PHYSICS

BOOKS - R G PUBLICATION

MODEL QUESTION PAPER 3

Exercise

1. What are the dimensions of surface tension?

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2. Given that the velocity of sound in a medium depends on the modulus of elasticity and the density of the medium, find an expression for velocity of sound by dimensional analysis.

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3. The length, breadth and height of a rectangular block of wood were measured to be $l = 12.13 \pm 0.02cm, b = 8.16 \pm 0.01cm, h = 3.46 \pm 0.01cm$. Determine the precentage error in the volume of the block upto two significant figures.

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4. When is the average speed of an object equal to the magnitude of its average velocity?

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5. The acceleration of a particle in ms^{-s} is given by $a = 3t^2 + 2t + 2$, where time t is in seconds. If the particle starts with a velocity $V = 2ms^{-1}$ at t=0, find the velocity after 2 seconds.

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6. A balloon ascending at the rate of $9.8ms^{-1}$ is at a height of 39.2 m above the ground when a packet is

dropped from the baloon. After how much time and with what velocity does it reach the ground? $g = 9.8ms^{-2}$.

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7. A body is projected such that its kinetic energy at the top of its trajectory is $\frac{3}{4}$ of its initial kinetic energy. What is the angle of projection of the projectile?

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8. Show that the trajectory of projectile is parabolic.

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9. If $\bar{a}$ and $\bar{b}$ are unit vectors and θ is the angle between them, show that $\frac{1}{2}\left[\bar{a}-\bar{b}\right]=\sin\frac{\theta}{2}$

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10. Find a unit vector which is perpendicular to both the vectors $2\hat{i}+\hat{j}-\hat{k}$ and $3\hat{i}+4\hat{j}-\hat{k}$.

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11. State the laws of static friction. What is limiting friction?

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12. A body of mass 2kg is lying on a rough inclined plane of inclination 30°. Find the magnitude of the force needed to make the block move up the incline. Coefficient of static friction is 0.2

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13. A body of mass 2kg is lying on a rough inclined plane of inclination 30°. Find the magnitude of the force needed to make the block move down the incline.

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14. Define impulse. A machine gun of 10kg mass fires 25 gm bullets at the rate of 5 bullets per second with a speed of $500ms^{-1}$. What force must be applied to the gun to hold it in position.

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15. Define 1 newton force. A balloon with mass 6 kg is descending down with an acceleration $5ms^{-2}$. Calculate the mass of its contents that must be removed so that it starts moving up with the same acceleration.

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16. Calculate the angle of banking for a circlular track of radius R for vehicles moving with a speed v.

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17. State and prove work-energy theorem.

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18. A block of mass 4 kg irioving horizontally on a frictionless table at speed $2ms^{-1}$ compresses a spring through a distance 10 cm before its speed is halved. Find the spring constant of the spring.

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19. The bob of a simple pendulum of length 1 m is' pulled aside from its equilibrium' position through an angle 60° and released. Calculate the speed at which the bob passes the equilibrium position.

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20. What is co-efficient of restitution? A woodenball is dropped from a height of 2m. What is the height upto which the ball will rebound if the co-efficient of restitution is 0.5?

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21. When is a collision said to be a perfectly inelastic? A mass is moving with speed v collides inelastically with another identical mass at rest. After collision, the first mass moves with velocity $\frac{\nu}{\sqrt{3}}$ in a direction perpendicular to the initial direction of motion. Find the speed of the second mass after collision.

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22. Two bodies of masses 10kg and 2 kg are moving with velocities $2\hat{i} - 7\hat{j} + 3\hat{k}ms^{-1}$ and $-10\hat{i} + -35\hat{j} - 3\hat{k}$ respectively. Find the velocity of the centre of mass.

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23. Deduce the relation $\tau = \frac{dL}{dt}$ relation the torque on a particle with its angular momentum.

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24. Find the torque due to a force $\left(7\hat{i} - 3\hat{j} - 5\hat{k}\right)N$ about the origin acting on a paticle whose position vector is $\left(\hat{i} + \hat{j} - \hat{k}\right)m$

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25. Define radius of gyration of a rigid body.What is the radius of gyration of a solid sphere of mass 1 kg and radius 50 cm?

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26. A solid cylinder rolles down an inclined plane. Its mass is 2 kg and radius 0.1 m. If the height of the inclined plane is 4m, what is its rotational kinetic energy when it reaches the bottom.

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27. State Newton's law of universal gravitation and hence define the universal gravitational constant G. What is its value?

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28. The radius of the Moon is $\frac{1}{4}^{t}$ h the radius of the earth and its mass is $\frac{1}{96}^{t}$ h the mass of the earth. If the escape velocity from the surface of the earth is $11.2kms^{-1}$, find the escape velocity from the surface of the Moon.

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29. Show how the acceleration due to gravity of the earth varies with depth from the surface of the earth.

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30. A planet's year is 11 times the earth's year. Calculate the distance of this planet from the sun if the distance of

the earth is 1.50×10^8km from the sun.

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31. State hooke's law and define the various moduliii of elasticity .

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32. State Pascal's law of transmission of pressure through a confined fluid. Name two applications of Pascal's law.

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33. State and prove Newton's law of cooling.

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34. 27 identical drops of water are falling down vertically in air with a terminal velocity $0.15m/s$. If they combine to from a single bigger drop, what will be its terminal velocity.

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35. A liquid cools from 60°C to 40°C in 10 minute what is the temperature of liquid in next 10 minute where temperature is surrounding in 5°C

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36. A solid floats in water with $\frac{3}{4}^{t} h$ of its volume below the surface of water, Calculate the density of the solid.

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37. Show that work done by a stretching force in producing an extension in the wire is given by $W = \frac{1}{2} \times stret\chi ngf \text{ or } ce \times extension.$

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38. 75 g of water at $100^{\circ}C$ is added to 20 g of ice at $-15^{\circ}C$. Calculate the resulting temperature, give that latent heat of $ice = 80calg^{-1}C^{-1}$ and specific heat of $ice = 0.5calg^{-1}C^{-1}$.

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39. Prove that the pressure exerted by an ideal gas given by $P = \frac{1}{3}\rho v^2$.

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40. Show that the molar volume of an ideal gas at STP is 22.4 litres. Given $R = 8.31Jmol^{-1}K^{-1}$.

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41. What is meant by degree of freedom?

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42. Calculate rms velocity of an oxygen molecule at $27^\circ C$, atomic weight of oxygen being 16. $(27^\circ$

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43. A SHM is represented by y(t) =5 sin(20t+0.5) m where t is in S. What is amplitude and time period.

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44. Find the expression of time period of a simple pendulum of length l.

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45. A particle of mass 10 g executing SHM has a velocity of $6cms^{-1}$ after one second of its starting from the mean position. If the time period is 6 seconds, find its maximum kinetic energy.

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46. Write down Newton's formula for velocity of sound and state the laplace's correction.

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47. At what temperature will the velocity of sound in air be double than the velocity in air at $22^\circ C$?

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48. What is the fundamental frequency at $20^\circ C$ of an open pipe of length 120 cm? The velocity of sound in air at $20^\circ C$ is $343 m / s$.

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49. State the first law of thermodynamics .

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50. Find the pressure required to compress a gas adiabatically at atmospheric pressure to one fifth of.its volume. Given $\square = 1.4, \log_e 5 = 0.6990.$

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51. Explain the operations of a Canot heat engine working between two temperatures and derive its effeciency.

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52. Calculate the efficiency of a Canot engine operating between 450 K and 300K.

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