ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

M.Sc. (ASTRO PHYSICS)

COURSE CODE : 313

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 313

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

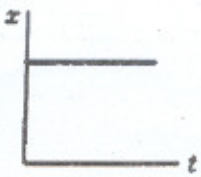
1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each of the question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you –1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

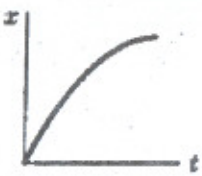
1. A heavy ball falls freely, starting from rest. Between the third and fourth second of time it travels a distance of

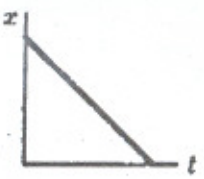
(A) 4.9 m (B) 9.8 m (C) 29.4 m (D) 34.3 m

2. Which of the following five coordinate versus time graphs represents the motion of an object moving with a constant non zero speed?

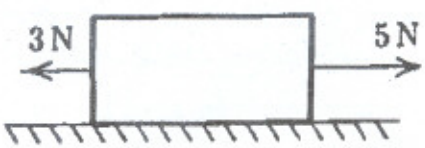
(A) 

(B) 

(C) 

(D) 

3. The block shown moves with constant velocity on a horizontal surface. Two of the forces on it are shown. A frictional force exerted by the surface is the only other horizontal force on the block. The frictional force is



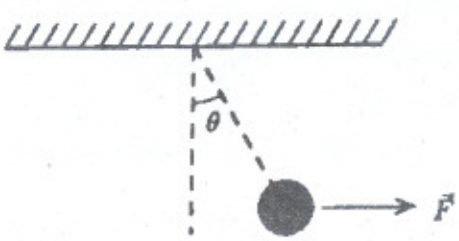
(A) 0

(B) slightly less than 2 N, leftward

(C) 2 N, rightward

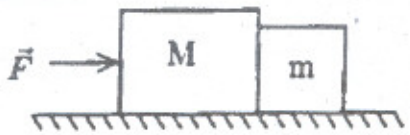
(D) 2 N, leftward

4. A 1-N pendulum bob is held at an angle θ from the vertical by a 2-N horizontal force F as shown. The tension in the string supporting the pendulum bob (in newtons) is



(A) $\sqrt{5}$ (B) $2/\cos\theta$ (C) 1 (D) $\cos\theta$

5. Two blocks with masses m and M are pushed along a horizontal frictionless surface by a horizontal applied force F as shown. The magnitude of the force of either of these blocks on the other is



(A) $\frac{mF}{m+M}$ (B) $\frac{mF}{M}$ (C) $\frac{mF}{m-M}$ (D) $\frac{MF}{m+M}$

6. A block of mass m is initially moving to the right on a horizontal frictionless surface at a speed v. It then compresses a spring of spring constant k. At the instant when the kinetic energy of the block is equal to the potential energy of the spring, the spring is compressed a distance of

(A) $\frac{mv^2}{4k}$ (B) $\frac{1}{4}\sqrt{\frac{mv}{k}}$ (C) $v\sqrt{\frac{2m}{k}}$ (D) $v\sqrt{\frac{m}{2k}}$

7. Evaluate the limit : $\lim_{n\to\infty} 6^n + 5^{n^{1/n}}$

(A) 6 (B) 5 (C) Infinity (D) 5/6

8. Let $f(x+y)=f(x)f(y)$ for all x and y. If $f(5)=2$ and $f'(0)=3$, then, the value of $f'(5)$ is equal to

(A) 5 (B) 8 (C) 6 (D) 0

9. Let $t=e^x$ and $y=t^2-1$. Then, the value of $\left.\frac{d^2y}{dx^2}\right|_{x=0}$ is equal to

(A) 0 (B) 4 (C) e^4 (D) log(4)

10. The minimum value of $f(x)=|3+x|+|2+x|+|5-x|$ where $x\in(-\infty,+\infty)$ is

(A) 7 (B) 10 (C) 0 (D) –3

11. Evaluate the integral : $I = \int \frac{dx}{\sin x + \cos x}$

(A) $\frac{1}{\sqrt{2}} \log \left| \tan\left(\frac{\pi}{4} + \frac{x}{8}\right) \right| + C$

(B) $\sqrt{2} \log \left| \tan\left(\frac{\pi}{8} + \frac{x}{2}\right) \right| + C$

(C) $\frac{1}{\sqrt{2}} \log \left| \tan\left(\frac{\pi}{8} + \frac{x}{2}\right) \right| + C$

(D) $\frac{1}{\sqrt{2}} \log \left| \tan\left(\frac{\pi}{8} - \frac{x}{2}\right) \right| + C$

12. Evaluate the definite integral : $I = \int_{\pi/4}^{3\pi/4} \frac{dx}{1 + \cos x}$

(A) 0 (B) $-\pi/2$ (C) 2 (D) $\pi/2$

13. If the vertex of a triangle is (1, 1) and the midpoints of two sides through this vertex are (–1, 2) and (3, 2) then, the centroid of the triangle is

(A) $\left(-1, \frac{7}{3}\right)$ (B) $\left(-\frac{1}{3}, \frac{7}{3}\right)$ (C) $\left(1, \frac{7}{3}\right)$ (D) $\left(\frac{1}{3}, \frac{7}{3}\right)$

14. A triangle is formed by the pair of straight lines $8x^2 - 6xy + y^2 = 0$ and the straight line $2x + 3y = c$. The area of the triangle so formed is equal to 7. Then, the value of c is equal to

(A) $14\sqrt{2}$ (B) 14 (C) 28 (D) $28/\sqrt{2}$

15. In an ellipse, the distance between the focii is 6 and the minor axis is 8. Then, its eccentricity is

(A) $1/\sqrt{5}$ (B) 3/5 (C) 1/2 (D) 4/5

16. Linearly polarised light can be converted to circularly polarised light with the introduction of a

(A) Half wave plate (B) Attenuator

(C) Quarter wave plate (D) Polariser

17. In Michelson interferometer, as you decrease the separation between the two mirrors

(A) Fringes appears expanding

(B) Fringes appear collapsing

(C) No change in fringe pattern

(D) Sometimes it collapses and sometimes it expands

18. Fraunhoffer diffraction can be observed for

(A) Source and screen are at finite distance

(B) Source and screen are at infinity

(C) Source is at finite and screen at infinity

(D) Source is at infinity and screen at finite distance

19. The potential energy between two atoms in a molecule is given by $U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$ where a and b are positive constants and x is the distance between two atoms in a molecule. The molecule will be in stable equilibrium if

(A) $x = 0$ (B) $x = \left(\frac{a}{2b}\right)^{1/6}$ (C) $x = \left(\frac{2a}{b}\right)^{1/6}$ (D) $x = \left(\frac{11a}{5b}\right)^{1/12}$

20. Sommerfeld explained the hydrogen fine structure by applying the

(A) Heisenberg's principle (B) Zeeman's effect

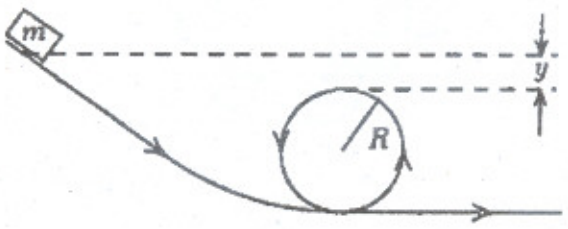
(C) Special theory of relativity (D) Compton Effect

21. An atom containing one single valence electron, the external magnetic field is greater than the internal fields due to the spin and orbital motion of the electron. We observe

(A) Zeeman effect (B) Paschen-Back effect

(C) Stark effect (D) Maxwell principle.

22. A small object of mass m starts from rest at the position shown and slides along the frictionless loop-the-loop track of radius R. What is the smallest value of y such that the object will slide without losing contact with the track?



(A) $R/4$ (B) R (C) $R/2$ (D) $2R$

23. How many electrons can f-sub-shell occupy?

(A) 12 (B) 14 (C) 6 (D) 8

24. Two stationary tuning forks (350 and 352 Hz) are struck simultaneously. The resulting sound is observed to

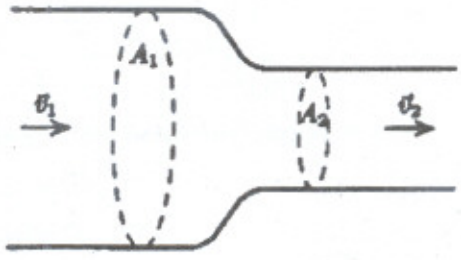
(A) beat with a frequency of 351 beats / Sec

(B) have a frequency of 702 Hz

(C) be Doppler shifted by 2 Hz

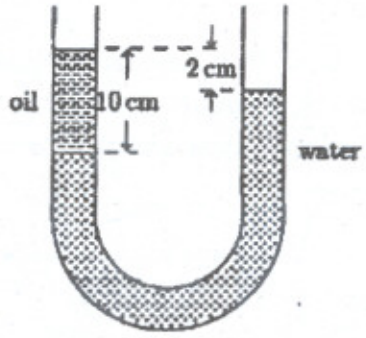
(D) beat with a frequency of 2 beats / Sec

25. The flow of an incompressible liquid in a pipe of varying diameter is shown in the figure. The speed of the liquid is v_1 in region where the area of cross section is A_1. Then, the ratio of the speeds v_2/v_1 is equal to



(A) $\sqrt{A_1/A_2}$ (B) A_2/A_1 (C) A_1/A_2 (D) A_1v_1/A_2v_2

26. The density of water is 1 g.cm^{-3}. The density of oil in the left column of the U-tube shown in the figure will be equal to



(A) 0.2 g.cm^{-3} (B) 1.3 g.cm^{-3} (C) 0.8 g.cm^{-3} (D) 1.8 g.cm^{-3}

27. A circular coil of 160 turns has a radius of 1.90 cm. Calculate the current that results in a magnetic dipole moment of 2.30 Am^2.

(A) 10.7 mA (B) 2.7A (C) 12.7A (D) 19.23 nA

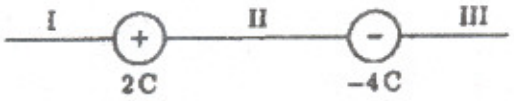
28. A solenoid has length of 1.23 m and inner diameter 3.55 cm and it carries a current of 5.57 A. It consists of five close packed layers, each with 850 turns along its length. What is the magnetic flux density at its center?

(A) 24.2×10^{-4} T (B) 242 μT (C) 242 nT (D) 24.2 mT

29. A particle with positive charge q is a distance d from a long straight wire that carries a current i, the particle is travelling with speed v perpendicular to the wire. What is the magnitude of force on the particle if it is moving toward the wire?

(A) $\frac{\mu_o i}{2\pi}\left(\frac{qv}{d}\right)$ (B) $\frac{\mu_o i}{2\pi}\left(\frac{qv}{2d}\right)$ (C) $\frac{\mu_o}{4\pi}\left(\frac{qv}{d}\right)$ (D) $\frac{\mu_o i}{4\pi}\left(\frac{qv}{d^2}\right)$

30. Two charged particles are arranged as shown in figure. In which region could a third particle, with charge +1 C, be placed so that the net electrostatic force on it is zero?



(A) Region I only (B) Region III only

(C) Between regions I and III only (D) Between regions I and II only

31. Two point charge q_1 = 1mC and q_2 = –2mC are located respectively at (3, 2, –1) and (–1, –1, 4). What is the electric force on a 10 nC charged located at (0, 3, 1)?

(A) $F = (-6.507i - 3.817j + 7.506k) \times 10^{-3}$ N

(B) $F = (-6.507i - 3.817j + 7.506k) \times 10^{-6}$ N

(C) $F = (-6.507i + 3.817j + 7.506k) \times 10^{-3}$ N

(D) F = 0 N

32. Which of the following relations is always true?

(A) $\nabla \cdot E = \frac{\rho}{\epsilon_0}$ (B) $\nabla \cdot B = 0$

(C) $\nabla \times B = \mu_o J + \mu_o \epsilon_o \frac{\partial E}{\partial t}$ (D) $\nabla \cdot J = 0$

33. The electric field $E = (3x^2 + y)i + xj$ kV/m exists in a certain region of space. Calculate the work done in moving a –2 μC charge from (0, 5, 0) to (2, –1, 0) along the path $y = 5 - 3x$.

(A) 0.12 J (B) 1.2 J (C) 0.012 J (D) 0.0012 J

34. Which of the following statements is true ?

(A) The electric field due to an electric dipole varies like r^{-3}

(B) The electric potential due to an electric dipole varies like r^{-3}

(C) In a linear dielectric, the electric polarization inversely proportional to the applied electric field.

(D) Non-polar molecules have permanent electric dipole moments.

35. The relative electric permittivity of sea water is $\epsilon_r = 80$. Its permittivity is

(A) 7.071×10^{-10} F/m (B) 81

(C) 79 (D) 5.162×10^{-10} F/m

36. When a steady potential difference is applied across the ends of a conducting wire

(A) All electrons move with a constant velocity,

(B) All electrons move with a constant acceleration.

(C) There will be an average constant velocity for all electrons.

(D) There will be a non-zero constant acceleration for each electron.

37. A parallel-plate capacitor connected to a battery stores twice as much charge with a given dielectric as it does with air as dielectric. Then, the susceptibility of the dielectric is

(A) 1 (B) 0 (C) 2 (D) 3

38. A rectangular block of iron has dimensions (1.2 × 1.2 × 15) cm. If the resistivity of iron is $\rho = 9.68 \times 10^{-8}$ Ω.m, calculate the resistance of the iron bar. [Assume that the voltage will be applied across the square face of the iron bar.]

(A) 10 mΩ (B) 0.1 μΩ (C) 100 μΩ (D) 6.5 μΩ

39. A uniform magnetic field $|B|$ = 1.2mT is directed vertically upward in a chamber. A proton with kinetic energy 5.3 MeV enters the chamber, moving horizontally from south to north. Calculate the initial acceleration of the of the proton. (Mass of proton = 1.67×10^{-27}kg.)

(A) $|a| = 3.7 \times 10^{12}\ ms^{-2}$ (B) $|a| = 6.1 \times 10^{-15}\ ms^{-2}$

(C) $|a| = 3.2 \times 10^{7}\ ms^{-2}$ (D) $|a| = 6.1 \times 10^{7}\ ms^{-2}$

40. A steady current i flows in a circular loop of radius R. The magnetic field at the center of the loop is

(A) Zero (B) $\frac{\mu_o i}{2R}$ (C) $\frac{\mu_o i}{4\pi R}$ (D) $\frac{\mu_o i}{2\pi R}$

41. In a thermodynamic process, the gas has the equations of state given by $V = V_\circ[1 + \alpha T - T_\circ]$, $\left(\frac{\partial V}{\partial P}\right)_T = 0$ and C_p is a constant. The change in entropy of the gas in the system is

(A) $\Delta S_\circ = C_p \log T - \alpha V_\circ p$ (B) Zero

(C) $\Delta S = C_p - \alpha V_\circ p$ (D) $\Delta S = C_p - \alpha V_\circ p \log T$

42. In the normal Zeeman effect in the hydrogen atom problem, the application of a uniform magnetic field causes the Zeeman splitting of energy levels because

(A) The spherical symmetry is intact

(B) It increases the energy of the system

(C) The spherical symmetry is broken

(D) It decreases the energy of the system

43. Zone plate is an physical object used to illustrate

(A) Fraunhofer diffraction (B) Fresnel diffraction

(C) Interference (D) Polarization

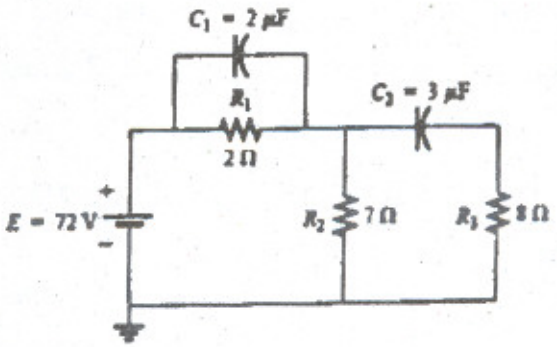
44. The maximum energy of deuteron coming out of a cyclotron accelerator is 20 MeV. The maximum energy of proton that can be obtained from this accelerator is

(A) 40 MeV (B) 30 MeV (C) 20 MeV (D) 10 MeV

45. A particle of mass m and charge q enters a homogeneous and stationary electric field $\vec{E}$ with a velocity v_0 perpendicular to the direction of the field. The particles path will be a

(A) Circle (B) Ellipse (C) Parabola (D) Straight line

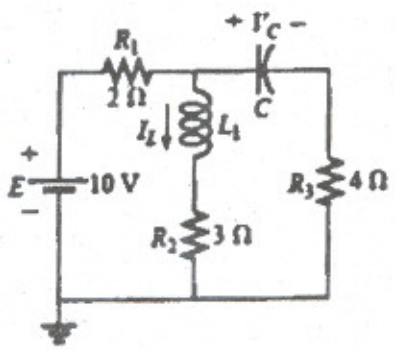
46. The energy stored by each capacitor of Figure are



(A) 256 μJ, 4704 μJ (B) 256 μJ, 470 μJ

(C) 256 μJ, 704 μJ (D) 250 μJ, 4704 μJ

47. The current I_L and the voltage V_c of Figure are



(A) 6A, 2V (B) 0.5A, 6V (C) 2A, 6V (D) 0.5A, 3V

48. The capacitance per unit length of a coaxial cable of inner and outer diameters a and b is

(A) $\frac{4\pi \in ab}{b-a}$ (B) $\frac{2\pi \in ab}{b-a}$ (C) $\frac{4\pi \in}{\log(a/b)}$ (D) $\frac{2\pi \in}{\log(b/a)}$

49. Let ϕ_1 and ϕ_2 be the angles made with normal by magnetic fields in regions 1 and 2 respectively. At the interface between two magnetic media of permeability μ_1 and μ_2 which of the following is true?

(A) $\frac{\tan\phi_1}{\tan\phi_2} = \frac{\mu_2}{\mu_1}$ (B) $\frac{\tan\phi_1}{\tan\phi_2} = \frac{\mu_1}{\mu_2}$

(C) $\frac{\phi_1}{\phi_2} = \tan^{-1}\left(\frac{\mu_1}{\mu_2}\right)$ (D) $\frac{\phi_1}{\phi_2} = \sin^{-1}\left(\frac{\mu_1}{\mu_2}\right)$

50. Let σ, $\in$ be the conductivity and permittivity of a conducting medium. When an a.c voltage of frequency w is applied, the dielectric loss in the medium is given by

(A) $\delta = \tan^{-1}\frac{\sigma \in}{w}$ (B) $\delta = \tan^{-1}\frac{\sigma}{w \in}$ (C) $\delta = \tan^{-1}\frac{w \in}{\sigma}$ (D) $\tan\delta = \frac{w}{\sigma \in}$

51. The electric field of a plane wave traveling in z direction is given by $E = 3\cos(wt - 0.5z)\hat{x} - 4\sin(wt - 0.5z)\hat{y}$. The state of polarization of the wave is

(A) Elliptically polarized (B) Circularly polarized

(C) Linearly polarized (D) Left circularly polarized

52. A plano-convex lens of refractive index μ = 1.523 and focal length 8 m is placed on an optically flat surface such that the convex surface is down. Using sodium vapor lamp (λ = 589.3 nm) and a traveling microscope, interference pattern (Newton's rings) is observed. The radius of the tenth dark ring will be

(A) 1.57 mm (B) 4.184 m

(C) 24.66×10^{-6} m (D) 4.97 mm

53. To achieve an output of 5 V with an input of 100 mV, what is the voltage gain that is required?

(A) 20 (B) 30 (C) 40 (D) 50

54. In which region, the transistor works as an amplifier

(A) In active region (B) In saturation region

(C) In cut-off region (D) None

55. A resistor R is held at a constant temperature T. A current of I amperes is passed through the resistor for a time t. The change in entropy of the resistor and of the universe are,

(A) Zero and $\frac{I^2Rt}{T}$ respectively

(B) $\frac{I^2Rt}{T}$ and $\frac{I^2Rt}{T}$ respectively

(C) Zero and Zero respectively

(D) $\frac{I^2Rt}{T}$ and Zero respectively

56. One mole of ideal gas is contained in a vessel of volume V. The pressure of this vessel varies as $p = p_o e^{-\beta V}$. The maximum attainable temperature of this system is

(A) $T_{max} = \frac{pV}{R}$ (B) $T_{max} = \frac{p}{e\beta R}$ (C) $T_{max} = \frac{p_o V}{R}$ (D) $T_{max} = \frac{p_o}{e\beta R}$

57. Covalent solids are not good conductors because

(A) Covalent bonds are directional

(B) There are no free electrons as these solids have only closed shells

(C) There are no free electrons as all valence electrons are shared

(D) None

58. The result of superposition of three waves $y_1 = 7\sin(wt + \pi/3)$, $y_2 = 12\cos(wt + \pi/4)$ and $y_3 = 20\sin(wt + \pi/5)$ is given by

(A) $Y = 28.6 \cos(wt + 0.372\pi)$

(B) $Y = \sqrt{28.6} \sin[wt + \tan^{-1}1.17]$

(C) $Y = 26.32 \cos(wt + 0.372\ \pi)$

(D) $Y = 28.6 \sin(wt + 0.372\pi)$

59. A power series $P(x)$ is given by $P(x) = 1 + 2x + 4x^2 + 8x^3 + \ldots$. For what range of x will this power series converge?

(A) $-1 < x < 1$ (B) $-2 < x < 1$ (C) $0 < x < 1$ (D) $|x| < \frac{1}{2}$

60. In Stern-Gerlach experiment, the type of magnetic field applied is a

(A) homogeneous magnetic field

(B) time varying magnetic field

(C) magnetic dipole field

(D) inhomogeneous magnetic field

61. A second order phase transition is one in which

(A) specific heat Vs temperature plot shows a discontinuity

(B) a plot of entropy as a function of temperature shows a discontinuity

(C) a plot of volume as a function of temperature shows a discontinuity

(D) compressibility Vs temperature plot shows a discontinuity.

62. A certain paramagnetic material, upon cooling, becomes antiferro magnetic. The temperature at which this transition occurs is known as

(A) Magnetic transition temperature (B) Curie temperature

(C) Weiss temperature (D) Neel temperature

63. Evaluate the integral $I = \int_{-1}^{1} \frac{dx}{x^2}$

(A) $I \to \infty$ (B) $I = -2$ (C) $I = +2$ (D) $I = 0$

64. The general solution to the differential equation

$\frac{d^3y}{dx^3} - 3\frac{dy}{dx} - 2y = 0$ is

(A) $y(x) = Ae^{x} + Bxe^{-x} + Cxe^{x}$ (B) $y(x) = Ae^{2x} + (Bx + C)e^{-x}$

(C) $y(x) = Ae^{-x} + Bxe^{x} + C$ (D) $y(x) = Ae^{-2x} + (Bx + C)e^{-x}$

65. At the point $x = 0$, which is correct for the function

$$f(x)\begin{cases} x^2 \cos\left(\frac{1}{2}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$$

(A) $f(x)$ is not continuous but $f'(x)$ is continuous

(B) $f(x)$ is differentiable but $f'(x)$ is not continuous

(C) $f(x)$ is not differentiable and $f'(x)$ is not continuous

(D) $f(x)$ is differentiable and $f'(x)$ is continuous

66. The potential energy of a charge Q uniformly distributed through-out a sphere of radius R is

(A) $\frac{3}{5}\frac{Q^2}{4\pi\varepsilon_0 R}$ (B) $\frac{3}{5}\frac{Q^2}{4\pi\varepsilon_0 R^2}$ (C) $\frac{5}{3}\frac{Q}{4\pi\varepsilon_0 R^2}$ (D) $\frac{Q}{4\pi\varepsilon_0 R^2}$

67. Natural light falls at the Brewster angle on the surface of a substance whose refractive index is n. The reflection coefficient of light is

(A) $\frac{1}{2}\left(\frac{n-1}{n+1}\right)^2$ (B) $\frac{1}{2}\left(\frac{n^2+1}{n^2-1}\right)^2$ (C) $\frac{1}{2}\left(\frac{n+1}{n-1}\right)^2$ (D) $\frac{1}{2}\left(\frac{n^2-1}{n^2+1}\right)^2$

68. For the dispersion relation $v \sim \frac{1}{\sqrt{\lambda}}$, the group velocity u and its phase velocity v is (λ, k, and w are the wavelength, wavenumber and angular frequency of the wave) are related by

(A) $u = \frac{3}{2}v$ (B) $u = \frac{2}{3}v$ (C) $u = \frac{1}{2}v$ (D) $u = 2v$

69. A particle moves in the field of force $\vec{F}$ whose components are given by $F_x = 2yz(1-6xyz)$, $F_y = 2xz(1-6xyz)$ and $F_z = 2xy(1-6xyz)$. Let H be total energy of the particle and $V(x,y,z)$ be the potential function (if exists). Then,

(A) $V(x,y,z)$ can be defined and H will not be conserved

(B) $V(x,y,z)$ can be defined and H will be conserved

(C) $V(x,y,z)$ cannot be defined and H will not be conserved

(D) $V(x,y,z)$ cannot be defined and H will be conserved

70. The group and phase velocity of the deBroglie's wave describing a free electron with classical velocity V is

(A) $\frac{c^2}{V}$ and V respectively (B) V and V respectively

(C) V and $2V$ respectively (D) V and $\frac{c^2}{V}$ respectively

71. At what value of kinetic energy is the deBroglie wavelength of an electron equal to its Compton wavelength?

(A) $2\pi^2 mc^2$ (B) mc^2 (C) $\left(\sqrt{2}-1\right)mc^2$ (D) $\left(\sqrt{2}+1\right)mc^2$

72. Thermal expansion of materials arises from

(A) asymmetiy of potential energy curve

(B) strong bonds

(C) weak bonds

(D) thermal vibrations

73. An octahedron has

(A) 8 corners and 12 edges
(B) 6 corners and 8 edges
(C) 6 corners and 6 faces
(D) 8 faces and 12 edges

74. The unit of diffusion coefficient D is

(A) $m.s^{-2}$ (B) m^2s^{-1} (C) $(ms)^{-2}$ (D) $m^{-2}s^{-1}$

75. High elastic modulus in materials arises from

(A) weak bonds with shallow potential well
(B) weak bonds with sharp curvature at the minimum potential energy
(C) high strength of bonds and shallow potential well
(D) high strength of bonds and sharp curvature at the minimum potential energy

76. Let E(3d) represent the energy of 3d -subshell, etc. We know that E(3d) > E(4s). The electronic configuration of Cr (atomic number = 24) is given by,

(A) E(5d)> E(4f) > E(6s) and $^{24}Cr = 1s^22s^22p^63s^23p^64s^13d^5$
(B) E(5d) > E(4f) > E(6s) and $^{24}Cr = 1s^22s^22p^63s^23p^64s^23d^4$
(C) E(5d) > E(4f) > E(6s) and $^{24}Cr = 1s^22s^22p^63s^23p^64s^13d^4$
(D) E(4f) > E(5d) > E(6s) and $^{24}Cr = 1s^22s^22p^63s^23p^64s^13d^5$

77. What is the SI unit of magnetic charge?

(A) Ampere-meter square
(B) Coulomb
(C) Ampere
(D) Ampere-meter

78. The dielectric constant of sea water is 80. Its electric permittivity is

(A) 6.9948×10^{-10} F/m
(B) 79
(C) 81
(D) 7.0833×10^{-10} F/m

79. Which one of the following is incorrect?

(A) The conductivities of conductors and insulators vary with temperature and frequency
(B) Nonpolar molecules have no permanent dipoles.
(C) In a linear dielectric, $|\vec{P}| \propto |\vec{E}|$
(D) A conductor is an equipotential body and $\vec{E}$ is always tangential to the conductor

80. In base SI units, tesla is expressed as

(A) $NA^{-1}m^{-1}$ (B) $NA^{-1}m^{-3}$ (C) $Kgm^{-2}s^{-2}A^{-1}$ (D) $Kgs^{-2}A^{-1}$

81. The van der Waals equation of state for one mole of a gas is given by

$$\left[p+\frac{a}{V^2}\right](V-b)=RT$$

Then, for n-moles of gas, it is given by

(A) $\left[p+\frac{a}{V^2}\right](V-b)=nRT$ (B) $\left[p+\frac{an^2}{V^2}\right](V-nb)=nRT$

(C) $\left[p+\frac{an}{V^2}\right](V-nb)=nRT$ (D) $\left[p+\frac{a}{n^2V^2}\right](V-nb)=nRT$

82. A naturally occuring mica sheet can act as a

(A) polarizer (B) light frequency filter

(C) light intensity filter (D) light wave retarder

83. The occurance of multiple colors in peacock's feathers is due to

(A) diffraction of light

(B) interference of light in thin films on its surface

(C) polarization of light due to thin films

(D) the presence of photonic crystal structures on its surface

84. The resolving powers of prism, Fabry-Perot etalon and diffraction grating are in the order

(A) prism < grating < Fabry-Perot etalon

(B) prism <Fabry-Perot etalon < grating

(C) prism > grating> Fabry-Perot etalon

(D) grating < prism < Fabry-Perot etalon

85. A CRO screen has 10 divisions on the horizontal scale. If a voltage signal $V=5\sin(314+45^\circ)$ is examined with a time-base setting of 5 ms/division, then, the number of cycles of signal displayed on the screen will be

(A) 0.5 cycles (B) 5 cycles (C) 10 cycles (D) 2.5 cycles

86. Evaluate $\int_2^3 \sqrt{x^2-4}\,dx$

(A) $\frac{3}{2}\sqrt{5}$ (B) +1.429 (C) $\cosh^{-1}\frac{3}{2}$ (D) −1.429

87. $x\left(\frac{dy}{dx}\right)^2 - y\frac{dy}{dx} + 1 = 0$ is a

(A) First degree, second order nonlinear differential equation
(B) First order, second degree nonlinear differential equation
(C) Second order, first degree nonlinear differential equation
(D) First order, second degree linear differential equation

88. The complex numbers z_1, z_2 and origin form an equilateral triangle. Then,

(A) $z_1^2 + z_2^2 + z_1 z_2 = 0$ (B) $\frac{z_2}{z_1} - \frac{z_1}{z_2} = 2\cos\left(\frac{\pi}{3}\right)$

(C) $\frac{z_2}{z_1} - \frac{z_1}{z_2} = 2\cos\left(\frac{\pi}{6}\right)$ (D) $z_1^2 + z_2^2 - z_1 z_2 = 0$

89. Calculate the linear correlation coefficient for the data points

10	20	30	40	50	60	70
0.22	0.40	0.61	0.85	1.20	1.45	1.70

(A) 0.99633 (B) 0.91919 (C) 0.99268 (D) 0.82900

90. Consider a right angled triangle whose hypotenuse is h and base is x. For what value of x, the area of the triangle will be a maximum?

(A) $x = \sqrt{3}h/2$ (B) $x = h/\sqrt{2}$ (C) $x = h^2/4$ (D) $x = h^2/\sqrt{2}$

91. The differential equation $\left|\frac{dy}{dx}\right| + |y| + c = 0$, $c > 0$

(A) Has only one trivial solution (B) Does not have a unique solution
(C) Has no solution (D) Has a unique solution

92. The differential equation $-udx + xdu = 0$ is

(A) Exact
(B) Not exact
(C) Not having any solution
(D) An inhomogeneous differential equation

93. Let u, v be vector fields and f, g, ϕ be scalars. Then, which of the following is false?

(A) $\nabla \cdot (u \times v) = v \cdot (\nabla \times u) + u \cdot (\nabla \times v)$ (B) $\nabla \cdot (f\nabla g) = f\nabla^2 g + \nabla f \cdot \nabla g$

(C) $u \times (\nabla \times u) = \frac{1}{2}\nabla u^2 - (u \cdot \nabla)u$ (D) $\nabla \cdot (\nabla \times u) \neq \nabla \times \nabla \phi$

94. Let $i = \sqrt{-1}$. Then, one root of $(3 + 4i)^{1/3}$ is

(A) $1.629 - 0.5202i$ (B) $-0.3641 - 1.671i$
(C) $1.265 - 1.151i$ (D) $0.3641 - 1.67i$

95. The solution of the differential equation $y'' - y' - 2y = 4x^2$ subject to the initial conditions $y(0) = 0$ and $y'(0) = 1$ is given by

(A) $y(x) = Ae^{2x} + Be^{-x}$, where $A = 2/3$ and $B = 7/3$

(B) $y(x) = -2x^2 + 2x - 3 + \frac{2}{3}e^{2x} + \frac{7}{3}e^{-x}$

(C) $y(x) = Ae^{2x} + Be^{-x}$, where $A = 7/3$ and $B = 2/3$

(D) $y(x) = Ae^{2x} + Be^{-x} + Ax^2 + Bx$, where $A = 7/3$ and $B = 2/3$

96. The SI units for Stefan-Boltzmann constant is

(A) $J.s.m^{-2}.K^{-4}$ (B) Wm^2K^{-4} (C) $Wm^{-2}K^4$ (D) $Wm^{-2}K^{-4}$

97. Heat conduction is governed by

(A) Fick's law (B) Stefan-Boltzmann law

(C) Fourier law (D) Beer law

98. In 3D space-time coordinates, Newton's second law is

(A) A set of three algebraic equations

(B) A set of three second order ordinary differential equations

(C) A single algebraic equation

(D) A single second order ordinary differential equation

99. Gravitational force is

(A) A short range force and weaker than nuclear force

(B) A short range but stronger than electrostatic force

(C) A long range and weaker than electrostatic force

(D) A long range and stronger than nuclear force

100. Choose the correct statement.

(A) Solar eclipse is defined as: When the earth is revolving in its orbit, it comes between the sun and the moon.

(B) In the year 2012, there will be no lunar eclipse

(C) Solar eclipse is defined as: The moon blocks the light of the sun and a shadow of the moon is cast over the earth's surface

(D) Lunar eclipse is defined as: The moon blocks the light of the sun and a shadow of the moon is cast over the earth's surface