

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-I

Time Allowed : 2 hours

Full Marks : 200

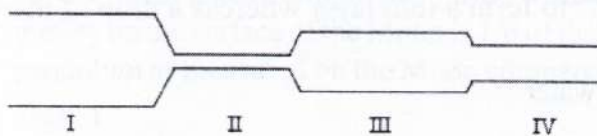
All questions carry equal mark of 2 each.

Attempt all questions.

- In order to keep a body moving in a circle, there exists a force on it that is directed toward the center of the circle. This force is known as
 - Centrifugal force
 - Centripetal force
 - Gravitational Force
 - Magnetic force
- At separation between a node and anti-node, wavelength becomes
 - λ
 - $\lambda/2$
 - $\lambda/4$
 - 2λ
- If an object moves a circular distance 's' of radius 'r', then it's angular displacement is
 - s/r
 - r/s
 - rs
 - r^2s
- According to Newton's 2nd law, the object's acceleration and centripetal force are
 - at right angles to each other
 - anti parallel to each other
 - make acute angle with each other
 - in same direction
- Satellite around the Earth follows a circular path because
 - gravitational force is parallel to velocity
 - gravitational force is not parallel to velocity
 - gravitational force is perpendicular to velocity
 - gravitational force is not perpendicular to velocity
- Momentum possessed by spinning objects is called
 - linear momentum
 - angular momentum
 - normal momentum
 - degrees' momentum
- Which of the following is a use of dimensional analysis?
 - To check the dimensional correctness of an equation
 - To solve the equation dimensionally.
 - To get the number of dimensional constant
 - To understand the dimensional equation
- The dimensions of magnetic field in M, L, T and C (Coulomb) is given as
 - $[MT^{-1}C^{-1}]$
 - $[MLT^{-1}C^{-1}]$
 - $[MT^2C^{-2}]$
 - $[MT^{-2}C^{-1}]$

9. According to Newton's law of universal gravitation, any two particles of finite mass attract one another with a force which is
- (a) Inversely proportional to the product of their masses and directly proportional to the square of their distance apart
 - (b) Inversely proportional to the product of their masses and directly proportional to their distance apart
 - (c) Directly proportional to the product of their masses and inversely proportional to the square of their distance apart
 - (d) Directly proportional to the product of their masses and inversely proportional to their distance apart
10. Acceleration of a rocket having mass 5000 kg and resultant force acting on it is 200,000 N is
- (a) 50 m s^{-2}
 - (b) 56 m s^{-2}
 - (c) 70 m s^{-2}
 - (d) 40 m s^{-2}
11. When displacement $x = 0$, the kinetic energy of a system is
- (a) minimum
 - (b) maximum
 - (c) constant
 - (d) zero
12. What is the moment of inertia of a rod about an axis passing through the centre and perpendicular to its central axis? Given that mass of rod is 1kg, length = 10 cm
- (a) 0.00083 kgm^2
 - (b) 0.0833 kgm^2
 - (c) 0.0033 kgm^2
 - (d) 0.00033 kgm^2
13. Moment of inertia of a spinning body about an axis doesn't depend on which of the following factors?
- (a) Distribution of mass around axis
 - (b) Angular velocity
 - (c) Orientation of axis
 - (d) Mass
14. A body weight 250N on the surface. Assuming the earth to be a sphere of uniform mass density, how much would it weigh halfway down to the centre of earth?
- (a) 240N
 - (b) 210 N
 - (c) 195N
 - (d) 125N
15. According to Special Theory of Relativity, time is not absolute quantity. It depends upon the motion of the _____
- (a) Relativity
 - (b) Frame of reference
 - (c) Observer
 - (d) Light
16. The length of a rod seems shorter to an observer when it moves in a specific direction. What change would he observe when the direction of the rod changes by 180° ?
- (a) The rod becomes even smaller
 - (b) The Length of rod increases
 - (c) The length of the rod remains the same
 - (d) The mass of rod change
17. In relativistic case, as the velocity of the particle approaches the speed of light, the kinetic energy approaches
- (a) Infinite
 - (b) Rest Energy
 - (c) K.E. as in non-relativistic case
 - (d) Zero
18. Lorentz transformation equations hold for
- (a) Non-Relativistic velocities only
 - (b) Relativistic velocities only
 - (c) All velocities - Non-Relativistic & Relativistic
 - (d) Photons only

19. The sun is positioned _____ on the planet's orbit, according to Kepler's law of planetary motion
- (a) in the center (b) in one of the foci
(c) in both foci (d) along semi-major axis
20. Gas escapes from the surface of a planet because it acquires an escape velocity. The escape velocity will depend on which of the following factors :
- I. Mass of the planet
II. Mass of the particle escaping
III. Temperature of the planet
IV. Radius of the planet
- Select the correct answer from the codes given below:
- (a) I and II (b) II and IV
(c) I and IV (d) I, III and IV
21. When a wire is stretched to double in length, the longitudinal strain produced in it is
- (a) 0.5 (b) 1.0
(c) 1.5 (d) 2.0
22. Every material obeys the Hooke's law within
- (a) Elastic limit (b) Plastic limit
(c) Inelastic limit (d) Limit of proportionality
23. In a simple bending theory, one of the assumptions is that the material of the beam is isotropic. This assumption means that the
- (a) elastic constants are same in all the directions (b) normal stress varies linearly in the material
(c) normal stress remains constant in all directions (d) elastic constants varies linearly in the material
24. The relationship between Young's modulus (Y), Modulus of rigidity (R) and Bulk modulus (K) is given by
- (a) $Y=9RK/(R+3K)$ (b) $Y=9RK/(2R+3K)$
(c) $Y=9RK/(3R+K)$ (d) $Y=9RK/(R-3K)$
25. The ratio of strength of a hollow shaft to that of a solid shaft subjected to torsion if both are of the same material and of the same outer diameters, the inner diameter of hollow shaft being half of the outer diameter is
- (a) 7/8 (b) 16/15
(c) 15/16 (d) 8/7
26. A fountain with an opening of radius 0.015 m shoots a stream of water vertically from ground level at 6.0 m/s. The density of water is 1000 kg/m³. The volume rate of flow of water is
- (a) 0.0012 m³/s (b) 0.0051 m³/s
(c) 0.0037m³/s (d) 0.0042 m³/s
27. A fluid is forced through a pipe of changing cross section as shown. In which section would the pressure of the fluid be a minimum?



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

28. The flow through a circular pipe is laminar. Now, the fluid through the pipe is replaced with a more viscous fluid and passed through the pipe again with the same velocity. What can we say about the nature of this flow?
- (a) The flow will become turbulent
(b) The flow will remain laminar
(c) The flow will be a transition flow
(d) The flow will be inverse
29. What happens to viscosity in the case of incompressible fluids as temperature is increased
- (a) It decreases
(b) It remains constant
(c) It first increase and then decrease
(d) It increases
30. Reynold's Number signifies the ratio of
- (a) gravity forces to viscous forces
(b) inertia force to viscous force
(c) inertia forces to viscous forces
(d) buoyant force to inertia force
31. Stoke's Law is not applicable in
- (a) Streamline flow
(b) Transition flow
(c) Steady flow
(d) Turbulent flow
32. Shapes of drops of liquid are spherical because of _____
- (a) Viscosity
(b) Conductivity
(c) Absorption
(d) Surface tension
33. Due to the surface tension, the molecules on the surface of the soap bubble experience the net force in the _____ normal to the surface.
- (a) inward direction
(b) outward direction
(c) Both (a) & (b)
(d) Neither (a) nor (b)
34. Water rises upto a height of 5cm in capillary tube of radius 2mm. What is the radius of the capillary tube if the water rises upto a height of 10cm in another capillary?
- (a) 7 mm
(b) 4mm
(c) 1 mm
(d) 3mm
35. If a liquid surface is curved, then _____
- (a) the pressure on the concave side is less than that on the convex side
(b) the pressure on the concave side is equal to that on the convex side
(c) the pressure on the concave side is more than that on the convex side
(d) the pressure on the convex side is atmospheric pressure
36. If the surface of a liquid is plane, then the angle of contact of the liquid with the walls of the container is _____
- (a) Acute angle
(b) Obtuse angle
(c) 90°
(d) 0°
37. η in Poiseuille's equation is representing _____
- (a) Velocity of fluids
(b) Viscosity of fluids
(c) Pressure of fluids
(d) Density of fluids
38. On a clean glass plate, a drop of water spreads to form a thin layer whereas a drop of mercury remains almost spherical because
- (a) Density of mercury is greater than that of water
(b) mercury is metal
(c) cohesion of water is lesser than its adhesion with glass
(d) cohesion of water is greater than its adhesion with glass

39. Bernoulli's Principle shows that, at points in a moving fluid where the potential energy change is very small
- (a) the pressure is low where the velocity is low and similarly, the pressure is high where the velocity is high
 - (b) the pressure is low where the velocity is high and conversely, the pressure is high where the velocity is low
 - (c) pressure becomes independent of the velocity of the moving fluid
 - (d) pressure remain independent of the speed of the stationary fluid

40. Which of the following cannot be determined using a torsion test?

- (a) Modulus of elasticity in shear
- (b) Torsion yield strength
- (c) Modulus of rupture
- (d) Young's modulus

41. A wave of the form $A \sin(\omega t + \pi)$ is added to a string carrying a wave of the form $A \sin(\omega t)$. What is the equation of the resulting wave?

- (a) 0
- (b) $2A \sin(\omega t)$
- (c) $A \sin(\omega t + \pi / 2)$
- (d) $-2A \sin(\omega t)$

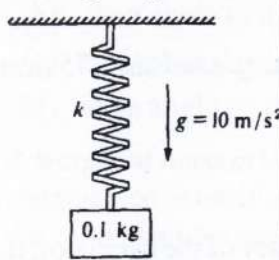
42. The angular velocity and the amplitude of simple pendulum is ' ω ' and ' a ' respectively. At a displacement ' x ' from mean position, if the kinetic energy is T and potential energy is V. Then ratio T to V is

- (a) $\frac{x^2 \omega^2}{(a - x^2 \omega^2)}$
- (b) $\frac{x^2}{(a^2 - x^2)}$
- (c) $\frac{a - x^2 \omega^2}{(x^2 - x^2 \omega^2)}$
- (d) $\frac{a - x^2}{x^2}$

43. When an object is oscillating in simple harmonic motion in the vertical direction, its maximum speed occurs when the object

- (a) has a position equal to its amplitude.
- (b) is at its lowest point.
- (c) is at the equilibrium point.
- (d) is at its highest point.

44. A 0.1-kilogram block is attached to an initially unstretched spring of force constant $k = 40$ Newtons per meter as shown in Fig. The block is released from rest at time $t = 0$. What is the amplitude of the resulting simple harmonic motion of the block?



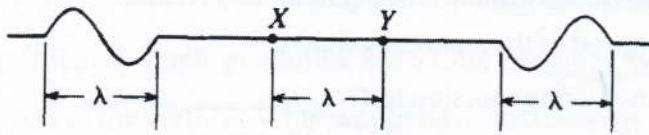
- (a) $\frac{1}{40} \text{ m}$
- (b) $\frac{1}{20} \text{ m}$
- (c) $\frac{1}{2} \text{ m}$
- (d) $\frac{1}{4} \text{ m}$

45. An astronaut takes a simple pendulum with her on a voyage to the Moon. The acceleration due to gravity on the surface of the Moon is $1/6$ of that on the Earth. What is the ratio of the frequency of the pendulum as measured on the Moon compared to the frequency on Earth?

- (a) 1
- (b) 6
- (c) $1 / \sqrt{6}$
- (d) $\sqrt{6}$

46. A rigid body suspended vertically and oscillates with small amplitude under the action of force of gravity is known as
- (a) Simple pendulum (b) Compound pendulum
(c) Torsional pendulum (d) Strain pendulum

47. Two wave pulses, each of wavelength λ , are traveling toward each other along a rope as shown.



When both pulses are in the region between points X and Y, which are at a distance λ apart, the shape of the rope is

- (a) (b)
(c) (d)

48. When two mutually perpendicular simple harmonic motions of same frequency, amplitude and phase are superimposed

- (a) the resulting motion is uniform circular motion
(b) the resulting motion is a linear simple harmonic motion along a straight line inclined equally to the straight lines of motion of component ones
(c) the resulting motion is an elliptical motion
(d) the two S.H.M's will cancel each other.

49. If the two input waveforms of equal amplitude and 90 degree phase difference is applied to the CRO, then the Lissajous patterns obtained will be

- (a) straight line tilted at 45 degree with respect to x-axis
(b) ellipse
(c) circle
(d) vertical straight line

50. In free vibrations, the velocity vector leads the displacement vector by

- (a) π (b) $\pi/2$
(c) $\pi/3$ (d) $\pi/4$

51. A child is sitting on a swing. Its minimum and maximum heights from the ground are 0.75 m and 2 m respectively. Taking $g=10\text{m/s}^2$, its maximum speed will be

- (a) 10 m/s (b) 5 m/s
(c) 8 m/s (d) 15 m/s

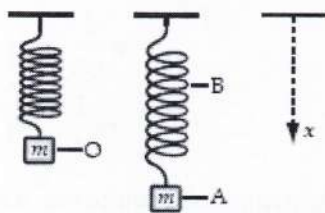
52. If the frequency of external periodic force is equal to the natural frequency of the oscillator, then the oscillator oscillates with maximum amplitude. This phenomenon is called as _____.

- (a) Free oscillations (b) Free damped oscillations
(c) Forced oscillations (d) Resonance

53. $m \frac{d^2 y}{dt^2} + R \frac{dy}{dt} + ky = f \sin qt$ represents differential equation for _____.

- (a) Free oscillations (b) Damped free oscillations
(c) Forced oscillations (d) Resonance

54. The differential equation of wave motion is given by _____.
- (a) $\frac{\partial^2 y}{\partial t^2} = v^2 \frac{\partial^2 y}{\partial x^2}$ (b) $\frac{\partial^2 y}{\partial x^2} = v^2 \frac{\partial^2 y}{\partial t^2}$
 (c) $\frac{\partial^2 y}{\partial t^2} = v^2 \frac{\partial^2 x}{\partial y^2}$ (d) $\frac{\partial^2 y}{\partial t^2} = v \frac{\partial^2 y}{\partial x^2}$
55. A pendulum is oscillating with a total mechanical energy E_0 . When the pendulum is at its maximum displacement, the kinetic energy K and the potential energy U are
- (a) $K=E_0/2; U=E_0/2$ (b) $K=0; U=E_0$
 (c) $K= E_0; U= E_0$ (d) $K=E_0; U=0$
56. When an oscillator completes 100 oscillations its amplitude reduces to 1/3 of its initial value. What will be its amplitude, when it further completes 200 oscillations?
- (a) 1/9 (b) 1/3
 (c) 1/6 (d) 1/27
57. The time period of a compound pendulum executes angular SHM is _____.
- (a) $2\pi\sqrt{\frac{I}{mgl}}$ (b) $2\pi\sqrt{\frac{l}{mgl}}$
 (c) $2\pi\sqrt{\frac{mgl}{I}}$ (d) $2\pi\sqrt{\frac{mgI}{l}}$
58. The resultant vibration of particle due to two SHMs having same frequency, same amplitude and acting at right angles to each other, having phase difference $\alpha = \frac{\pi}{2}$ or $3\frac{\pi}{2}$, traces a curve which is _____
- (a) simple ellipse (b) oblique ellipse
 (c) parabola (d) circle
59. Lissajous figures are obtained, when a particle is subjected to two S.H.M.s simultaneously _____.
- (a) along the same straight line
 (b) at an angle of $3\pi/4$ to each other
 (c) at right angles to each other
 (d) at an angle of $\pi/3$ to each other
60. A weight of mass m is at rest at O when suspended from a spring, as shown. When it is pulled down and released, it oscillates between positions A and B. Which statement about the system consisting of the spring and the mass is correct?



- (a) The gravitational potential energy of the system is greatest at A.
 (b) The rate of change of momentum has its greatest magnitude at A and B.
 (c) The elastic potential energy of the system is greatest at O.
 (d) The rate of change of gravitational potential energy is smallest at O.

61. When the natural frequency $\frac{\omega}{2\pi}$ is equal to the forcing frequency $\frac{q}{2\pi}$, then
- (a) velocity resonance takes place
 - (b) amplitude resonance takes place
 - (c) virtual resonance take place
 - (d) both velocity and amplitude resonance take place
62. A particular simple pendulum has a total energy E_0 when it swings to a maximum angle of θ_0 with respect to the vertical. What would be its total energy if it could reach a maximum of $2\theta_0$?
- (a) $E_0/2$
 - (b) $E_0/4$
 - (c) $2E_0$
 - (d) $4E_0$
63. Two mutually perpendicular simple harmonic vibrations have the same amplitude, frequency and phase. When they superimposed, the resulting motion will be
- (a) a uniform circular motion
 - (b) a uniform linear motion
 - (c) an elliptical motion
 - (d) a parabolic motion
64. In mechanical vibration, the maximum amplitude is obtained
- (a) when the frequency of driving force is greater than the natural frequency of the system
 - (b) when the frequency of driving force is less than the natural frequency of the system
 - (c) when the frequency of driving force is equal to the natural frequency of the system
 - (d) when the frequency of driving force is inversely proportional to the natural frequency of the system
65. In free vibrations, the acceleration leads the displacement vector by
- (a) $\pi/3$
 - (b) $\pi/2$
 - (c) $2\pi/3$
 - (d) π
66. A particle moves in a circle in such a way that the x and y -coordinates of its motion are given in meters as functions of time t in seconds by:
 $x = 5\cos(3t), y = 5\sin(3t)$. What is the period of revolution of the particle?
- (a) $2\pi/3$ s
 - (b) 3 s
 - (c) $1/3$ s
 - (d) $3\pi/2$ s
67. The equation of motion of a simple harmonic oscillator is $d^2x/dt^2 = -9x$, where x is displacement and t is time. The period of oscillation is
- (a) 6π
 - (b) $9/2\pi$
 - (c) $3/2\pi$
 - (d) $2\pi/3$
68. A simple pendulum consists of a 1.0 kilogram brass bob on a string about 1.0 meter long. It has a period of 2.0 seconds. The pendulum would have a period of 1.0 second if the
- (a) string were replaced by one about 2.0 meters long
 - (b) string were replaced by one about 0.25 meter long
 - (c) bob were replaced by a 0.25 kg brass sphere
 - (d) bob were replaced by a 4.0 kg brass sphere
69. If two waves are in phase and have same amplitude, then resultant wave has
- (a) half of amplitude of single wave
 - (b) same amplitude as single wave
 - (c) twice of amplitude of single wave
 - (d) thrice of amplitude of single wave

70. Oscillations become damped due to
(a) friction
(b) normal force
(c) tangential force
(d) parallel force
71. If there is no transfer of energy between two objects, then their temperature is
(a) different
(b) same
(c) zero
(d) infinite
72. An ideal gas is made up of N diatomic molecules, each of mass M . All of the following statements about this gas are true **except**:
(a) The temperature of the gas is proportional to the average translational kinetic energy of the molecules.
(b) The average number of collisions per unit time that the molecules make with the walls of the container depends on the temperature of the gas.
(c) The molecules make elastic collisions with each other and with the walls of the container.
(d) All of the molecules have the same speed.
73. The number of molecules of a gas (or the mass of gas enclosed) in a container is doubled. What will be the effect on the rms speed of gas molecules?
(a) Increase
(b) decrease
(c) remains unchanged
(d) zero
74. Root mean square velocity v of a molecule at normal pressure and temperature, is
(a) 499 m/s
(b) 532 m/s
(c) 520 m/s
(d) 398 m/s
75. As per the law of equipartition of energy, each vibrational mode gives how many degrees of freedom?
(a) 1
(b) 2
(c) 3
(d) 4
76. A monoatomic gas ($\gamma = 5/3$) is suddenly compressed to $1/8$ of its original volume adiabatically, then the pressure of the gas will change to
(a) $24/5$
(b) $40/3$
(c) 4
(d) 10
77. Two cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at 300 K. The piston of A is free to move, while that of B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30 K, then the rise in temperature of the gas in B is
(a) 30K
(b) 42K
(c) 50K
(d) 62K
78. The degree of freedom for triatomic gas at room temperature is
(a) 6
(b) 5
(c) 4
(d) 2
79. In high pressure condition, the real gases conform more closely with
(a) Ideal gas equation
(b) Boyle's law
(c) Specific heat
(d) Van der Waals equation
80. The equation of state for 5g of oxygen at a pressure P and temperature T when occupying a volume V will be
(a) $PV = (5/2) RT$
(b) $PV = (5/16) RT$
(c) $PV = (5/32) RT$
(d) $PV = RT$

90. Water at standard atmospheric conditions
- (a) is far below its critical state
 - (b) is far above its critical state
 - (c) behaves as an ideal gas
 - (d) is mostly liquid
91. In defining the temperature scale, the standard reference point is taken as
- (a) zero Kelvin
 - (b) boiling point of water
 - (c) freezing point of water
 - (d) triple point of water
92. Absolute zero is best described as that temperature at which
- (a) the molecules of a substance have a maximum kinetic energy.
 - (b) the molecules of a substance have a maximum potential energy.
 - (c) the molecules of a substance have minimum kinetic energy.
 - (d) water freezes at standard pressure.
93. A perfect black body has a unique characteristic features as
- (a) a good absorber and a good radiator
 - (b) a good absorber
 - (c) neither absorber nor radiator
 - (d) a good radiator
94. Which statement is incorrect?
- (a) All reversible cycles have same efficiency
 - (b) Reversible cycle has more efficiency than an irreversible one
 - (c) Carnot cycle is a reversible cycle
 - (d) Carnot cycle has the maximum efficiency in all cycles.
95. A diatomic molecule has translational, rotational and vibrational degrees of freedom. The $\frac{C_p}{C_v}$ is
- (a) 1.29
 - (b) 1.33
 - (c) 1.4
 - (d) 1.67
96. For a given mass of a gas in an adiabatic change, the temperature and pressure are related according to the law:
- (a) $P/T = \text{constant}$
 - (b) $PT^\gamma = \text{constant}$
 - (c) $P^{1-\gamma} T^\gamma = \text{constant}$
 - (d) $P^\gamma T^{1-\gamma} = \text{constant}$
97. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is
- (a) $2/5$
 - (b) $3/5$
 - (c) $3/7$
 - (d) $5/7$
98. The enthalpy and internal energy are the function of temperature for
- (a) ideal gas
 - (b) water
 - (c) all gases
 - (d) steam
99. At what temperature will oxygen molecules have the same root mean square speed as hydrogen molecules at 300K ?
- (a) 1200 K
 - (b) 3600 K
 - (c) 2400 K
 - (d) 4800 K
100. Force exerted on a person by atmosphere at sea level is
- (a) 200,000 N
 - (b) 300,000 N
 - (c) 400,000 N
 - (d) 500,000 N