Physics 2A Spring 2020
Discussion 2

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1. **Warm-ups**

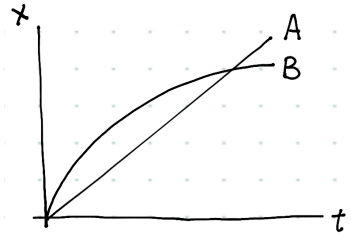
   (1) Approximately how fast does your car accelerate?

   A. 0.3 m/s^2
   B. 3 m/s^2
   C. 30 m/s^2
   D. 300 m/s^2
   E. 3000 m/s^2

   (2) A train moves at a constant speed of 36 km/h along a straight track, which terminates 3 km ahead. This means the operator must bring the train to a complete stop before it reaches the end of the track and has to figure out the required (negative) acceleration. Assume he can only apply a constant acceleration to the train. Which of the following equations is *best* for this problem?

   A. $v(t) = v(0) + at$
   B. $v(t)^2 = v(0)^2 + 2a\Delta x$
   C. $\Delta x = \frac{1}{2}(v(0) + v(t))t$
   D. $x(t) = x(0) + v(0)t + \frac{1}{2}at^2$

   (3) The following diagram shows the positions of A and B as functions of time. Do the two objects ever have the same velocity? If so, at what time? Do they ever have the same acceleration?



2. **2D kinematics**

   A ball is launched in the horizontal direction with velocity 3 m/s off a cliff with a height of 500 m. How far is the ball from the cliff when it lands? (Assume $g = 9.8$ m/s^2 and no air resistance. The ground is flat.) Also find and sketch the trajectory of the ball.

3. **Non-constant acceleration**

   A bead is connected to the ceiling through a spring and oscillates up and down about its equilibrium position $x = 0$ with initial position x_0 and initial velocity v_0. Find the velocity v and position y of the bead as functions of time for the following scenarios:

   (a) $a = A\cos(\omega t)$ where $A = 2$ cm/s^2 and $\omega = 2\pi$ s^{-1}.

   (b) $a = a_0 e^{bv}$ where $a_0 = 1$ cm/s^2 and $b = 1$ s/cm (you can use $\int dx \ln x = -x + x\ln x + C$).