CLASS XI
SAMPLE PAPER
PHYSICS

TIME: $2^1/_2$ hrs. MAX. MARKS: 50

INSTRUCTIONS:

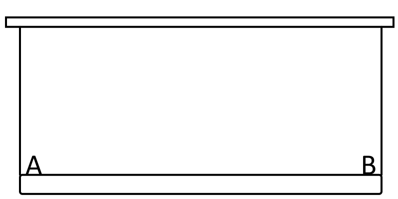
- The question paper consists of 3 pages and 20 questions.
- All questions are compulsory.

Q.1: Give the expression for the Newton's Law of cooling. (1)
Q.2: Name any two factors affecting velocity of sound. (1)
Q.3: A small spherical ball of density ρ is gently released in a liquid of density σ ($\rho>\sigma$). Find the initial acceleration of the ball. (1)
Q.4: A particle is executing SHM along y- axis such that its velocities are v_1 and v_2 at distances y_1 and y_2 from the mean position. Calculate the time period of motion. (1)
Q.5: A man walking in a rainstorm can withstand the falling raindrops even though the raindrops fall through a large height. How? (1)
Q.6: Two SHM's are

i) $x_1 = 1.0 \sin\left[\frac{\pi}{4}(12t+1)\right]$

ii) $x_2 = 0.5 [\sin 3\pi t + \sqrt{3}\cos 3\pi t]$

Find the phase difference between the two SHM's. (1)
Q.7: If n identical water droplets falling under gravity with terminal velocity v coalesce to form a single drop which has the terminal velocity 4v, find the number n. (2)
Q.8: A uniform rod of mass m and length *l* is suspended by means of two light inextensible strings as shown in figure. Find the tension in one string immediately after other string is cut. (2)



Q.9: The specific heat of many solids at low temperatures varies with absolute temperature T according to the relation $S = AT^3$, where A is a constant. What is the heat energy required to raise the temperature of a mass m of such a solid from T=0 to T=20 K? (2)

Q.10: A particle of mass 'm' is located in a uni-dimensional potential field where potential energy of the particle depends on coordinate x as $U(x)= U_0(1-\cos bx)$; U_0 and b are constants. Find the period of small oscillations that the particle performs about equilibrium position. (2)

Q.11: A standing wave set up in a medium is given by

$$y = 4 \cos\left(\frac{\pi x}{3}\right) \sin 40\pi t$$

where x and y are in cm and t is in seconds.

i) Write the equation of the two component waves and give amplitude and velocity of each wave.

ii) What is the distance between the adjacent nodes?

iii) What is the velocity of the particle of the medium at x = 3 cm at time $t=\frac{1}{8}$ sec? $(1{}^1/_2 + {}^1/_2 + 1)$

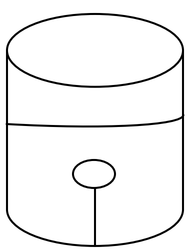
Q.12: A cylinder of radius R made of a material of thermal conductivity K_1 , is surrounded by a cylindrical shell of inner radius R and outer radius 2R made of a material of thermal conductivity K_2. The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surfaces and the system is in steady state. What is the effective thermal conductivity of the system? (3)

Q.13: A solid sphere of mass m= 2 kg and specific gravity s=0.5 is held stationary relative to a tank filled with water as shown in figure. The tank is accelerating vertically upward with acceleration 2 m/s^2.

i) Calculate the tension in the thread connecting the sphere and the bottom of the tank.

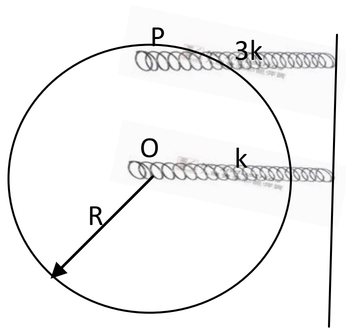
ii) If the thread snaps, calculate the acceleration of the sphere with respect to the tank.

(Density of water is $\rho=1000\ kg/m^3$ and $g = 10\ m/s^2$.) $(1{}^1/_2 + 1{}^1/_2)$



Q.14: A ball is thrown from the bottom point A of an inclined plane of inclination 30^o with velocity u at an angle of 60^o from the ground. The ball strikes the inclined plane at point B. Find the distance AB. (taking $g=10\ m/s^2$) (3)

Q.15: A solid cylinder of mass m and radius R is kept in equilibrium on a horizontal smooth surface. Two unstretched springs of spring constant k and 3k are attached to the cylinder as shown. Find the period of small oscillations. (Given that the surface is rough enough to prevent slipping.) (3)



Q.16: An ideal gas has a molar heat capacity C_V at constant volume. Find the molar heat capacity of this gas as a function of its volume V, if the gas undergoes the process $T = T_0 e^{\alpha V}$. (3)

Q.17: A cube of side a is moving with velocity v_0 on a smooth horizontal surface. After some time, it collides with a stone fixed at a particular position on the ground. Find the minimum value of v_0 in terms of ω such that this cube will topple. (3)

Q .18: A) Give reasons:

a) The surface tension of a film is $\frac{S}{2L}$ and not $\frac{S}{L}$. (1)

b) To keep a piece of paper horizontal, you should blow over, not below it. (1)

B) a) Draw the graph between frequency and square root of density of a wire(keeping length, radius and tension constant). (1)

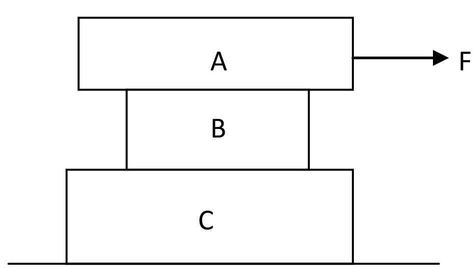
b) The ratio of intensities of two waves moving in same medium and having same frequency is 1:16. What is the ratio of their amplitudes? (1)

c) When a train blowing its whistle passes by you, you first hear a high pitched note and later a low pitched note. Why? (1)

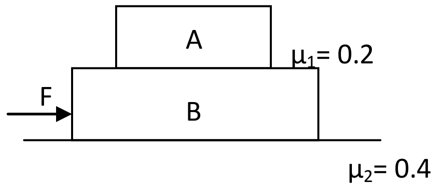
Q.19: a) Give the derivation of the potential energy of a spring using calculus. (1)

b) Given m_A= 30 kg, m_B= 10 kg, m_c= 20 kg. Between A and B μ_1= 0.3, between B and C μ_2= 0.2 and between C and ground μ_3= 0.1. What is the least horizontal force F required to start motion of any part of the system of three blocks resting upon one another as shown in figure? (2)

(TAKE g= 10 m/s^2)



c) In the figure, m_A = 2 kg and m_B = 4 kg. For what minimum value of F, A starts slipping over B? (2)



(TAKE g= 10 m/s^2)

Q.20: a) A disc of radius R rolls on a horizontal surface with linear velocity v and angular velocity ω. There is a point P on the circumference of the disc at angle α with the vertical which has a vertical velocity. Here α is

(1) $\pi + \sin^{-1}\left(\frac{V}{R\omega}\right)$ (2) $\pi - \sin^{-1}\left(\frac{V}{R\omega}\right)$ (3) $\pi + \cos^{-1}\left(\frac{V}{R\omega}\right)$ (4) $\pi - \cos^{-1}\left(\frac{V}{R\omega}\right)$

Tick the correct option(s) with proper explanation. (2)

b) Four holes of radius R are cut from a thin square plate of side 4R and mass M. What is the moment of inertia of the remaining portion about z-axis. (3)

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