Problem Sheet No. 10

1. The 200-kg lunar lander is descending onto the moon's surface with a velocity of 6 m/s when its retro-engine is fired. If the engine produces a thrust T for 4 s that varies with the time as shown and then cuts off, calculate the velocity of the lander when t = 5 s, assuming that it has landed. Gravitational acceleration at the moon's surface is 1.62 m/s^2.
   Ans. v = 2.10 m/s

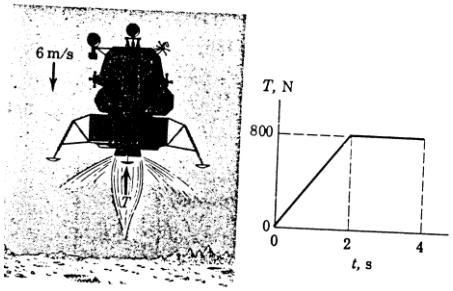

Figure-1

2. The vertical motion of the 3-kg cylinder is controlled by the force P applied to the end rollers of the extensible framework shown. If the upward velocity v of the cylinder is increased from 2 m/s to 4 m/s in 2 seconds, calculate the average force R_{av} under each of the to rollers during the 2-s interval. Analyze the entire system as a unit and neglect the small mass of the framework.
   Ans. R_{av} = 16.22 N

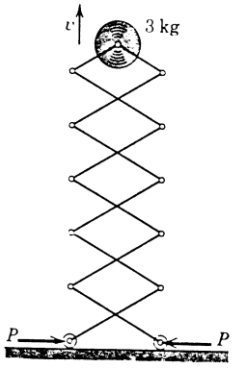

Figure-2

3. The force P, which is applied to the 10-kg block initially at rest, varies linearly with the time as indicated. If the coefficients of static and kinetic friction between the block and the horizontal surface are 0.6 and 0.4 respectively, determine the velocity of the block when t = 4 s.
   Ans. v =6.61 m/s

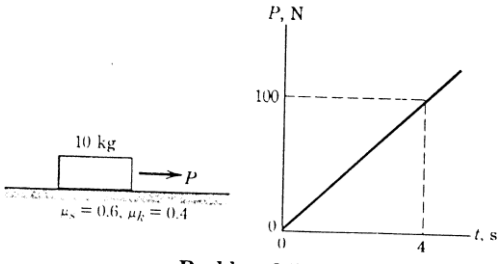

Figure-3

4. A tennis player strikes the tennis ball with her racket while the ball is still rising. The ball speed before impact with the racket is v_1 = 15 m/s and after impact is speed is v_2 = 22 m/s, with directions as shown in the figure. If the 60g ball is in contact with the racket for 0.05s, determine the magnitude of the average force R exerted by the racket on the ball. Find the angle β made by R with the horizontal. Comment on the treatment of the ball weight during impact.
   Ans. R = 43.0 N, β = 8.68^0

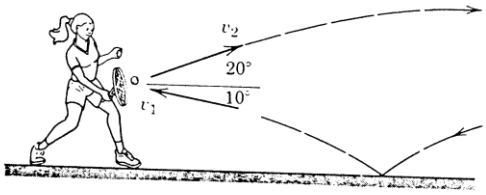

Figure-4

5. The simple pendulum A of mass m_A and length l is suspended from the trolley B of mass mg. If the system is released from rest at θ = 0, determine the velocity v_B of the trolley when θ = 90^0. Friction is negligible.

$$Ans. v_B = \frac{m_A}{m_B}\sqrt{\frac{2gl}{l + m_A / m_B}}$$

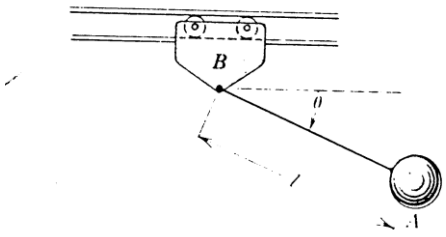

Figure-5