1. (20%)

In a "worst-case" design scenario, a 2000-kg elevator with broken cables is falling at 25m/s when it first contacts a cushioning spring at the bottom of the shaft. The spring is supposed to stop the elevator, compressing 3.00m as it does so (Fig. 1). During the motion a safety clamp applies a constant 17,000-N frictional force to the elevator. As a design consultant, you are asked to determine what the force constant of the spring should be.

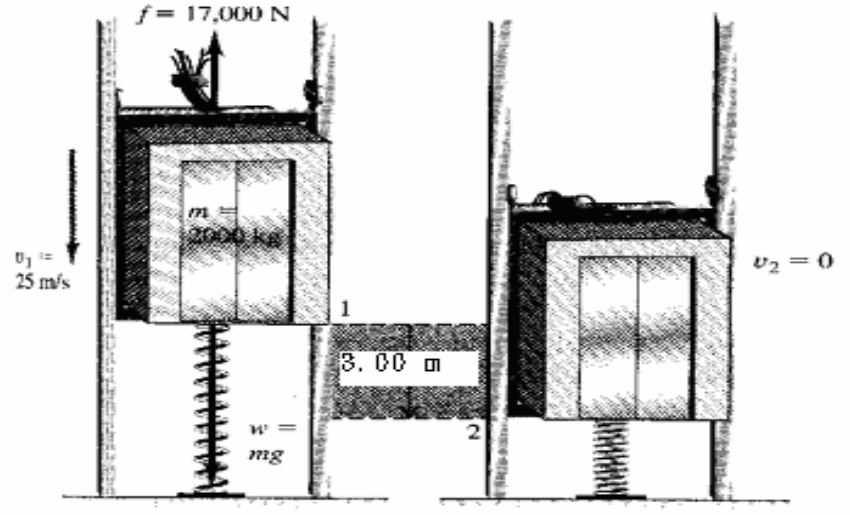

Fig. 1

2. (20%)

Fig. 2 shows the flywheel in a car engine under test. The angular position θ of the flywheel is given by

$$\theta = (2.0 rad/s^3)t^3$$

The diameter of the flywheel is 0.36m.

(a) Find the angle θ, in radians and in degrees, at times $t_1 = 2.0s$ and $t_2 = 5.0s$.

(b) Find the distance that a particle on the rim moves during that time interval.

(c) Find the average angular velocity, in rad/s and in rev/min (rpm), between $t_1 = 2.0s$ and $t_2 = 5.0s$.

(d) Find the instantaneous angular velocity at time $t = t_2 = 5.0s$.

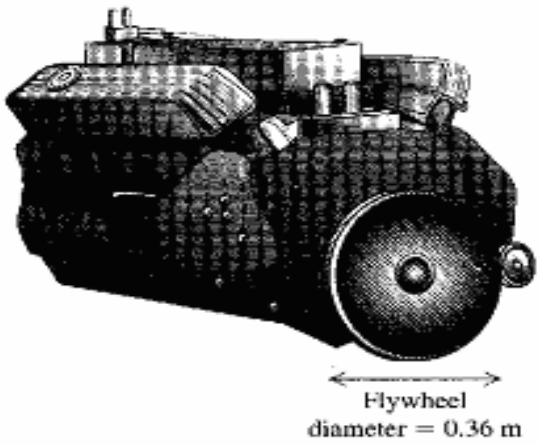

Fig. 2