PHYSICS – MECHANICS

SCAN 61-62

Exercise 1 – Statics

The uniform slender bar of length $3r$ and mass m rests against the circular wall as shown in Figure 1. Static equilibrium is assumed and friction is neglected.

1 – Introduce all the relevant coordinate systems and parameters.

2 – Determine the contact force at point C in terms of m, g and geometrical parameters

3 – Determine the reaction force at the pivot at point O in terms of m, g and geometrical parameters.

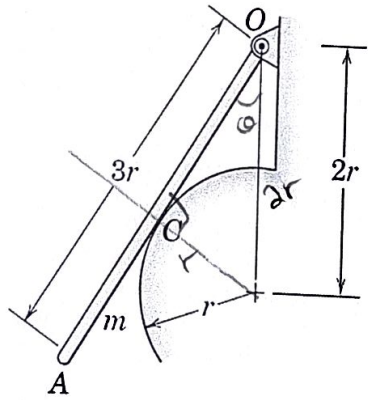

Figure 1.

Exercise 2 – Miscellaneous topics…:

Consider the man of mass m in a cart of mass M on an incline as shown in Figure 2. In what follows, all friction and the mass of the rope and pulleys are neglected.

1 – Assuming static equilibrium, what is the pull Ps exerted by the man on the rope? Explain the interest of the pulley system in reducing the force needed for equilibrium.

2 – The man now exerts a pull Pd (larger than Ps), determine the acceleration of the cart and deduce the time needed to climb a distance D from the position of static equilibrium along the incline.

3 – Determine the work generated by all the external forces on the system cart + man when it moves a distance D from the position of static equilibrium along the incline.

$W.D = (P_y - (M+m)g\sin\alpha)\,D$

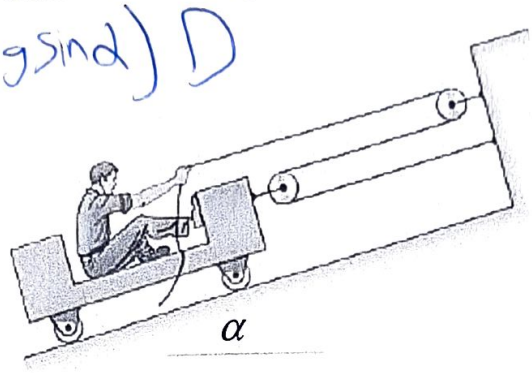

Figure 2.

Exercise 3 – Energy – Work:

The crawler-wrecking crane in Figure 3 is moving at constant speed v when it is suddenly brought to a stop. The objective of this exercise is to determine the maximum angle θ_{MAX} through which the wrecking ball swings.

1 – What is the value of angle θ when the system moves at constant speed? Precise justifications are required.

2 – Isolate the ball (mass m) and determine the work of the external forces between $\theta = 0$ and a position defined by angle θ as shown in the figure.

3 – Apply the Kinetic Energy Theorem to the isolated ball.

4 – Deduce the maximum angle of oscillation θ_{MAX} reached after the sudden stop.

$F = Ma$

$W = F \times D$

$= 0$

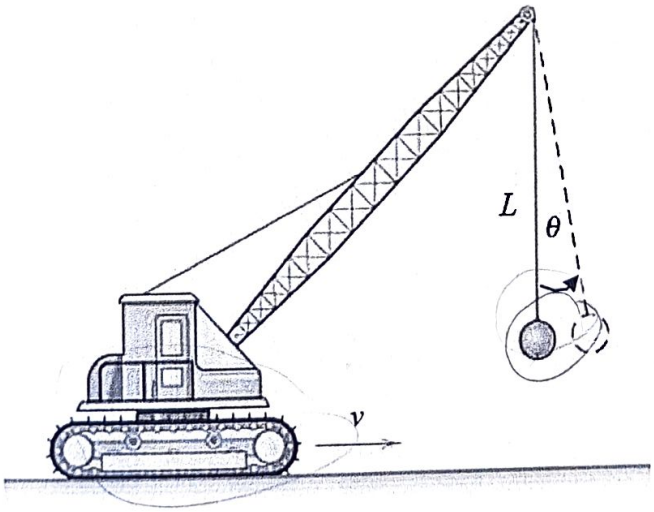

Figure 3.