Reminders 02-25-10:

-POW 5 Due Tuesday March 2 by 5PM.

-Quiz 5 Today Ch.5 and 6 in Lecture.

-Exam 2 March 2 Ch 5,6, and 14.

-Video lectures http://ocw.mit.edu/OcwWeb/Physics/8-01Physics-IFall1999/CoursesHome/index.htm

Objectives:

-Fluids Worksheet

-Work

-Work-Kinetic Energy Theorem

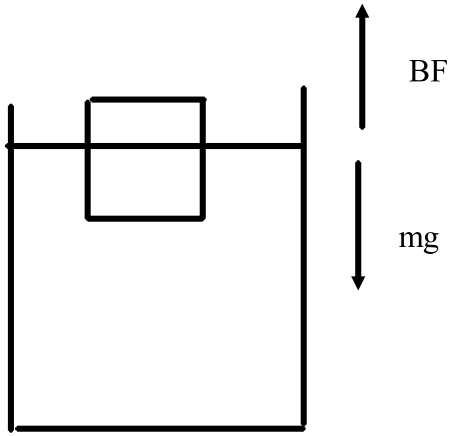
A cube of ice whose edges measure 20.0 mm is floating in a glass of ice-cold water with one of its faces parallel to the water's surface.

(a) How far below the water surface is the bottom face of the block?

m

(b) Ice-cold ethyl alcohol is gently poured onto the water's surface to form a layer 4.50 mm thick above the water. The alcohol does not mix with the water. When the ice cube again attains hydrostatic equilibrium, what will be the distance from the top of the water to the bottom face of the block?

m



part a

mg=BF

$$\rho_{object}V_{object}g=\rho_{water}V_{displaced}g=\rho_{water}(Ah)_{displaced}g$$

part b

$$mg=\rho_{object}V_{object}g=BF_{water}+BF_{alcohol}=$$
$$=\rho_{water}(Ah)_{displaced}g+\rho_{alcohol}(A0.00450m)_{displaced}g$$

F (displacement) = Work

Force through a displacement

displacement of point of application of force.

Better

$F_{parallel}$ (displacement)

$W = (F\cos\theta)(\text{displacement})$

If force produces x & y motion

$W = F_x \Delta x + F_y \Delta y = \vec{F} \cdot \Delta\vec{r}$

$= |\vec{F}||\Delta\vec{r}|\cos\theta$

$\vec{F} \cdot \Delta\vec{r} = |\vec{F}||\Delta\vec{r}|\cos\theta$

dot product

$$\vec{F} = F_x \hat{i} + F_y \hat{j} + F_z \hat{k}$$

$$\vec{S} = S_x \hat{i} + S_y \hat{j} + S_z \hat{k}$$

$$\vec{F} \cdot \vec{S} = \left(F_x \hat{i} + F_y \hat{j} + F_z \hat{k}\right) \cdot \left(S_x \hat{i} + S_y \hat{j} + S_z \hat{k}\right)$$

$$F_x \hat{i} \cdot S_x \hat{i} = F_x S_x \hat{i} \cdot \hat{i} = F_x S_x$$

$$F_x \hat{i} \cdot S_y \hat{j} = F_x S_y \hat{i} \cdot \hat{j} = 0$$

$$= F_x S_x + F_y S_y + F_z S_z$$

Example:

A force $\vec{F} = 1\,\hat{i} - 4\,\hat{j} + 2\,\hat{k}$

results in a displacement

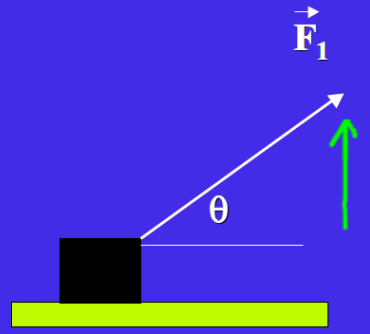
$$\vec{S} = 3\,\hat{i} + 2\,\hat{j} + 2\,\hat{k}$$

the work done by F through S is:

$W = (1)(3) + (-4)(2) + (2)(2) = -1\ N\,m$

Example:

A 10 kg mass is pulled by a 100 N force at an angle of 30°. The force is applied through a displacement of 3 m and the coefficient of kinetic friction is 0.2. What is the work done by the applied force? By friction? What is the net work done on the block?



$N = mg - F_1 \sin 30$

$= 98\,N - 100 \sin 30$

$= 48\,N$

$W_f = (100N)(3m)\cos 30° = 260J$

$W_N = 0 \qquad W_{mg} = 0$

$W_{f_k} = (\mu N)(3m)\cos 180°$

$= -(.2)(48N)3 = -29J$

$W_T = W_{NET} = 260J + -29J = \underline{231J}$

force that is not constant

$dW_1 = F_1 dx$

$dW_2 = F_2 dx$

⋮ ⋮

Add them up to find total work over finite displacement

$$W = \int F dx$$

even better

$$W = \int \vec{F} \cdot d\vec{r}$$

path integral

Best definition