Topic Name : Physics Major-1(Rotational Mech+Waves +Gravitation)
Test Duration : 90 minutes
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Target: JEE Main & Advanced | NEET
Marking Scheme: +4 & -1
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This world is but a canvas for our imagination.

Henry David Thoreau (A Week on the Concord and Merrimack Rivers, 1849)

01. The diameter of a flywheel increases by 1%. What will be percentage increase in moment of inertia about axis of symmetry?

(a) 2% (b) 4%
(c) 1% (d) 0.5%

02. Two circular discs A and B are of equal masses and thicknesses but made of metal with densities d_A and d_B ($d_A > d_B$). If their moments of inertia about an axis passing through their centres and perpendicular to circular faces be I_A and I_B, then

(a) $I_A = I_B$ (b) $I_A > I_B$
(c) $I_A < I_B$ (d) $I_A \geq I_B$

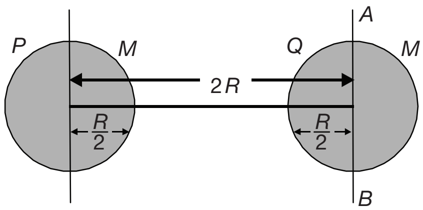
03. Moment of inertia of a uniform annular disc of internal radius r and external radis R and mass M about an axis through its centre and perpendicular to its plane is

(a) $\frac{1}{2}M(R^2 - r^2)$ (b) $\frac{1}{2}M(R^2 + r^2)$
(c) $\frac{M(R^4 + r^4)}{2(R^2 + r^2)}$ (d) $\frac{1}{2}\frac{M(R^4 + r^4)}{(R^2 - r^2)}$

04. A closed tube partly filled with water lies in a horizontal plane. If the tube is rotated about perpendicular bisector, the moment of inertia of the system

(a) increases
(b) decreases
(c) remains constant
(d) depends on sense of rotation

05. Two spheres each of mass M and radius $R/2$ are connected with a massless rod of length $2R$ as shown in the figure.



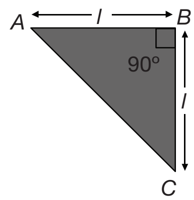
The moment of inertia of the system about an axis passing through the centre of one of the spheres and perpendicular to the rod is

(a) $\frac{21}{5}MR^2$ (b) $\frac{2}{5}MR^2$
(c) $\frac{5}{2}MR^2$ (d) $\frac{5}{21}MR^2$

06. Let I be the moment of inertia of a uniform square plate about an axis AB that passes through its centre and is parallel to two of its sides. CD is a line in the plane of the plate that passes through the centre of the plate and makes an angle θ with AB. The moment of inertia of the plate about the axis CD is then equal to

(a) I (b) $I \sin^2 \theta$
(c) $I \cos^2 \theta$ (d) $I \cos^2 (\theta/2)$

07. Figure shows a thin metallic triangular sheet ABC. The mass of the sheet is M.



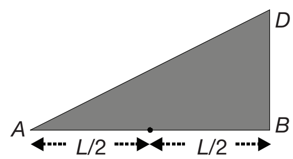
The moment of inertia of the sheet about side AC is

(a) $\frac{Ml^2}{18}$ (b) $\frac{Ml^2}{12}$
(c) $\frac{Ml^2}{6}$ (d) $\frac{Ml^2}{4}$

08. An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 rpm, the acceleration of a point on the tip of a blade is about

(a) 4740 m/s^2 (b) 5055 m/s^2
(c) 1600 m/s^2 (d) 2370 m/s^2

09. A triangular plate of uniform thickness and density is made to rotate about an axis perpendicular to the plane of the paper and (a) passing through A, (b) passing through B, by the application of some force F at C (mid-point of AB) as shown in the figure. In which case angular acceleration is more?



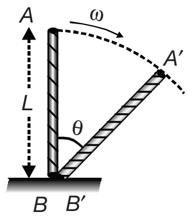
(a) In case (a)
(b) In case (b)
(c) In both cases (a) and (b)
(d) None of these

10. A rigid body rotates about a fixed axis with variable angular velocity equal to $\alpha - \beta t$ at time t, where α and β are constants. The angle through which it rotates before it comes to rest is

(a) $\frac{\alpha^2}{2\beta}$ (b) $\frac{\alpha^2 - \beta^2}{2\alpha}$

(c) $\frac{\alpha^2 - \beta^2}{2\beta}$ (d) $\frac{\alpha(\alpha - \beta)}{2}$

11. A uniform rod of length L is free to rotate in a vertical plane about a fixed horizontal axis through B. The rod begins rotating from rest from its unstable equilibrium position. When it has tuned through an angle θ its average angular velocity ω is given as

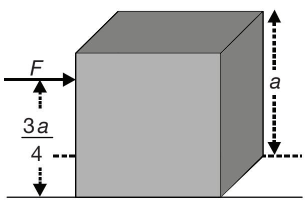


(a) $\sqrt{\frac{6g}{L}}\sin\theta$ (b) $\sqrt{\frac{6g}{L}}\sin\frac{\theta}{2}$

(c) $\sqrt{\frac{6g}{L}}\cos\frac{\theta}{2}$ (d) $\sqrt{\frac{6g}{L}}\cos\theta$

12. A uniform cube of side a and mass m rests on a rough horizontal table. A horizontal force F is applied normal to one of the faces at a point that is directly above the centre of face, at a height $\frac{3a}{4}$ above the base. The minimum value of F for which the cube begins to tilt about the edge is

(Assume that the cube does not slide)



(a) $\frac{mg}{4}$ (b) $\frac{2mg}{3}$

(c) $\frac{3mg}{4}$ (d) mg

13. A small object of mass m is attached to a light string and made to rotate on a frictionless table in a circular path whose radius can be changed by pulling the other end of the string through the hole at the centre. If the initial and final values of the radius of the orbit, speed and angular velocities of the object are r_1, v_1, ω_1 and r_2, v_2, ω_2 respectively, then ω_2/ω_1 is

(a) r_1/r_2 (b) $(r_1/r_2)^2$

(c) $(r_2/r_1)^2$ (d) r_2/r_1

14. A wheel with an initial angular velocity ω_o reaches an angular velocity of $5\omega_o$ while it turns through an angle of 6 rad. Its uniform angular acceleration α is

(a) $\frac{1}{3}\omega_o^2$ rad/sec^2 (b) $\frac{2}{3}\omega_o^2$ rad/sec^2

(c) $2\omega_o^2$ rad/sec^2 (d) $4\omega_o^2$ rad/sec^2

15. Two wheels are mounted side by side and each is marked with a dot on its rim. The two dots are aligned with the wheels at rest, then one wheel is given a constant angular acceleration of $\pi/2$ rad/s^2 and the other $\pi/4$ rad/s^2. Then the two dots become aligned again for the first time after

(a) 2 seconds (b) 4 seconds

(c) 1 second (d) 8 seconds

16. If vector $\vec{F}$ be a force acting on a particle having the position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin, then

(a) $\vec{r}\cdot\vec{\tau} = 0$ and $\vec{F}\cdot\vec{\tau} = 0$

(b) $\vec{r}\cdot\vec{\tau} = 0$ and $\vec{F}\cdot\vec{\tau} \neq 0$

(c) $\vec{r}\cdot\vec{\tau} \neq 0$ and $\vec{F}\cdot\vec{\tau} \neq 0$

(d) $\vec{r}\cdot\vec{\tau} \neq 0$ and $\vec{F}\cdot\vec{\tau} = 0$

17. The angular velocity of the body changes from ω_1 to ω_2 without applying torque but by changing moment of inertia. The initial radius of gyration to the final radius of gyration is

(a) $\omega_2 : \omega_1$ (b) $\omega_2^2 : \omega_1^2$

(c) $\sqrt{\omega_2} : \sqrt{\omega_1}$ (d) $\frac{1}{\omega_2} : \frac{1}{\omega_1}$

18. A cubical block of mass M and edge a slides down a rough inclined plane of inclination θ with a uniform velocity. The torque of the normal force on the block about its centre has a magnitude

(a) zero (b) Mga

(c) $Mga \sin\theta$ (d) $\frac{Mga\sin\theta}{2}$

19. A cylinder of mass M, radius R is resting on a horizontal platform (which is parallel to XY-plane) with its axis fixed along the y-axis and free to rotate about its axis. The platform is given a motion in X-direction given by $x = A\cos\omega t$. There is no slipping between the cylinder and platform. The maximum torque acting on the cylinder during its motion is

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

(c) $2MRA\omega^2$ (d) $MRA\omega^2 \times \cos\omega t$

20. A body rolls without slipping. The radius of gyration of the body about an axis passing through its centre of mass is k. If radius of the body be R, then the fraction of total energy associated with its rotational energy will be

(a) $(k^2 + R^2)$ (b) (k^2/R^2)

(c) $[k^2/(k^2 + R^2)]$ (d) $[R^2/(k^2 + R^2)]$

21. If a rigid body rolls on a surface without slipping, then

(a) angular speed is different at different points of a rigid body

(b) linear speed is same at all points of the rigid body

(c) linear speed is minimum at the highest point but maximum at the point of contact

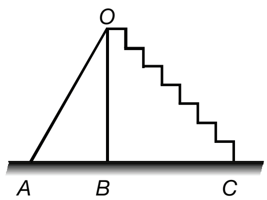
(d) linear speed is maximum at the highest point but minimum at the point of contact

22. The speed of a homogeneous solid sphere after rolling down an inclined plane of vertical height h, from rest, without sliding is

(a) $\sqrt{gh}$ (b) $\sqrt{(6/5)gh}$

(c) $\sqrt{(4/3)gh}$ (d) $\sqrt{(10/7)gh}$

23. Three different balls of masses m_1, m_2 and m_3 are allowed to roll down from rest on three different frictionless paths OA, OB and OC respectively. Speeds v_1, v_2 and v_3 of masses m_1, m_2 and m_3 at the bottom of A, B and C are



24. A body of mass m slides down an incline and reaches the bottom with a velocity v. If the same mass was in the form of a ring which rolls down this incline, the velocity of the ring at the bottom would have been

(a) v (b) $\sqrt{2}v$

(c) $v/\sqrt{2}$ (d) $(\sqrt{2/5})v$

25. Two identical solid cylinders run a race starting from rest at the top of an inclined plane. If one cylinder slides and the other rolls, then

(a) the sliding cylinder will reach the bottom first with greater speed

(b) the rolling cylinder will reach the bottom first with greater speed

(c) both will reach the bottom simultaneously with the same speed

(d) both will reach the bottom simultaneously but with different speeds

26. If a solid sphere, disc and cylinder are allowed to roll down an inclined plane from the same height

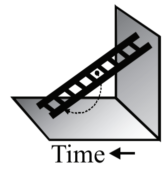
(a) the cylinder will reach the bottom first

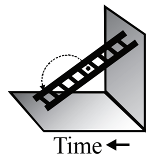
(b) the disc will reach the bottom first

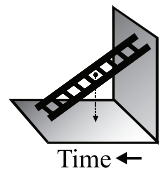
(c) the sphere will reach the bottom first

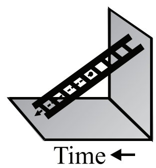
(d) all will reach the bottom at the same time

27. A ladder is leaned against a smooth wall and it is allowed to slip on a frictionless floor. Which figure represents trace of its centre of mass?

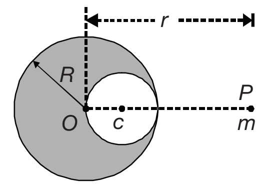
(a) 

(b) 

(c) 

(d) 

28. A solid sphere of lead has a mass M and radius R. A hollow sphere is dug from it shown in the figure. The boundary of hollow sphere is passing through the centre and touching the boundary of the solid sphere. The gravitational force on a mass m placed at a point P distant r from O due to the hollow portion is



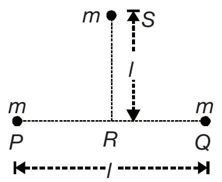
(a) $\dfrac{GMm}{8\left(r-\dfrac{R}{2}\right)^2}$ along $\vec{OP}$

(b) $\dfrac{GMm}{8\left(r-\dfrac{R}{2}\right)^2}$ along $\vec{PO}$

(c) $\dfrac{GMm}{\left(r-\dfrac{R}{2}\right)^2}$ along $\vec{OP}$

(d) $\dfrac{GMm}{\left(r-\dfrac{R}{2}\right)^2}$ along $\vec{PO}$

29. Two particles each of mass m are placed at points P and Q as shown in the figure. R is the mid-point of $PQ = l$. The gravitational force on the third particle of mass m placed at point S on the perpendicular bisector of PQ is



(a) $\dfrac{Gm^2}{l^2}$ (b) $\dfrac{16Gm^2}{5l^2}$

(c) $\dfrac{16Gm^2}{5\sqrt{5}\,l^2}$ (d) $\dfrac{4\sqrt{2}\,Gm^2}{5l^2}$

30. Three uniform spheres each having of mass M and radius a are kept in such a way that they touch each other. The magnitude of the gravitational force on any one of the spheres, due to the other two is

(a) zero (b) $\dfrac{\sqrt{3}\,GM^2}{4a^2}$

(c) $\dfrac{3GM^2}{2a^2}$ (d) $\dfrac{\sqrt{2}\,GM^2}{a^2}$

31. A body suspended on a spring balance inside the space-ship weighs W when ship is at rest at the earth's equator. If W_0 is the weight of the body in the stationary ship when we assume earth not rotating about its axis and ω is the angular velocity of rotation of earth then weight W is

(a) $W_0\left(1+\dfrac{R\omega^2}{g}\right)^{-1}$ (b) $W_0\left(1+\dfrac{R\omega^2}{g}\right)^{-1}$

(c) $W_0\left(1+\dfrac{R\omega^2}{g}\right)^{1/2}$ (d) $W_0\left(1+\dfrac{R\omega^2}{g}\right)^{-1/2}$

32. In Q. No. 31, when the ship begins to move due east, i.e., along the sense of Earth's rotation, with velocity v, then the weight of the body inside the moving ship is very close to

(a) $W\left(1-\dfrac{\omega v}{g}\right)$ (b) $W\left(1-\dfrac{2\omega v}{g}\right)$

(c) $W\left(1+\dfrac{\omega v}{g}\right)$ (d) $W\left(1+\dfrac{2\omega v}{g}\right)$

33. If the radius of earth shrinks by 2%, the acceleration due to gravity on the earth's surface (Assuming mass of earth to be constant)

(a) decreases by 2%
(b) increases by 2%
(c) decreases by 4%
(d) increases by 4%

34. The fractional decrease in the value of free-fall acceleration g for a particle when it is lifted from the surface to an elevation h ($h << R$) is (R-radius of earth)

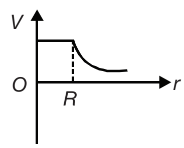
(a) $\dfrac{h}{R}$ (b) $\dfrac{2h}{R}$

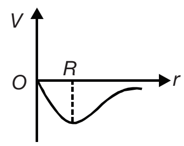
(c) $\dfrac{h}{3R}$ (d) $\dfrac{h}{4R}$

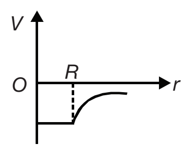
35. Average density of the earth

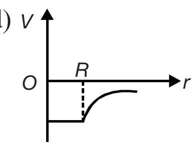
(a) does not depend on g
(b) is a complex function of g
(c) is directly proportional to g
(d) is inversely proportional to g

36. Which of the following curve represents the variation of gravitational potential of a hollow sphere of radius R with distance r

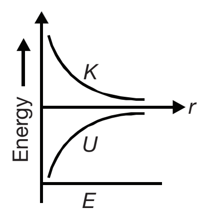
(a)


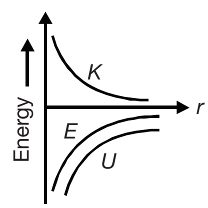
(b)


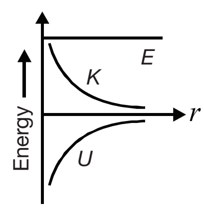
(c)


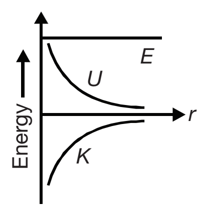
(d)


37. The variation of total energy (E), kinetic energy (K) and potential energy (U) of a satellite with its distance r from the centre of earth is correctly represented by which of the following curves

(a)


(b)


(c)


(d)


38. There is a region of gravitational force in which gravitational field intensity I is given by

$$\vec{I} = a\hat{i} + b\hat{j} - c\hat{k}$$

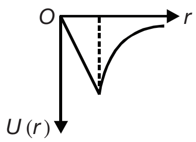
The work done by the gravitational force to displace a point mass m in the region from point (0, 0, 0) to (1, 2, 3) is

(a) $m(a+2b-c)$ (b) $m\left(\frac{ab^2}{c^3}\right)$

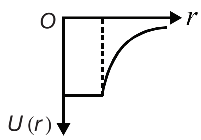
(c) $m(a+2b-3c)$ (d) 6 $mabc$

39. A shell of mass M and radius R has a point mass m placed at a distance from its centre. The variation of gravitational potential energy $U(r)$ with distance r is correctly shown by which of the following curve

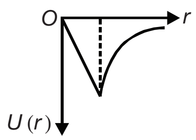
(a)



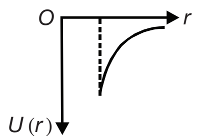
(b)



(c)



(d)

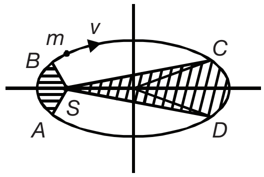


40. A system of binary stars of masses m_A and m_B are moving in circular orbits of radii r_A and r_B respectively. If T_A and T_B are the time-periods of masses m_A and m_B respectively then,

(a) $\frac{T_A}{T_B} = \left(\frac{r_A}{r_B}\right)^{3/2}$ (b) $T_A > T_B$ (if $r_A > r_B$)

(c) $T_A > T_B$ (if $m_A > m_B$) (d) $T_A = T_B$

41. The figure shows elliptical orbit of a planet m about the sun S. The shaded area SCD is twice the shaded area SAB. If t_1 is the time for the planet to move from C to D and t_2 is the time to move from A to B then



(a) $t_1 = 4t_2$ (b) $t_1 = 2t_2$
(c) $t_1 = t_2$ (d) $t_1 > t_2$

42. The additional kinetic energy to be provided to a satellite of mass m revolving around a planet of mass M, to transfer it from a circular orbit of radius R_1 to another of radius $R_2(R_2 > R_1)$ is

(a) $GmM\left(\frac{1}{R_1^2} - \frac{1}{R_2^2}\right)$

(b) $GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

(c) $2GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

(d) $\frac{1}{2}GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

43. (1) Centre of gravity (CG) of a body is the point at which the weight of the body acts.
(2) Centre of mass coincides with the centre of gravity if the earth is assumed to have infinitely large radius.
(3) To evaluate the gravitational field intensity due to any body at an external point, the entire mass of the body can be considered to be concentrated at its CG.
(4) The radius of gyration of any body rotating about an axis is the length of the perpendicular dropped from the CG of the body to the axis.

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

44. The condition for a uniform spherical mass m of radius r to be a black hole is [G = gravitaional constant and g = acceleration due to gravity]

(a) $\left(\frac{2Gm}{r}\right)^{1/2} \leq c$ (b) $\left(\frac{2gm}{r}\right)^{1/2} = c$

(c) $\left(\frac{2Gm}{r}\right)^{1/2} \geq c$ (d) $\left(\frac{gm}{r}\right)^{1/2} \geq c$

[2005]

45. Kepler's second law is based on
(a) Newton's first law
(b) special theory of relativity
(c) Newton's second law
(d) conservation of angular momentum

[2002]

46. When two coherent waves interfere, there is:
(a) loss in energy
(b) gain in energy
(c) redistribution of energy which changes with time
(d) redistribution of energy which does not change with time

47. The complete destructive interference of two sound waves takes place when the two waves are travelling in the same direction
(a) with the same frequency and amplitude and are in phase
(b) with the same frequency and amplitude and are in opposite phase
(c) with the same frequency and amplitude
(d) with the same frequency and opposite phase

48. To demonstrate the phenomenon of beats, we need
(a) two sources which emit radiation of nearly the same frequency
(b) two sources which emit radiation of exactly the same frequency
(c) two sources which emit radiation of exactly the same frequency and have a definite phase relationship
(d) two sources which emit radiation of exactly the same wavelength

49. Out of the given four waves (1), (2), (3) and (4),

$$y = 20 \sin (100\pi t) \quad (1)$$
$$y = 20 \sin (101\pi t) \quad (2)$$
$$y = 20 \cos (100\pi t) \quad (3)$$
$$y = 20.1 \sin (100\pi t) \quad (4)$$

emitted by four different sources S_1, S_2, S_3 and S_4 respectively, interference phenomenon would be observed in space under appropriate conditions when
(a) source S_1 emits wave (1) and S_4 emits wave (4)
(b) source S_2 emits wave (2) and S_4 emits wave (4)
(c) source S_1 emits wave (1) and S_3 emits wave (3)
(d) interference phenomenon cannot be observed by the combination of any of the given waves

50. When two progressive waves of intensity I_1 and I_2 but slightly different frequencies superpose, the resultant intensity fluctuates between
(a) $(\sqrt{I_1}+\sqrt{I_2})^2$ and $(\sqrt{I_1}-\sqrt{I_2})^2$
(b) $(\sqrt{I_1}+\sqrt{I_2})$ and $(\sqrt{I_1}-\sqrt{I_2})$
(c) (I_1+I_2) and $\sqrt{I_1-I_2}$
(d) $\dfrac{I_1}{I_2}$ and $\dfrac{I_2}{I_1}$

51. Two waves are passing through a region in the same direction at the same time. If the equations of these waves are

$$y_1 = a \sin\frac{2\pi}{\lambda}(vt-x)$$

and $$y_2 = b \sin\frac{2\pi}{\lambda}[(vt-x)+x_o],$$

then the amplitude of the resulting wave for $x_o = (\lambda/2)$ is
(a) $|a-b|$
(b) $a+b$
(c) $\sqrt{a^2+b^2}$
(d) $\sqrt{a^2+b^2+2ab\cos x}$

52. Two coherent sources must have the same
(a) amplitude
(b) phase difference only
(c) frequency only
(d) both (b) and (c)

53. Three sound waves of equal amplitude have frequencies $(\nu+1)$, ν, $(\nu+1)$. They superpose to give beats. The number of beats produced per second will be
(a) 4
(b) 3
(c) 2
(d) 1

54. Two vibrating tuning forks producing progressive waves given by: $y_1 = 4 \sin (500\pi t)$ and $y_2 = 2 \sin (506\pi t)$ are held near the ear of a person. The person will hear
(a) 3 beats per second with intensity ratio between maxima and minima equal to 9
(b) 3 beats per second with intensity ratio between maxima and minima equal to 2
(c) 6 beats per second with intensity ratio between maxima and minima equal to 2
(d) 6 beats per second with intensity ratio between maxima and minima equal to 9

55. Two vibrating tuning forks producing progressive waves given by:

$$y_1 = 4 \sin (500\pi t) \text{ and } y_2 = 2 \sin (506\pi t),$$

are held near the ear of a person. If the number of beats heard per second be B and the ratio of maximum to minimum intensity be A, then
(a) $B = 3$ and $A = 2$
(b) $B = 3$ and $A = 9$
(c) $B = 6$ and $A = 2$
(d) $B = 6$ and $A = 9$

56. When two tuning forks A and B are sounded together, x beats/sec are heard. Frequency of A is n. Now when one prong of fork B is loaded with a little wax, the number of beats/sec decreases. The frequency of fork B is
(a) $n+x$
(b) $n-x$
(c) $n-x^2$
(d) $n-2x$

57. The equation of a plane progressive wave is

$$y = 0.09 \sin 8\pi\left(t - \frac{x}{20}\right),$$

When it is reflected at rigid support, its amplitude becomes (2/3)rd of its previous value. The equation of the reflected wave is

(a) $y = 0.09 \sin 8\pi \left(t - \frac{x}{20}\right)$

(b) $y = 0.06 \sin 8\pi \left(t - \frac{x}{20}\right)$

(c) $y = 0.06 \sin 8\pi \left(t + \frac{x}{20}\right)$

(d) $y = -0.06 \sin 8\pi \left(t + \frac{x}{20}\right)$

58. For the stationary wave:

$$y = 4 \sin (\pi x/15) \cos (96\pi t),$$

the distance between a node and the next antinode is

(a) 7.5 (b) 15
(c) 22.5 (d) 30

59. In the equation $y = 4 \cos (2\pi x/50) \sin 100 \pi t$, y represents the displacement of a particle at the distance x from the origin and at the time t. Then, a node occurs at the following distance

(a) 12.5 cm (b) 50 cm
(c) 20 cm (d) $(100/2\pi)$ cm

60. In stationary waves, antinodes are the points where there is

(a) minimum displacement and minimum pressure change
(b) minimum displacement and maximum pressure change
(c) maximum displacement and maximum pressure change
(d) maximum displacement and minimum pressure change

61. Two organ pipes give 4 beats when sounded together at 27ºC. Calculate the number of beat at 127ºC

(a) 4.6 beats/sec (b) 3.9 beats/sec
(c) 4 beats/sec (d) none of these

62. Two wires with different densities are joined at $x = 0$. An incident wave:

$$y_i = a_i \sin (\omega t - k_1 x),$$

travelling from left to right is partly reflected and partly transmitted at $x = 0$. If the amplitude of reflected and transmitted waves be a_r and a_t respectively, then a_r/a_i is

(a) $\frac{2k_1}{k_1 + k_2}$ (b) $\frac{2k_2}{k_1 + k_2}$

(c) $\frac{k_1 - k_2}{k_1 + k_2}$ (d) $\frac{\sqrt{k_1} - \sqrt{k_2}}{\sqrt{k_1} + \sqrt{k_2}}$

63. An open pipe is suddenly closed with the result that the second overtone of the closed pipe is found to be higher in frequency by 100 Hz than the first overtone of the original pipe. The fundamental frequency of open pipe will be

(a) 100 Hz (b) 300 Hz
(c) 150 Hz (d) 200 Hz

64. In a closed organ pipe, the 1st resonance occurs at 50 cm. At what length of pipe, the 2nd resonance will occur?

(a) 150 cm (b) 50 cm
(c) 100 cm (d) 200 cm

65. If L_1 and L_2 are the lengths of the first and second resonating air columns in a resonance tube, then the wavelength of the note produced is

(a) $2(L_2 + L_1)$ (b) $2(L_2 - L_1)$

(c) $2\left(L_2 - \frac{L_1}{2}\right)$ (d) $2\left(L_2 + \frac{L_1}{2}\right)$

66. One requires 11eV of energy to dissociate a carbon monoxide molecule into carbon and oxygen atoms. The minimum frequency of the appropriate electromagnetic radiation to achieve the dissociation lies in

(a) visible region
(b) infrared region
(c) ultraviolet region
(d) microwave region

67. A linearly polarized electromagnetic wave given as $\mathbf{E} = E_0\hat{\mathbf{i}}\cos(kz - \omega t)$ is incident normally on a perfectly reflecting infinite wall at $z = a$. Assuming that the material of the wall is optically inactive, the reflected wave will be given as

(a) $\mathbf{E}_r = -E_0\hat{\mathbf{i}}\cos(kz - \omega t)$
(b) $\mathbf{E}_r = E_0\hat{\mathbf{i}}\cos(kz + \omega t)$
(c) $E_r = -E_0\hat{i}\cos(kz + \omega t)$
(d) $E_r = E_0\hat{i}\sin(kz - \omega t)$

68. Light with an energy flux of 20 W/cm^2 falls on a non-reflecting surface at normal incidence. If the surface has an area of 30 cm^2. the total momentum delivered (for complete absorption) during 30 minutes is

(a) 36×10^{-5} kg m/s
(b) 36×10^{-4} kg m/s
(c) 108×10^{4} kg m/s
(d) 1.08×10^{7} kg m/s

69. What is your observation when two sources are emitting sound with frequency 499 Hz and 501 Hz?

(a) Frequency of 500 Hz is heard with change in intensity take place twice.

(b) Frequency of 500 Hz is heard with change in intensity take place once.

(c) Frequency of 2 Hz is heard with change in intensity take place once.

(d) Frequency of 2 Hz is heard with change in intensity take place twice.

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70. On the same path, the source and observer are moving such a ways that the distance between these two increases with the time. The speeds of source and observer are same and equal to 10 ms^{-1} with respect to the ground while no wind is blowing. The apparent frequency received by observer is 1950 Hz, then the original frequency must be (the speed of sound in present medium is 340 m/s)

(a) 2068 Hz (b) 2100 Hz

(c) 1903 Hz (d) 602 Hz

[2015]