

Assignment No. 2

Problem 1

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$$x(t) = at^2 - bt^3$$

where $a = 1.5 \text{ m/s}^2$ and $b = 0.0500 \text{ m/s}^3$.

Calculate the average velocity of the car for each time interval:

- a) $t = 0$ to $t = 2.00 \text{ s}$;
 - b) $t = 0$ to $t = 4.00 \text{ s}$
 - c) $t = 2.00 \text{ s}$ to $t = 4.00 \text{ s}$
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Problem 2

The position of the front bumper of a test car under microprocessor control is given by

$$x(t) = 2.17 \text{ m} + (4.80 \text{ m/s}^2)t^2 - (0.100 \text{ m/s}^6)t^6$$

- a) Find its position and acceleration at the instants when the car has zero velocity.
 - b) Draw x - t , v_x - t , and a_x - t graphs for the motion of the bumper between $t = 0$ and $t = 2.00 \text{ s}$.
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Problem 3

The table shows test data for a fastest sport car. The car is moving in a straight line (x -axis)

Time (s)	0.0	2.1	20.0	53.0
Speed (mi/h)	0	60	200	253

- a) sketch v_x - t graph of this car's velocity (in m/s) as a function of time. Is its acceleration constant?
 - b) Calculate the car's average acceleration (in m/s^2) between (i) 0 and 2.1 s; (ii) 2.1 s and 20.0 s. (iii) 20.0 s and 53 s. Are these results consistent with your graph in part a)? Explain.
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Problem 4

Two cars start 300 m apart and drive toward each other at steady 10.0 m/s. On the front of one of them an energetic grasshopper jumps back and forth between the cars with a constant velocity of 15 m/s relative to the ground. The insect jumps the instant he lands, so he spends no time resting on either car. What total distance does the grasshopper travel before the cars hit?

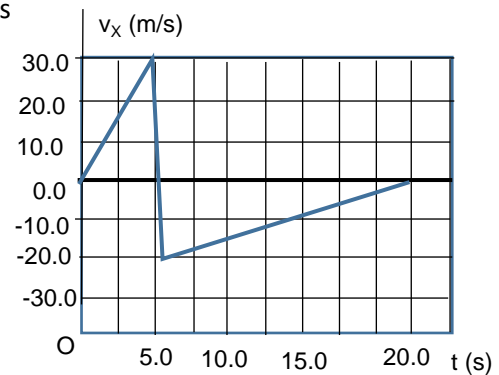
Problem 5

A jet fighter pilot wishes to accelerate from rest at a constant acceleration of $5g$ to reach Mach 3 (three times speed of sound) as quickly as possible. Experimental tests reveal that he will black out if this acceleration lasts for more than 5.0 s. Use 331 m/s for the speed of sound.

- a) Will the period of acceleration last long enough to cause him black out?
 - b) What is the greatest speed he can reach with an acceleration of $5g$ before black out?
 g is acceleration of gravity
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Problem 6

A rigid ball traveling in straight line (the x-axis) hits a solid wall and suddenly rebounds during a brief instant. The v_x - t graph shows this ball's velocity as a function of time. During the first 20.0 s of its motion, find: (a) the total distance the ball moves and (b) its displacement. (c) Sketch a graph of a_x - t for this ball's motion. (d) Is the graph shown really vertical at 5.0 s? Explain.

**Problem 7**

Given two vectors $\underline{A} = 4.00\hat{i} + 7.00\hat{j}$ and $\underline{B} = 5.00\hat{i} - 2.00\hat{j}$.

- find the magnitude of each vector;
- write an expression for the vector difference $\underline{A} - \underline{B}$ using unit vectors;
- find the magnitude and direction of vector difference $\underline{A} - \underline{B}$;
- In a vector diagram show \underline{A} , \underline{B} , and $\underline{A} - \underline{B}$, and also show that your diagram agrees qualitatively with your answer in part c).