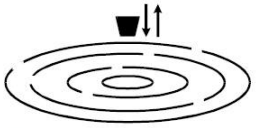
1. The extension in a string, obeying Hooke's law is x. The speed of sound in the stretched string is v. If the extension in the string is increased to 1.5 x , the speed of sound will be
(A) 1.22 v (B) 0.61 v (C) 1.50 v (D) 0.75 v

2. A 1 kg stone at the end of 1 m long string is whirled in a vertical circle at constant speed of 4 m/sec. The tension in the string is 6 N when the stone is at ($g = 10\ m/sec^2$) :
(A) top of the circle (B) bottom of the circle (C) halfway down (D) none of these

3. A closed pipe and an open pipe have their first overtones identical in frequency. Their lengths are in the ratio-
(A) 1 : 2 (B) 2 : 3 (C) 3 : 4 (D) 4 : 5

4. A piece of cork is floating on water in a small tank. The cork oscillates up and down vertically when small ripples pass over the surface of water. The velocity of the ripples being 0.21 ms^{-1}, wave length 15 mm and amplitude 5 mm, the maximum velocity of the piece of cork is -



(A) 0.44 ms^{-1} (B) 0.24 ms^{-1} (C) 2.4 ms^{-1} (D) 4.4 ms^{-1}

5. The work done in increasing the size of a rectangular soap film with dimensions 8 cm × 3.75 cm to 10cm × 6 cm is 2×10^{-4} J. The surface tension of the film in N/m is :
(A) 1.65×10^{-2} (B) 3.3×10^{-2} (C) 6.6×10^{-2} (D) 8.25×10^{-2}

6. A person is standing in a room of width 200 cm. A plane mirror of vertical length 10 cm is fixed on a wall in front of the person. The person looks into the mirror from distance 50 cm. How much width (height) of the wall behind him will he be able to see:
(A) 30 cm (B) 40 cm (C) 50 cm (D) none of these

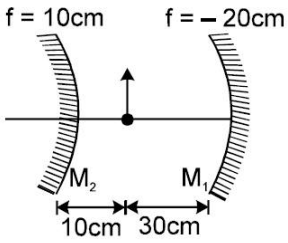
Space for rough work

7. A car of mass m moves in a horizontal circular path of radius r metre. At an instant its speed is v m/s and is increasing at a rate a m/s^2, then the acceleration of the car is :

(A) $\sqrt{a\left(\frac{v^2}{r}\right)}$ (B) $\sqrt{a^2+\left(\frac{v^2}{r}\right)^2}$ (C) $\frac{v^2}{r}$ (D) a

8. In the figure shown find the total magnification after two successive reflections first on M_1 & then on M_2

(A) + 1 (B) – 2 (C) + 2 (D) – 1



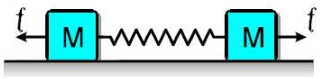
9. A luminous point object is moving along the principal axis of a concave mirror of focal length 12 cm towards it. When its distance from the mirror is 20 cm its velocity is 4 cm/s. The velocity of the image in cm/s at that instant is

(A) 6, towards the mirror (B) 6, away from the mirror
(C) 9, away from the mirror (D) 9, towards the mirror.

10 A concave lens of glass, refractive index 1.5, has both surfaces of same radius of curvature R. On immersion in a medium of refractive index 1.75, it will behave as a

(A) convergent lens of focal length 3.5R (B) convergent lens of focal length 3.0 R.
(C) divergent lens of focal length 3.5 R (D) divergent lens of focal length 3.0 R

11. A spring of force constant α has two blocks of same mass M connected to each end of the spring. Same force f extends each end of the spring. If the masses are released, then period of vibration is :



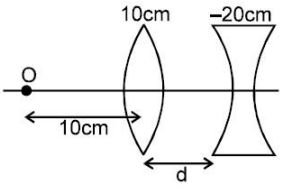
(A) $2\pi\sqrt{\frac{M}{2\alpha}}$ (B) $2\pi\sqrt{\frac{M}{\alpha}}$ (C) $2\pi\sqrt{\frac{2\alpha M}{\alpha^2}}$ (D) $2\pi\sqrt{\frac{M\alpha^2}{2\alpha}}$

Space for rough work

12. The ratio of speed of sound in nitrogen gas to that in helium gas at 300 K is

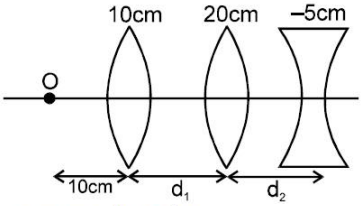
(A) $\sqrt{2/7}$ (B) $\sqrt{1/7}$ (C) $\sqrt{3}/5$ (D) $\sqrt{6/5}$

13. What should be the value of distance d so that final image is formed on the object itself. (focal lengths of the lenses are written on the lenses).



(A) 10 cm (B) 20 cm
(C) 5 cm (D) none of these

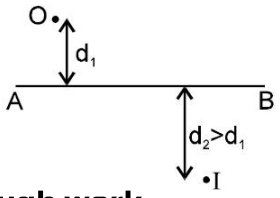
14.* The values of d_1 & d_2 for final rays to be parallel to the principle axis are:
(focal lengths of the lenses are written above the respective lenses)



(A) d_1 = 10 cm, d_2 = 15 cm
(B) d_1 = 20 cm, d_2 = 15 cm
(C) d_1 = 30 cm, d_2 = 15 cm
(D) None of these

15. The distance between an object and its doubly magnified image by a concave mirror is:
[Assume f = focal length]
(A) 3 f/2 (B) 2 f/3 (C) 3 f
(D) depends on whether the image is real or virtual.

16. In the figure shown, the image of a real object is formed at point I. AB is the principal axis of the mirror. The mirror must be:



(A) concave & placed towards right of I
(B) concave & placed towards left of I
(C) convex & placed towards right of I
(D) convex & placed towards left of I.

Space for rough work

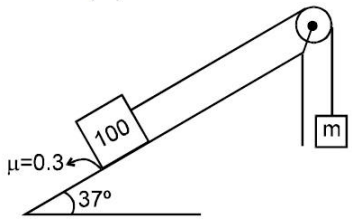
17. A spherical ball of iron of radius 2 mm is falling through a column of glycerine. If densities of glycerine and iron are respectively : 1.3×10^3 kg/m^3 and 8×10^3 kg/m^3 η for glycerine = 0.83 kgm/sec,, then the terminal velocity is :

(A) 0.7 m/s (B) 0.07 m/s (C) 0.007 m/s (D) 0.0007 m/s

18. The value of mass m for which the 100 kg block remains is static equilibrium is

(A) 35 kg (B) 37 kg

(C) 83 kg (D) 85 kg



19. Equation of SHM is $x = 10 \sin 10\pi t$. Find the distance between the two points where speed is 50π cm/sec. x is in cm and t is in seconds.

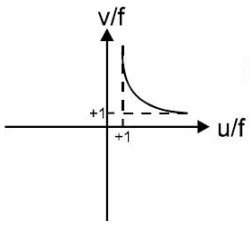
(A) 10 cm (B) 20 cm (C) 17.32 cm (D) 8.66 cm.

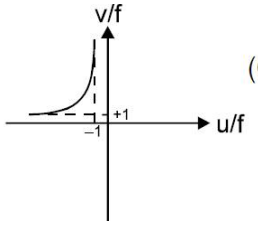
20. A small steel ball falls through a syrup at constant speed of 10 cm/s. If the steel ball is pulled upwards with a force equal to twice its effective weight, how fast will it move upwards ?

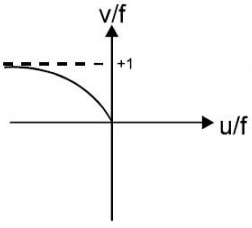
(A) 10 cm/s (B) 20 cm/s (C) 5 cm/s (D) – 5 cm/s

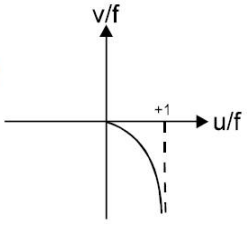
Space for rough work

21. A real inverted image in a concave mirror is represented by (u, v, f are coordinates)

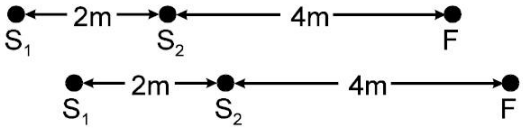
(A) 

(B) 

(C) 

(D) 

22*. S_1 and S_2 are two sources of sound emitting sine waves. The two sources are in phase. The sound emmited by the two sources interfere at point F. The waves of wavelength :



(A) 1 m will result in constructive interference

(B) $\frac{2}{3}$ m will result in constructive interference

(C) 2m will result in destructive interference

(D) 4m will result in destructive interference

23*. The angle of minimum deviation from a prism is 30º. If the prism angle is 90º, if the refractive index of the material of the prism is μ and the angle of incidence required for minimum deviation is i, then

(A) $\mu = \sqrt{\frac{3}{2}}$ (B) $i = 60°$ (C) $\mu = 1.5$ (D) $i = 90º$

24. The fundamental frequency of a closed organ pipe is same as the first overtone frequency of an open pipe. If the length of open pipe is 50 cm, the length of closed pipe is

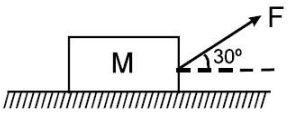
(A) 25 cm (B) 12.5 cm (C) 100 cm (D) 200 cm

Space for rough work

25. An object is kept perpendicular to the principal axis of a convex mirror of radius of curvature 20 cm. If the distance of the object from the mirror is 20 cm then its magnification will be:

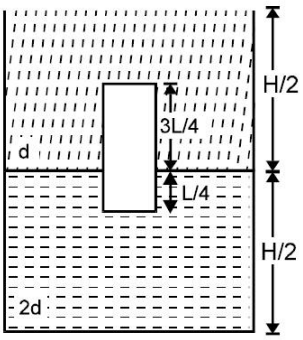
(A) + 1/3 (B) – 1/3 (C) – 1 (D) none of these

26. A block of mass M = 5 kg is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force F = 40 N is applied, the acceleration of the block will be ($g = 10\ m/s^2$) :



(A) 5.73 m/sec^2 (B) 8.0 m/sec^2 (C) 3.17 m/sec^2 (D) 10.0 m/sec^2

27. A container of a large uniform cross-sectional area A resting on a horizontal surface holds two immiscible, non-viscous and incompressible liquids of densities 'd' and '2d' each of height (1/2)H as shown. The smaller density liquid is open to atmosphere. A homogeneous solid cylinder of length $L\left(< \frac{1}{2} H\right)$ cross-sectional area (1/5) A is immersed such that it floats with its axis vertical to the liquid-liquid interface with length (1/4) L in denser liquid. If D is the density of the solid cylinder then :



(A) $D = \frac{3d}{2}$ (B) $D = \frac{d}{2}$ (C) $D = \frac{2d}{3}$ (D) $D = \frac{5d}{4}$

28. A particle of mass m begins to slide down a fixed smooth sphere from the top. What is its tangential acceleration when it breaks off the sphere ?

(A) $\frac{2g}{3}$ (B) $\frac{\sqrt{5}g}{3}$ (C) g (D) $\frac{g}{3}$

29. If the radius of the earth be increased by a factor of 5, by what factor its density be changed to keep the value of g the same ?

(A) 1/25 (B) 1/5 (C) $1/\sqrt{5}$ (D) 5

Space for rough work

30. The power (in diopters) of an equi convex lens with radii of curvature of 10 cm & refractive index 1.6 is:

(A) + 12 (B) − 12 (C) + 1.2 (D) − 1.2

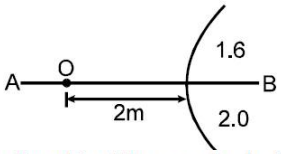
31. A ray of monochromatic light is incident on one refracting face of a prism of angle 75^0. It passes through the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

(A) 30^0 (B) 45^0 (C) 60^0 (D) 0^0

32. If λ_1, λ_2, λ_3 are the wavelengths of the waves giving resonance in the fundamental, first and second overtone modes respectively in a open organ pipe, then the ratio of the wavelengths $\lambda_1 : \lambda_2 : \lambda_3$, is :

(A) 1 : 2 : 3 (B) 1 : 3 : 5 (C) 1 : 1/2 : 1/3 (D) 1 : 1/3 : 1/5

33. In the figure shown a point object O is placed in air. A spherical boundary of radius of curvature 1.0 m separates two media. AB is principal axis. The refractive index above AB is 1.6 and below AB is 2.0. The separation between the images formed due to refraction at spherical surface is:



(A) 12 m (B) 20 m (C) 14 m (D) 10 m

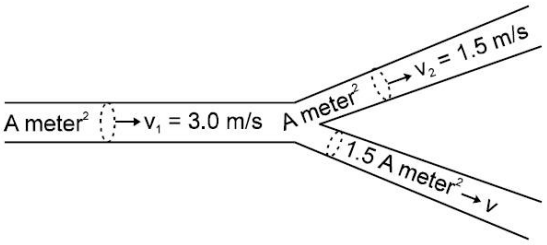
34. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$ then

(A) T^2 is proportional to R^3 (B) T^2 is proportional to $R^{7/2}$

(C) T^2 is proportional to $R^{3/2}$ (D) T^2 is proportiona to $R^{3.75}$

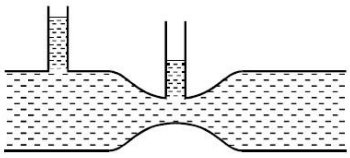
Space for rough work

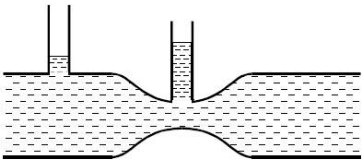
35. An incompressible liquid flows through a horizontal tube as shown in the figure. Then the velocity 'v' of the fluid is:

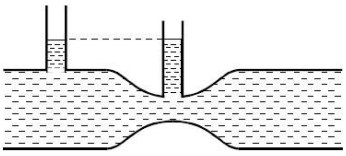


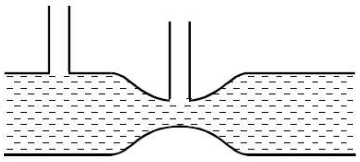
(A) 3.0 m/s (B) 1.5 m/s (C) 1.0 m/s (D) 2.25 m/s

36. For a fluid which is flowing steadily, the level in the vertical tubes is best represented by

(A) 

(B) 

(C) 

(D) 

Space for rough work

37. A particle moves under the effect of a force F = Cx from x = 0 to x = x_1. The work done in the process is

(A) Cx_1^2 (B) $\frac{1}{2}Cx_1^2$ (C) Cx_1 (D) Zero

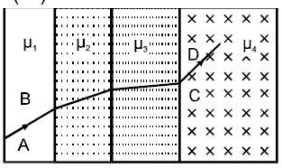
38. A rod of length 1m and mass 0.5 kg hinged at one end, is initially hanging vertical. The other end is now raised slowly until it makes an angle 60º with the vertical. The required work is :(use g=9.8 m/s²)

(A) 1.522 J (B) 1.225 J (C) 2.125 J (D) 3.125 K

39. For a glass prism ($\mu = \sqrt{2}$) the angle of minimum deviation is equal to the refracting angle of the prism. The angle of the prism is:

(A) 80^0 (B) 45^0 (C) 60^0 (D) 90^0

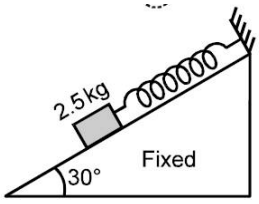
40. A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 & μ_4 as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have:



(A) $\mu_1 = \mu_2$ (B) $\mu_2 = \mu_3$ (C) $\mu_3 = \mu_4$ (D) $\mu_4 = \mu_1$

Space for rough work

41. A smooth inclined plane having angle of inclination 30° with horizontal has a mass 2.5 kg held by a spring which is fixed at the upper end. If the mass is taken 2.5 cm up along the surface of the inclined plane, the tension in the spring reduces to zero. If the mass is then released, the angular frequency of oscillation in radian per second is

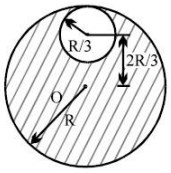


(A) 0.707 (B) 7.07 (C) 1.414 (D) 14.14

42. If the distance between the earth and the sun were half its present value, the number of days in a year would have been :

(A) 64.5 (B) 129 (C) 182.5 (D) 730

43. A disc has mass 9m. A hole of radius $\frac{R}{3}$ is cut from it as shown in the figure.



The moment of inertia of remaining part about an axis passing through the centre 'O' of the disc and perpendicular to the plane of the disc is:

(A) $8\ mR^2$ (B) $4\ mR^2$ (C) $\frac{40}{9}\ mR^2$ (D) $\frac{37}{9}\ mR^2$

44. In the arrangement shown tension in the string connecting 4kg and 6kg masses is

(A) 8N (B) 12N
(C) 6N (D) 4N

45. Friction force on 4 kg block is

(A) 4N (B) 6 N (C) 12 N (D) 8 N

46. Friction force on 6 kg block is

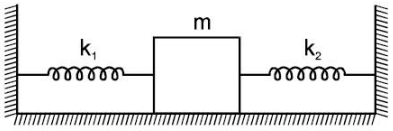
(A) 12 N (B) 8 N (C) 6 N (D) 4 N

Space for rough work

47. A child is standing with folded hands at the center of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system doubles. The kinetic energy of the system now is

(A) 2K (B) $\frac{K}{2}$ (C) $\frac{K}{4}$ (D) 4K

48. A block of mass m is attached to two unstretched springs of spring constants k_1 and k_2 as shown in figure. The block is displaced towards right through a distance x and is released. Find the speed of the block as it passes through the mean position shown.

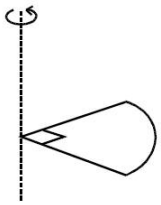


(A) $\sqrt{\frac{k_1+k_2}{m}}\,x$ (B) $\sqrt{\frac{k_1k_2}{m(k_1+k_2)}}\,x$ (C) $\sqrt{\frac{k_1^2k_2^2}{m(k_1^2+k_2^2)}}\,x$ (D) $\sqrt{\frac{k_1^3k_2^3}{m(k_1^3+k_2^3)}}$

49. A particle moves with a velocity $\vec{v} = (5\hat{i} - 3\hat{j} + 6\hat{k})$ m/s under the influence of a constant force $\vec{F} = (10\hat{i} + 10\hat{j} + 20\hat{k})$N. The instantaneous power applied to the particle is :

(A) 200 J/s (B) 40 J/s (C) 140 J/s (D) 170 J/s

50. One quarter sector is cut from a uniform circular disc of radius R. This sector has mass M. It is made to rotate about a line perpendicular to its plane and passing through the centre of the original disc. Its moment of inertia about the axis of rotation is



(A) $\frac{1}{2}MR^2$ (B) $\frac{1}{4}MR^2$ (C) $\frac{1}{8}MR^2$ (D) $\sqrt{2}\,MR^2$

Space for rough work

Space for rough work