

PHYSICS 180

Problem set #1

due: 5 PM, Wednesday, Sept 20th

*"I hear and I forget.
I see and I remember.
I do and I understand."
...anonymous*

(mks units throughout)

- 1) Annie and Evelyn observe that, on average, it takes approximately 10 days for a small glass of water to completely evaporate when left outdoors. What would they estimate for the average annual precipitation on planet Earth?

- 2) Emily measures that a ball has a displacement from a hole given by $x(t) = (5 - t - 3t^2)e^{-t/2}$ for $t > 0$. What is the average speed of the ball between 1 and 2 s? When is the ball at its maximum distance from the hole? What is the speed of the ball at $t = 0.25$ s?

- 3) i) The gravitational force between two objects varies as the product of their masses and inversely as the square of the distance separating them. What is the dimensionality of the proportionality constant?
ii) It is found that the force on an object varies as $F = AV^{-3}\left(\frac{dm}{dt}\right) + \frac{B}{t}v^n$ where V is the object's volume, dm/dt is the rate at which it gains mass and v is its speed. What is the dimensionality of A and what is n if $B = 5 \text{ kgs}^2/\text{m}^2$?

- 4) Alex, who is moving her belongings to residence at the University of Toronto, is driving a Dodge truck south on highway 400. Suddenly a box falls off her truck and stays where it lands. Peter, who is driving a Toyota at 100 km/hr, is 30 meters (~6 or 7 car lengths) behind the Dodge when he sees the box fall. It takes him 0.4 s to react (*i.e.*, before he can brake) after he sees the box hit the road, and he can then uniformly decelerate his car to a stop in 1.8 s. Can he avoid hitting the box if he doesn't change lanes? For the same deceleration what is Peter's minimum reaction time to avoid hitting the box?