MEC3705 – DYNAMICS

KINEMATICS OF PARTICLES

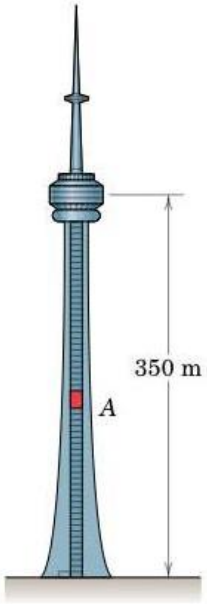
- **RECTILINEAR MOTION**

ASSIGNMENT 1 : Due: Friday 23rd August, 2024

INSTRUCTIONS: Please show your working clearly and use the SI units for all your calculations.

Question 1

2/20 The main elevator A of the CN Tower in Toronto rises about 350 m and for most of its run has a constant speed of 22 km/h. Assume that both the acceleration and deceleration have a constant magnitude of $\frac{1}{4}g$ and determine the time duration t of the elevator run.



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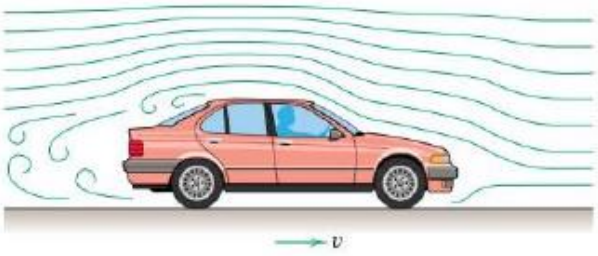
Question 2

2/41 The aerodynamic resistance to motion of a car is nearly proportional to the square of its velocity. Additional frictional resistance is constant, so that the acceleration of the car when coasting may be written $a = -C_1 - C_2v^2$, where C_1 and C_2 are constants which depend on the mechanical configuration of the car. If the car has an initial velocity v_0 when the engine is disengaged, derive an expression for the distance D required for the car to coast to a stop.

Ans. $D = \frac{1}{2C_2} \ln\left(1 + \frac{C_2}{C_1} v_0^2\right)$



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Question 3

2/46 On its takeoff roll, the airplane starts from rest and accelerates according to $a = a_0 - kv^2$, where a_0 is the constant acceleration resulting from the engine thrust and $-kv^2$ is the acceleration due to aerodynamic drag. If $a_0 = 2$ m/s^2, $k = 0.00004$ m^{-1}, and v is in meters per second, determine the design length of runway required for the airplane to reach the takeoff speed of 250 km/h if the drag term is (*a*) excluded and (*b*) included.

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