جيمس مدرستنا الهندية
GEMS OUR OWN INDIAN SCHOOL
Anchored In Excellence

# Worksheet Booklet

**Name: _____**

**Grade: 11**

**Subject: Physics**









**PHYSICS WORKSHEET FOR GRADE XI**

**INDEX**


| Sl No. | TOPIC | Page No. |
|---|---|---|
| 1 | Units and Measurements | 3-4 |
| 2 | Motion in One Dimension | 5-6 |
| 3 | Motion in Two Dimension | 7-8 |
| 4 | Newton's Laws of Motion | 9 |
| 5 | Work-Power-Energy | 10-11 |
| 6 | Rotational Motion | 12-13 |
| 7 | Gravitation | 14-15 |
| 8 | Solids and Liquids Mechanics | 16-18 |
| 9 | Thermal Properties of Matter | 19-21 |
| 10 | Kinetic Theory of Gases | 22-23 |
| 11 | Thermodynamics | 24 |
| 12 | Oscillations and Waves | 25-26 |
| 13 | Holiday HW1 | 27-29 |
| 14 | Holiday HW1 | 30-32 |

## Topic: Units and measurements

Answer the following:

1. The viscous drag in fluid flow can be assumed to depend on the velocity of liquid layers, the viscosity co efficient and the radius of the flow tube. Derive a relation from dimensional analysis.
2. A famous relation in physics relates 'moving mass' m to the 'rest mass' $m_o$ of a particle in terms of its speed v and the speed of light, c. (This relation first arose as a consequence of special relativity due to Albert Einstein). A boy recalls the relation almost correctly but forgets where to put the constant c. He writes : $m = m_0 / \sqrt{(1 - v^2/c^2)}$ . Guess where to put the missing c.
3. A SONAR (sound navigation and ranging) uses ultrasonic waves to detect and locate objects under water. In a submarine equipped with a SONAR the time delay between generation of a probe wave and the reception of its echo after reflection from an enemy submarine is found to be 77.0 s. What is the distance of the enemy submarine? (Speed of sound in water = 1450 m/s).
4. Determine the equivalent of 72 km/h in SI units.
5. The frequency of vibrations in a string is assumed to depend on the tension in the string the length and the mass per unit length. Derive a relation on the basis of dimensional method.
6. The depth x to which a bullet penetrates the skin, depends on the coefficient of elasticity and the kinetic energy. By dimensions method establish a relation amongst the physical quantities.
7. When white light passes through glass, the refractive index varies with wavelength as $\mu = A + B/\lambda^2$, where A and B are constants. Find their dimensions.

8. The potential difference across a wire is measured with a voltmeter of LC is 0.2 V and the current is measured with an ammeter of LC 0.1 A. If the voltage is 6.4 V and the current is 3.2 Amp, find resistance with max possible error.
9. The parallax of a heavenly body measured from two points diametrically opposite on equator of earth is 2 minute. If radius of earth is 6400 km, calculate distance of heavenly body.
10. Name the various systems of units and discuss them briefly.
11. Check the accuracy of the relation $\vartheta = \frac{1}{2l}\sqrt{T/m}$, where is $\vartheta$ the frequency, l is the length, T is the tension and m is the mass of unit length of the string.
12. In the Vander wall's equation $(P+a/v^2)(V-b)=RT$, what are the dimensions of a and b? Here P is the pressure, V is the volume, T is the temperature and R is the gas constant.
13. The length and breadth of a rectangle are $(5.7 \mp 0.1)$ cm and $(3.4 \mp 0.2)$ cm. calculate area of the rectangle with error limits.
14. A particle moves along the side of a square of length l starting from A and reaches the opposite corner C by travelling from A to B and B to C. If the time taken is t, the average velocity of the particle is ---
15. Which pair of quantities has dimensions different from the other three pairs?
    a) Impulse and linear momentum b) Planck's constant and angular momentum
    c) Moment of inertia and moment of force d) Young's Modulus and pressure.
16. The period of revolution of a planet around the sun depends on the radius of the orbit R, the mass of sun M and the gravitational constant G. From dimensional considerations obtain the Kepler's law of periods of the planetary motion

## Topic: Motion in one dimension

Answer the following:

1. A car is moving from point O to P on a straight line in 18 s. and then from P to Q in 8 s. What is the avg speed and avg velocity of the car in going from O to P and from O to P and back to Q? (Given P = 360m and Q = 240m from O.)
2. A cyclist cycles at a speed of 3 m/s for t secs, and at 5 m/s for another t secs. Find the avg speed.
3. A car covers the first half distance at a speed 40 km/hr and the next half distance at 60 km/hr. Calculate the avg speed of the car.
4. A man walks on a straight road from his home to a market 2.5 km away with a speed of 5 km/h. Finding the market closed, he instantly turns and walks back home with a speed of 7.5 km/h. What is the (a) magnitude of average velocity, and (b) average speed of the man over the interval of time (i) 0 to 30 min, (ii) 0 to 50 min, (iii) 0 to 40 min?
5. A woman starts from her home at 9.00 am, walks with a speed of 5 km/h on a straight road up to her office 2.5 km away, stays at the office up to 5.00 pm, and returns home by an auto with a speed of 25 km/h. Choose suitable scales and plot the *x*-*t* graph of her motion.
6. Two trucks start from two cities A and B 480 km apart, towards each other. The first truck took 8 hrs to reach B from A while the other took 10 hrs to reach A. If both travelled at a constant speed, find when and where they meet?
7. A drunkard walking in a narrow lane takes 5 steps forward and 3 step backward, followed again by 5 steps forward and 3 steps backward, and so on. Each step is 1m long and requires 1 s. Plot the *x*-*t* graph of his motion. Determine graphically and otherwise how long the drunkard takes to fall in a pit 13 m away from the start.

8. A jet airplane travelling at the speed of 500 km/h ejects its products of combustion at the speed of 1500 km/h relative to the jet plane. What is the speed of the latter with respect to an observer on the ground?
9. Look at the graphs (a) to (d) (Fig. 3.20) carefully and state, with reasons, which of these *cannot* possibly represent one-dimensional motion of a particle.
10. A three-wheeler starts from rest, accelerates uniformly with 1 $ms^{-2}$ on a straight road for 10 s, and then moves with uniform velocity. Plot the distance covered by the vehicle during the nth second (n = 1,2,3..) versus n. What do you expect this plot to be during accelerated motion: a straight line or a parabola?
11. A boy standing on a stationary lift (open from above) throws a ball upwards with the maximum initial speed he can, equal to 49 m/s. How much time does the ball take to return to his hands? If the lift starts moving up with a uniform speed of 5 m/s and the boy again throws the ball up with the maximum speed he can, how long does the ball take to return to his hands.
12. A car moving along a straight highway with speed of 126 km/h is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform), and how long does it take for the car to stop? Under what condition is the average velocity equal to instantaneous velocity?
13. A cyclist moving on a circular track of radius 100m completes one revolution in 4 minutes. What is his (i) average speed (ii) average velocity in one full revolution?
14. Give position-time graphs for an object moving with negative velocity, moving with positive velocity and at rest.

**Topic: Motion in a plane**

Answer the following:

1. What is the angular velocity of the minute hand of a watch in rad/sec?
2. The velocity of projection of a body is 10 **i** + 20 **j**. What is the horizontal range of the projectile?
3. Two projectiles with their departure angles 30° and 60° have the same velocity at maximum height. Determine the ratio of their velocities.
4. Two forces 6N and 8N acting at a point have their resultant 10 N. At what angle are they inclined with each other?
5. Find the angle which **i** + **j** make with the x axis.
6. Rain falls with a speed 30 m/s. What direction should a cyclist moving south hold his umbrella as to have shelter from the rain?
7. Prove that the vectors 2i - 3j – k and -6i + 9j +3k are parallel.
8. What is the condition that two vectors are perpendicular?
9. Two particles 1 and 2 move with velocities $v_1$ and $v_2$. At the initial moment their radii vectors are $r_1$ and $r_2$. How must these four vectors be interrelated such that the particles collide?
10. A fighter jet flies horizontally with a speed 720 km/hr at height 1.5 km from the ground. At what angle should a gun with muzzle speed 600 m/s be fired to hit the jet? At what minimum altitude should the pilot fly to avoid being hit?
11. A projectile has an initial velocity x**i** + y**j**. The range of the projectile is twice the height of the projectile. Calculate ratio y/x.
12. A cricket ball is thrown at a speed of 28 m/s in a direction 30° above the horizontal. Calculate (a) the maximum height, (b) the time taken by the ball to return to the

same level, and (c) the distance from the thrower to the point where the ball returns to the same level.

13. A cricketer can throw a ball to a maximum horizontal distance of 100 m. How much high above the ground can the cricketer throw the same ball?

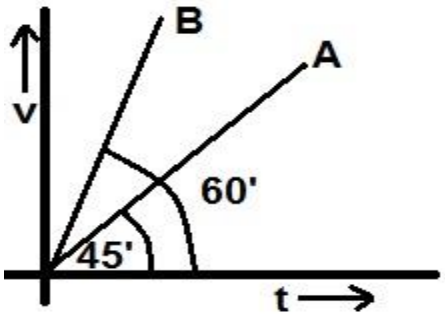
14. The ceiling of a long hall is 25 m high. What is the maximum horizontal distance a ball thrown with a speed of 40 m can go without hitting the ceiling of the hall?

15. Show that for a projectile the angle of projection is $\tan^{-1}[4H/R]$.

16. Show that for a projectile the angle between the velocity and the x axis as a function of time is $= \tan^{-1}[(v_{0y} - gt/2)/v_{0x}]$.

17. A cyclist riding at a speed of 27 km/h approaches a circular turn of radius 80m. He begins reducing his speed at the rate 0.5 m/s every sec. Determine the magnitude and direction of the net acceleration of the cyclist?

18. The velocity-time graph of two bodies A and B are shown in figure , The ratio of their acceleration is:




19. When a body is projected with a certain velocity and departure angle, derive expressions for a) the trajectory b) the max height d) maximum horizontal range e) the time of flight of the projectile.

20. Determine the magnitude and direction of the resultant of adding two vectors.

## Topic: Newton's Laws of Motion

Answer the following:

1. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15 m $s^{-1}$. How long does the body take to stop?
2. A constant force acting on a body of mass 3.0 kg changes its speed from 2.0 m $s^{-1}$ to 3.5 m $s^{-1}$ in 25 s. The direction of the motion of the body remains unchanged. What is the magnitude of the force?
3. A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N. Give the magnitude and direction of the acceleration of the body.
4. The driver of a three-wheeler moving with a speed of 36 km/h sees a child standing in the middle of the road and brings his vehicle to rest in 4.0 s just in time to save the child. What is the average retarding force on the vehicle? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg.
5. A stone of mass 0.25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of 40 rev/min in a horizontal plane. What is the tension in the string? What is the maximum speed with which the stone can be whirled around if the string can withstand a maximum tension of 200 N?
6. Derive the equations of motion from calculus principles.
7. A disc revolves with a speed of 33 1/3 rev/min, and has a radius of 15 cm. Determine the acceleration and its direction.
8. A force 19 I -6j +8k produces an acceleration i $m/s^2$ in a body of mass m. Find m.

## Topic: Work-Power-Energy

Answer the following:

1. An elastic spring is compressed by an amount x. Show that its P.E is ½ $kx^2$ where k is the spring constant.
2. Derive an expression for K.E of a body moving with a velocity v using calculus method.
3. Show that total mechanical energy of a body falling under gravity is conserved.
4. How high must a body be lifted to gain an amount of P.E equal to the K.E it has when moving at speed 20 m/s.
5. After bullet id fired, gun recoils freely. Compare the K.E of bullet and the gun ($K.E_g < KE_b$).
6. A bob is pulled sideway so that string becomes parallel to horizontal and released. Length of the pendulum is 2m. If due to air resistance loss of energy is 10%, what is the speed with which the bob arrived at the lowest point?
7. Two springs A and B are identical except that A is harder than B (KB<KA) if these are stretched by the equal force. In which spring will more work be done?
8. Explain the term work. Show that work done is equal to the dot product of force and displacement
9. Find the work done if a particle move from a position $\mathbf{r_1}$=3i+2j-6k to a position $\mathbf{r_2}$=14i+13j-9k under the effect of force **F**=4i+j+3k.
10. How much energy is released when 1mg of U is completely destroyed in an atomic bomb?
11. A force F=2j N acts in a region, where a particle moves clock wise along the sides of a square of length 2m.Find the total amount of work done.

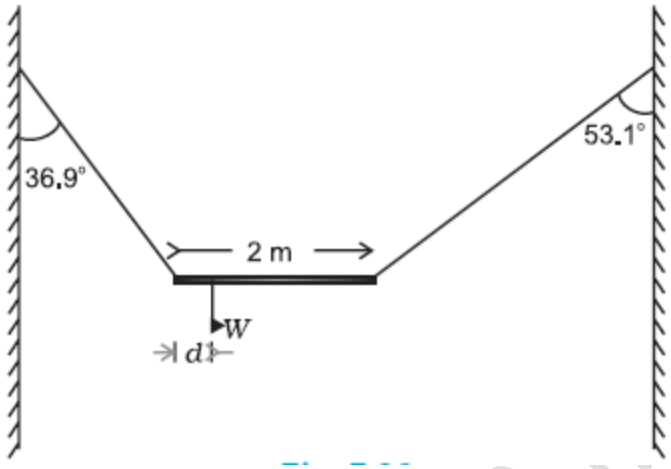
12. State and prove work energy theorem
13. Show that in an elastic one dimensional collision the relative velocity of approach before collision is equal to the relative velocity of separation after collision.
14. Show that in head on collision between two balls of equal masses moving along a straight line the balls exchange their velocities.
15. A force acting on a body along Y axis the direction of motion of body. If this force produces a potential energy $U = Ax^4$ when $a = 1.2 Jm^{-4}$. What is the force acting on the body when the body is at x= 0.8m.
16. A spring of spring constant K is cut in to two equal pieces. Calculate force constant of each part.
17. A spring is stretched by x by applying a force F. Now the extension of the spring is increases to 3x. What will be the new force required to keep the spring in this condition? Calculate the work done in increasing the extension?
18. Show that at any instant of time during the motion total mechanical energy of a freely falling body remains constant. Show graphically the variation of K.E and P.E during the motion.
19. A car of mass 2000kg is lifted up a distance of 30m by a crane in 1 minute. A second crane does the same job in 2 minute. Do the cranes consume the same or different amounts of fuel? What is the power supplied by each crane? Neglect power dissipation against friction.
20. One coolie take some minute to raise a box through a height of 2 metre. Another one takes 30 second for the same job and does the same amount of work. Which one of the two has greater power and which one uses greater energy?
21. What is represented by area under power-time graph?

## Topic: Rotational Motion

Answer the following:

1. Locate the centre of mass of HCl molecule given that the mass of chlorine is 35.5 times the mass of hydrogen and the atoms are separated by a distance 1.27 Å.
2. The H atoms of the water molecule are aligned with the oxygen atom such that the angle subtended between them is 105°. If the distance between the O and H atom is $9.57 \times 10^{-11}$ Å determine the centre of mass of the water molecule.
3. A car weighs 1800 kg. The distance between the front and back axles is 1.8 m. The centre of gravity is 1.05 m behind the front axle. Determine the force exerted by the level ground on each of the four wheels.
4. An electron revolves round the nucleus of H atom in a circle of radius 0.53 Å with a velocity of $2.2 \times 10^{6}$ m/s. Show that the angular momentum = $h / 2\pi$ where h is the Planck's constant.
5. The angular displacement of a particle is given by $\theta = 2t^2 + 5t - 3$. Determine the angular velocity
6. A wheel is rotating at 900 rpm about its axis. When switched off it comes to rest in a minute. What is the angular acceleration?
7. A cord of negligible mass is wound round the rim of a fly wheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord as shown in Fig. 7.35. Refer NCERT Text page 171. The flywheel is mounted on a horizontal axle with frictionless bearings. (a) Compute the angular acceleration of the wheel. (b) Find the work done by the pull, when 2m of the cord is unwound. (c) Find also the kinetic energy of the wheel at this point. Assume that the wheel starts from rest.

8. Three bodies, a ring, a solid cylinder and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of the bodies are identical. Which of the bodies reaches the ground with maximum velocity?
9. A non-uniform bar of weight *W* is suspended at rest by two strings of negligible weight as shown in Fig.




The angles made by the strings with the vertical are 36.9° and 53.1° respectively. The bar is 2 m long. Calculate the distance *d* of the centre of gravity of the bar from its left end.

14. From a uniform disk of radius *R*, a circular hole of radius *R*/2 is cut out. The centre of the hole is at *R*/2 from the centre of the original disc. Locate the centre of gravity of the resulting flat body.

15. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5 g are put one on top of the other at the 12.0 cm mark, the stick is found to bebalanced at 45.0 cm. What is the mass of the metre stick?

## Topic: Gravitation

Answer the following:

1. Suppose that two objects attract each other with a gravitational force of 16 units. If the distance between the two objects is doubled, what is the new force of attraction between the two objects?
2. Suppose that two objects attract each other with a gravitational force of 16 units. If the distance between the two objects is reduced in half, then what is the new force of attraction between the two objects?
3. Suppose that two objects attract each other with a gravitational force of 16 units. If the mass of both objects was doubled, and if the distance between the objects remained the same, then what would be the new force of attraction between the two objects?
4. Suppose that two objects attract each other with a gravitational force of 16 units. If the mass of both objects was doubled, and if the distance between the objects was doubled, then what would be the new force of attraction between the two objects?
5. Suppose that two objects attract each other with a gravitational force of 16 units. If the mass of both objects was tripled, and if the distance between the objects was doubled, then what would be the new force of attraction between the two objects?
6. Suppose that two objects attract each other with a gravitational force of 16 units. If the mass of object 1 was doubled, and if the distance between the objects was tripled, then what would be the new force of attraction between the two objects?
7. As a star ages, it is believed to undergo a variety of changes. One of the last phases of a star's life is to gravitationally collapse into a black hole. What will

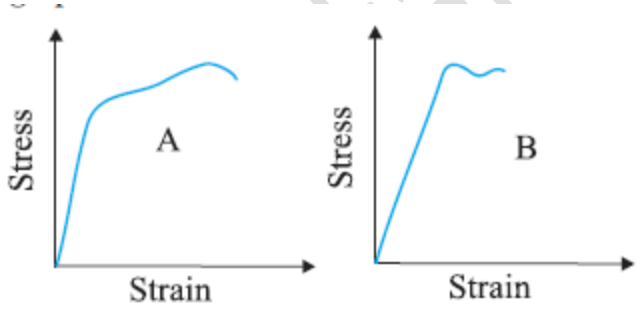
happen to the orbit of the planets of the solar system if our star (the Sun shrinks into a black hole)? (And of course, this assumes that the planets are unaffected by prior stages of the Sun's evolving stages.)

8. Having recently completed her first Physics course, Dawn Well has devised a new business plan based on her teacher's *Physics for Better Living* theme. Dawn learned that objects weigh different amounts at different distances from Earth's center. Her plan involves buying gold by the weight at one altitude and then selling it at another altitude at the same price per weight. Should Dawn buy at a high altitude and sell at a low altitude or vice versa?
9. Anita Diet is very concerned about her weight but seldom does anything about it. After learning about Newton's law of universal gravitation in Physics class, she becomes all concerned about the possible effect of a change in Earth's mass upon her weight. During a (rare) free moment at the lunch table, she speaks up "How would my weight change if the mass of the Earth increased by 10%?" How would you answer Anita?
10. When comparing mass and size data for the planets Earth and Jupiter, it is observed that Jupiter is about 300 times more massive than Earth. One might quickly conclude that an object on the *surface* of Jupiter would weigh 300 times more than on the surface of the Earth. For instance, one might expect a person who weighs 500 N on Earth would weigh 150000 N on the *surface* of Jupiter. Yet this is not the case. In fact, a 500-N person on Earth weighs about 1500 N on the *surface* of Jupiter. Explain how this can be.

**Topic: Solids and Liquid Mechanics**

Answer the following:

1. The average depth of Indian Ocean is about 3000 m. Calculate the fractional compression, $\Delta V/V$, of water at the bottom of the ocean, given the bulk modulus of water is $2.2 \times 10^9$ N m$^{-2}$. (Take $g$ = 10 m s$^{-2}$)
2. The stress-strain graphs for materials *A* and *B* are shown as follows. The graphs are drawn to the same scale. (a) Which of the materials has the greater Young's modulus? (b) Which of the two is the stronger material.




3. Two wires of diameter 0.25 cm, one made of steel and the other made of brass are loaded as shown in Fig. 9.13. The unloaded length of steel wire is 1.5 m and that of brass wire is 1.0 m. compute the elongations of the steel and the brass wires.
4. Show that the work done per unit volume of a material, in stretching it $\frac{Stress \times strain,}{2}$
5. A tension $T_1$ applied to a wire causes it to elongate to $l_1$ while another $T_2$ elongates it to $l_2$. Find the natural length of the wire.

6. A body of mass m is tied to a string of length l and radius r and whirled in a vertical circle with an angular velocity, f revolutions per sec. Find the elongation of the wire at the lowest point, if the young's modulus is Y.
7. Estimate the density of water at a depth where the pressure is 80 atm given the density at surface is $1.03 \times 10^3$ kg per cubic m.
8. The Marina trench is located in the Pacific Ocean, and at one place it is nearly 11 km beneath the surface of water. The water pressure at the bottom of the trench is about $1.1 \times 10^8$ Pa. A steel ball of initial volume 0.32 $m^3$ is dropped into the ocean and falls to the bottom of the trench. What is the change in the volume of the ball when it reaches to the bottom?
9. A 50 kg girl wearing high heel shoes balances on a single heel. The heel is circular with a diameter 1.0 cm. What is the pressure exerted by heel on the horizontal floor?
10. A body weighs 60 N when suspended in air. When the same is submerged in water it weighs 40 N. What is the specific gravity of the body?
11. A body weighs 160 g in air, 130 g in water and 136 g in oil. Find the specific gravity of oil.
12. What is the specific gravity of a metal piece of dimensions 12cm x 2 cm x 1 cm and weighing 192g?
13. Density of ice = 917 kg/$m^3$. What fraction of ice lies below water? What fraction is visible assuming that density of ice is the same 917 kg/$m^3$.
14. A vertical off-shore structure is built to withstand a maximum stress of $10^9$ Pa. Is the structure suitable for putting up on top of an oil well in the ocean? Take the depth of the ocean to be roughly 3 km, and ignore ocean currents.

15. A hydraulic automobile lift is designed to lift cars with a maximum mass of 3000 kg. The area of cross-section of the piston carrying the load is 425 $cm^2$. What maximum pressure would the smaller piston have to bear?
16. A U-tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are in level with 10.0 cm of water in one arm and 12.5 cm of spirit in the other. What is the specific gravity of spirit?
17. In the previous problem, if 15.0 cm of water and spirit each are further poured into the respective arms of the tube, what is the difference in the levels of mercury in the two arms ? (Specific gravity of mercury = 13.6)
18. In a test experiment on a model aero plane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70 m/s and 63 m/s respectively. What is the lift on the wing if its area is 2.5 $m^2$? Take the density of air to be 1.3 kg $m^{-3}$.
19. What is the pressure inside the drop of mercury of radius 3.00 mm at room temperature? Surface tension of mercury at that temperature (20 °C) is $4.65 \times 10^{-1}$ N $m^{-1}$. The atmospheric pressure is $1.01 \times 10^5$ Pa. Also give the excess pressure inside the drop.
20. What is the excess pressure inside a bubble of soap solution of radius 5.00 mm, given that the surface tension of soap solution at the temperature (20 °C) is $2.50 \times 10^{-2}$ N/ m? If an air bubble of the same dimension were formed at depth of 40.0 cm inside a container containing the soap solution (of relative density 1.20), what would be the pressure inside the bubble? (1 atmospheric pressure is $1.01 \times 10^5$ Pa.

**Topic: Thermal properties of matter**

Answer the following:

1. Why does the earth not become as hot as the Sun although it has been receiving heat from the Sun for ages?
2. Two vessels made of two different metals are identical in all aspects. They are completely filled with ice at $0^0$C. The ice in one is melted in 20 minute and that in another in 15 minute by heat coming from outside. Compare the thermal conductivities of metals.
3. A bar of copper of length 75cm and a bar of length 125cm are joined end to end. Both are of circular cross – section with diameters 2cm. The free ends of copper and steel are maintained at $100^0$C and $0^0$C respectively. The surfaces of the bars are thermally insulated. What is the temperature of copper – steel junction? Thermal conductivity of copper = $9.2x10^{-2}Js^{-1}m^{-1}K^{-1}$ and that of steel is $1.1x10^{-2}Js^{-1}m^{-1}K^{-1}$?
4. A circular hole of diameter 2.00 cm is made in an aluminum plate at 0°C. What will be the diameter at 100°C. $\alpha$ for aluminum = $2.3 \times 10^{-3}$ °$C^{-1}$.
5. A glass vessel measures exactly 10cm × 10cm × 10cm at 0°C. It is filled completely with mercury at this temperature. When the temperature rises to 10°C, 1.6 $cm^3$ of mercury overflows. Calculate the Coefficient of volume of mercury. Coefficient of linear expansion of glass = $6.5 \times 10^{-6}$°$C^{-1}$.
6. A steel rod is clamped at its two ends and rests on a fixed horizontal base. The rod is unstrained at 20°C. Find the longitudinal strain developed in the rod if temperature rises to 50°C. Coefficient of linear expansion of steel is $1.2 \times 10^{-5}$°$C^{-1}$

7. Two thermos flasks of the same height and same capacity. One has a circular cross section while the other has a square cross section. Which of the two is better?
8. A steel ring of 3.000 in inside diameter at 20°C is to be heated and slipped over a brass shaft measuring 3.002 inch in diameter at 20°C $\alpha_{brass} = 2 \times 10^{-5}$ °C$^{-1}$ $\alpha_{steel} = 1.2 \times 10^{-5}$ °C$^{-1}$

   (a) To what temperature should the ring be heated?

   (b) If the ring and shaft together are cooled by some means such as liquid air, at what temperature will the ring just slip off the shaft?
9. A bimetallic strip is formed out of two identical strips .One of the copper and other of brass. The coefficient of linear expansion of the two metals are $\alpha_c$ and $\alpha_B$. On heating the strip through the temperature change $\Delta T$, the strip bends into an arc of the circle. Find the radius of the curvature of the strip.
10. A bullet of mass 30 gm. enters into a fixed wooden block with a speed 50 m/s and stops in it. Calculate the change in internal energy during this process.
11. Develop a relation between the co-efficient of linear expansion, co-efficient superficial expansion and coefficient of cubical expansion of a solid?
12. Show that CP - CV = R Where [CP = specific heat at constant pressure; CV = specific heat at constant volume and R = Universal Gas constant] for an ideal gas?
13. The ends of the two rods of different materials with their thermal conductivities, radii of cross – section and length in the ratio 1:2 are maintained at the same temperature difference. If the rate of flow of heat through the larger rod is 4 cal/s, what is the rate of flow through the shorter rod?
14. Comment on the statement Ït is not heat but humidity which makes us uncomfortable".

15. Pieces of glass and copper are heated to the same temperature. Why does the piece of copper feel hotter on touching?
16. A woolen blanket keeps our body warm. The same blanket if wrapped around ice would keep ice cold. How do you explain this apparent paradox?
17. Why snow is a better heat insulator than ice?
18. Heat is generated continuously in an electric heater but its temperature becomes constant after some time. Why?
19. Two metal bars of different material having same cross sectional area are joined together. The two free ends of the combination are kept at two temperatures. Derive an expression for the rate of flow of heat and the temperature of interface of the two rods.
20. Explain the phenomenon of conduction of heat. Define the thermal conductivity of the substance and give its dimensional formula.
21. Imagine a fire ball suspended in air. Would you experience more heat above the ball or below the ball?
22. A perfect Carnot heat engine utilizes an ideal gas as the working substance. The source temperature is $227^0$C and the sink temperature $127^o$C. Find the efficiency of this engine, and find the heat received from the source and the heat released to the sink when 10000J of external work is done.
23. Two Carnot engines A and B are operated in series. The first one A receives heat at 800K and rejects to a reservoir at temperature TK. The second engine B receives the heat rejected by the first engine and in turn rejects to a heat reservoir at 300K. Calculate the temperature TK for the following situation. The efficiencies the two engines are equal.

## Topic: Kinetic Theory of Gases

Answer the following:

1. Give the molecular interpretation of temperature.
2. A gas is heated in a vessel at constant volume. Pressure increases, why?
3. What is absolute zero temperature? Explain it on the basis of kinetic theory of gases.
4. Why do bicycles tubes burst in summer? Explain.
5. What do you mean by one mole of a gas?
6. Explain Boyle's law on the basis of kinetic theory of gases
7. What is the significance of Boltzmann constant?
8. Give the postulates of kinetic theory of gases. Hence derive an expression for the pressure exerted by an ideal gas.
9. Derive an expression for average kinetic energy per molecule of an ideal gas.
10. Distinguish between average speed and r.m.s speed. If three molecules have speeds $u_1$,$u_2$ and $u_3$ what will be their average speed and r.m.s speed?
11. Helium gas is filled in a closed vessel whose coefficient of thermal expansion is negligible. Find the average kinetic energy of Helium atom when it is heated from 300K to 600K.
12. What are the degrees of freedom for monoatomic, diatomic and polyatomic gas molecules?
13. Under what conditions do real gases obey ideal gas equation strictly? Explain.

14. Gas bubbles are released from a diver's breathing equipment deep below the surface of the sea. One of the bubbles has a volume of 3,5 cm3 at a pressure of 250 kPa. It rises from a depth of 25 m to the surface where the temperature is 5° C to the surface where the temperature is 25° C and the pressure is 101,3 kPa

    a) What happens to the volume of the bubble as it moves up?

    b) Explain, by using the kinetic theory of gases, your previous answer

    c) What is the relationship between pressure and the volume of an enclosed gas?

    d) Give the relationship mathematically.

    e) Calculate the volume of the bubble at the surface.

15. A sample of Helium occupies a volume of 160 $cm^3$ at 100 KPa and $25^0$C. What volume will it occupy if the pressure is adjusted to 80 KPa and the temperature remain unchanged?

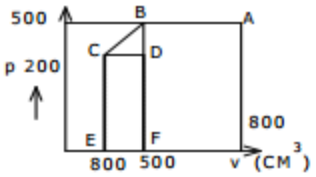
16. A bicycle pump contains 250$cm^3$ of air at a pressure of 90 KPa. If the air is compressed, the volume is reduced to 200 $cm^3$. What is the pressure of the air inside the pump?

17. Ammonium chloride and calcium hydroxide are allowed to react. The ammonia that is released in the reaction is collected in a gas syringe (a syringe that has very little friction so that the plunger can move freely) and sealed in. This gas is allowed to come to room temperature which is $20^0$C. The volume of the ammonia is found to be 122mL. It is now placed in water bath set at $32^0$C. What will be the volume reading after the syringe has been left in the bath for 1 hour (assume the plunger moves completely freely)? (By leaving the syringe for this length of time, we can be certain that the sample of gas is at the higher temperature.)

**Topic: Thermodynamics**

Answer the following:

1. What is the ratio of find volume to initial volume if the gas is compressed adiabatically till its temperature is doubled?
2. How does Carnot cycle operates?
3. Calculate the work done by the gas in going from the P-V graph of the thermodynamic behavior of a gas from point A to point B to point C?

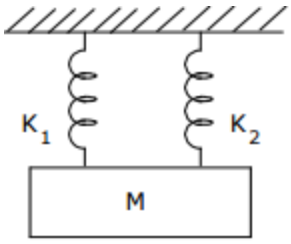



4. Why does absolute zero not correspond to zero energy?
5. State the Second law of thermodynamics and write 2 applications of it?
6. A Carnot engine develops 100 H.P. and operates between 270C and 2270C. Find 1) thermal efficiency; 2) heat supplied3) heat rejected?
7. If the door of a refrigerator is kept open in a room, will it make the room warm or cool?
8. A quantity of oxygen is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original volume is restored. Find the final pressure in terms of initial pressure? Take Y = 1.4
9. A Carnot engine absorb 6×105 cal at $227^0$C calculate work done per cycle by the engine if it sink is at $127^0$C? Draw a P – V diagram for isothermal and adiabatic expansion?
10. Calculate difference in efficiency of a Carnot energy working between:- 1) 400K and 350K 2) 350K and 300K.

## Topic: Oscillations and Waves

Answer the following:

1. Explain the difference between longitudinal and transverse waves and give an example of each.
2. What is the relation between uniform circular motion and S.H.N?
3. What is the minimum condition for a system to execute S.H.N?
4. Springs is spring constant K, 2K, 4K, K ----- are connected in series. A mass M Kg is attached to the lower end of the last spring and system is allowed to vibrate. What is the time period of oscillation?
5. Show that the total energy of a body executing SHN is independent of time?
6. A mass = m suspend separately from two springs of spring constant k1 and k2 gives time period t1 and t2 respectively. If the same mass is connected to both the springs as shown in figure. Calculate the time period 't' of the combined system?




7. Determine the time period of a simple pendulum of length = l when mass of bob = m Kg?
8. At what distance from the mean position, is the kinetic energy in a simple harmonic oscillator equal to potential energy?
9. A simple harmonic oscillator is represented by the equation: Y = 0.40 sin(440t+0.61) Y is in metre t is in seconds Find the values of 1) Amplitude 2)

Angular frequency 3) Frequency of oscillation 4) Time period of oscillation, 5) Initial phase.

10. An 8 kg body performs S.H.M. of amplitude 30 cm. The restoring force is 60N, when the displacement is 30cm. Find: - a) Time period b) the acceleration c) potential and kinetic energy when the displacement is 12cm?
11. The kinetic energy of a particle executing S.H.M. is 16J when it is in its mean position. If the amplitude of oscillations is 25cm and the mass of the particle is 5.12kg. Calculate the time period of oscillations?
12. Is the motion of a simple pendulum strictly simple harmonic?
13. A simple pendulum is executing Simple harmonic motion with a time T. If the length of the pendulum is increased by 21 %. Find the increase in its time period?
14. Using the correspondence of S. H. M. and uniform circular motion, find displacement, velocity, amplitude, time period and frequency of a particle executing SH.M?
15. The component waves producing a stationary wave have amplitude, Frequency and velocity of 8 cm, 30HZ and 180 cm/s respected. Write the equation of the stationary wave?
16. If two sound waves has a phase difference of 600, then find out the path difference between the two waves? Differentiate between the types of vibration in closed and open organ pipes?
17. Show that the frequency of nth harmonic mode in a vibrating string which is closed at both the end is 'n' times the frequency of the first harmonic mode?
18. A particles moves such that its acceleration 'a' is given by a = -b x where x = displacement from equilibrium position and b is a constant. Find the period of oscillation?

**Topic: HOLIDAY HW 1**

Answer the following:

1. In an experiment to determine the density of a rectangular block a caliper was used of LC 0.01cm and the mass was found using a beam balance of least count 0.1 gm. The measured values are mass of block = 39.3g, length = 5.12 cm breadth = 2.56 cm and thickness = 0.37 cm. Find the maximum error in the measurement of density.
2. A sprinter covers 100.5 m in 10.3 s. Find his average speed upto appropriate significant figures.
3. Write the dimensions of a) Stefan's constant b) coefficient of thermal conductivity c) universal gas constant d) Reynolds number
4. The volume v of water passing any point of a flow tube in t secs is related to the area of cross section A, the velocity U by the relation $V = A^{\alpha} U^{\beta} t^{\gamma}$. Which of the following is true? a) $\alpha = \beta = \gamma$ b) $\alpha \neq \beta = \gamma$ c) $\alpha = \beta \neq \gamma$ d) $\alpha \neq \beta \neq \gamma$
5. A calorie is the unit of heat and its value is 4.186 J. Suppose we use a new system in which the unit of mass is $\alpha$ kg, that of length is $\beta$ m and the unit of time is $\gamma$ s, find the value of the calorie in the new system of units.
6. If the velocity of light c, gravitational constant G and Planck's constant h are chosen as fundamental units, find the dimensions of mass length and time in the new system of units.
7. In the measurement of a quantity $X = a^2 B / C^{4/3} D^3$, the errors are 2%, 2%, 4% and 5% respectively, then the minimum % of error in the measurement of X is contributed by which of the four physical quantities involved?
8. Find the propagation of error in the following cases. a) $Z = A.B$ b) $A / B$ c) $A^m / B^n$

9. A bullet is fired vertically up with an initial velocity of 50 m/s. It covers a distance h1 in the first second and a distance h2 in the last 3 secs of its upward motion. If g = 10 m/s2, bring out the relation between h1 and h2.
10. A swimmer swims at a speed of 5 m/s in still water. While crossing a river his average speed is 3m/s.If he crosses the river in the shortest period of time what is the speed of flow of water?
11. Rain falls at a speed 4 m/s and the wind direction is from N to S. In order to protect himself which direction should a man on the ground must tilt his umbrella?
12. A car accelerates from rest at a rate α for some time after which it decelerates at a rate β to come to rest. If the total time is t find the maximum velocity obtained and the total distance travelled.
13. A ball is released from a height h and reaches the ground in time T. Where will it be from the point of release in a time a) T/2 b) 3T/4 c) 5T/6 ?
14. A metallic ball bearing falls on a metal surface from a height 3m. If at the time of release the speed is zero, plot the variation of the velocity graphically with time.
15. Two stones are thrown up simultaneously from the edge of a cliff 200 m high with initial speeds of 15 m/ s and 30 m /s. Verify that the graph shown in Fig 3.27

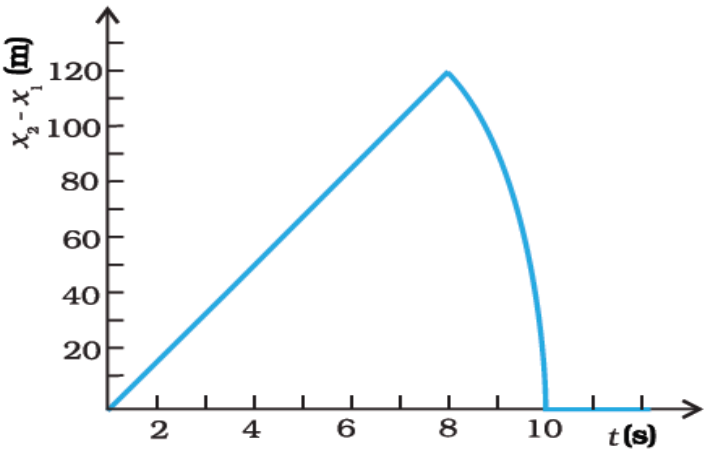


Fig. 3.27

16. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward, followed again by 5 steps forward and 3 steps backward, and so on. Each step is 1 m long and requires 1 s. Plot the *x-t* graph of his motion. Determine graphically and otherwise how long the drunkard takes to fall in a pit 13 m away from the start.
17. Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of 72 km h.1 in the same direction, with A ahead of B. The driver of B decides to overtake A and accelerates by 1 m s.2. If after 50 s, the guard of B just brushes past the driver of A, what was the original distance between them?
18. The magnitude of the resultant of two equal vectors is equal to the magnitude of either vector. What is the angle between the two vectors?
19. Establish the following vector inequalities geometrically or otherwise :
    (a) $|\mathbf{a}+\mathbf{b}| < |\mathbf{a}| + |\mathbf{b}|$ (b) $|\mathbf{a}+\mathbf{b}| > ||\mathbf{a}| - |\mathbf{b}||$ (c) $|\mathbf{a}-\mathbf{b}| < |\mathbf{a}| + |\mathbf{b}|$
    (d) $|\mathbf{a}-\mathbf{b}| > ||\mathbf{a}| - |\mathbf{b}||$
20. An airplane flies horizontally with a velocity 600 km/hr at a height 1960 m. When it is at a certain height from the ground a bomb is released? At what distance will the bomb hit the ground?
21. On an open ground, a motorist follows a track that turns to his left by an angle of 600 after every 500 m. starting from a given turn, specify the displacement of the motorist at the third, sixth and eighth turn. Compare the magnitude of the displacement with the total path length covered by the motorist in each case.
22. A passenger arriving in a new town wishes to go from the station to a hotel located 10 km away on a straight road from the station. A dishonest cabman takes him along a circuitous path 23 km long and reaches the hotel in 28 min. What is (a) the average speed of the taxi, (b) the magnitude of average velocity? Are the two equal?

**Topic: Physics-Holiday homework 2**

Answer the following:

1. Is the Young's modulus of rubber greater than that of steel?
2. State the SI unit of angular velocity.
3. A light body and a heavy body have same momentum. Which one has greater kinetic energy? Support your answer with an explanation
4. What is escape velocity? Derive an expression for the same.
5. State Pascal's law. Explain the working of hydraulic lift using the theorem.
6. Explain why heating systems based on circulation of steam are more efficient in warming a building than those based on circulation of hot water.
7. A cylinder of fixed capacity 44.8 liters contains helium gas at standard temperature and pressure. What is the amount of heat needed to raise the temperature of the gas in the cylinder by $15^0$C? Given R = 8.32J/mol/K.
8. Suresh was struggling to understand the Kepler's second law of planetary motion. Then his friend Raman who came to him explained how the planet moves around the sun obeying Kepler's law of planetary motion. (a) Comment upon the values of Raman. (b) State Keplers 'laws of planetary motion
9. State and prove the Bernoulli's theorem for fluid flow. As a consequence describe the working of the Venturimeter.

**10.** Describe the elastic collision in one dimension and find the speeds of the bodies after collision assuming that both bodies have the same masses. Two bodies of masses 50g and 30g moving along the same line with velocities 50 cm/s and 30 cm/s respectively suffer one dimensional collision.

**11.** At what depth below the earth surface is the acceleration due to gravity the same as at a given height?

**12.** Draw the variation of potential energy stored in a spring as a function of extension.

**13.** If the momentum of a body increases by 20 % what is the % change in kinetic energy of the body?

**14.** Write the expression for escape velocity. Why that is the moon has no atmosphere?

**15.** Find the moment of inertia of a sphere about a tangent to the sphere, given the moment of inertia of the sphere about any of its diameters to be $2MR^2/5$, where $M$ is the mass of the sphere and $R$ is the radius of the sphere.

**16.** A body weighs 63 N on the surface of the earth. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth?

**17.** A woman throws an object of mass 500g with a speed of 25 m/s, if the object hits a wall and rebounds with half the original speed, what is the change in momentum of the object?

**18.** State and explain the parallel axis and perpendicular axes theorem.

**19.** Three uniform spheres, each having mass m and radius R, are kept in such a way that each touches the other two. Find the magnitude of gravitational force on any sphere due to the other two.

**20.** Which is more elastic rubber or steel? Explain.

**21.** Differentiate between conservative and neoconservative forces. Give one example for each.

**22.** A steel wire of length 4.7 m and cross-sectional area $3.0 \times 10^{-5}$ $m^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area $4.0 \times 10^{-5}$ $m^2$ under a given load. What is the ratio of Young's modulus of steel to that of copper?