}$

c) $\frac{\mu_r\mu_0 NI}{2\pi r}$

d) $2\pi\mu_r\mu_0 NIr$