**Energy**

1. **Sprinter's Energy:** A 100m sprinter converts chemical energy from food into kinetic energy. Assuming a sprinter has a mass of 70kg and reaches a top speed of 10m/s, calculate their kinetic energy at maximum speed. How efficient is this energy conversion if they consumed 300 kcal of energy before the race? (Note: 1 kcal = 4184 J)
2. **High Jumper's Potential Energy:** A high jumper of mass 65kg reaches a height of 2.3m. Calculate their gravitational potential energy at this point. Assuming no energy loss, what is their velocity just before they leave the ground?
3. **Bow and Arrow:** Discuss the energy transformations involved in archery, from the potential energy stored in the bow to the kinetic energy of the arrow. How does the mass of the arrow affect its kinetic energy for a given draw strength?

**Momentum**

1. **Javelin Throw:** A javelin with a mass of 0.8kg is thrown at a speed of 30m/s. Calculate its momentum. If the athlete exerts a force of 800N on the javelin for 0.2s, what is the impulse imparted to the javelin?
2. **Weightlifting:** A weightlifter lifts a 150kg barbell from the ground to a height of 2.2m in 2 seconds. Calculate the average power output of the weightlifter. What is the momentum of the barbell when it is at its highest point?
3. **Hockey Puck:** A hockey puck with a mass of 0.16kg is hit with a force of 200N for 0.05s. Calculate the change in momentum of the puck. If the puck was initially at rest, what is its final velocity?

**Additional Questions**

1. **Diving:** Analyse the energy transformations involved in a diving competition, from the diver's potential energy on the platform to their kinetic energy entering the water.
2. **Cycling:** Explain the factors affecting a cyclist's power output, such as air resistance and rolling resistance. How does gear ratio influence a cyclist's speed and power?

Solutions















