De Anza College

Introduction to Mechanics
How to Solve Problems

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Last time

- graphs of kinematic quantities

Overview

- how to solve problems
- example & exercise

How to solve problems

1. Draw a diagram, sketch, or graph showing the situation in the question.
2. Make a hypothesis or estimate of what the answer will be.
3. Solve the question or problem:
   a. Here, it's a 'problem' -
      i. Write out quantities given in question and quantity asked for.
      ii. Write out the equation(s) you will use. (Start from equations we have discussed in class.)
      iii. Do any required algebra.
      iv. Plug in givens and solve.
      v. Check units.
4. Analyze answer as appropriate.
   a. Compare answer to hypothesis - if it is not the same try to explain why.
   b. Is your answer reasonable? / Compare to other things your are familiar with.
   c. Consider limits or special cases.

Example 2.5 (from the textbook)

A boat moves slowly inside a marina (so as not to leave a wake) with a constant speed of 1.50 m/s. As soon as it passes the breakwater, leaving the marina, it throttles up and accelerates at 2.40 m/s^2.

(a) How fast is the boat moving after accelerating for 5.00 s?

(b) How far has the boat traveled in this time?

[1] Walker, pg 31.

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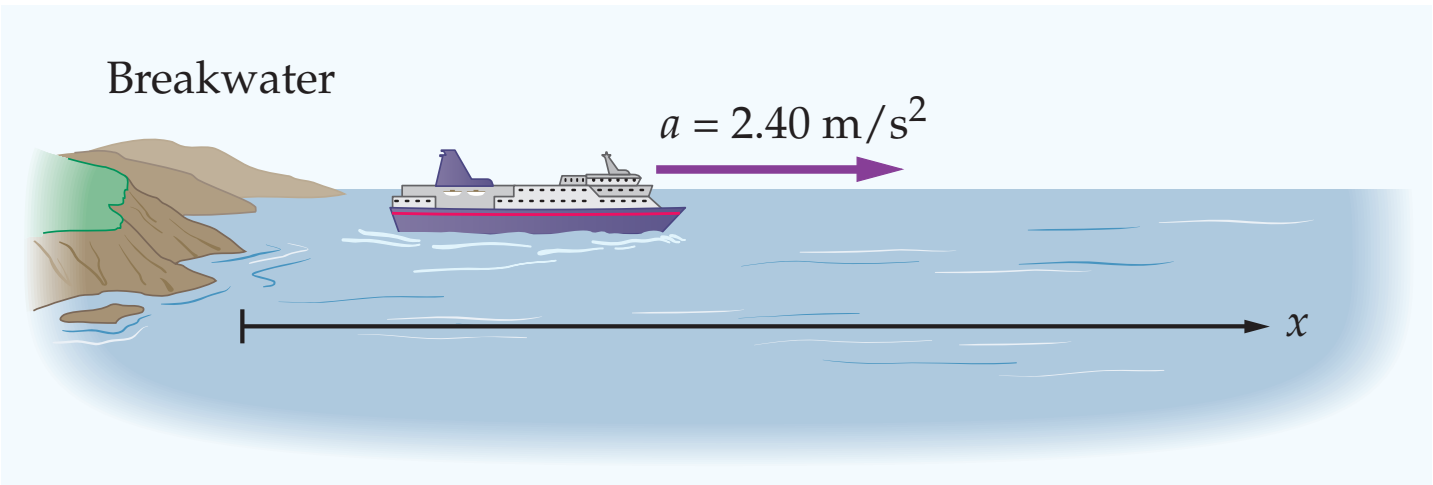
Sketch:



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Hypothesis:

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Hypothesis:
(a) 10 m/s. (Must be bigger than 1.50 m/s, but there's only so fast a boat can go.)

(b) 30 m. If the average speed is about 6 m/s (between 1.50 and 10 m/s) multiply that by 5 s to get 30 m.

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(a) How fast is the boat moving after accelerating for 5.00 s?

Given: $a = 2.40$ m/s^2, $v_0 = 1.50$ m/s, $t = 5.00$ s
Want: v_f

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Want: v_f

$$\vec{\mathbf{a}}_{\text{avg}} = \frac{\overrightarrow{\Delta \boldsymbol{v}}}{\Delta t} = \frac{\vec{\mathbf{v}} - \vec{\mathbf{v}}_0}{\Delta t}$$

Acceleration is constant, so $\vec{\mathbf{a}}_{\text{avg}} = \vec{\mathbf{a}}$

$$\vec{\mathbf{v}} = \vec{\mathbf{v}}_0 + \vec{\mathbf{a}}t$$

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Acceleration is constant, so $\vec{\mathbf{a}}_{\text{avg}} = \vec{\mathbf{a}}$

$$\begin{aligned} \vec{\mathbf{v}} &= \vec{\mathbf{v}}_0 + \vec{\mathbf{a}}\, t \\ &= \underline{13.5 \text{ m/s } \hat{\mathbf{i}}} \end{aligned}$$

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(b) How far has the boat traveled in this time?

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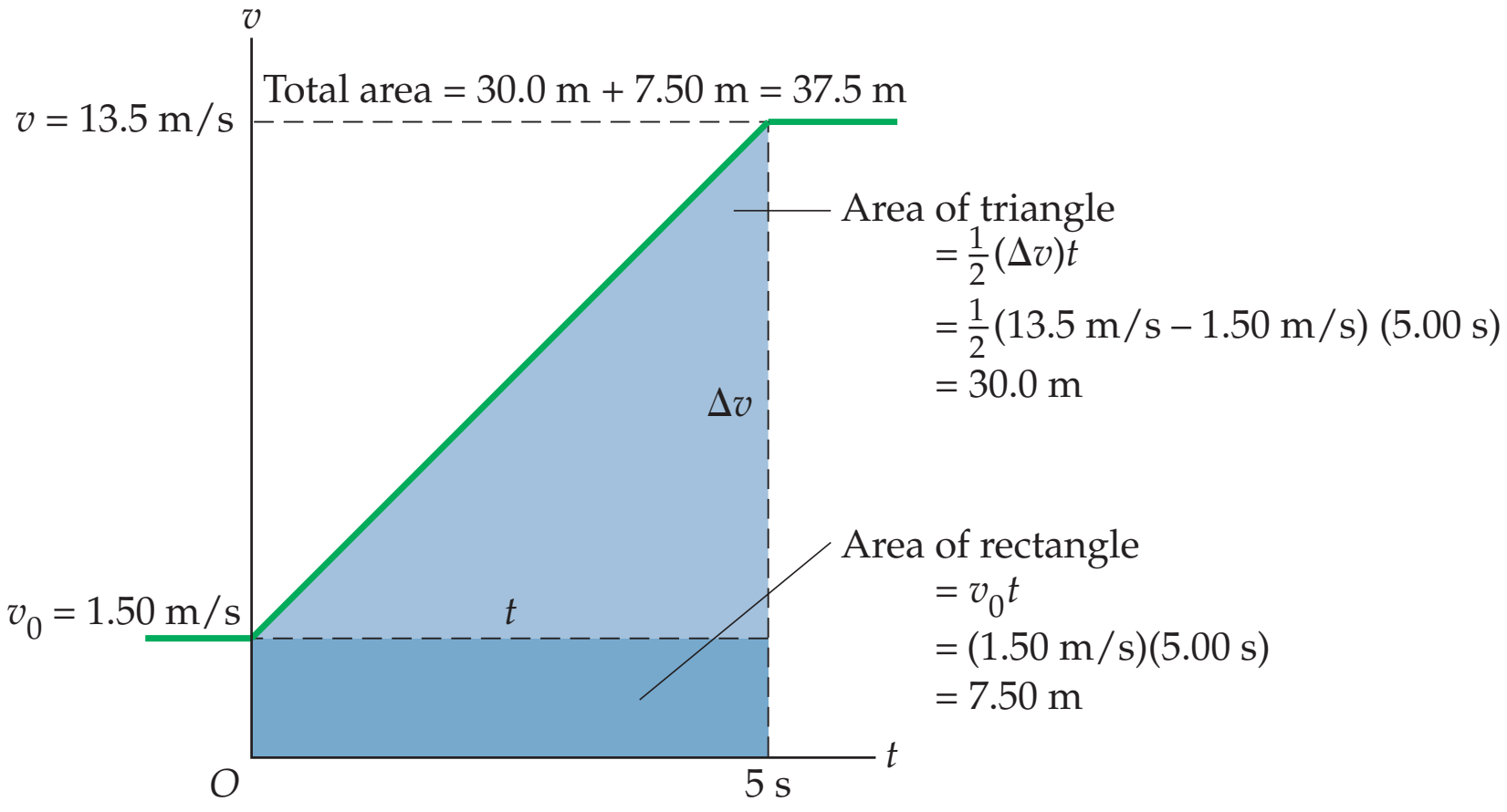

$$\overrightarrow{\Delta x} = 37.5 \text{ m } \hat{\mathbf{i}}$$

Example 2.5

Analyze answers:

(a) 13.5 m/s $\hat{\mathbf{i}}$. This one is a little bit bigger than my initial guess, but it's close. The units are correct. Seems reasonable.

(b) 37.5 m $\hat{\mathbf{i}}$. This is also bigger than my estimate, but it would be since my guess for part (a) was small. Units are correct. Also reasonable.

Now You Try It

A car is traveling along a straight road at 11 m/s and accelerates at a constant rate of 1.8 m/s^2. How long does it take to reach a speed of 20 m/s?

Summary

- how to solve problems
- example & exercise

First Test next week **Thursday, Jan 30**.

Homework

- graphs multiple choice worksheet, *do on 882-E scantron sheet*, due Wednesday, Jan 22.