FIRST PU PHYSICS MOST IMPORTANT NUMERICALS

Chapter 4: Motion in a plane

1. A cricket ball is thrown at a speed of 56 ms^{-1} 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. ($g = 9.8\ ms^{-2}$)
2. A football player kicks a ball at an angle of 30° to the horizontal with a velocity of $15ms^{-1}$. Assuming that ball travels in a vertical plane. Calculate a) maximum height b) time of flight c) the horizontal range. (d) the velocity with which it hits the ground at end of its flight (e) velocity at the highest point and time taken to reach that point. ($g = 9.8\ ms^{-2}$)
3. A football player kicks a ball at a distance 10m from a vertical pole at an angle of 45°. The ball just clears the tip of the pole and falls at a distance of 10m on the other side. Determine the height of the vertical pole. ($g = 9.8\ ms^{-2}$)
4. The ceiling of a long hall is 25m high. What is the maximum horizontal distance that a ball thrown with a speed of 40 ms^{-1} can go without hitting the ceiling of the hall? ($g = 9.8\ ms^{-2}$)
5. 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? ($g = 9.8\ ms^{-2}$)
6. A stone tied to the end of a string 80 cm is whirled in a horizontal circle with constant speed. If the stone makes 14 revolutions in 26 s, then what is the magnitude and direction of the force on the stone?

Chapter 6: Work, Energy and Power

1. A car weighing 900 kg moving with a velocity 20 ms^{-1} is uniformly accelerated with an acceleration of 20 ms^{-2} for 10 s. Calculate the work done and the force required to accelerate the car
2. A bullet of mass 40 g enters a block of wood with a velocity of 60 ms^{-1} and penetrates to a depth of 60cm. Calculate the average resistive force of the wood to the penetration of the bullet.
3. A bullet of mass 15g hits a metal plate of thickness 10cm with a velocity of $400ms^{-1}$ and emerges from it with a velocity of 260 ms^{-1}. Find (i) work done (ii) the average resistance offered by the plate to the motion of bullet.
4. A pump on the ground floor of a building pumps water to fill a tank of volume 30 m^3 in 15 minutes. If the tank is 40 m above the ground and efficiency of the pump is 30%, how much electrical power is consumed by the pump? (Density of water = 1000 kgm^{-3}, $g = 9.8\ ms^{-2}$)
5. A man weighing 60 kg climbs to the top of a building 100 m tall in 6 minute. Calculate the work done by the man and his power. ($g = 10\ ms^{-2}$)

Chapter 7: Systems of Particles and Rotational motion

1. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 $rads^{-1}$. The radius of the cylinder is 0.25 m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis?
2. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. (i) What is its angular acceleration, assuming the acceleration to be uniform? (ii) How many revolutions does the engine make during this time?
3. The moment of inertia of a grind stone about its axis of rotation is 25 kgm^2. Starting from rest it acquires a speed of 120 rpm in 10 s. Find the torque acting on it.
4. Weighs of 10 kg and 15 kg are suspended from the ends of a light rod 5 m long. At which point must the rod be suspended by a string to keep it horizontal?
5. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5g are put one on top of the other at the 12.0 cm mark, the stick is found to be balanced at 45cm. What is the mass of the metre stick?

Chapter 11: Thermal properties of matter

1. A brass wire of 1.8 m long at 300 K temperature is held stretched between two rigid supports. If the wire is cooled to a temperature of 234 K, then what is the tension developed in the wire if its radius 1 mm? [Given: Coefficient of linear expansion of brass = $\alpha_b = 2 \times 10^{-5}$ K^{-1}, Young's modulus of brass = $Y_b = 0.91 \times 10^{11}$ Pa]

2. In an experiment on specific heat of a metal, a 0.20 kg block of the metal at 150°C is dropped in a copper calorimeter (of water equivalent 0.025 kg) containing 150 cm^3 of water at 27°C. The final temperature is 40°C. Compute the specific heat of the metal. If heat losses to the surroundings are not negligible, is your answer greater or smaller than the actual value for the specific heat of the metal. Specific heat of water = 4180$Jkg^{-1}K^{-1}$, density of water = 1000 kgm^{-3}

3. A copper block of mass 2.5 kg is heated in a furnace to a temperature of 500°C and then placed on a large ice block. What is the maximum amount of ice that can melt? (Specific heat of copper = 390 Jkg^{-1} K^{-1}, heat of fusion of water = 335 $kJkg^{-1}$)

4. When 0.15 kg of ice of 0°C mixed with 0.30 kg of water at 50°C in a container, the resulting temperature is 6.7°C. Calculate the heat of fusion of ice. (C_{water} = 4186 $Jkg^{-1}K^{-1}$)

5. Calculate the heat required to convert 3 kg of ice at -12° C kept in a calorimeter to steam at 100°C at atmospheric pressure. Given specific heat capacity of ice = 2100 J kg^{-1} K^{-1}, specific heat capacity of water = 4186 J kg^{-1} K^{-1}, latent heat of fusion of ice = 3.35×10^5 J kg^{-1} and latent heat of steam = 2.256×10^6 J kg^{-1}.

6. A metal cylinder of length 0.628 m having diameter 0.04 m has one end in boiling water at 100°C and other end in melting ice. Calculate the amount of ice melted in one hour. Given thermal conductivity of metal cylinder is 378 $Wm^{-1}K^{-1}$. Latent heat of fusion of ice = 3.36×10^5 J kg^{-1}

7. The lower surface of a cubical slab of stone of side 0.1 m is exposed to steam at 373 K and thick layer of ice covers the upper surface and the other faces are covered by non-conducting material. If in 40 minutes 0.15 kg of ice melts then find the thermal conductivity for the stone. (Give latent heat of ice = 336×10^3 Jkg^{-1})

8. A thermocole ice box is a cheap and efficient method for storing small quantities of cooked food in summer in particular. A cubical icebox of side 30 cm has a thickness of 5.0 cm. If 4.0 kg of ice is put in the box, estimate the amount of ice remaining after 6 hour. The outside temperature is 45°C, and coefficient of thermal conductivity of thermocole is 0.01 $Wm^{-1}K^{-1}$.
[Heat of fusion of ice = 335 $kJkg^{-1}$]

9. A man is inside a room where the air temperature is 20°C. If his body temperature is 28°C, find the rate at which his body loses heat. Assume that the surface of the skin is $2m^2$ and emissivity of the skin is 0.97. (Stefan's constant = 5.67×10^{-8} $Wm^{-2}K^{-4}$)

Chapter 15: Waves

1. Progressive wave is represented by equation y = 0.002 sin (20x – 7t), where x, y are in metre and t is in second. Find (a) period (b) frequency (c) Wavelength and (d) Wave velocity of progressive wave.

2. Progressive wave is represented by equation $y = 2\sin\pi(40t - 2x)$, where x, y are in metre and t is in second. Find (a) frequency (b) Wavelength and (c) Wave velocity of progressive wave

3. A wave travelling along a string is described by, y (x, t) = 0.005 sin (80.0 x – 3.0 t), in which the numerical constants are in SI units. Calculate (a) amplitude (b) wavelength (c) period (d) frequency of the wave. Also, calculate the displacement y of the wave at a distance x = 30.0 cm and time t = 20 s?

4. A police man blows a whistle of frequency 300 Hz as a car speeds past him with a velocity of 36 kmph. Find the change in the frequency as heard by the driver of the car just as he passes the police man.

5. A train standing at the outer signal of a railway station blows a whistle of frequency 400 Hz in still air.
(i) What is the frequency of whistle for a platform observer when the train (a) approaches the platform

with speed of 10 ms^{-1} (b) recedes from the platform with the speed of 10 ms^{-1}. ii) What is the speed of the sound in each case? [The speed of sound in still air = 340 ms^{-1}]

6. A train moving at a speed of 30 ms^{-1} approaches a station and sounds a horn of frequency 500 Hz. What is the apparent frequency of the horn as heard by a man on the platform as the train approaches him. Calculate the change in frequency as heard by the man. Speed of sound = 340 ms^{-1} **[2018]**

7. Two pipes of same diameter, one closed at one end and other open at both the ends are 0.75 m and 1.56 m long when sounded together 17 beats are heard in 4s. Calculate their frequencies. **[2013]**

8. A steel rod 100 cm long is clamped at its middle. The fundamental frequency of longitudinal vibrations of the rod is given to be 2.53kHz. What is the speed of sound in steel? **[2016]**