MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF

INSPECTOR OF LEGAL METROLOGY

UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM

NOVEMBER, 2023

PHYSICS PAPER-III

Time Allowed : 2 hours | Full Marks : 200

All questions carry equal mark of 2 each.
Attempt all questions.

1. Which of the following is true?
- (a) Conduction electrons are more mobile than holes
- (b) Conduction electrons are less mobile than holes
- (c) Conduction electrons and holes have same mobility
- (d) Conduction electrons may be more or less mobile than holes depending on the temperature

2. In intrinsic semiconductor
- (a) The number of conduction electrons and holes are same
- (b) There are more conduction electrons than holes
- (c) There are less conduction electrons than holes
- (d) There are no conduction electrons and holes at any temperature

3. What will happen to intrinsic semiconductor if we doped it with pentavalent impurities?
- (a) The conductivity of the semiconductor will decrease
- (b) The number of holes in the valence band will increase
- (c) The number of conduction electrons will increase
- (d) The conduction band becomes wider

4. The Hall voltage is
- (a) Parallel to applied current and perpendicular to applied magnetic field
- (b) Perpendicular to applied current and parallel to applied magnetic field
- (c) Parallel to both applied current and applied magnetic field
- (d) Perpendicular to both applied current and applied magnetic field

5. What causes the formation of depletion region in a pn junction?
- (a) Diffusion of conduction electrons from the n-type semiconductor to the p-type semiconductor
- (b) Diffusion of holes from the n-type semiconductor to the p-type semiconductor
- (c) Diffusion of conduction electrons from the p-type semiconductor to the n-type semiconductor
- (d) Temperature difference across the pn junction

6. An ideal diode
- (a) Behaves like a perfect conductor when reverse bias is applied to it
- (b) Behaves like a perfect conductor when forward bias is applied to it
- (c) Behaves like a perfect insulator when forward bias is applied to it
- (d) Behaves like an open switch when forward bias is applied to it

7. A battery of 10 V is connected in series to a diode and 5 Ω resistor (assume that the diode is forward biased). If the forward bias resistance of the diode is zero and the voltage drop across the diode is 0.7 V, what is the current flowing through the circuit?

(a) 0 A
(b) 1.86 A
(c) 2 A
(d) 0.14 A

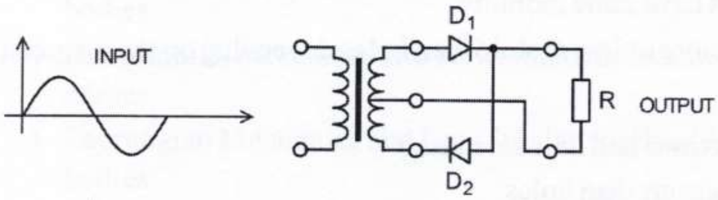
8. Which of the following is a correct statement for a zener diode?

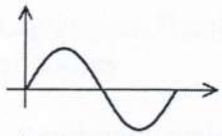
(a) Beyond breakdown voltage the diode current is almost constant
(b) Beyond breakdown voltage the voltage difference across the diode is almost constant
(c) Zener diode will be damaged if operated beyond the breakdown voltage
(d) The forward bias characteristic of a zener diode is different from an ordinary diode

9. A battery of 100 V is connected in series to a Zener diode and resistor of 10 Ω. Assuming that the Zener diode is in reverse bias, what will be the voltage difference across the Zener diode if its breakdown voltage is 20 V?

(a) 100 V
(b) 80 V
(c) 20 V
(d) 0 V

10. What is the output for the following rectifier circuit?



(a)


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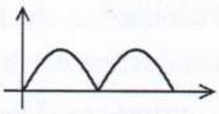

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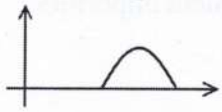

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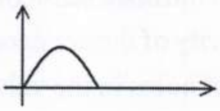


11. Which is the normal operation mode of a transistor

(a) Emitter-base and collector-base are both forward biased
(b) Emitter-base and collector-base are both reverse biased
(c) Emitter-base is forward biased and collector-base is reverse biased
(d) Emitter-base is reverse biased and collector-base is forward biased

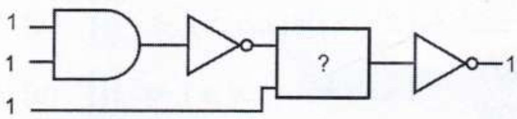
12. If I_B, I_C and I_E respectively represent the base, collector and emitter current of a transistor, which of the following is correct?

(a) $I_E = I_B + I_C$
(b) $I_C = I_B + I_E$
(c) $I_B = I_E + I_C$
(d) $I_B + I_E + I_C = 0$

13. In NPN transistor in common emitter configuration, if 98% of the emitter current reach the collector, what is the current gain $\left(\beta = \frac{I_C}{I_B}\right)$

(a) 98
(b) 2
(c) 49
(d) 102

14. In the circuit shown below, what is the logic gate in the question mark?



(a) AND (b) OR
(c) NOT (d) NAND

15. Which of the following logic gate can be used to construct all the other logic gates?

(a) AND (b) OR
(c) NOT (d) NAND

16. What are the terminals of UJT?

(a) Collector, Base and Emitter (b) Emitter, Base 1 and Base 2
(c) Emitter 1, Emitter 2 and Base (d) Gate, Drain and Source

17. A UJT exhibit negative resistance when

(a) Current is less than valley current
(b) Current is less than peak current
(c) Current is more than peak current but less than valley current
(d) Current is zero

18. In n-channel JFET, increasing the value of gate-source voltage

(a) Increases the drain current
(b) Increases the depletion region
(c) Decreases the drain current
(d) Drain current is not affected by gate-source voltage

19. When a JFET is operated beyond the pinch-off voltage

(a) Drain current remains nearly constant (b) Drain current started rapidly increasing
(c) Drain current started rapidly decreasing (d) The depletion region becomes smaller

20. A relaxation oscillator can produce

(a) Sine wave (b) Cosine wave
(c) Solitonic wave (d) Square wave

21. Which of the following can be explained by classical physics?

(a) Interference of light (b) Stability of atoms
(c) Photoelectric effect (d) Spectrum of blackbody radiation

22. Which of the following can be explained by the particle nature of light?

(a) Heisenberg's uncertainty principle (b) Photoelectric effect
(c) Interference of light (d) Diffraction of light

23. In photoelectric effect, the energy of the electron knocked out by the photon is

(a) Independent of the intensity of the incident light
(b) Independent of the wavelength of the incident light
(c) Independent of the frequency of the incident light
(d) Independent of the intensity, wavelength and frequency of the incident light

24. According to Planck's radiation law

(a) All photons have the same energy

(b) Photons of larger wavelength have larger energy

(c) Photons of smaller frequency have smaller energy

(d) Photons of larger frequency have larger energy

25. We send one electron at a time through a double slit. After we send many electrons through the slits, the intensity distribution of electrons hitting a screen behind the slits will be

(a) Similar to that of bullets fired toward the slits (b) Uniform

(c) Similar to interference pattern of waves (d) Gaussian

26. If h is the Planck's constant, the de Broglie wavelength of a particle of momentum p is given by

(a) hp (b) $\frac{p}{h}$

(c) $\frac{c}{v}$ (d) $\frac{h}{p}$

27. The motion of an object can be approximated accurately by classical mechanics when

(a) The dimension of the object is small compared to the de Broglie wavelength of the object

(b) The dimension of the object is large compared to the de Broglie wavelength of the object

(c) The momentum of the object is very small compared to the Planck's constant

(d) The object is very small

28. The experiment which confirms the wave nature of electrons is

(a) Davisson-Germer experiment (b) Stern-Gerlich experiment

(c) Rutherford experiment (d) Millikan experiment

29. The fact that the electron cannot exist inside the nucleus is due to

(a) Pauli's exclusion principle (b) Quantization of energy

(c) Heisenberg's uncertainty principle (d) Ehrenfest theorem

30. Which of the following is a correct statement of the Heisenberg's uncertainty principle

(a) $\Delta x \Delta p = 0$ (b) $\Delta x \Delta p \geq \frac{h}{4\pi}$

(c) $\Delta x \Delta p \leq \frac{h}{4\pi}$ (d) $\Delta x \Delta p = \frac{h}{4\pi}$

31. According to Heisenberg energy-time uncertainty principle

(a) The width of energy spectrum of excited states does not depend on the lifetime of the excited states

(b) The width of energy spectrum of excited states with larger lifetime is larger

(c) The width of energy spectrum of excited states with larger lifetime is smaller

(d) The width of energy spectrum of excited states with smaller lifetime is smaller

32. The commutation relation between position and momentum operator in quantum mechanics is

(a) $[\hat{x}, \hat{p}] = 0$ (b) $[\hat{x}, \hat{p}] = i\hbar$

(c) $[\hat{x}, \hat{p}] = 1$ (d) $[\hat{x}, \hat{p}] = h^2$

33. How does the momentum operator $\hat{p}_x$ act on the wave-function?

(a) $\hat{p}_x \psi(x, y, z) = x\psi(x, y, z)$ (b) $\hat{p}_x \psi(x, y, z) = \frac{\partial}{\partial x}\psi(x, y, z)$

(c) $\hat{p}_x \psi(x, y, z) = \psi(x, y, z)$ (d) $\hat{p}_x \psi(x, y, z) = -i\hbar \frac{\partial}{\partial x}\psi(x, y, z)$

34. A particle is trapped inside a box V, then the wave-function of the particle satisfy

(a) $\iiint_V \psi^*(x,y,z)\psi(x,y,z)\,dxdydz = 1$
(b) $\iiint_V \psi(x,y,z)\psi(x,y,z)\,dxdydz = 1$
(c) $\iiint_V \psi^*(x,y,z)\,dxdydz = 1$
(d) $\iiint_V \psi(x,y,z)\,dxdydz = 1$

35. The differential equation for the wave function of a particle of mass m and energy E in a potential $V(x)$ is given by

(a) $-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2}+V(x)\psi(x)=E\psi(x)$
(b) $-\frac{\hbar^2}{2m}\frac{d\psi(x)}{dx}+V(x)\psi(x)=E\psi(x)$
(c) $\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2}+V(x)\psi(x)=-E\psi(x)$
(d) $\frac{\hbar^2}{2m}\frac{d\psi(x)}{dx}+V(x)\psi(x)=E\psi(x)$

36. The equation which governs how the wave-function of a particle change with time is given by

(a) $\hat{H}\psi(x,t)=E\psi(x,t)$
(b) $\frac{\partial\psi(x,t)}{\partial t}=E\psi(x,t)$
(c) $\hat{H}\psi(x,t)=i\hbar\frac{\partial\psi(x,t)}{\partial t}$
(d) $\frac{\partial\psi(x,t)}{\partial t}=0$

37. The wave-function of a particle trapped inside a one-dimensional box of length L is given by $\psi(x)=A\sin\left(\frac{\pi x}{L}\right)$. The probability of finding the particle is maximum around

(a) $x=0$
(b) $x=\frac{L}{2}$
(c) $x=\frac{L}{4}$
(d) $x=\frac{L}{8}$

38. The existence of discrete energy levels (quantization of energy) for a particle confined in a box with rigid walls is due to

(a) Pauli's exclusion principle
(b) Heisenberg uncertainty principle
(c) Confinement
(d) Spin-statistics principle

39. The allowed energy of a particle of mass m confined in a cubic box with rigid walls is given by $E=\frac{\pi^2\hbar^2}{2mL^2}\left(n_x^2+n_y^2+n_z^2\right)$, where n_x, n_y and n_z are positive integers (1,2,3,...). How many numbers of states do we have with energy $\frac{3\pi^2\hbar^2}{mL^2}$?

(a) 0
(b) 1
(c) 2
(d) 3

40. For a particle of mass m in a one-dimensional box of length L, the lowest energy is given by

(a) $\frac{\pi^2\hbar^2}{4mL^2}$
(b) $\frac{\pi^2\hbar^2}{2mL^2}$
(c) $\frac{2\pi^2\hbar^2}{mL^2}$
(d) $\frac{4\pi^2\hbar^2}{mL^2}$

41. If A and B are matrices, which of the following is not always satisfied?

(a) A + B = B + A
(b) AB = BA
(c) $AA^{-1} = I$
(d) A - B = -B + A

42. If $A=\begin{bmatrix}1 & 0\\0 & 2\end{bmatrix}$, $B=\begin{bmatrix}0 & 2\\3 & 0\end{bmatrix}$, then AB is

(a) $\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$
(b) $\begin{bmatrix}1 & 2\\3 & 2\end{bmatrix}$
(c) $\begin{bmatrix}2 & 4\\6 & 8\end{bmatrix}$
(d) $\begin{bmatrix}0 & 2\\6 & 0\end{bmatrix}$

43. If $A=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$, then A^5 is

(a) 5A
(b) 4A
(c) 2A
(d) A

44. The transpose of $\begin{bmatrix}1 & 3\\4 & 2\end{bmatrix}$ is

(a) $\begin{bmatrix}1 & 4\\3 & 2\end{bmatrix}$
(b) $\begin{bmatrix}2 & 4\\3 & 1\end{bmatrix}$
(c) $\begin{bmatrix}2 & 3\\4 & 1\end{bmatrix}$
(d) $\begin{bmatrix}4 & 2\\1 & 3\end{bmatrix}$

45. The determinant of the matrix $\begin{bmatrix}4 & 2\\2 & 3\end{bmatrix}$ is

(a) 11
(b) 8
(c) 2
(d) 0

46. The inverse of a matrix A is given by (adj A = adjoint of A, det A = determinant of A)

(a) $A^{-1} = adj\, A$
(b) $A^{-1} = \det A\, adj\, A$
(c) $A^{-1} = \dfrac{adj\, A}{det\, A}$
(d) $A^{-1} = \dfrac{\det A}{adj\, A}$

47. The inverse of $\begin{bmatrix}0 & 1\\-1 & 0\end{bmatrix}$ is

(a) $\begin{bmatrix}1 & 0\\0 & -1\end{bmatrix}$
(b) $\begin{bmatrix}0 & 1\\-1 & 0\end{bmatrix}$
(c) $\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}$
(d) $\begin{bmatrix}-1 & 0\\0 & 1\end{bmatrix}$

48. For orthogonal matrix (note that T = transpose, † = transpose conjugate)

(a) $AA^T = 1$
(b) $A = A^{-1}$
(c) $A = A^T$
(d) $A = A^{\dagger}$

49. For unitary matrix

(a) $AA^T = 1$
(b) $A = A^{-1}$
(c) $A = A^T$
(d) $AA^{\dagger} = 1$

50. The matrix $\begin{bmatrix} \cos x & -\sin x \\ \sin x & \cos x \end{bmatrix}$ is

(a) Singular matrix
(b) Orthogonal matrix
(c) Symmetric matrix
(d) Skew-symmetric matrix

51. Which of the following is true for any matrices A and B?

(a) $(AB)^T = B^T A^T$
(b) $(AB)^T = A^T B^T$
(c) $(AB)^T = AB$
(d) $(AB)^T = BA$

52. Which of the following is true for any matrices A and B?

(a) $(AB)^{-1} = B^{-1} A^{-1}$
(b) $(AB)^{-1} = A^{-1} B^{-1}$
(c) $(AB)^{-1} = AB$
(d) $(AB)^{-1} = BA$

53. A is a symmetric matrix if

(a) $A - A^{-1} = 0$
(b) $A - A^{\dagger} = 0$
(c) $A - A^T = 0$
(d) $\det A = 0$

54. The matrix $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ is

(a) Singular matrix
(b) Skew-symmetric matrix
(c) Hermitian matrix
(d) Diagonal matrix

55. For Skew-Hermitian matrices

(a) $AA^T = 1$
(b) $A = A^{-1}$
(c) $A = -A^{\dagger}$
(d) $A = A^{\dagger}$

56. For any matrix A, the matrix $B = A + A^T$ is always

(a) Hermitian
(b) Symmetric
(c) Singular
(d) Skew-symmetric

57. Which of the following is a singular matrix?

(a) $\begin{bmatrix} 0 & 1 \\ 2 & 0 \end{bmatrix}$
(b) $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
(d) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

58. The eigenvalues of Hermitian matrix are always

(a) Zero
(b) Real numbers
(c) Purely imaginary numbers
(d) Real even numbers

59. The characteristic equation for finding the eigenvalues λ of a matrix A is given by

(a) $\det(A - \lambda I) = 0$
(b) $\det(A + \lambda I) = 0$
(c) $\det(A - \lambda I) = \lambda$
(d) $\det A = \lambda$

60. One of the eigenvalue of the matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ is

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

61. Which of the following is an eigenvector of $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$?

(a) $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$

(c) $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$ (d) $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$

62. The determinant of non-invertible matrix is

(a) Even numbers (b) Zero

(c) Imaginary numbers (d) Odd numbers

63. Which of the following is an odd function?

(a) $f(x) = a + \cos x$ (b) $f(x) = x^2$

(c) $f(x) = a + x^5$ (d) $f(x) = x^3$

64. Which of the following is a periodic function?

(a) e^x (b) $\log x$

(c) $\sin x + 2 \cos x$ (d) x^2

65. According to Fourier's theorem any real periodic function with period L can be expressed as

(a) $f(x) = \sum_{n=1}^{\infty} b_n \sin\left(\frac{2n\pi x}{L}\right)$

(b) $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos\left(\frac{2n\pi x}{L}\right)$

(c) $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n e^{\frac{2n\pi x}{L}} + \sum_{n=1}^{\infty} b_n e^{-\frac{2n\pi x}{L}}$

(d) $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos\left(\frac{2n\pi x}{L}\right) + \sum_{n=1}^{\infty} b_n \sin\left(\frac{2n\pi x}{L}\right)$

66. Fourier transforms of periodic odd function contain

(a) Sine terms only (b) A constant term only

(c) A constant and cosine terms only (d) A constant and sine terms only

67. Fourier transforms of periodic even function contains

(a) Sine terms only (b) A constant term only

(c) A constant and cosine terms only (d) A constant and sine terms only

68. Which of the following is the correct Fourier expansion of $f(x) = x$ in the interval $-\pi < x < \pi$?

(a) $f(x) = \sum_{n=1}^{\infty} \frac{2(-1)^{n+1}}{n} \sin(nx)$

(b) $f(x) = \frac{2\pi^3}{3} + \sum_{n=1}^{\infty} \frac{4(-1)^n}{n^2} \sin(nx)$

(c) $f(x) = \sum_{n=1}^{\infty} \frac{8(-1)^n}{n} \sin(nx)$

(d) $(x) = \frac{2\pi^3}{3} + \sum_{n=1}^{\infty} \frac{4(-1)^n}{n^2} \sin(nx) + \sum_{n=1}^{\infty} \frac{2(-1)^{n+1}}{n} \sin(nx)$

69. If n and m are different integers, the value of the integral $\int_0^{2\pi} \sin(nx)\sin(mx)\,dx$ is

(a) π
(b) 0
(c) 2π
(d) $\frac{\pi}{nm}$

70. Consider the half wave rectifier with output voltage:

$$V(t)=\begin{cases}\sin t, & for\, 0\le t\le \pi\\ 0, & for\, \pi\le t\le 2\pi\end{cases}$$

This can be expanded as $V(t)=\frac{a_0}{2}+\sum_{n=1}^{\infty} a_n\, cos(n\pi)+\sum_{n=1}^{\infty} b_n\, sin(n\pi)$. What is the value of a_0?

(a) 0
(b) π
(c) $\frac{2}{\pi}$
(d) 2π

71. For two bodies of masses m_1 and m_2 and position $\vec{r}_1$ and $\vec{r}_2$, the centre of mass of the system is

(a) $\frac{m_1\vec{r}_1+m_2\vec{r}_2}{m_1+m_1}$
(b) $\frac{m_1\vec{r}_1+m_2\vec{r}_2}{m_1 m_1}$
(c) $m_1\vec{r}_1+m_2\vec{r}_2$
(d) $\frac{\vec{r}_1+\vec{r}_2}{m_1+m_1}$

72. If there is no external force acting on two bodies except the force between them, then the centre of mass of the two bodies $\vec{R}_{CM}$ always satisfy

(a) $\vec{R}_{CM}=0$
(b) $\vec{R}_{CM}=Constant$
(c) $\frac{d\vec{R}_{CM}}{dt}=0$
(d) $\frac{d^2\vec{R}_{CM}}{dt^2}=0$

73. The reduced mass of two masses 3 kg and 6 kg is

(a) 2 kg
(b) 3 kg
(c) 4 kg
(d) 9 kg

74. Consider a two-body system of masses m_1 and m_2 and reduced mass μ. If $\vec{r}$ is the displacement vector between the two bodies, then

(a) $\vec{F}(r)=\frac{\mu}{m_1+m_2}\frac{d^2\vec{r}}{dt^2}$
(b) $\vec{F}(r)=(m_1+m_2)\frac{d^2\vec{r}}{dt^2}$
(c) $\vec{F}(r)=(m_1-m_2)\frac{d^2\vec{r}}{dt^2}$
(d) $\vec{F}(r)=\mu\frac{d^2\vec{r}}{dt^2}$

75. In central force between two bodies, the magnitude of the force depends only on

(a) Distance between the two bodies and velocity of the bodies
(b) Distance between the two bodies
(c) Velocity of the two bodies
(d) Distance between the two bodies and angles

76. In central force between two bodies, the direction of the force is

(a) Perpendicular to the line joining the two bodies
(b) Along the line joining the two bodies
(c) Opposite to the velocities of the bodies
(d) Same direction as the velocities of the bodies

77. According to Kepler's first law, the orbit of the planets around the sun is

(a) Circular (b) Parabolic

(c) Elliptical (d) Spiral

78. According to Kepler's law, for planet orbiting the sun, the sun is

(a) Located at the center of the orbit (b) Located at one foci of the orbit

(c) Located at both foci of the orbit (d) Located along the semi-minor axis

79. If the area swept out in time T by a planet orbiting around the sun is A, then the area swept out in time 2T will be

(a) A (b) 2A

(c) 4A (d) 8A

80. If a is the semi-major of the orbit of a planet revolving around the sun, then the time period of revolution of the planet will be proportional to

(a) a (b) a^2

(c) a^3 (d) a^4

81. For a planet revolving around the sun, which of the following quantity does not change with time?

(a) Angular momentum (b) Kinetic energy

(c) Potential energy (d) Velocity

82. If r is the distance between two objects, then the gravitational force between the two object is proportional to

(a) $\frac{1}{r^2}$ (b) $\frac{1}{r}$

(c) r (d) r^2

83. What is the SI unit of Newton's constant G (note that N is the SI unit of force)

(a) $N\,m^2kg^{-2}$ (b) $N\,m^{-2}kg^2$

(c) $N\,m^2$ (d) $N\,kg^{-2}$

84. Two bodies of masses 1 kg and 4 kg are separated by a distance of 4 m. We put another body of mass 6 kg between the two bodies (all the three bodies are lying on a straight line). If the total gravitational force on the body with 6 kg mass is zero, its distance from the body with 1 kg mass is

(a) $\frac{1}{4}$m (b) $\frac{4}{3}$ m

(c) $\frac{5}{4}$ m (d) $\frac{7}{6}$ m

85. Using the same pendulum, the time period of oscillation will be the largest in

(a) Jupiter (b) Saturn

(c) Earth (d) Moon

86. The number of generalized co-ordinates needed to describe the motion of a particle moving on the surface of a sphere is

(a) 6 (b) 4

(c) 3 (d) 2

87. If we introduce N number of constraints on a system, the number of generalized co-ordinates of the system will be reduced by

(a) 0 (b) N

(c) 2N (d) 3N

88. The Hamiltonian is defined as

(a) Difference in energy of the system
(b) Total energy of the system
(c) Kinetic energy of the system
(d) Potential energy of the system

89. In equilibrium, the virtual work of forces applied to a system is

(a) Positive
(b) Negative
(c) Zero
(d) Infinite

90. The Lagrangian is a function of

(a) q, p, t
(b) $q, \dot{p}, t$
(c) $\dot{q}, p, t$
(d) $q, \dot{q}, t$

91. The Lagrangian in terms of the kinetic energy (K.E) and potential energy (P.E) is given by

(a) L = K.E + P.E
(b) L = K.E
(c) L = K.E - P.E
(d) L = P.E

92. If q_i and L are the generalized co-ordinates and the Lagrangian of a particle, the equation of motion of the particle is given by

(a) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) = \frac{\partial L}{\partial q_i}$
(b) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_i}\right) = \frac{\partial L}{\partial \dot{q}_i}$
(c) $\frac{\partial^2 L}{\partial q_i} = \frac{d}{dt}\left(\frac{\partial L}{\partial q_i}\right)$
(d) $\frac{\partial L}{\partial \dot{q}_i} = -\frac{\partial L}{\partial q_i}$

93. The Hamiltonian is a function of

(a) q, p, t
(b) $q, \dot{p}, t$
(c) $\dot{q}, p, t$
(d) $q, \dot{q}, t$

94. If L is the Lagrangian of a system, the canonical momentum p_i conjugate to the generalized co-ordinate q_i is given by

(a) $p_i = \dot{q}_i$
(b) $p_i = \frac{\partial L}{\partial \dot{q}_i}$
(c) $p_i = \frac{\partial L}{\partial q_i}$
(d) $p_i = \frac{\partial^2 L}{\partial q_i}$

95. The Hamiltonian in terms of the Lagrangian, generalized co-ordinates and momentum conjugate to generalized co-ordinates is given by

(a) $H = L$
(b) $H = \sum_i p_i^2 - L$
(c) $H = \sum_i p_i^2 q_i + L$
(d) $H = \sum_i p_i \dot{q}_i - L$

96. The Hamiltonian equation of motion is given by

(a) $\frac{\partial H}{\partial q_i} = -\dot{p}_i$, $\frac{\partial H}{\partial p_i} = \dot{q}_i$
(b) $\frac{\partial H}{\partial q_i} = -\dot{q}_i$, $\frac{\partial H}{\partial p_i} = \dot{p}_i$
(c) $\frac{\partial^2 H}{\partial q_i^2} = -\dot{p}_i$, $\frac{\partial^2 H}{\partial p_i^2} = \dot{q}_i$
(d) $\frac{\partial^2 H}{\partial q_i^2} = \dot{q}_i$, $\frac{\partial^2 H}{\partial p_i^2} = \dot{p}_i$

97. Let l and m be the length of a pendulum and mass of the bob of a pendulum. If g is the acceleration due to gravity and $\theta(t)$ the angular displacement of the pendulum from its vertical position at time t. Then Lagrangian of the pendulum is given by

(a) $\frac{1}{2}ml^2\dot{\theta}^2(t)+mgl\cos\theta(t)+mgl$

(b) $\frac{1}{2}ml^2\dot{\theta}^2(t)+mgl\cos\theta(t)-mgl$

(c) $\frac{1}{2}ml^2\dot{\theta}^2(t)$

(d) $-mgl\cos\theta(t)+mgl$

98. The principle which states that "The sum of the differences between the forces acting on a system of massive particles and the time derivatives of the momenta of the system itself projected onto any virtual displacement consistent with the constraints of the system is zero" is known as

(a) Zeroth's principle

(b) Maupertius's principle

(c) D'Alembert's principle

(d) Birkhoff's principle

99. Which of the following is conserved for particle moving under the influence of a central force

(a) Angular momentum

(b) Kinetic energy

(c) Potential energy

(d) Velocity

100. Which of the following is not true?

(a) Lagrangian mechanics and Newtonian mechanics gave the same answer for trajectories of bodies

(b) Hamiltonian mechanics and Newtonian mechanics gave the same answer for trajectories of bodies

(c) Lagrangian Mechanics and Hamiltonian mechanics gave the same answer for trajectories of bodies

(d) Lagrangian, Hamiltonian and Newtonian mechanics all gave different answers for trajectories of bodies

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