OR

(a) The displacement of a particle executing SHM i represented by the equation :

$y = 7.5 \sin [0.05x + 2t + \pi/4]$ cm

Find the (i) amplitude (ii) frequency (iii) wave velocity (iv) maximum particle velocity.

(b) The apparant frequency of the whistle of an engine changes in the ratio 3:2 as the engine approaches and recedes away from a stationary observer. Calculate the velocity of the engine if speed of sound is 300 m/s.

Q26. (a) Write the theorem of perpendicular axis.

(b) Obtain the moment of inertia of a uniform disc of mass M and radius R about an axis passing from a distance of R/3 from the centre of disc and in the plane of the disc.

(c) A hollow and a solid cylinder start rolling from rest from the top of an incline simultaneously. Which of them will reach the foot of incline with greater speed?

OR

(a) A 2kg and 3kg obejct are moving along the *x*-axis. At an instant, the 2kg object is 1m from origin and has a velocity of 3 m/s and 3kg object is 2m from the origin & has a velocity of –1 m/s. Find the position and velocity of the centre of mass.

(b) A rod of length L and Mass Mnegligibly small is held horizontal. Two forces F_1 and F_2 act on it such that (i) the rod does not rotate but slides (ii) the rod rotates but does not slides. Mark the direction of forces F_1 and F_2 wrt both situations.

SUBJECT : PHYSICS (SET-II)

M.M.: 70

Time : 3 Hrs.

General Instructions :

(i) All questions are compulsory.

(ii) Question numbers 1 to 5 are very short answer type questions carrying 1 marks each.

(iii) Question numbers 6 to 10 are very short answer type questions carrying 2 marks each.

(iv) Question numbers 11 to 22 are short answer type questions carrying 3 marks each.

(v) Question numbers 23 is also a short answer type question carrying 4 marks.

(vi) Question numbers 24 to 26 are long answer type questions carrying 5 marks each.

(vii) You may use the following constants :

$G = 6.6 \times 10^{-11}\ Nm^2kg^{-2}$ $\quad R_e = 6.4 \times 10^6\ m$

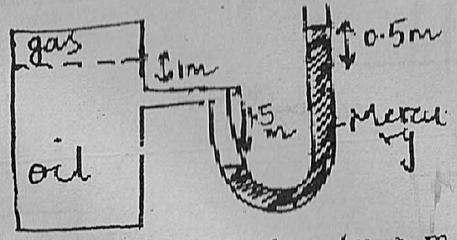
$M_e = 6 \times 10^{24}\ kg$ $\quad R = 8.3\ J\ mol^{-1}K^{-1}$

Q1. A particle is executing SHM. Identify the position of the particle where KE = 0.

Q2. Why does a cyclist, who is negotiating a curve at high speed, bend more than a cyclist negotiating the same curve at low speed?

Q3. If the ice on the polar caps of the earth melts, how will it affect the duration of the day? Explain.

Q4. From the following figure, calculate the pressure of the gas.



Q5. Two bodies of masses m_1 and m_2 ($m_1 > m_2$) have equal kinetic energies. Which will have more momentum?

Q6. Find the angle between two vectors $\vec{A}$ and $\vec{B}$ such that $|\vec{A}| = |\vec{B}| = |\vec{R}|$, where $\vec{R}$ is the resultant of the vectors $\vec{A}$ and $\vec{B}$.

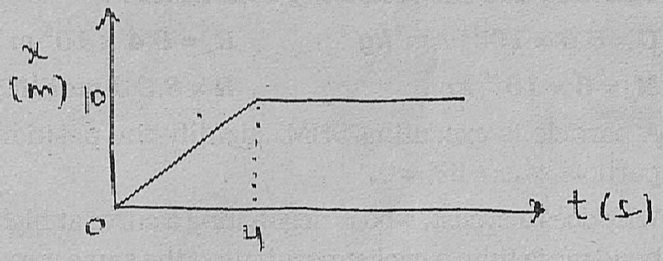
Q7. The radius of earth is reduced by 4% keeping the density same. What will be the percentage change in the acceleration due to gravity?

Q8. Justify that a refrigerator works better when the food stuff is kept in it at nearly the room temperature rather than keeping hot objects.

Q9. (a) Steel is more elastic than rubber. Justify.

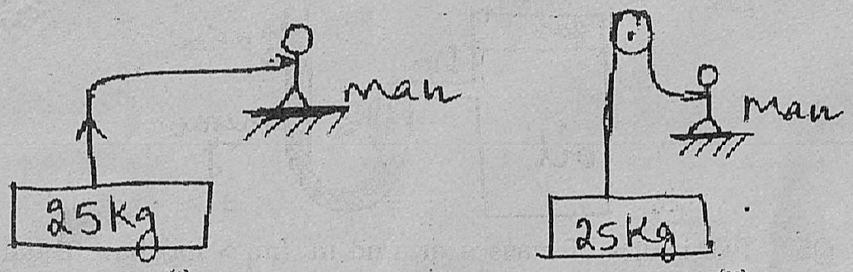
(b) On what factors does the Young's modulus of elasticity of a wire depend?

Q10. The adjoining figure shows position-time graph of a particle of mass 4 kg. What is the force on the particle for (i) $t > 4s$ (ii) $0 < t < 4s$.



OR

A block of mass 25 kg is raised by a 50 kg man in two different ways as shown. If the maximum normal force which the floor can withstand is 700N,, then which mode should the man adopt to lift the mass and why?

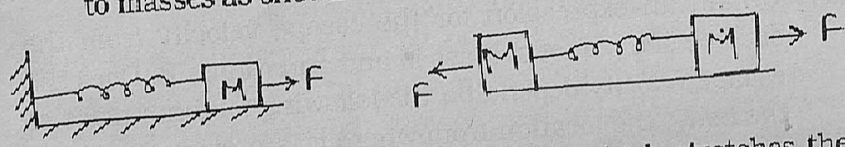


Q11. A planet moves around the sun in a circular orbit. The time period of revolution (T) dpeends on (i) radius of orbit (r), (ii) mass of sun (M) and (iii) Gravitational constant (G). Dimensionally prove that $T^2 \propto R^3$.

Q12. For a particle in SHM, the displacement 'x' of the particle as a function of time 't' is given as $x = A\sin\left(2\frac{\pi}{T}t\right)$. If the time taken by the particle to travel from $x = 0$ to $x = A/2$ is T_1 and that to travel from $x = A/2$ to $x = A$ is T_2, then find T_1/T_2. Also find the velocity of the particle at $x = A/2$.

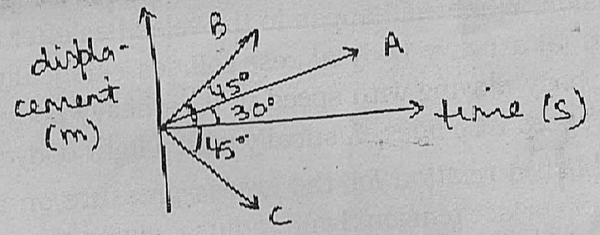
OR

Figures show two identical springs of constant K attached to masses as shown :



A force F is applied at the free end which stretches the spring. (a) What is the extension of the spring in each case? (b) What will be the time period of the spring in first case when released?

Q13. Given figure shows displacement-time graph for three cars A, B and C. Find (i) relative velocity of A wrt B. (ii) relative velocity of B wrt C.



Q14. Give reasons why -

(a) a horse cannot pull a cart and run in empty space.

(b) a child in a merry-go-round press the side of his seat radially outward.

(c) Wheels are circular in shape.

Q15. Obtain an expression for the work done by an ideal gas during adiabatic expansion in terms of temperautre of the gas before and after the expansion.

Q16. State bernoullis theorem and hence prove that velocity of efflux is equal to that of a freely falling body

Q17. Obtain an expression for the escape velocity from the surface of a planet of Mass M and and radius R. Does the escape velocity depend on the following factors : mass of the body, the location from where it is projected and the direction of projection. Why or why not?

Q18. State the law of equipartition of energy. Using it, find the value of γ for a monoatomic gas.

Q19. Describe the essential parts of an ideal heat engine (carnot engine) and state the formula for its efficiency.

Q20. collision. What will happen to the velocities after collision when (a) a heavy body at rest collides elastically with a light body moving with speed u. (b) a heavy body moving with speed u collides elastically with a light body at rest.

Q21. Establish a relation for the excess pressure on a liquid drop of surface tension S and radius r, giving reason for its presence.

Q22. A trolley of mass 60 kg starts from rest and slides down an incline of angle 30°. Calculate the speed and distance covered by the trolley after 10s, if a constant friction of 2 to 270N acts on the trolley.

Q23. Kabir goes to see a sky diving show. He saw three people diving from a large height in the sky without any fear. He saw that those people had spread their bodies and at a height of around 4 km, they open the parachutes and their velocities get slowed down. FInally, they reach the ground with reduced velocity. Kabir was surprised to see them landing safely inspite of falling from a large height. He rushed to those people and asked for the reason of spreading their bodies and the role of parachute. Kabir was able to understand the whole mechanism after they sky divers explained him.

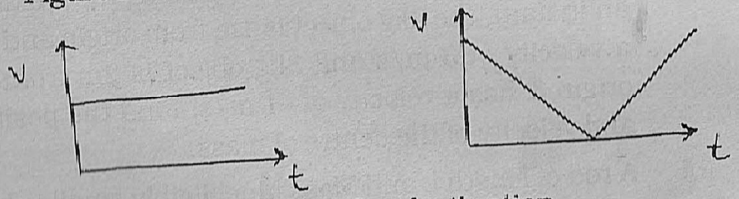
(a) What were the values displayed by Kabir?

(b) Draw a diagram showing the directions of viscous force, buoyant force and gravitational force on the skier and derive the expression for terminal velocity.

Q24. Derive an expression for the time period of a projectile of mass 'm' projected upwards with speed is u an angle 'θ' wrt the horizontal. Also find the speed with which the projectile hits the ground. Find the angle of projection for which range and height of projectile are same.

OR

Figure shows velocity-time graphs for two situations.



(a) Give an example of each situation.

(b) Draw corresponding acceleration-time graphs.

(c) Find the angle betewen $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$.

Q25. An incident and a reflected wave are given as : $y_1 = a \sin \frac{2\pi}{\lambda}(vt - x)$ and $y_2 = a \sin \frac{2\pi}{\lambda}(vt + x)$. Derive the equation of the stationary wave and calculate the position of nodes and antinodes.