APEX CARE

INSTITUTE FOR PG - TRB, SLET AND NET IN PHYSICS

1. The value of the closed surface integral $\int \mathbf{r}.d\mathbf{S}$ where **r** is the radius vector and d**S** is **V** represents a solenoidal vector field. The value of the net flux crossing any arbitrary closed surface will be
   A) Zero B) Infinity
   C) Finite and positive D) Finite and negative

2. The value of the contour integral

$$\oint \frac{e^{-z}dz}{(z - i\pi/2)}$$

   over the closed curve C is
   A) -2π B) 2π
   C) $2i\pi$ D) $e^{-\pi/2}$

3. If A is a Hermitian matrix, then e^{iA} will be
   A) A real matrix B) Orthogonal to A
   C) Unitary D) Skew-Hermitian

4. A and B are two arbitrary vectors. What is the nature of the quantity A_iB_j?
   A) A scalar B) A vector
   C) A tensor of 3rd rank D) A tensor of 2nd rank

5. A periodic function is defined as

$$f(x) = \begin{cases} A, & 0 \le x \le L \\ 0, & L < x \le 2L \end{cases}$$

   The value of b_{2k}, the coefficient of sin(2kx) in the Fourier expansion of the function is
   A) 0 B) $2A/(2k-1)\pi$
   C) $A/2\pi$ D) $A/k\pi$

6. The equation of the curve passing through (2, 7/2) and having a slope equal to $1 - 1/x^2$ is
   A) $y = x^2 + x + 1$ B) $xy = x + 1$
   C) $xy = x^2 + x + 1$ D) $xy = y + 1$

7. If **A** is any vector and **i** , **j** and **k** are the unit vectors along the respective axes, then the expression $|\mathbf{A} \times \mathbf{i}|^2 + |\mathbf{A} \times \mathbf{j}|^2 + |\mathbf{A} \times \mathbf{k}|^2$ is equal to
   A) A^2 B) $2A^2$ C) $3A^2$ D) Zero

8. In a radioactivity measurement, the total counts for a time period t is N_t and the background counts for the same interval of time is N_b. What is the statistical error in the net counts $(N_t - N_b)$?
   A) $\sqrt{(N_t - N_b)}$ B) $\sqrt{(N_t + N_b)}$ C) $\sqrt{N_t}$ D) $\sqrt{N_b}$

9. A is an n X n matrix. If |A| denotes its determinant, what is |-A| equal to?
A) -|A| B) |A|
C) $(-1)^n|A|$ D) Not defined

10. Which of the following does the integral

$$\frac{n!}{2\pi i}\oint \frac{f(\omega)\,d\omega}{(\omega-z)^{n+1}}$$

correspond to?
A) $[df(z)/dz]^n$ B) $d^nf(z)/dz^n$
C) $n!df(z)/dz$ D) $f(\omega - z)$

11. A generalized force F acts on a system of particles. Then
A) F will always have the dimensions of a force.
B) F can sometimes have the dimensions of a force.
C) F will never have the dimensions of a force.
D) $\int Fdq$ will sometimes have dimensions of energy, where q is the generalized co-ordinate.

12. In the classical scattering of a particle in a central force field,
A) The angle of scattering increases when the impact parameter decreases.
B) The angle of scattering increases when the impact parameter increases.
C) The angle of scattering first increases as the impact parameter increases, then remains constant.
D) The angle of scattering is independent of the impact parameter.

13. The Lagrangian of a particle is given by $L = ½ m(\dot{x}^2+\dot{y}^2+\dot{z}^2) + kz$ with k = a constant. Then
A) The x component of the momentum is a constant
B) The y component of the momentum is a constant
C) Both x and y components of the momentum are constants
D) The angular momentum is a constant.

14. A particle of mass m moves under the influence of a force $F(x,t) = -k\,x\,\exp(-t/\tau)$ where k and τ are positive constants. Identify the correct expressions for the Lagrangian L and the Hamiltonian H :
A) $L = ½ m\dot{x}^2 + ½ k x^2\exp(-t/\tau)$ and $H = ½ m\dot{x}^2 - ½ k x^2\exp(-t/\tau)$
B) $L = ½ m\dot{x}^2 - ½ k x^2\exp(-t/\tau)$ and $H = ½ m\dot{x}^2 - k x^2\exp(-t/\tau)$
C) $L = ½ m\dot{x}^2 - ½ k x^2\exp(-t/\tau)$ and $H = ½ m\dot{x}^2 + ½ k x^2\exp(-t/\tau)$
D) $L = ½ m\dot{x}^2 - k x^2\exp(-t/\tau)$ and $H = ½ m\dot{x}^2 + ½ k x^2\exp(-t/\tau)$

15. A particle of reduced mass moves with angular momentum L in an attractive central force field having inverse square dependence on r. This motion can be described by an effective potential (k being the constant of proportionality for the force)

A) $k/r^2 + L^2/2 \quad r^2$ B) $- k/r + L^2/2 \quad r^2$
C) $k/r + 2 \quad r^2/L^2$ D) $k/r + 2 \quad L^2/r^2$

16. A massless spring with a spring constant k is compressed by a distance s and the launches a ball of mass m. What should be s so that the ball reaches a velocity v ultimately?

A) $v\sqrt{(k/m)}$ B) $v\sqrt{(m/k)}$ C) k/m D) m/k

17. A moon orbits a distant planet in an elliptical orbit. The distance covered by the moon each day

A) Is greatest when the moon is nearest to the planet
B) Is greatest when the moon is farthest to the planet
C) Remains the same irrespective of its distance from the planet
D) Remains the same irrespective of its distance from the sun

18. Which of the following transformations is **not** canonical?

A) Q = aq + bp and P = cq + dp with ad-bc = 1
B) Q = q and P = p
C) Q = p and P = -q
D) Q = p and P = q

19. A meter stick with a speed of 0.8c moves past an observer. In the observer's reference frame, how long does it take the stick to pass the observer?

A) 1.6 ns B) 2.5 ns C) 4.2 ns D) 5.5 ns

20. The Hamilton-Jacobi equation is expressed as $H + \partial S/\partial t = 0$ where H is the Hamiltonian and S is the Hamilton's principal function. Then, if L is the Lagrangian, S satisfies

A) $S = \int L dt + \text{constant}$ B) $S = \int H dt$
C) $S = L + H$ D) $S + L = 0$

21. A simple pendulum of length l is suspended from the ceiling of an elevator that is accelerating upward with constant acceleration a . For small oscillations, the period, T, of the pendulum is

A) $2\pi\sqrt{(l/g)}$ B) $2\pi\sqrt{[l/(g-a)]}$
C) $2\pi\sqrt{[l/(g+a)]}$ D) $2\pi\sqrt{[la/g(g+a)]}$

22. The total energy of a system of particles is a constant. This is a consequence of

A) Mass energy equivalence
B) Symmetry under space translations
C) Symmetry under time translations
D) Symmetry under space inversion

23. A variable F is a constant of motion for a system. Then
A) The Poisson bracket with the Lagrangian {F, L} will be zero.
B) The Poisson bracket with the Hamiltonian {F, H} will be zero.
C) Both Poisson brackets will be zero.
D) Any one of the Poisson brackets can be zero.

24. What will be the velocity of an alpha particle when its mass is 3 times its rest mass?
A) 94% of the velocity of light
B) 50% of the velocity of light
C) 33% of the velocity of light
D) 17.3% of the velocity of light

25. Which statement is TRUE about the Lorentz force?
A) Always acts at right angles to the direction of motion of a charged particle.
B) Always acts in the direction of the motion of the charged particle
C) Produces no acceleration of the charged particle.
D) Acts only on all types of elementary particles.

26. The dominant mode in a rectangular waveguide is the TE_{10} mode because
A) This mode has the highest cutoff wavelength.
B) This mode has the lowest cutoff wavelength.
C) This mode only has no cut off.
D) There is no attenuation for this mode.

27. An electrostatic field **E**(**r**) and the corresponding scalar potential V(**r**) exists in a region of space containing a charge distribution ρ (**r**). One of the following quantities is linearly related to ρ (**r**). Which one is it?
A) $\nabla^2 E$ B) ∇V C) $\nabla . E$ D) $\nabla X E$

28. As a coil is removed from a magnetic field an emf is induced in the coil which causes a current to flow within the coil. The current interacts with the magnetic field and produces a force which
A) Acts at right angles to the direction of motion of the coil.
B) Acts along the direction of motion of the coil.
C) Acts opposite to the direction of motion of the coil.
D) Causes the coil to flip over.

29. An infinitely long straight conductor carrying a current I is placed at the centre of a loop of wire carrying a current I' such that it is perpendicular to the plane of the loop. What will be the force acting on the wire?
A) It will be directed outward along a radius of the loop
B) It will be directed inward along a radius of the loop
C) It will be directed along the length of the wire
D) There will be no force on the wire

30. In the TM mode of propagation along the Z axis of electromagnetic waves through a rectangular waveguide kept with its axis along the z direction?
A) Only H_z is present.
B) $H_z = 0$ and $E_z = 0$.
C) Magnetic lines of force are perpendicular to the Z axis.
D) Magnetic lines of force are parallel to the Z axis.

31. Pick the correct boundary conditions at the interface separating two media?
A) The normal component of **B** is continuous whereas the tangential component of **H** is discontinuous by an amount equal to the surface current density.
B) The tangential component of **B** is continuous whereas the normal component of **H** is discontinuous by an amount equal to the surface charge density.
C) The normal component of **D** is continuous whereas the tangential component of **E** is discontinuous by an amount equal to the surface charge density.
D) The tangential component of **E** is continuous whereas the normal component of **D** is discontinuous by an amount equal to the surface current density.

32. An electron moves with constant velocity without deflection through electric and magnetic fields of strengths 3.8×10^6 N/C and 4.9×10^{-2} T respectively at right angles to each other and to the direction of motion of the electron. Now the electric field is removed. What will happen to the electron?
A) Continues to move unaffected with a velocity 7.76×10^7 ms^{-1}
B) Continues to move in the same direction with increased velocity
C) Performs circular motion of radius 9.02×10^{-3} m at a speed of 7.76×10^7 ms^{-1}
D) Performs circular motion with increased velocity

33. The skin depth in a copper conductor at 10 GHz is 0.654 m. Its value at 1 MHz will be
A) 654 m
B) 0.654 cm
C) 0.00654 cm
D) 6.54 m

34. The electric field close to the surface of a charged conductor (surface charge density σ):
A) Parallel to the surface and of magnitude σ/ε_0
B) Normal to the surface and of magnitude σ/ε_0
C) Normal to the surface and of magnitude $\sigma/2\varepsilon_0$
D) Parallel to the surface and of magnitude $\sigma/2\varepsilon_0$

35. The total electric charge of either sign in a 1 cm^3 cube of copper is
A) 1 C
B) 1 C
C) Less than 100 C
D) Greater than 1000 C

36. A beam of light is incident on the surface of an optical medium in air at an angle of incidence of 60°. The refracted beam makes an angle of 15° with the incident beam. What is the velocity of light in the medium?

A) $3 \times 10^8\ ms^{-1}$ B) $2 \times 10^8\ ms^{-1}$

C) $3.67 \times 10^8\ ms^{-1}$ D) $2.45 \times 10^8\ ms^{-1}$

37. A line of force in an electric field is a curve that gives the trajectory of the particle so that

A) The electric force at any point is along the tangent to the curve at that point.
B) The electric force at any point is along the normal to the curve at that point.
C) The electic potential will be a constant along the curve
D) The electic potential increases along the curve in the direction of the line of force

38. Magnetic vector potential of a volume current distribution can be expressed as

A) $\oint_S \frac{\mu_o J\, dV}{4\pi r}$ B) $\oint_S \frac{\mu_o J\, dV}{4\pi r^2}$

C) $\oint_S \frac{\mu_o J\, dV}{2\pi r}$ D) $\oint_S \frac{\mu_o J\, dV}{2\pi r^2}$

39. A coil of wire having an inductance L has a current I passing through it. Now the current is reduced to 0.3I. How much magnetic energy has the coil lost in the process?

A) 30% B) 9% C) 70% D) 91%

40. The magnetic vector of a plane electromagnetic wave is given by the expression

$$\mathbf{B}(y) = \mathbf{j}\, B_o \cos(10y + 3 \times 10^9\, t)$$

Where the vector **j** is a unit vector in the Y direction, y is in meters and t is in seconds. What are the values of the wavelength and period of the wave?

A) $\pi/10$ m and $\pi/3$ ns B) $\pi/5$ m and $2\pi/3$ ns

C) 0.1 m and 0.3 ns D) $\pi/5$ nm and $2\pi/3$ ns

Highlights

* Class are handled by TRB / NET / SLET qualified faculties

* PG -TRB 2015 – 16 , District I st Place and 18 students qualified

* PG - TRB 2016 – 17 , District I st Place and 23 students qualified

* 2017 – 18 : SLET Interaction class is going on /
Admission Free - (Selection based on Entrance)

PG - TRB Admission going on.....