HCU M.Sc. 2020

Part A

Q1. In a thermodynamic process,

(a) entropy is a state function and heat supplied is a path function

(b) entropy and heat supplied are both path functions

(c) entropy and heat supplied are both state functions

(d) entropy and work done are both path functions

Q2. A thermally isolated system goes from an initial equilibrium state C to a final equilibrium state D. The entropies $S(C)$ and $S(D)$ associated with these equilibrium states are related by

(a) $S(C)=S(D)\neq 0$ (b) $S(C)=S(D)=0$

(c) $S(C)\leq S(D)$ (d) $S(C)\geq S(D)$

Q3. A Carnot engine is operating with an efficiency of 50% with the cold reservoir at $300\,K$. To achieve an efficiency of 60% without disturbing the cold reservoir, the temperature of the hot reservoir needs to be

(a) increased by $100\,K$ (b) increased by $150\,K$

(c) decreased by $100\,K$ (d) decreased by $150\,K$

Q4. During an adiabatic expansion of a mono-atomic ideal gas, the volume changes from 1 litre to 2 litres. Given the initial temperature $T_i = 300\,K$, the final temperature T_f satisfies the relation,

(a) $T_f = T_i$ (b) $2T_i > T_f > T_i$

(c) $T_f > 2T_i$ (d) $T_f < T_i$

Q5. A given data set in a finite interval has some missing entries. Which of the following numerical methods can be used to obtain the missing data?

(a) Gauss Seidel Method (b) Trapezoidal Method

(c) Lagrange's Interpolation Method (d) Runge Kutta Method

Q6. The heat equation $\frac{\partial \omega}{\partial t} - \alpha \frac{\partial^2 \omega}{\partial z^2} = 0$ is an example of a

(a) Hyperbolic equation (b) Parabolic equation
(c) Elliptical equation (d) Circular equation

Q7. M is a two-dimensional square matrix with elements, $M_{11} = M_{22} = 0, M_{12} = M_{21} = 1$. The sum of the eigenvalues and the product of the eigenvalues of the matrix respectively are

(a) $0,0$ (b) $0,-1$ (c) $0,1$ (d) $1,-1$

Q8. Three identical uniformly distributed spherical objects, each of mass m and radius r, are arranged such that their centers are located at points with coordinates $(-r,0,0)$, $(0,\sqrt{3}r,0),(r,0,0)$ respectively. The coordinates of the center of mass are

(a) $0,0,0$ (b) $\frac{r}{\sqrt{3}},0,0$ (c) $0,0,\frac{r}{\sqrt{3}}$ (d) $0,\frac{r}{\sqrt{3}},0$

Q9. The moment of inertia I of a thin rod of length L and mass M, about an axis perpendicular to the rod at one end, is given by

(a) $I = \frac{ML^2}{2}$ (b) $I = \frac{ML^2}{3}$ (c) $I = \frac{ML^2}{4}$ (d) $I = \frac{ML^2}{12}$

Q10. If h is the Planck constant, G is the gravitational constant and c is the speed of light, which of the following can represent a length scale?

(a) $\sqrt{hG/c^3}$ (b) hG/c^3 (c) h^2G/c (d) $\sqrt{h^2G/c}$

Q11. In the earth's reference frame, a star is 82 light-years away. The speed at which an astronaut would have to travel so that the distance would be 35 light-years away is

(a) c (b) $0.3c$ (c) $0.6c$ (d) $0.9c$

Q12. Consider a set of orthonormal states $|1\rangle,|2\rangle,|3\rangle$. The value of the constant α, for which the states $|\Psi_1\rangle = \frac{5}{2}|1\rangle - \frac{3}{2}|2\rangle + 2|3\rangle$ and $|\Psi_2\rangle = |1\rangle - 5|2\rangle + \alpha|3\rangle$ are mutually orthogonal, is

(a) 5 (b) –5 (c) 10 (d) –10

Q13. A $100\,MeV$ photon collides with a proton at rest. The maximum possible energy loss for the photon is

(a) $50\,MeV$ (b) $100\,MeV$ (c) $25.4\,MeV$ (d) $17.6\,MeV$

Q14. For two light sources (each of intensity of I_0), having a randomly varying phase difference $\phi(t)$, the resultant intensity is given by

(a) $\frac{I_0}{2}$ (b) $\frac{I_0}{\sqrt{2}}$ (c) $\sqrt{2}I_0$ (d) $2I_0$

Q15. A thin convex lens made from glass (of refractive index $\mu = 3/2$) has focal length f. When it is measured in two different liquids having refractive indices $4/3$ and $5/3$, it has focal lengths f_1 and f_2 respectively. The relation between the focal lengths is given by

(a) $f_1 = f_2 < f$

(b) $f_2 > f$, f_1 becomes negative

(c) $f_1 > f$, f_2 becomes negative

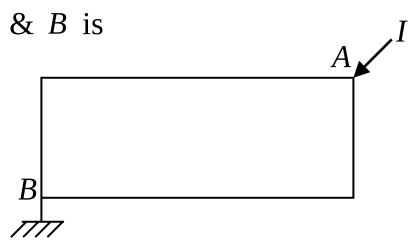
(d) f_1 and f_2 both become negative

Q16. A spherical shell of radius R carries a uniform charge Q. The magnitudes of the electric field and the electric potential inside this spherical shell are respectively given by

(a) $\frac{1}{4\pi \epsilon_0}\frac{Q}{R^2}, \frac{1}{4\pi \epsilon_0}\frac{Q}{R}$ (b) $\frac{1}{4\pi \epsilon_0}\frac{Q}{R^2}, 0$

(c) $0, \frac{1}{4\pi \epsilon_0}\frac{Q}{R}$ (d) $0, 0$

Q17. A metal wire, dissipating a power of "W" when a d.c. current of "I" passes through it, is used to make the rectangle shown in figure. The power dissipated by this wire when current (I) passes through the diagonal points A & B is



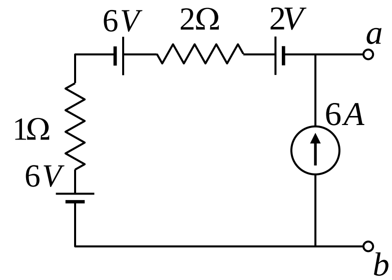
(a) W

(b) $W/2$

(c) $W/4$

(d) $4W$

Q18. The voltage (V_{ab}), across the current source in the circuit shown in the figure, is



(a) $28V$

(b) $10V$

(c) $8V$

(d) $0V$

Q19. The electric field produced inside a uniformly polarized sphere of radius R, with a constant dielectric polarization $\vec{P}$, is

(a) $\vec{P}/3\epsilon_0$ (b) $-\vec{P}/\epsilon_0$ (c) $\vec{P}/\epsilon_0$ (d) $-\vec{P}/3\epsilon_0$

Q20. A hydrogen atom has a Balmer line at $410\,nm$. If the spectrum was observed with deuterium atoms instead, the wavelength of the line would appear to be

(a) increased (b) decreased (c) unchanged (d) halved

Q21. Consider a half-wave rectifier with V_{rpp} as the peak to peak ripple voltage. Which of the following statements are correct?

(I) V_{rpp} decreases with the decrease in the frequency of the input signal.

(II) V_{rpp} decreases with the increase in the frequency of the input signal.

(III) V_{rpp} decreases with the increase in the time constant of the load circuit.

(IV) V_{rpp} decreases with the decrease in the time constant of the load circuit.

(a) I, III (b) I, IV (c) II, III (d) II, IV

Q22. The nuclear spin of ${}_{26}Fe^{58}$ is

(a) 1

(b) $3/2$

(c) $1/2$

(d) 0

Q23. Which of the following statements are correct?

(I) Nuclear forces are always attractive in nature.

(II) Nuclear forces depend on charge.

(III) Nuclear forces depend on spin.

(IV) Some particles are immune to nuclear forces.

(a) I, II (b) II, III (c) III, IV (d) I, III

Q24. Water is flowing in a $6\,m$ deep river. If the shearing stress between horizontal layers across the depth of water is $0.8\,mN/m^2$, the velocity of water in kilometer / hour is nearly (coefficient of viscocity of water is 0.01 poise)

(a) 2.6 (b) 12.8 (c) 17.3 (d) 25.6

Q25. When two air bubbles of different sizes are attached to both ends of a cylindrical pipe with a stop-cock, upon opening the stop-cock,

(a) air flows from the smaller bubble into the larger bubble

(b) air flows from the larger bubble into the smaller bubble

(c) no air flows between the bubbles

(d) air flows into both the bubbles

Part B

Q26. Consider a probability distribution $P(x)$ over the continuous variable x, given as

$$P(x) = P_0 \quad \text{for } a < x < b$$
$$= 0 \quad \text{otherwise,}$$

The mean squared fluctuation of the variable x, defined as $\overline{x^2 - \bar{x}^2}$, is given by

(a) $\frac{(a+b)^2}{4}$ (b) $\frac{(b-a)^2}{12}$ (c) $\frac{a^2+b^2-10ab}{12}$ (d) $\frac{a^2+ab+b^2}{3}$

Q27. A system can be in any one of the energy levels $E_n = \left(n + \frac{1}{2}\right)\hbar\omega$, where n can take any nonnegative integer and $\omega > 0$. If this system is coupled to a thermal reservoir maintained at temperature T, the probability that the system can be found in the ground state is

(a) 1 (b) $e^{-\hbar\omega/k_BT}$ (c) $\frac{1}{1-e^{-\hbar\omega/k_BT}}$ (d) $1-e^{-\hbar\omega/k_BT}$

Q28. The vapour pressure P of water depends on the absolute temperature T through the relation $\ln P = M - \frac{L}{RT}$, where M is a constant, the molar latent heat of vapourization $L = 9720\, Cal/mol$, the gas constant $R = 2\, Cal/mol-K$. Given the vapour pressure at $T = 373\,K$ is $760\, Torr$, the vapour pressure at $T = 353\,K$ approximately, is

(a) $1520\, Torr$ (b) $190\, Torr$ (c) $363\, Torr$ (d) $760\, Torr$

Q29. In 1905, Einstein connected the diffusion constant D to the temperature T by the relation $D = \mu k_B T$, where μ is the mobility (the ratio of the terminal drift velocity to the applied force) and k_B is the Boltzmann constant. The dimension of the diffusion constant is (using $m \equiv$ meter, $Kg \equiv$ kilogram, $s \equiv$ second)

(a) m^2/s (b) m/s^2 (c) $m\,Kg/s$ (d) m^2s/Kg

Q30. The isothermal compressibility $\chi = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$, for an ideal gas at atmospheric pressure (in units of inverse *Pascal*), is

(a) 10^{-5} (b) 10^{5} (c) 1 (d) 760

Q31. A system consisting of n moles of a monoatomic ideal gas undergoes a quasi-static process of an isobaric expansion. The initial and final values of the pressure, temperature and volume respectively are (P_1, T_1, V_1) and (P_2, T_2, V_2). The work done by the gas during the process is

(a) $nR(T_2 - T_1)\ln\frac{V_2}{V_1}$ (b) $P_1(V_2 - V_1)$

(c) $P_1(V_1 - V_2)$ (d) $nR(T_1 - T_2)\ln\frac{V_2}{V_1}$

Q32. The probability of results of three tosses of a true coin (equal probability for head or tail), not being the same is

(a) $1/4$ (b) $1/2$ (c) $3/4$ (d) 1

Q33. The Fourier series representation of a function $f(x)$ is given by $f(x) = \sum_1^\infty a_n \sin nx + \sum_{00}^\infty b_n \cos nx$. The number of nonzero coefficients, for the function $f(x) = 4\sin^2 x$, is

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

Q34. The magnitude and phase of the complex number $1/(1+i)$ are given respectively by

(a) $\frac{1}{\sqrt{2}}, -\frac{\pi}{4}$ (b) $\frac{1}{\sqrt{2}}, \frac{\pi}{4}$ (c) $1, \frac{\pi}{4}$ (d) $1, -\frac{\pi}{4}$

Q35. For two functions, $f_1(x)=\frac{\sin x}{x}$ and $f_2(x)=|3-x|$, where x is real, which of the following statements is NOT true?

(a) Both f_1 and f_2 are continuous functions.

(b) f_1 is bounded and f_2 is not.

(b) Both f_1 and f_2 are differentiable.

(c) f_1 is not a non-negative function but f_2 is.

Q36. If $\cot\theta=\sin 2\theta$, the possible values of $\tan\theta$ are

(a) $0,1$ (b) $-1,0$ (c) $-1,1$ (d) $-1/2, 1/2$

Q37. The solution of the differential equation, $\frac{d^2y}{dx^2}+4y=0$, is given by

(a) $y=6\cos^2 x-3$ (b) $y=6\sin^2 x+3$

(c) $y=3\cos^2 x-6$ (d) $y=3\sin^2 x-6$

Q38. A particle of mass m moves along a trajectory given by $x=x_0\cos\omega_1 t,\ y=y_0\sin\omega_2 t$. The condition for the force to be a central force is given by

(a) $\omega_1=2\omega_2$ (b) $2\omega_1=\omega_2$ (c) $\omega_1=3\omega_2$ (d) $\omega_1=\omega_2$

Q39. A particle of mass m moves under a conservative force with potential $V(x)=\frac{cx}{x^2+a^2}$, where $c>0,\ a>0$. The position of stable equilibrium is given by

(a) $x=a$ (b) $x=-a$ (c) $x=a/2$ (d) $x=-a/2$

Q40. A projectile of mass m, fired from the earth's surface along a direction making 45^0 with the vertical, is seen to reach a maximum vertical height in two seconds and subsequently reaches the earth's surface. The ratio of the horizontal distance traveled to the maximum vertical height reached, is

(a) $1/2$ (b) 1 (c) 2 (d) 4

Q41. An athlete weighing $50\,Kg$ accelerates from rest to a final speed of 36 kilometer/hour in ten seconds, by applying a forward force. The average force and the power generated by the athlete in this event (in SI units), are

(a) 50, 200 (b) 50, 250 (c) 100, 250 (d) 100, 200

Q42. A particle of mass m moving in the x-y plane, approaches the point with coordinates (x, y) along the negative y- direction with speed v. It changes its direction due to an impulse and leaves the point along x- direction with the same speed. The change in angular momentum during this process is

(a) $mvx\,\hat{y}$ (b) $mvy\,\hat{x}$ (c) $mv(y-x)\hat{z}$ (d) $mv(y+x)\hat{z}$

Q43. A mass m connected to a spring of force constant k is stretched by a length A and then released from rest, so that it executes simple harmonic motion. The average kinetic energy, averaged over one time period, is

(a) $kA^2/2$ (b) $k^2A/2m$ (c) $kA^2/4$ (d) $k^2A^4/4m$

Q44. An astronaut travels to the nearest star system 4 light-years away and returns at a speed $0.3c$. The present age of the astronaut relative to the people on earth is

(a) 25.4 years (b) 27 years (c) 30.5 years (d) 44 years

Q45. A stationary body explodes into two fragments, each of mass $0.9\,Kg$, that move apart at speeds of $0.8c$ relative to the original body. The mass of the original body was

(a) $3\,Kg$ (b) $1.8\,Kg$ (c) $2.25\,Kg$ (d) $1.5\,Kg$

Q46. Suppose that a certain quantity y can be written as a continued fraction as: $\dfrac{1}{3+\dfrac{1}{3+\dfrac{1}{3+\dfrac{1}{3+....}}}}$. The value of y is equal to

(a) $\dfrac{3}{2}+\dfrac{\sqrt{13}}{2}$ (b) $3+\sqrt{13}$ (c) 3.335 (d) $\dfrac{3}{2}+\dfrac{\sqrt{3}}{2}$

Q47. Given $\psi_n(x)$ are the normalized eigenfunctions of the linear harmonic oscillator, with corresponding eigen values $E_n = \left(n+\frac{1}{2}\right)\hbar\omega$, let $\psi(x,0) = \frac{1}{2}\psi_0(x) + \frac{1}{\sqrt{3}}\psi_5(x) + i\sqrt{\frac{5}{12}}\psi_7(x)$ represent the wavefunction at $t=0$. The probability of finding the value $\frac{11}{2}\hbar\omega$, upon making a measurement of energy, is

(a) 0 (b) $1/3$ (c) $1/4$ (d) $1/2$

Q48. A particle of mass m is placed in a three-dimensional cubic box of side L. The degeneracy of its energy level of energy $14\left(\frac{\hbar^2\pi^2}{2mL^2}\right)$, is

(a) 3 (b) 12 (c) 6 (d) 4

Q49. The smallest separation that can be resolved by a microscope is of the order of wavelength used. The required energies of electrons needed in an electron microscope, to resolve separations of (a) $15\,nm$ and (b) $1.5\,nm$, are

(a) $6.78\times10^{-3}\,eV$, $6.78\times10^{-5}\,eV$ (b) $6.78\times10^{-3}\,eV$, $6.78\times10^{-1}\,eV$

(c) $6.78\times10^{-1}\,eV$, $6.78\,eV$ (d) $6.78\times10^{-1}\,eV$, $6.78\times10^{-3}\,eV$

Q50. In an X-ray diffraction experiment, if X-rays of wavelength $0.5\,A^0$ are detected at an angle of 5^0, the spacing between adjacent planes in the crystal and the angle at which the second maximum will occur are respectively given by

(a) $6A^0$, 10^0 (b) $6A^0$, 15^0 (c) $3A^0$, 10^0 (d) $3A^0$, 15^0

Q51. In Young's double slit interference arrangement, introduction of a thin transparent glass plate of thickness t, in the path of one of the beams, has resulted in a shift of $0.2\,cm$ in the central bright fringe. It is given that the distance between the two slits is $0.1\,cm$, the distance between the source plane and image is $50\,cm$, the wavelength of the light is $630\,nm$ and the refractive index of glass is 1.5. What is the thickness of the thin glass plate?

(a) $0.02\,cm$ (b) $0.002\,cm$ (c) $0.008\,cm$ (d) $0.004\,cm$

Q52. Unpolarized light is incident on a polarizer, followed by a half wave plate and then a quarter wave plate. If the axes of all these optical components are parallel to each other, the output light is

(a) linearly polarized (b) elliptically polarized

(c) circularly polarized (d) unpolarized

Q53. A lens of focal length $22\,mm$ is being used for imaging an object on a screen kept at $25\,mm$. The object distance, spatial and angular magnification, respectively, are

(a) $183\,mm$, 0.880 and 1.136

(b) $183\,mm$, -0.136 and -7.320

(c) $183\,mm$, -0.880 and -1.136

(d) $183\,mm$, -1.136 and -0.880

Q54. Ordinary and extraordinary refractive indices of a calcite crystal respectively are 1.658 and 1.486. The thickness of this crystal, required to convert linearly polarized light at $589\,nm$ to circularly polarized light, is

(a) $0.86\,\mu m$ (b) $0.96\,\mu m$ (c) $0.76\,\mu m$ (d) $0.66\,\mu m$

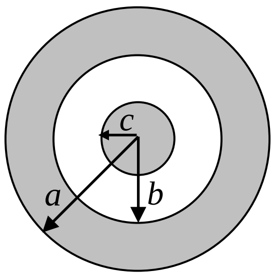
Q55. Three point charges of $+2\,\mu C, +3\mu C$ and $4\mu C$ are placed at the vertices of an equilateral triangle of side $10\,cm$. The magnitude of the resultant force, acting on the $+4\mu C$ charge, is

(a) $7.2\,N$ (b) $10.8\,N$ (c) $15.7\,N$ (d) $9.0\,N$

Q56. A solid sphere of radius R has charge 'q' uniformly distributed over its volume. At what distance from the surface, the value of the electrostatic potential is half of that on the surface?

(a) $2R$ (b) R (c) $R/2$ (d) $R/3$

Q57. A coaxial cable consists of an inner copper wire of radius a surrounded by an outer shell of inner and other radii b and c respectively. The outer shell (b to c) is filled with a material of dielectric constant $\in$. The capacitance, per unit length of the coaxial cable, is



(a) $\dfrac{2\pi \in_0}{\ln\left(\dfrac{a}{b}\right)+\dfrac{1}{\in_r}\ln\left(\dfrac{c}{b}\right)}$ (b) $\dfrac{2\pi \in_0}{\ln\left(\dfrac{b}{a}\right)+\dfrac{1}{\in_r}\ln\left(\dfrac{c}{b}\right)}$

(c) $\dfrac{2\pi \in_0}{\ln\left(\dfrac{a}{b}\right)+\in_r \ln\left(\dfrac{c}{b}\right)}$ (d) $\dfrac{2\pi \in_0}{\ln\left(\dfrac{a}{b}\right)+\in_r \ln\left(\dfrac{b}{c}\right)}$

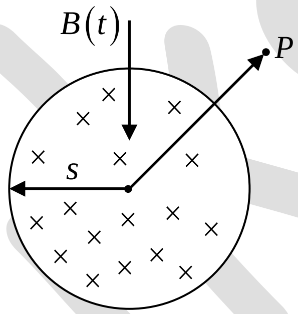
Q58. A uniform time-varying magnetic field $B(t)$, in a circular region of radius 's', is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P, at a distance r from the center of the circular region, is

(a) 0

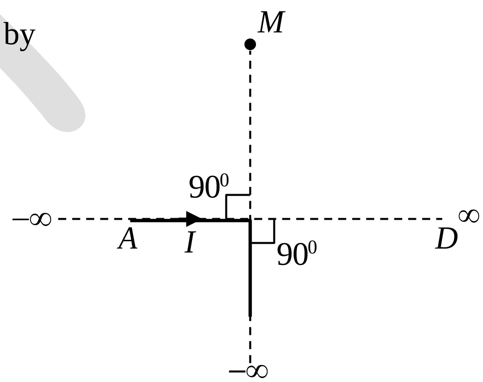
(b) $\dfrac{s^2}{2r}\left|\dfrac{dB}{dt}\right|$

(c) $\dfrac{s}{2}\left|\dfrac{dB}{dt}\right|$

(d) $\dfrac{r}{2}\left|\dfrac{dB}{dt}\right|$



Q59. An infinitely long conductor ABC is bent to form a right angle as shown in figure. A current I flows through ABC. The magnetic field due to this current at the point M is H_1. Another infinitely long straight conductor BD is connected at B as shown in the figure. Now, the current flowing through each of the two arms BC and BD is $I/2$, with the current in arm AB remaining unchanged. The magnetic field at M is now H_2. The ratio H_2/H_1 is given by



(a) $1/2$ (b) 2 (c) $3/2$ (d) $2/3$

Q60. The magnitude of the magnetic field, at a point on the axis of an infinitely long solenoid, consisting of n turns per unit length, wound around a cylindrical tube of radius a, carrying a steady current I, is

(a) $\mu_0 nI$ (b) $\mu_0 nI/2$ (c) $\mu_0 n^2 I$ (d) $\mu_0 n^2 I/2$

Q61. Consider a series LCR circuit with $L = 60\ mH$, $C = 0.50\,\mu F$, $R = 300\ \Omega$. The amplitude and the angular frequency of the applied signal respectively are $V = 50V$ and $\omega = 10,000\ rad/s$. The amplitude of the voltage across the inductor is

(a) $10V$ (b) $20V$ (c) $30V$ (d) $60V$

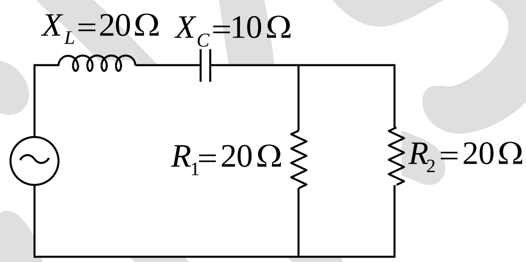
Q62. The total impedence of the AC circuit shown in figure is (where $j^2 = -1$)

(a) $10\Omega + j10\Omega$

(b) $10\Omega - j10\Omega$

(c) $20\Omega + j30\Omega$

(d) $30\Omega - j10\Omega$



Q63. Among three tuning forks K, L and M, the frequency of K is 2% smaller than that of L and frequency of M is 3% greater than that of L. If 8 beats are heard when K and M are sounded together, frequency of tuning fork M is close to

(a) $85\,Hz$ (b) $160\,Hz$ (c) $165\,Hz$ (d) $180\,Hz$

Q64. The ionization potential of the hydrogen atom is $13.6\,eV$. The energy of the emitted photon when the electron makes a transition from $n = 2$ to $n = 1$ state is

(a) $10.2\,eV$ (b) $13.6\,eV$ (c) $11.0\,eV$ (d) $6.8\,eV$

Q65. A $20\,Kg$ load is suspended by a steel wire of Young's modulus $19.6\times10^{10}\ N/m$. Its frequency, when plucked, is 20 times the frequency of the wire when rubbed with resin cloth. What is the area of cross-section of the wire?

(a) $4.0\times10^{-7}\ m^2$ (b) $3.0\times10^{-7}\ m^2$

(c) $2.0\times10^{-7}\ m^2$ (d) $1.0\times10^{-7}\ m^2$

Q66. Two spherical soap bubbles of radii a and b coalesce to form a single spherical bubble of radius c without any leakage of air. If P is the external pressure, then the surface tension of the solution from which the bubble formed is

(a) $\frac{P}{4}\left[\frac{\left(\sqrt{a+b+c}\right)^3}{\left(a+b+c\right)^2}\right]$ (b) $\frac{P}{4}\left[\frac{\left(c^3-b^3-a^3\right)}{\left(a^2+b^2-c^2\right)}\right]$

(c) $\frac{P}{4}\left[\frac{\left(a^3+b^3+c^3\right)}{\left(a^2+b^2+c^2\right)}\right]$ (d) $\frac{P}{4}\left[\frac{\left(a^2+b^2-c^2\right)}{\left(c^3-b^3-a^3\right)}\right]$

Q67. An electron, confined in an infinite box, is making transitions between its allowed energy levels emitting photons. The longest wavelength of the emitted photons is measured to be $450\,nm$. The value of the width of the box approximately is

(a) 450 nm (b) 1 nm (c) 450 μm (d) 100 nm

Q68. A voltage source, a resistor and a silicon p-n diode are connected in series such that the diode is forward biased. The load line of this circuit intersects the x- axis at $5V$ and the y- axis at $2.5\ mA$. A possible operating point of this diode circuit is

(a) $0.7V, 4.3mA$ (b) $0.7V, 2.15mA$

(c) $0.7V, 1.75mA$ (d) $0.7V, 2.5mA$

Q69. Which of the following Boolean expressions is/are correct?

I: $A(B+C) = AB + AC$

II: $A + BC = (A+B)(A+C)$

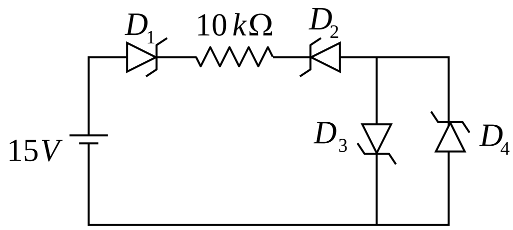
III: $A + AB = B$

(a) I (b) I, II (c) I, II, III (d) I, III

Q70. In a common emitter (CE) amplifier configuration with emitter bypass capacitor, the DC current flowing through the emitter is $2.6\ mA$ and the CE current gain (β_{ac}) of the transistor is 150. The input impedance of this amplifier at $300\,K$ is (Thermal voltage $V_T = 26\,mV$ at $300\,K$)

(a) 150Ω (b) 750Ω (c) 1500Ω (d) 390Ω

Q71. The forward voltage drop and the breakdown voltage of all the Zener diode (D_1, D_2, D_3 and D_4) in the circuit are $0.7V$ and $8V$ respectively. Current flowing through the diode D_2 is



(a) $0\ mA$ (b) $0.56\ mA$ (c) $0.63\ mA$ (d) $1.43\ mA$

Q72. A sample of rock when tested reveals the ratio of ^{206}Pb to ^{238}U to be 0.5. The age of the rock is (given the half-life of ^{238}U is 4.5×10^9 year)

(a) $4.5\times10^9 \frac{\ln(3/2)}{\ln(2)}$ year (b) $4.5\times10^9 \frac{\ln(2)}{\ln(3/2)}$ year

(c) $4.5\times10^9 \ln(3)$ year (d) $4.5\times10^9 \ln(2)$ year

Q73. It is given that the radius of Ho^{165} is $8\,fm$. Then what will be the approximate radius of Ca^{40}?

(a) $2\,fm$ (b) $3\,fm$ (c) $5\,fm$ (d) $9\,fm$

Q74. When a uniform cylindrical Indian rubber cord is stretched within the elastic limits, the change in volume is negligible compared to the change in shape. What is the Poisson ratio of the material?

(a) 0.2 (b) 0.5 (c) 0.7 (d) 1.0

Q75. The excess pressure inside an infinitely long cylindrical air bubble of radius r formed in a liquid of surface tension T, is

(a) $\frac{T}{2r}$ (b) $\frac{T}{r}$ (c) $\frac{2T}{r}$ (d) $\frac{4T}{r}$