HCU (M.Sc) PAPER 2016

SECTION - A

Q1. The eigenvalues of the matrix

$$A = \begin{pmatrix} 5 & -2 \\ 0 & 0 \end{pmatrix}$$

are

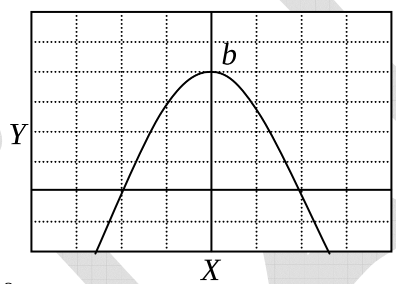
(a) $0, 0$ (b) $5, 0$ (c) $0, 6$ (d) $5, 6$

Q2. Which one of the following is not an equation of a circle?

(a) $\frac{1}{x^2} + \frac{1}{y^2} = a^2$ (b) $y^2 = a^2 - x^2$

(c) $y = \sqrt{(a+x)(a-x)}$ (d) $x = a\cos\theta, y = a\sin\theta$

Q3. The curve shown in the following figure is represented by



(a) $y = -4a(x-b)^2$ (b) $y = -4ax^2 - b$

(c) $y = -4ax^2 + b$ (d) $y = -4ax^2$

Q4. The determinant of the matrix $A = \begin{pmatrix} e^{ix} & -1 \\ 1 & 1 \end{pmatrix}$ is,

(a) 1 (b) π (c) $i\pi$ (d) 0

Q5. The vector $\vec{A} = 5\hat{i} + 6\hat{j}$ is rotated through an angle 45° about the z-axis in the anticlockwise direction. The resultant vector is

(a) $11\hat{i} + 1\hat{j}$ (b) $1\hat{i} + 11\hat{j}$

(c) $\frac{11}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}$ (d) $\frac{1}{\sqrt{2}}\hat{i} + \frac{11}{\sqrt{2}}\hat{j}$

Q6. The area swept by the radial vector of the planet Jupiter at equal time intervals is constant. This is due to

(a) the conservation of energy

(b) the conservation of linear momentum

(c) the elliptical orbit of Jupiter around Sun

(d) the conservation of angular momentum

Q7. The velocity and acceleration of a particle moving in a two-dimensional plane (with unit vectors e_r and e_θ) in terms of the polar coordinates are

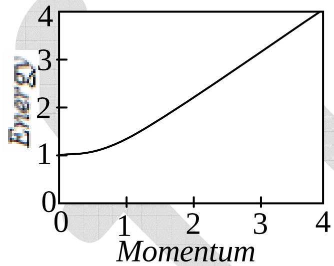
(a) $\dot{r}\, e_r + \dot{r}\,\dot{\theta} e_\theta,\ \left(\ddot{r} - \dot{r}\dot{\theta}\theta\right) e_r + \left(\ddot{r}\dot{\theta} + \dot{r}\ddot{\theta}\right) e_\theta$

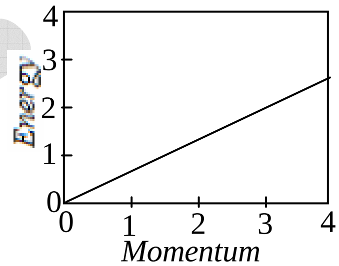
(b) $r\, e_r + \dot{r}\,\dot{\theta} e_\theta,\ \left(\dot{r} - \dot{r}\dot{\theta}^2\right) e_r + \left(\dot{r}\dot{\theta} + \dot{r}\ddot{\theta}\right) e_\theta$

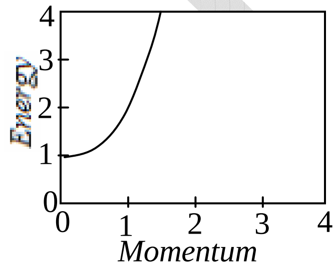
(c) $\dot{r}\, e_r + r\,\dot{\theta} e_\theta,\ \left(\ddot{r} - \dot{r}\dot{\theta}^2\right) e_r + \left(2\dot{r}\dot{\theta} + r\ddot{\theta}\right) e_\theta$

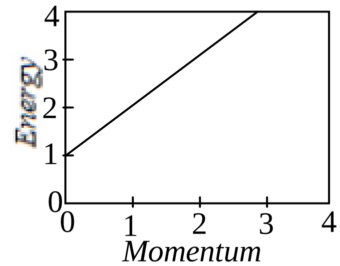
(d) $\dot{r}\, e_r + r\,\dot{\theta} e_\theta,\ \left(\ddot{r}_r - \dot{\theta}^2\right) e_r + \left(2\dot{r}\dot{\theta} + r\dot{\theta}\right) e_\theta$

Q8. Which one of the following plots represent the energy momentum relation of a relativistic particle of mass m

(a)


(c)


(b)


(d)


Q9. The electric and magnetic components of an electromagnetic wave propagating along x-direction is respectively described by

$$E = E_0 \sin(kx - \omega t); B = B_0 \sin(kx - \omega t)$$

then which of the following relation is true

(a) $E_0\omega^2 = B_0 k^2$ (b) $E_0 B_0 = \omega k$ (c) $E_0\omega = B_0 k$ (d) $E_0 k = B_0 \omega$

Q10. The interaction energy between a dipole having dipole moment $\vec{p}$ in an electric field $\vec{E}$ is

(a) $\vec{p}.\vec{E}$ (b) $-\vec{p}.\vec{E}$ (c) $\vec{p}\times\vec{E}$ (d) $-\vec{p}\times\vec{E}$

Q11. A charge Q is placed at the centre of a cube of side a. The total flux of the electric field through the six surface of the cube is

(a) $\frac{Q}{a\in_0}$ (b) $\frac{Q}{6\in_0}$ (c) $\frac{Q}{\in_0}$ (d) $\frac{Qa}{\in_0}$

Q12. Consider a plane electromagnetic wave:

$$\vec{E} = \hat{x}E_1 \exp\left[i(kz - \omega t)\right] + \hat{y}E_2 \exp\left[i(kz - \omega t + \pi)\right]$$

where k, ω, E_1 and E_2 are all real. This plane wave is split into two, polarized along x and y directions. If the two waves acquire a path difference of $\frac{2\pi}{k}$ and are then recombined on a screen, the average intensity observed is proportional to

(a) $E_1^2 + E_2^2$ (b) $E_1^2 - E_2^2$ (c) $(E_1 + E_2)^2$ (d) 0

Q13. A large stone is dropped in a still pond generating water waves. The amplitude of a generated wave is 15 cm at a distance 9 cm from the center where the stone is dropped. Then the amplitude of the wave at 100 cm from the center is

(a) 6.75 cm (b) 9.0 cm (c) 2.25 cm (d) 4.5 cm

Q14. Consider yourself walking with a velocity v towards a mirror, in a straight line forming an angle α with the plane of the mirror. Assuming that you and your image are symmetric relative to the plane of the mirror, the velocity v_r at which you approach your image is

(a) $v\sin\alpha$ (b) $2v\sin\alpha$ (c) $2\sin\alpha$ (d) $2v\cos\alpha$

Q15. Which of the following statements is correct for a liquid flowing with the velocity components given by

$$v_x = 3xy + y^2,\ v_y = 5xy + 2x$$

(a) steady incompressible of flow is not possible

(b) steady incompressible of flow is possible

(c) steady flow is possible

(d) steady, compressible flow is not possible

Q16. Water is filled in cylindrical container upto a height H. A small hole is made at the side wall at depth h below the water surface. The distance from the container's base at which the flowing water strikes the floor is

(a) $\frac{1}{2}\sqrt{h(H-h)}$ (b) $\sqrt{h(H-h)}$

(c) $2\sqrt{h(H-h)}$ (d) $2\sqrt{h(h-H)}$

Q17. The radius of a water pipe reduces from 10 cm to 5 cm. If the average velocity of water in the wider portion is $4\ m/\sec$, then the average velocity in the narrower region is

(a) 16 $m/\sec$ (b) 1 $m/\sec$ (c) 8 $m/\sec$ (d) 32 $m/\sec$

Q18. An engine is being operated between two heat reservoirs at temperatures 100 K and 300 K. The maximum efficiency of the engine is

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{4}{9}$ (d) $\frac{4}{3}$

Q19. Consider an amount of heat Q transferred between two heat reservoirs at temperatures T_1 and $T_2\ (T_1 > T_2)$. Then the change is entropy is

(a) $\frac{Q}{\sqrt{T_1T_2}}\ln\left(\frac{T_1}{T_2}\right)$ (b) $\frac{Q}{\sqrt{T_1T_2}}$

(c) $\frac{Q}{T_1 - T_2}$ (d) $\frac{Q}{T_1T_2}(T_1 - T_2)$

Q20. If the pressure of a gas, at temperature T, in a closed container is decreased then the mean free path of gas molecules will

(a) increase first then decrease (b) decrease

(c) increase (d) remain the same

Q21. Which of the following Boolean expressions is not valid?

(a) $A+(BC)=(A+B)(A+C)$ (b) $A(B+C)=(AB)+(AC)$

(c) $A+\bar{A}B=A+B$ (d) $A+A\bar{B}=A+\bar{B}$

Q22. A BJT whose base-emitter and base-collector junctions are forward biased is said to be operating in

(a) active region (b) saturating region

(c) reverse active region (d) cut-off region

Q23. The current flowing through a n-type semiconductor is

(a) only due to electrons

(b) only due to holes

(c) sum of both electron and hole currents in same direction

(d) sum of both electron and hole currents in opposite directions

Q24. Let m be the mass of the electron, e its charge and n the principal quantum number. The allowed energy states of the electron in the Bohr model of the Hydrogen atom are

(a) $\dfrac{-me^4}{\left(8\in_0^2 h^2n^2\right)}$ (b) $\dfrac{-me^4}{\left(8\in_0 h^2n^2\right)}$ (c) $\dfrac{-me^4}{\left(8\in_0^2 hn^2\right)}$ (d) $\dfrac{-me^4}{\left(4\in_0^2 h^2n^2\right)}$

Q25. In the photoelectric effect experiment, if we increase the intensity of the incident light, then

(a) the kinetic energy of the emitted electrons increase

(b) the kinetic energy of the emitted electrons decreases because the number of electrons emitted increase

(c) the kinetic energy of the emitted electrons does not change but the number of electrons emitted increase

(d) both the kinetic energy and the number of electrons emitted increase

SECTION - B

Q26. Two vectors in Cartesian coordinates are defined as

$\vec{a} = \sin(t)\hat{i} + \hat{j} + \cos(t)\hat{k}$

and $\vec{b} = \sin(t)\hat{i} - \hat{j} + \cos(t)\hat{k}$

for some parameter t. Then these two vectors are said to be

(a) parallel to each other

(b) perpendicular to each other

(c) make an angle t between them

(d) not related to each other

Q27. If $\psi_0(x) = u_0(x)$ and $\psi_1(x) = u_1(x) + \alpha\psi_0(x)$ for $a \le x \le b$ then $\psi_1(x)$ will be orthogonal to $\psi_0(x)$ if

(a) $\alpha = \frac{1}{|\psi_0|^2}\int_a^b \psi_0^* u_1 \, dx$

(b) $\alpha = \frac{1}{|\psi_0|^2}\int_a^b \psi_0^* u_1 \, dx$

(c) $\alpha = \frac{1}{|\psi_0|^2}\int_a^b \psi_0^* u_0 \, dx$

(d) $\alpha = \frac{1}{|\psi_0|^2}\int_a^b \psi_0^* u_0 \, dx$

Q28. If a is a non-zero, positive constant, $f\left(\frac{1}{ax}\right)$dx is.

(a) $a\ln|x| + C$

(b) $\ln|x| + |a| + C$

(c) $\left(\frac{1}{a}\right)\ln x + C$

(d) $\ln|ax| + C$

Q29. Given $z = x + iy$, e^{iz} reduces to

(a) $(\cos x + i\sin x)e^{-y}$

(b) $(\cos x + i\sin x)\, e^{y}$

(c) $(\cos x - i\sin x)(\cos y - i\sin y)$

(d) $(\cos x + i\sin x)(\cos y - i\sin y)$

Q30. The series, $S = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + ...,$

(a) converges

(b) diverges

(c) oscillates

(d) convergence can not be tested

Q31. Which of the following is not a property of a general group

(a) closure (b) associative law

(c) distributive law (d) existence of inverse for every element

Q32. The value of the integral is $\int_0^1 dx \int_0^x y\, dy$ *is*

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{6}$ (d) $\frac{1}{8}$

Q33. If $x = \frac{a}{t}$ and $y = 3bt^2$, then $\frac{dy}{dx}$ is

(a) $\frac{3b}{2at}$ (b) $\frac{-6bt^3}{a}$ (c) $\frac{3bt}{a}$ (d) $\frac{-at^2}{6b}$

Q34. If $\vec{E}_1 = xy\hat{i} + 2yz\hat{j} + 3xz\hat{k}$ and $\vec{E}_2 = y^2\hat{i} + \left(2xy + z^2\right)\hat{j} + 2yz\hat{k}$ then

(a) both are not static electric fields

(b) both are static electric fields

(c) only $\vec{E}_1$ is a possible static electric field

(d) only $\vec{E}_2$ is a possible static electric field

Q35. Two vectors on a plane are given as $\vec{a} = 3\hat{i} + 5\hat{j}$ and $\vec{b} = 4\hat{i} + 10\hat{j}$. The plane is then defined by the vector

(a) $50\hat{k}$ (b) $10\hat{k}$ (c) $0\hat{k}$ (d) $15\hat{i}$

Q36. A particle at rest has a lifetime of $3\mu\text{sec}$. An observer measures the speed of this particle to be $\frac{3c}{5}$. The distance traveled by particle, measured by the observer, is

(a) $\frac{9c}{4}\times 10^{-6}\ m$ (b) $\frac{15c}{4}\times 10^{-6}\ m$

(c) $\frac{18c}{5}\times 10^{-6}\ m$ (d) $\frac{9c}{16}\times 10^{-6}\ m$

Q37. The initial and final positions of a particle moving in the two-dimensional space are $(1,5)$ and $(-3,7)$. The displacement and the distance traveled by this particle are

(a) $-4i-2j, 2\sqrt{5}$ (b) $4i+2j, 2\sqrt{5}$

(c) $4i-2j, 2\sqrt{5}$ (d) $-4i+2j, 2\sqrt{5}$

Q38. A block of mass is attached to a pair of springs connected in series. Both the springs have same spring constant k. The period of oscillations of the block is T_1. The period of oscillations of the same block attached to the same springs, connected in parallel is T_2. The ratio $T_1 : T_2$ is

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

Q39. One end of a spring is fixed to a rigid support and a body of mass m is attached to the other end such that the spring hangs vertically downwards. The unscratched length of the spring is l and it has a spring constant k. The extension of the spring (z) when the body is in equilibrium is

(a) $\frac{mg}{2k}$ (b) $-\frac{mg}{2k}$ (c) $\frac{mg}{k}$ (d) $-\frac{mg}{k}$

Q40. A particle whose mass varies with time, moves under the influence of a force $\vec{F}$. If T is the kinetic energy and $\vec{p}$ is the momentum of this particle, which of the following equation is valid

(a) $\frac{dT}{dt}=\frac{\vec{F}.\vec{p}}{m}$ (b) $\frac{d}{dt}(mT)=\frac{\vec{F}.\vec{p}}{m}$

(c) $\frac{d}{dt}(mT)=m\vec{F}.\vec{p}$ (d) $\frac{d}{dt}(mT)=\vec{F}.\vec{p}$

Q41. The radius of the Earth is $6400\ km$ and that of Saturn is $60000\ km$. The mass of Saturn is 95 times that of the Earth. If a block weighs $10\ N$ on the Earth, its weight on Saturn is

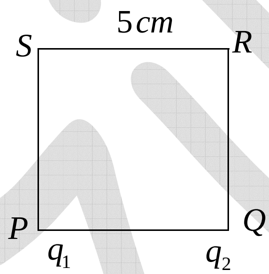
(a) $950\ N$ (b) $879.90\ N$ (c) $10.81\ N$ (d) $8349.61\ N$

Q42. A flat circular disc of radius R carries a uniform surface charge density σ. The potential at a distance z perpendicularly above the centre of this disk is $\frac{\sigma}{2\epsilon_0}\left(\sqrt{R^2+z^2}-z\right)$. The electric field at z is

(a) $\frac{\sigma}{2\epsilon_0}\left(1-\frac{z}{\sqrt{z^2+R^2}}\right)$ (b) $\frac{\sigma}{2\epsilon_0}\left(\frac{1}{2\sqrt{z^2+R^2}}-1\right)$

(c) $\frac{\sigma}{4\epsilon_0}\left(1-\frac{z}{\sqrt{z^2+R^2}}\right)$ (d) $\frac{\sigma}{2\epsilon_0}\left(1-\frac{1}{2\sqrt{z^2+R^2}}\right)$

Q43. Charge $q_1 = 2\times10^{-6}\,C$ and $q_2 = 1\times10^{-6}\,C$ are placed at the corners P and Q of a square of side $5\,cm$ as shown in figure. The work done in moving a charge $1\times10^{-6}\,C$ from corner R to S is given by

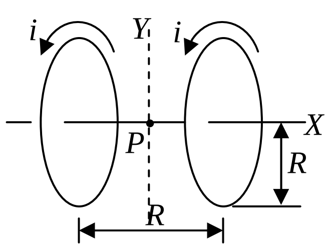


(a) $0.053\,J$ (b) $0.53\,J$ (c) $1.06\,J$ (d) $0.106\,J$

Q44. A conducting circular loop is placed in a uniform magnetic field $B = 0.02\,T$ with its plane perpendicular to the field. If the radius of the loop starts shrinking at a constant rate of $1.0\,mm\,s^{-1}$, the induced e.m.f. on the loop at an instant when its radius is $2\,cm$, is

(a) $5\,\mu V$ (b) $5\,mV$ (c) $2.5\,mV$ (d) $2.5\,\mu V$

Q45. Two circular coils of radius R are placed at a distance R from each other as shown in figure. They both carry equal current i in the same direction. The magnitude of magnetic field at the mid point p between two coils is



(a) $\frac{\mu_0 i}{2\sqrt{2}R}$ (b) $\frac{4\mu_0 i}{5\sqrt{5}R}$ (c) $\frac{8\mu_0 i}{5\sqrt{5}R}$ (d) 0

Q46. The acceleration of a solid cylinder of radius R and mass M rolling down an inclined plane of inclination θ is

(a) $\frac{2g\sin\theta}{3}$ (b) $\frac{4g\sin\theta}{3}$ (c) $2g\cos\theta$ (d) $\frac{2g\cos\theta}{3}$

Q47. A compound pendulum has mass M, length L and moment of inertia I_0 about its center of mass. If the pendulum is made to oscillate with a small angular displacement θ, then the square of its angular velocity is

(a) $\frac{MLg}{I_0}$ (b) $\frac{MLg}{\left(I_0+ML^2\right)}$

(c) $\frac{MLg}{\left(I_0-ML^2\right)}$ (d) $\frac{MLg}{2\left(I_0+ML^2\right)}$

Q48. Consider a simple telescope whose objective and eyepiece are convex lenses with a common focal point in between them. To achieve an angular magnification of 10 using a 1.0 m focal length objective lens, the separation between the two lenses should be

(a) 1.1 m (b) 1.0 m (c) 0.9 m (d) 1.5 m

Q49. Consider two horizontally held glass plates separated by a thin film of air between them. This system is illuminated by light of wavelength 488 nm and observed in reflection. The first there thicknesses for which the air film appears bright are

(a) 0,122 nm, 366 nm (b) 0,122 nm, 244 nm

(c) 122 nm, 366 nm, 610 nm (d) 122 nm, 244 nm, 488 nm

Q50. A polarizer P is placed between a crossed polarizer-analyzer pair. The optic of axis of P makes an angle α with respect to that of the analyzer. If the intensity of incident light is I_0 neglecting losses due to reflection and absorption at the polarizers, the intensity of the transmitted light is

(a) $I_0\cos^2\alpha$ (b) $I_0\sin^2 2\alpha$

(c) $\frac{1}{8}I_0\cos^2 2\alpha$ (d) $\frac{1}{8}I_0\sin^2 2\alpha$

Q51. Consider a plane wave incident on a double slit, each of width ω, separated by a distance d. Keeping ω fixed, if d is varied, the distance at which the central bright maximum change to a minimum is

(a) $\frac{3\omega}{2}$ (b) $\sqrt{2}\,\omega$ (c) $\frac{\omega}{2}$ (d) $\frac{2\omega}{3}$

Q52. Consider a point source of light kept at a distance outside a transparent, solid cylinder on its axis and near the end face (base). The minimum refractive index of the material of the cylinder for which none of the rays entering the base will emerge from the curved surface is

(a) 2.0 (b) 1.414 (c) 1.515 (d) 1.586

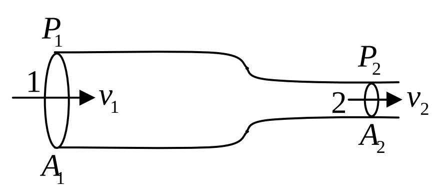
Q53. Consider two sinusoidal waves with same with same frequency and traveling in the same direction having a $\frac{\pi}{2}$ phase difference between them. If the amplitudes of the waves are respectively $6.0\ cm$ and $8.0\ cm$, the amplitude of the resultant wave is

(a) $100\ cm$ (b) $14\ cm$ (c) $5.29\,cm$ (d) $10\ cm$

Q54. Consider rain drops falling through air with terminal velocity $V_T\ cm/s$. Two rain drops of same size coalesce into one while falling, the terminal velocity of this new droplet is

(a) V_T (b) $2^{\frac{1}{3}}V_T$ (c) $4^{\frac{1}{3}}V_T$ (d) $2V_T$

Q55. A liquid of density ρ flows as shown in the figure below, P_1, A_1, v_1 and P_2, A_2, v_2 correspond respectively to the pressure, cross sectional area and flow velocity at the two positions 1 and 2. The flow velocity at position 2 is



(a) $A_1\sqrt{\frac{2(P_1-P_2)}{\rho\left(A_1^2-A_2^2\right)}}$ (b) $\sqrt{\frac{2(P_1-P_2)}{\rho\left(A_1^2-A_2^2\right)}}$

(c) $A_1\sqrt{\frac{(P_2-P_1)}{\rho\left(A_2^2-A_1^2\right)}}$ (d) $A_2\sqrt{\frac{(P_1-P_2)}{\rho\left(A_2^2-A_1^2\right)}}$

Q56. Consider a dam of width ω wherein water of density ρ is filled upto a height H from the floor level. The resultant force on the vertical wall of the dam is

(a) $\frac{1}{2}\rho g\omega H^2$ (b) $\rho g\omega H^2$ (c) $\frac{1}{2}\rho g\omega H$ (d) $\frac{1}{4}\rho g\omega H^2$

Q57. A $700\,g$ solid cube of length $10\ cm$ floats partially in water. The volume of the portion of the cube floating above the water level is (density of water is $1000\ kg\,m^{-3}$).

(a) $1000\ cm^3$ (b) $700\ cm^3$ (c) $300\ cm^3$ (d) $500\,cm^3$

Q58. The work done in stretching a wire of $1\,mm^2$ cross section and $2\ m$ long through $0.1\ mm$ (Young's modulus is $2\times10^{11}\ N/m^2$) is

(a) $5\times10^{-3}\ J$ (b) $5\times10^{-4}\ J$ (c) $1\times10^{-3}\,J$ (d) $1\times10^{-4}\ J$

Q59. A spherical soap bubble of radius $0.01\ m$ is formed inside another soap bubble of radius $0.02\ m$. The radius of single bubble which will have an excess pressure equal to the difference in pressure between the inside of the inner bubble and the outside of the large bubble is equal to

(a) $6.67\times10^{-3}\ m$ (b) $7.67\times10^{-3}\ m$ (c) $5.67\times10^{-3}\ m$ (d) $3\times10^{-3}\ m$

Q60. A gas is compressed reversibly from the initial state (P_1,V_1) to the final state (P_2,V_2). During the compression process the pressure and volume are related by equation $PV^{\gamma} = \text{constant}$. Then the work done by the gas

(a) 0 (b) $\frac{P_2V_2+P_1V_1}{\gamma-1}$ (c) $\frac{P_2V_2+P_1V_1}{1+\gamma}$ (d) $\frac{P_2V_2-P_1V_1}{1-\gamma}$

Q61. A gas is compressed in a piston-cylinder assembly, from the initial state (P_1,V_1) to a final state (P_2,V_2). The pressure volume relationship during the compression process is $P = a+bV$, where a and b are constants. Then the work done on the gas is

(a) $(P_1+P_2)(V_2-V_1)$ (b) $\frac{P_1+P_2}{2}(V_2-V_1)$

(c) $(P_2-V_1)\frac{(V_2+V_1)}{2}$ (d) $\frac{P_2V_1-P_1V_2}{2}$

Q62. A rapidly spinning paddle wheel raises the temperature of 200 mL of water from $21^{o}C$ to $25^{o}C$. Then the increases in internal energy of water is (the specific heat of water is 4200 J/Kg and the density of water is $1000\,kg/m^3$)

(a) 4200 J (b) 3200 J (c) 4360 J (d) 3360 J

Q63. Consider one mole of an ideal gas undergoing an adiabatic process. For this process which one of the following statements is not correct

(a) $TdS = dE + pdV + \mu dN$ (b) $pV = RT$

(c) $dE = -pdV$ (d) $pV^{\gamma} =$ constant

Q64. Which one of the following is not a Maxwell's relation for thermodynamics

(a) $\left.\frac{\partial S}{\partial V}\right|T - \left.\frac{\partial p}{\partial T}\right|_V$ (b) $\left.\frac{\partial T}{\partial p}\right|S = \left.\frac{\partial V}{\partial S}\right|_p$

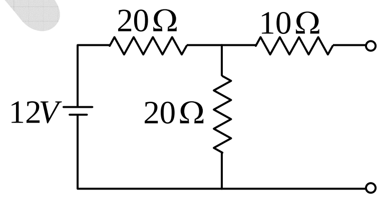
(c) $\left.\frac{\partial S}{\partial P}\right|T - \left.\frac{\partial p}{\partial T}\right|_P$ (d) $\left.\frac{\partial T}{\partial V}\right|S = -\left.\frac{\partial p}{\partial S}\right|_V$

Q65. If energy $(\in)$ distribution formula for an ideal gas in thermal equilibrium at temperature T is given by $dN_{\in} \propto \in^{j} e^{\frac{-\in}{k_BT}} d\in$ (where j is real number), then the velocity distribution of the system is proportional to

(a) $v^2 e^{\frac{-mv^2}{2mk_BT}} dv$ (b) $v^{2j} e^{\frac{-mv^2}{2mk_BT}} dv$

(c) $v^{2j-1} e^{\frac{-mv^2}{2mk_BT}} dv$ (d) $v^{2j+1} e^{\frac{-mv^2}{2mk_BT}} dv$

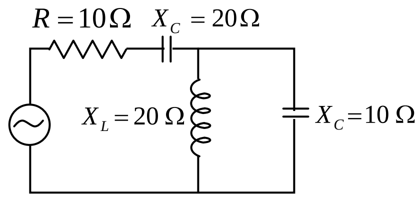
Q66. The Thevenin's voltage and resistance across the thermals the terminals a and b are



(a) $12V$, 20 Ω (b) $6V$, 20 Ω

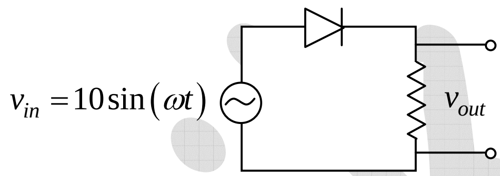
(c) $6V$, 10 Ω (d) $12V$, 30 Ω

Q67. The total impedance of the circuit shown in the following figure is



(a) $10 + j20$ (b) $10 + j40$ (c) $10 - j40$ (d) $20 + j20$

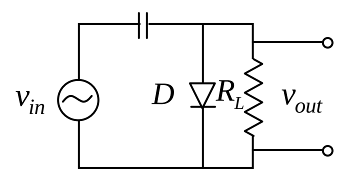
Q68. The forward voltage drop across the diode shown in figure is zero. The average and r.m.s. components of the output voltage respectively are



(a) $\frac{10}{\pi}, \frac{10}{\sqrt{2}}$ (b) $\frac{10}{\pi}, \frac{10}{2}$

(c) $\frac{10}{2\pi}, \frac{10}{\sqrt{2}}$ (d) $\frac{10}{2\pi}, \frac{10}{2}$

Q69. if the output signal V_{out} of a clamper, shown in the figure, is identical to its input signal V_{in} then



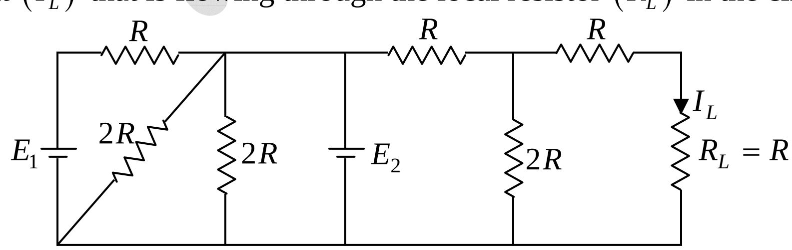
(a) Probably the diode is opened and the capacitor is shorted

(b) probably the diode is shorted and the capacitor is opened

(c) both the diode and capacitor are opened

(d) the circuit is operating normally

Q70. The current (I_L) that is flowing through the local resistor (R_L) in the circuit below is



(a) $\frac{E_2}{2R}$ (b) $\frac{E_2}{4R}$ (c) $\frac{E_1 - E_2}{2R}$ (d) $\frac{E_1 - E_2}{4R}$

Q71. An $a.c$ voltage source, a resistor and an ideal capacitor are connected in series. The r.m.s voltage measured across the resistor and capacitor are $3V$ and $4\,V$ respectively.

(a) $7\,V$ (b) $1V$ (c) $5\,V$ (d) $5\sqrt{2}\,V$

Q72. The de Broglie wavelength of electrons $\left(m_e = 9.1\times10^{-31}\,kg \text{ and } e = 1.6\times10^{-19}\,C\right)$ acceleration from rest through a potential difference of V (volts) is

(a) $\sqrt{\frac{15}{V}}\,nm$ (b) $\sqrt{\frac{1.5}{V}}\,nm$ (c) $\frac{15}{\sqrt{V}}\,nm$ (d) $\sqrt{\frac{V}{1.5}}\,nm$

Q73. A collimated beam of neutral atoms sent through inhomogeneous magnetic field in Stern-Gerlach experiment splits into 7 equally spaced lines. The total angular momentum of the atom is

(a) 7 (b) 6 (c) 5 (d) 3

Q74. Consider a Rutherford scattering experiment in which $2\,MeV$ alpha particles were incident on a thin gold $\left({}_{79}Au^{197}\right)$ foil. The distance of closest approach is

(a) 228 fm (b) 567 fm (c) 114 fm (d) 197 fm

Q75. Four moles of a radioactive material decays into 0.5 moles in 90 seconds. Then the disintegration constant is

(a) $\frac{0.693}{30}s^{-1}$ (b) $\frac{0.693}{45}s^{-1}$ (c) $\frac{0.693}{15}s^{-1}$ (d) $\frac{0.693}{90}s^{-1}$