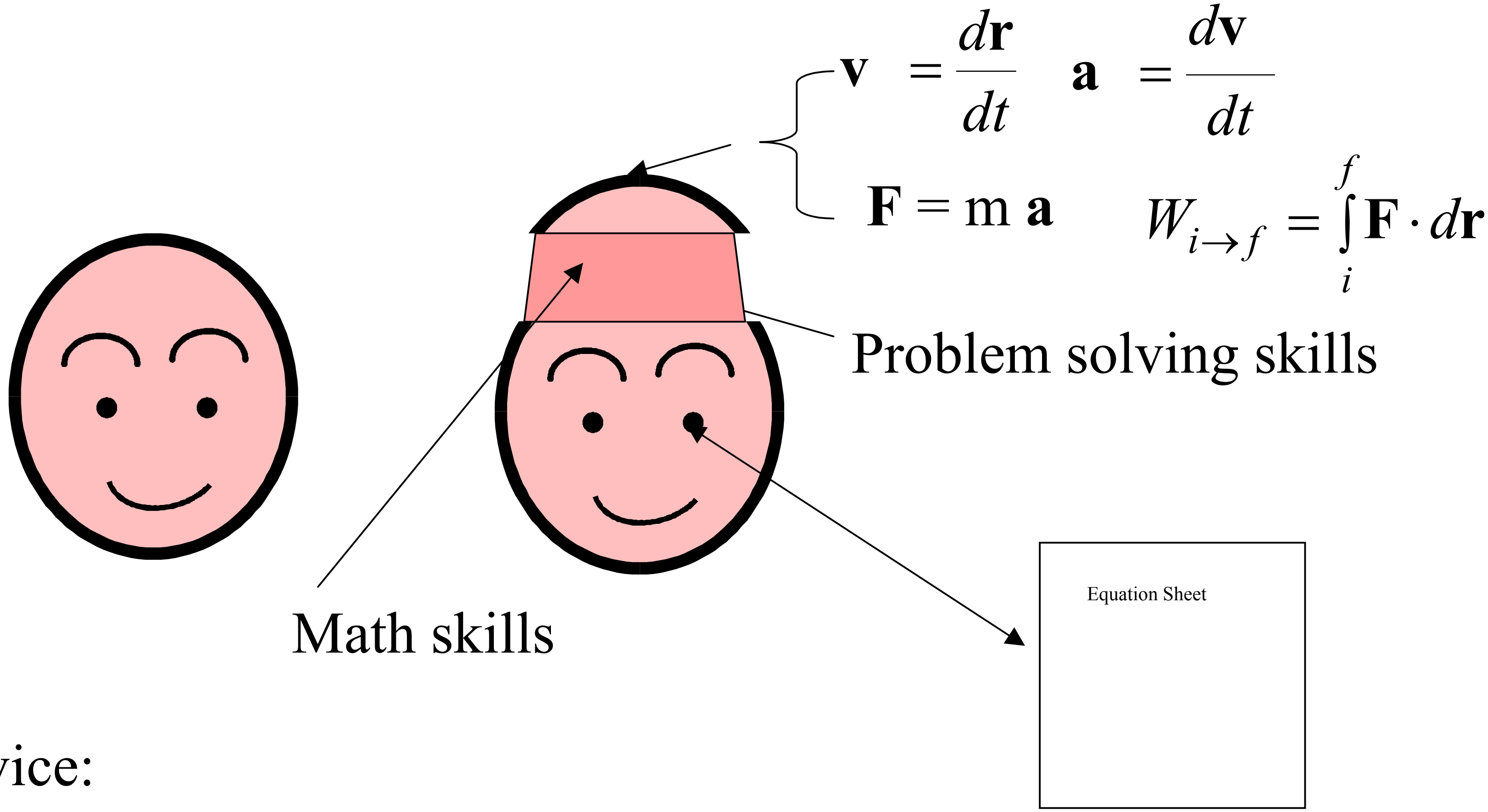
Announcements

First hour exam – Wed., Sept. 25th

- Bring HW notebook (label with your name) – I will collect it at the door and give you your exam with an assigned seat.
- For the exam itself bring:
  - Equation sheet
  - Calculator
  - Pencil
  - Clear head
- Before 10:55 AM, turn in exam booklet with equation sheet and all exam papers included and pick up your HW notebook.



Advice:

1. Keep basic concepts and equations at the top of your head.
2. Practice problem solving and math skills
3. Develop an equation sheet that you can consult.

Fundamental concepts and definitions:

$$\mathbf{r}(t) = \int_0^t dt'\,\mathbf{v}(t') = \int_0^t dt' \int_0^{t'} dt''\,\mathbf{a}(t'')$$

$$\mathbf{v}(t) = \frac{d\mathbf{r}(t)}{dt} = \int_0^t dt'\,\mathbf{a}(t')$$

$$\mathbf{a} = \frac{d\mathbf{v}}{dt}$$

$$W_{i\to f} = \int_i^f \mathbf{F}\cdot d\mathbf{r}$$

Fundamental "laws"

$$\mathbf{F} = \mathrm{m}$$

➔ $$W_{i\to f} = \tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_i^2$$

Special cases:

When $\mathbf{F}$=(constant), ➔ $\mathbf{a}$=(constant)

$\mathbf{v}(t) = \mathbf{v}_i + \mathbf{a}t$; $\mathbf{r}(t) = \mathbf{r}_i + \mathbf{v}_i t + \frac{1}{2}\mathbf{a}\, t^2$

Special forces:

Gravity near the surface of the earth: $\mathbf{F} = -mg\,\mathbf{j}$

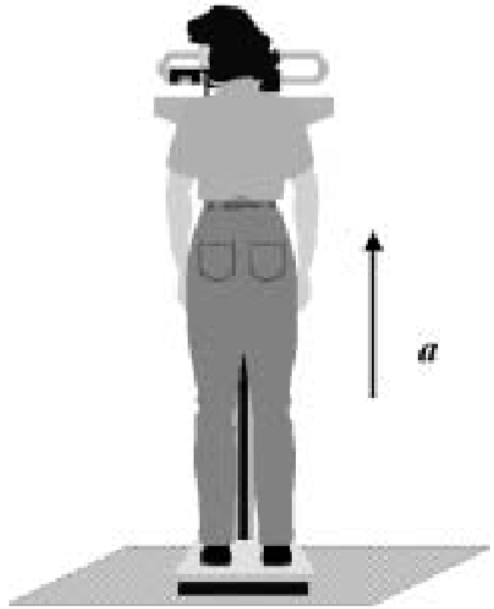
Kinetic friction: $f_k = \mu_k n$ (along surface opposing motion)

Static friction: $f_s = -F_{applied}$ (for $|f_s| < f_{s,max}$)

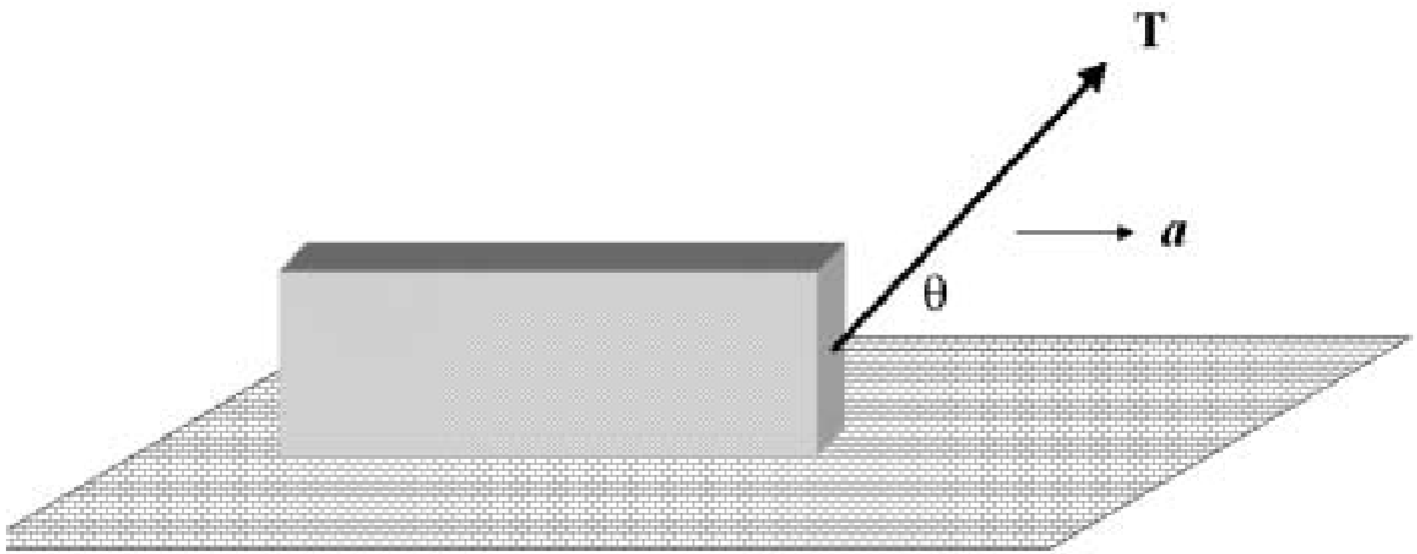
$f_{s,max} = \mu_s n$

Problem solving steps

1. Visualize problem – labeling variables
2. Determine which basic physical principle applies
3. Write down the appropriate equations using the variables defined in step 1.
4. Check whether you have the correct amount of information to solve the problem (same number of knowns and unknowns.
5. Solve the equations.
6. Check whether your answer makes sense (units, order of magnitude, etc.).

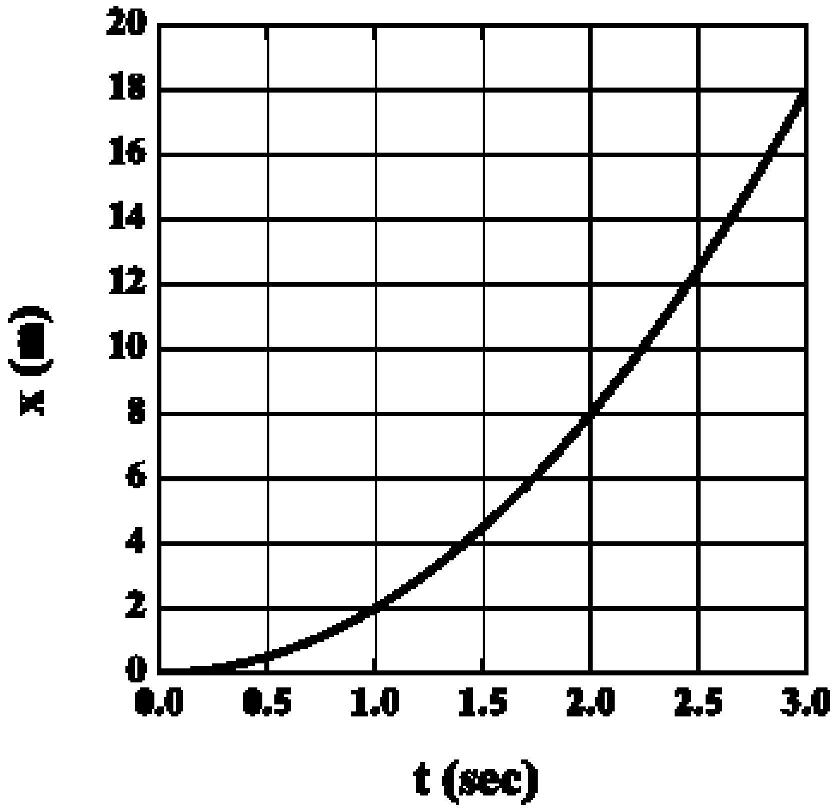


6. Consider the process of measuring weight in an accelerating elevator. Suppose that the elevator is initially rest and the scale (with the person on it) measures 600 N. Now, the elevator accelerates upward at a constant rate of $a = 2.45\ \text{m/s}^2$. What does the scale read now?



7. A heavy box (weight W = 1000 N) is being dragged along the floor with a constant horizontal acceleration $a = 2\ \mathrm{m/s^2}$ by a rope having a tension $\mathbf{T}$ at an angle $\theta = 20^\circ$ measured relative to the horizontal direction. The coefficient of kinetic friction between the box and the floor is $\mu_k = 0.5$. What is the magnitude of the tension $\mathbf{T}$?

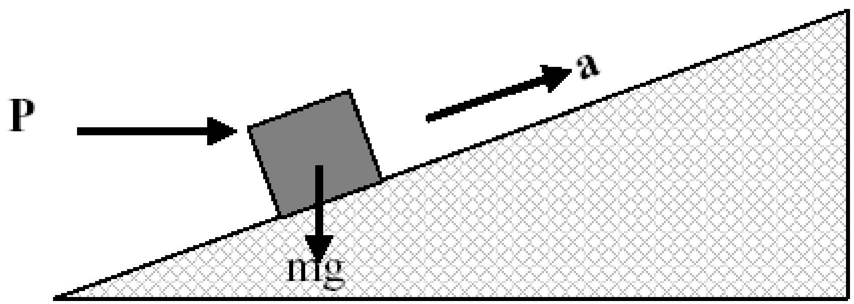
8. In the problem above, assume that the box starts at rest. What is its kinetic energy after it has moved a horizontal distance of 0.4 m?



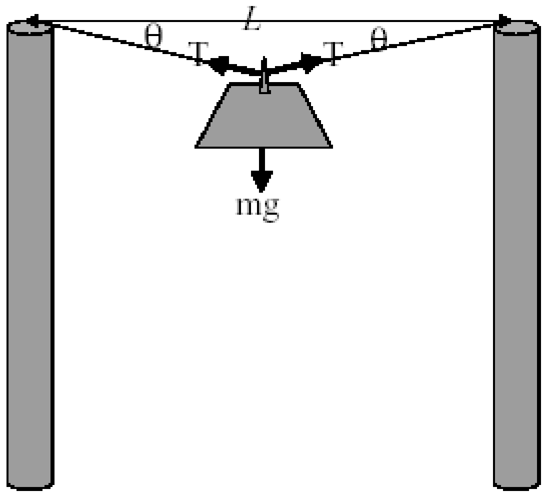
1. Consider the diagram shown above which shows the one-dimensional displacement versus time of a particle. What is

   (a) the *average* velocity $< v >_{avg}$ between the times of $t = 0$ and $t = 3$ s?

   (b) the *instanteous* velocity $v(t)$ at $t = 1$ s?



5. Suppose you are pushing with a horizontal force **P** a box of weight $mg = 300$ N up an incline at a constant acceleration of $a = 0.2$ m/s^2. Assume that the coefficient of kinetic friction between the box and the surface of incline is $\mu_k = 0.2$ and that the angle of the incline is $\theta = 10^o$. What is the magnitude of **P**?



6. A strong rope of length $L = 12$ m is stretched between two poles as shown in the figure. An object of weight $mg = 600$ N is suspended from the center of the rope which now is displaced from the horizontal by an angle of $\theta = 4^o$. What is the magnitude of the tension T in the rope?