

Okay, here are some physics scenario-based questions suitable for S5 students, covering common topics in a typical term one curriculum. These questions aim to test understanding of concepts and their application in different situations.

Mechanics:

1. **Scenario:** A small luggage bag is placed on a horizontal conveyor belt moving at a constant velocity of 2 m/s . The coefficient of static friction between the bag and the belt is 0.5, and the coefficient of kinetic friction is 0.3. The bag has a mass of 5 kg .
 - What is the maximum force of static friction that can act on the bag?
 - What force acts on the bag immediately after it is placed on the belt? Explain your reasoning.
 - If the conveyor belt suddenly accelerates at a rate of 1 m/s^2 , what is the frictional force acting on the bag at that instant? Will the bag slip? Justify your answer.
 - If the belt continues to accelerate, at what acceleration will the bag start to slip?
2. **Scenario:** A car of mass 1200 kg is moving up a hill inclined at an angle of 10° to the horizontal at a constant speed of 15 m/s . Assume that the frictional forces opposing the motion are 500 N .
 - Draw a free body diagram showing all the forces acting on the car.
 - Calculate the component of the car's weight acting down the slope.
 - Determine the total resistive force acting against the car's motion.
 - What is the power output of the car's engine required to maintain this constant speed?
3. **Scenario:** A ball of mass 0.2 kg is thrown vertically upwards with an initial velocity of 20 m/s from the ground. Neglect air resistance. (Use $g = 9.8 \text{ m/s}^2$)
 - Calculate the maximum height reached by the ball.
 - Determine the time taken for the ball to reach its maximum height.
 - What is the velocity of the ball when it returns to the ground?
 - Calculate the kinetic energy of the ball just before it hits the ground.

Thermal Physics:

1. **Scenario:** A metal block of mass 0.5 kg at a temperature of 80°C is placed in 1.0 kg of water initially at 20°C in a thermally insulated container. The specific heat capacity of the metal is $390 \text{ J/kg}^\circ \text{C}$ and that of water is $4200 \text{ J/kg}^\circ \text{C}$.
 - Explain the concept of thermal equilibrium.
 - Write down the principle of conservation of energy as applied to this situation.
 - Calculate the final temperature of the mixture when thermal equilibrium is reached.
 - How much heat energy did the metal block lose?
2. **Scenario:** A gas is enclosed in a container with a movable piston. Initially, the gas has a volume of 0.02 m^3 at a pressure of $2.0 \times 10^5 \text{ Pa}$. The gas expands isothermally to a final volume of 0.05 m^3 .
 - State Boyle's Law and explain why this process is described by it.
 - Calculate the final pressure of the gas.
 - Sketch a pressure-volume (P-V) diagram for this process.
 - If the process were adiabatic instead of isothermal, how would the final pressure compare to the isothermal case? Explain your reasoning.

Waves:

1. **Scenario:** A tuning fork with a frequency of 440 Hz produces sound waves that

travel through air at a speed of 340 m/s .

- Define the terms frequency and wavelength of a wave.
 - Calculate the wavelength of the sound waves produced by the tuning fork.
 - If the sound waves travel from air into water where the speed of sound is 1480 m/s , what happens to the frequency and wavelength of the sound waves? Calculate the new wavelength in water.
 - Explain the phenomenon of superposition of waves. Give one example.
2. **Scenario:** Two loudspeakers are placed 2.0 m apart and emit sound waves of the same frequency and are in phase. An observer walks along a line parallel to the line joining the loudspeakers at a distance of 5.0 m from them.
- Explain the conditions for constructive and destructive interference of sound waves.
 - At what positions along the observer's path will they hear the loudest sound? (Consider only the direct path from the speakers).
 - How would the pattern of loud and soft sounds change if the frequency of the sound waves was increased?

These scenarios cover concepts like forces, motion, energy, heat transfer, thermal properties of matter, wave properties, and superposition. They encourage students to apply the principles they have learned to real-world situations. You can adjust the numerical values and contexts to suit the specific topics covered in your S5 term one curriculum.