Problem Sheet No. 11

1. What fraction n of the weight of the jet airplane is the net thrust) nozzle thrust T minus air resistance R) required for the airplane to climb at an angle θ with the horizontal with an acceleration a in the direction of flight.

$$Ans.n = \sin\theta + \frac{a}{g}$$

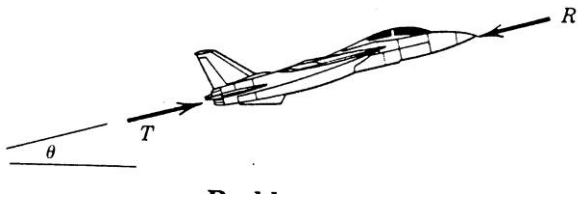

figure-1

2. One cylinder B is connected with block A as shown. Neglect all friction and the mass of the pulleys and determine the accelerations of bodies A and B upon release from rest.
Ans. $a_A = 1.024$ m/s^2 down the incline
$a_B = 0.682$ m/s^2 up.

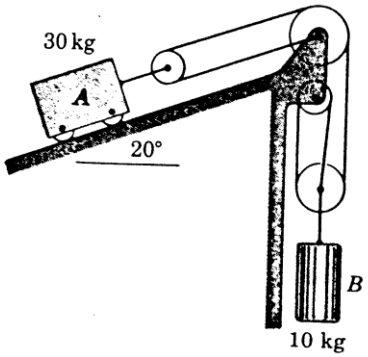

Figure-2

3. The 1.8 kg collar is released from rest against the light elastic spring, which has a stiffness of 1750 N/m and has been compressed a distance of 150 mm. Determine the acceleration a of the collar as a function of the vertical displacement x of the collar measured in meters from the point of release. Find the velocity v of the collar when x = 0.15m. Friction is negligible.
Ans. $a_x = 136.0 - 972x$, v = 4.35 m/s.

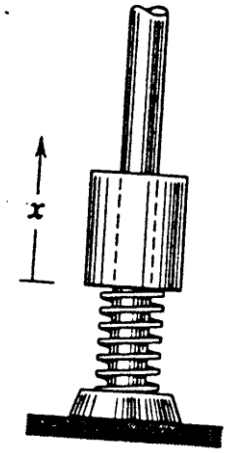

Figure-3

4. A chain of length 2*l* with a mass *p* per unit length is hanging in the equilibrium position shown. If end B is given a slight downward displacement, the imbalance cause an acceleration. Determine the acceleration of the chain in terms of the upward displacement *x* of end A and find the velocity *v* of end A as it reaches the top. Neglect the mass and diameter of the pulley.

$$Ans.a = \frac{x}{l}g, v = \sqrt{gl}$$

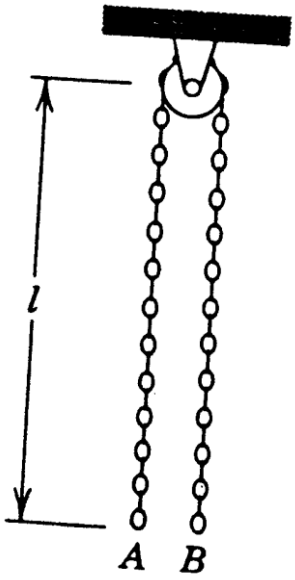

Figure-4

5. In a test of resistance to motion in an oil bath, a small steel ball of mass m is released from rest at the surface (y = 0). If the resistance to motion is given by $R = kv$ where k is a constant, derive an expression for the depth h required for the ball to reach a velocity v.

$$Ans.h = \frac{m^2 g}{k^2} in\left(\frac{1}{1-kv/(mg)}\right) - \frac{mv}{k}$$

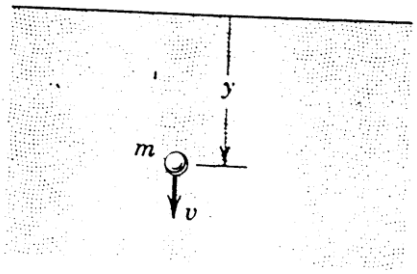

Figure-5

6. The system is released from r3est in the position shown. Calculate the tension T in the cord and the acceleration a of the 30-kg block. The small pulley attached to the block has negligible mass and friction. (Suggestion : First establish the kinematic relationship between the acceleration of the two bodies)
Ans. T = 138.0 N, a = 0.766 m/s^2

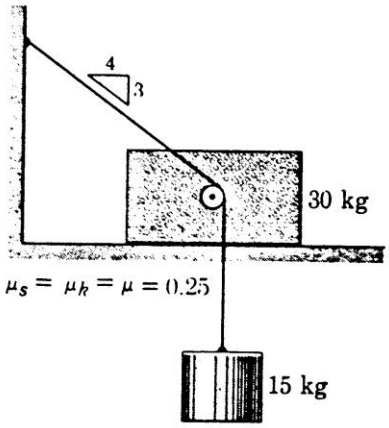

Figure-6