Problem Sheet No. 6

1. The spring is unstretched when x =0. If the body moves from the initial position $x_1 = 100$ mm to the final position $x_2 = 200$ mm, (a) determine the work done by the spring on the body and (b) determine the work done on the body by its weight.
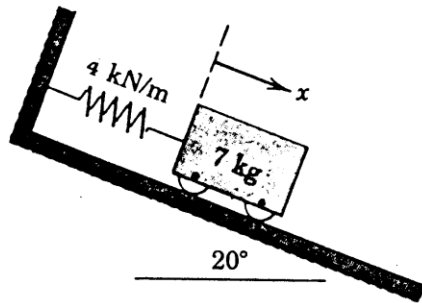Ans. (a) $U_{1-2} = -60$ J, (b) $U_{1-2} = 2.35$ J.

Figure -1

2. The small collar of mass m is released from rest at A and slides down the curved rod in the vertical plane with negligible friction. Express the velocity v of the collar as it strikes the base at B in terms of the given conditions.
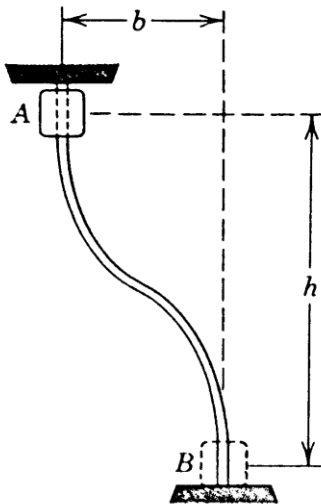$$Ans. v = \sqrt{2gh}$$

Figure -2

3. The 6 kg cylindrical collar is released from rest in the position shown and drops onto the spring. Calculate the velocity v of the cylinder when the spring has been compressed 50 mm.
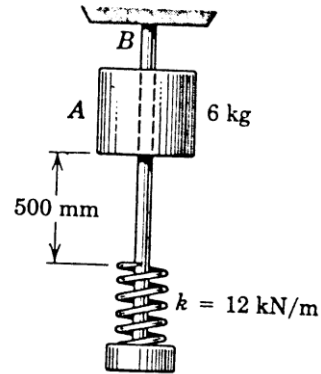Ans. $v = 2.41$ m/s

Figure -3

4. The nest of two springs is used to bring the 0.5-kg plunger A to a stop from a speed of 5 m/s and reserve its direction of motion. The inner spring increases the deceleration, and the adjustment of its position is used to control the exact point at which the reversal takes place. If this point is to correspond to a maximum deflection $\delta = 200$ mm for outer spring, specify the adjustment of the inner spring by determining the distance s. The outer spring has a stiffness of 300 N/m and the inner one a stiffness of 150 N/m.
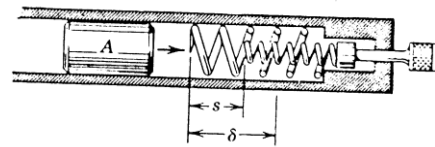Ans. $s = 142.3$ mm

Figure-4

5. The force P = 40 N is applied to the system, which is initially at rest. Determine the speeds of A and B after A has moved 0.4 m.
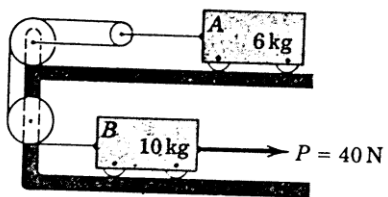Ans. $v_A = 1.180$ m/s, $v_B = 2.36$ m/s

Figure-5

6. The car of mass m accelerates on a level road under the action of the driving force F from a speed v1 to a higher speed v2 in a distance s. If the engine develops a constant power output P, determine v2. Treat the car as a particle under the action of the single horizontal force F.

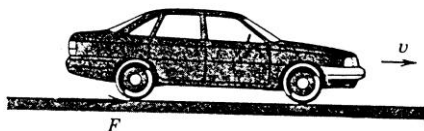Ans. $v_2 = \left(\dfrac{3Ps}{m} + v_1^{\,3} \right)^{\frac{1}{3}}$

Figure -6