

Due before the last tutorial, monday December 17th.

If any calculations are required to obtain your answers, please show them.

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1. An object moves along a straight line. Its position at time  $t$  is given by

$$x = 1 - \frac{1}{2}t$$

- (a) [2 pts.] What is the position of the particle at time  $t = 0$ ? What is the position at time  $t = 6$ ?
- (b) [2 pts.] At what time does the object pass the point  $x = 0$ ?
- (c) [3 pts.] Find the velocity, speed and acceleration of the object.
- (d) [3 pts.] Plot the position as a function of time, i.e., plot the function  $x(t)$ .  
Plot the velocity as a function of time.  
Plot the acceleration as a function of time.
- (e) [1 pts] When does the velocity reach the value  $v = +2$ ?

2. An electron moving along the  $x$  axis has position given by  $x = 4te^{-t}$ .

- (a) [1 pt.] What is the position of the electron at time  $t = 0$ ?
- (b) [4 pts.] At which instant will the electron momentarily stop?
- (c) [3 pts.] What is the position of the electron, when it momentarily stops?
- (d) [2 pts.] Is the electron moving under constant acceleration? Explain why or why not.

3. (a) [2 pts.] An automobile has speed 70 km/h. Express this in SI units.
- (b) [2 pts.] A racing car has acceleration  $1.45g$ , where  $g$  is the acceleration due to gravity. Express the acceleration in SI units.

4. A ball of foamy material is expanding. Its volume at time  $t$  is given by

$$V(t) = A + Bt \quad \begin{cases} A \text{ and } B \\ \text{are positive} \end{cases}$$

The expanding ball has constant mass  $m_0$  and the density is uniform within the ball.

- (a) [**5 pts.**] Find the dimensions of the constants  $A$  and  $B$ , in terms of the fundamental dimensions  $M$ ,  $L$  and  $T$  (mass, length and time).
- (b) [**1 pt.**] Find the rate of change of the volume.
- (c) [**5 pts.**] Calculate the density at time  $t$ . Does the density increase or decrease with time? Find the rate of change of the density.
5. A body moves with uniform acceleration along a straight line. At time  $t = 0$ , the position is  $-5$  and the velocity is  $2$ . At time  $t = 2$ , the body is found to be at position  $+5$ .
- (a) [**3 pts.**] Calculate the acceleration of the particle.
- (b) [**3 pts.**] What will be the position at time  $t = 6$ ?
6. A ball is thrown vertically upwards with velocity  $19.6\text{m/s}$ .
- (a) [**3 pts.**] At what time does the ball reach its highest point?
- (b) [**3 pts.**] How high does the ball reach?
- (c) [**2 pts.**] How much time does the ball need to return to the point from which it was thrown?