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Monday Nov 8, Session 31 Review Exam III

MJA office hr 3:30-4:30PM Mon Nov 8

Wed Nov 10, Session 32 Work Energy, GC, HW#7 Returned

Friday Nov 12, Session 33, Exam III, 8:30-9:30AM JEB 104

Monday Nov 15, Session 34, MJA

Wedne office hour 3:30-4:30 PM MJA

Wed Nov 17, Session 35, MJA

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Thur Nov 18, Office hour: GE

Friday, Nov 19, Class canceled.

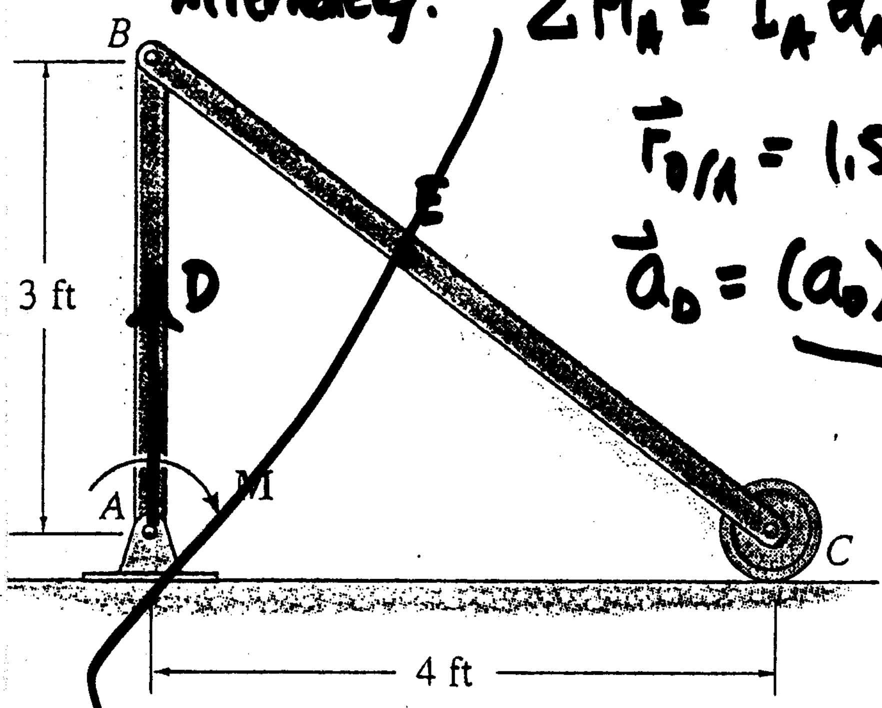
…he two pin-connected bars each have a weight …/ft. If a moment of $M = 60$ lb · ft is applied to bar …ermine the initial vertical reaction at C and the …al and vertical components of reaction at B. … the size of the roller at C. The bars are initially

In 29/2; We used $\sum M_D = I_D \alpha_{AB}$

Alternately: $\sum M_A = I_A \alpha_{AB} + m_{AB} \vec{r}_{D/A} \times \vec{a}_D$

$\vec{r}_{D/A} = 1.5 \vec{j}$

$\vec{a}_D = \underbrace{(a_D)_x \vec{i} + (a_D)_y \vec{j}}$



$\circlearrowleft - F_{By}(3) - M = I_A \alpha_{AB} + m_{AB} (1.5\vec{j}) \times [\ \ ]$

Prob. 17–103

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Move On To New Topic(s)

Integrals of Motion: Work & Energy, Impulse & Momentum.

	Work & Energy	Impulse & Momentum
Particles	14.1-14.6	15.1-15.4
Rigid Body	18	19

Start with Work & Energy for Particles

Text sections 14.1-14.6

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Work/Energy: The two configurations are defined in terms of geometry.

Fundamental Idea: Conservation of Energy Concept.

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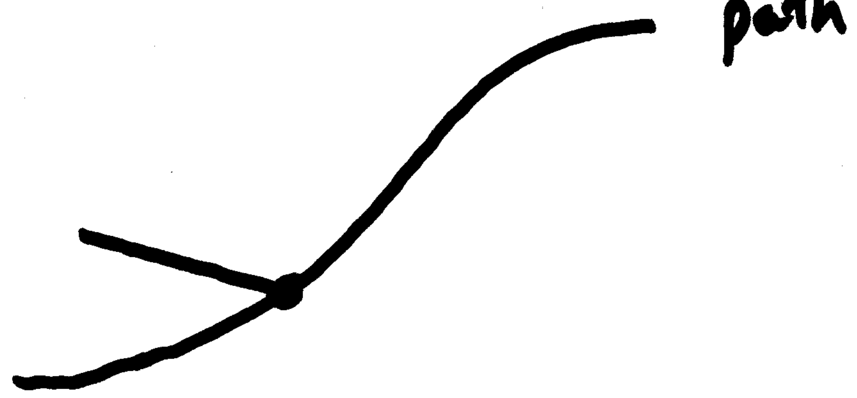
Work Done By a Force



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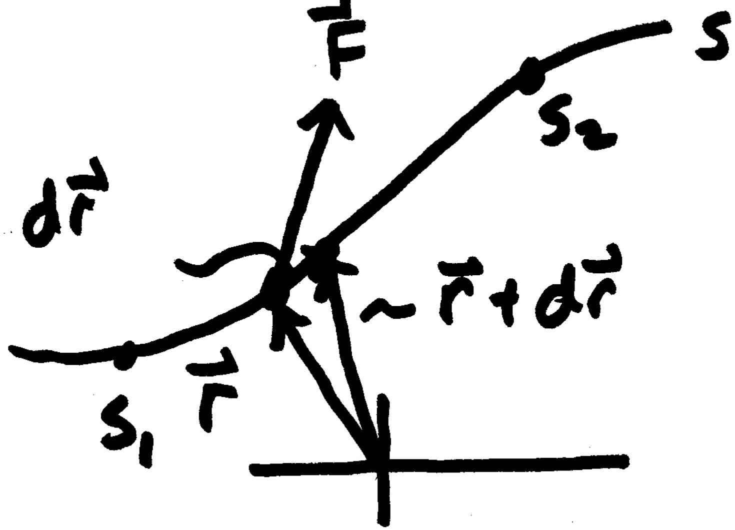

$\vec{F}$ = applied external force

We compute the work done by force $\vec{F}$ on the particle over the incremental movement $d\vec{r}$ by

$$dU = \vec{F} \cdot d\vec{r} = \text{Work}$$

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

Part of force in direction of motion

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Only the portion of the force that acts in the direction of motion contributes to work done on the particle

- Units of work U are $N \cdot m$ = Joule, $lb_f \cdot ft$ ......

If we wish to compute the total work done on a particle moving it from S_1 to S_2 along the path, then we must ~~and~~ integrate;

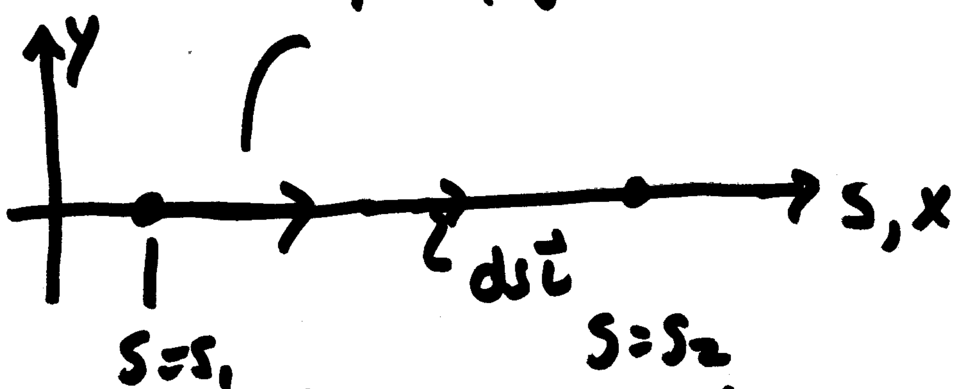
$$\int_{S_1}^{S_2} dU = U_{1-2} = \int_{S_1}^{S_2} \vec{F}(s) \cdot d\vec{r}(s) \Rightarrow$$ In general, is complicated

$$= \int_{S_1}^{S_2} |\vec{F}(s)| \cdot \cos[\theta(s)] \cdot ds$$

 In many situations, the integral can done ahead of time:

- Force moving ptcle along a straight line - Force in direction of line

$$\vec{F} = F\vec{i}$$



$$U_{1-2} = \int_{s_1}^{s_2} \vec{F} \cdot d\vec{r} = \int_{s_1}^{s_2} (F\vec{i}) \cdot (ds\,\vec{i}) = \int_{s_1}^{s_2} F ds = F(s_2 - s_1)$$

$$= \int_{s_1}^{s_2} |\vec{F}(s)| \cdot \cos[\theta(s)] \cdot ds = \int_{s_1}^{s_2} F \cdot 1 \cdot ds = F(s_2 - s_1)$$

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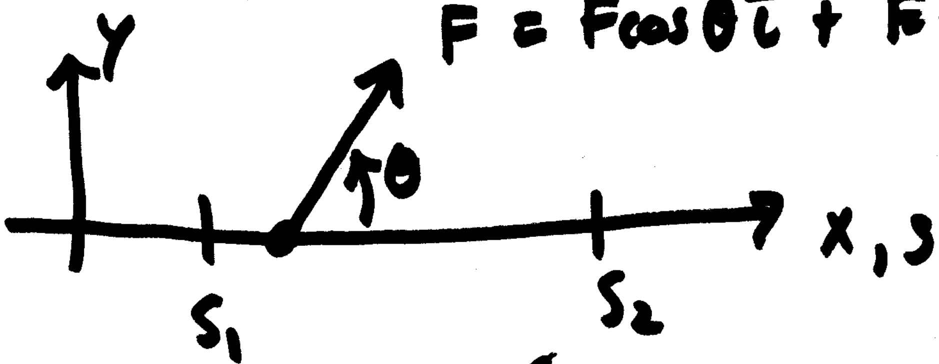
- Force moving ptcle along a straight line – Force not in direction of motion

$\vec{F} = F\cos\theta\,\vec{i} + F\sin\theta\,\vec{j}$



$$U_{1-2} = \int_{S_1}^{F_2} \vec{F}\cdot d\vec{r} = \int_{S_1}^{S_2} \left(F\cos\theta\,\vec{i} + F\sin\theta\,\vec{j}\right)\cdot\left(ds\,\vec{i}\right)$$

$$= \int_{S_1}^{S_2} F\cos\theta\, ds = F\cos\theta\,(S_2 - S_1)$$

$$\boxed{U_{1-2} = F\cos\theta\,(S_2 - S_1)}$$

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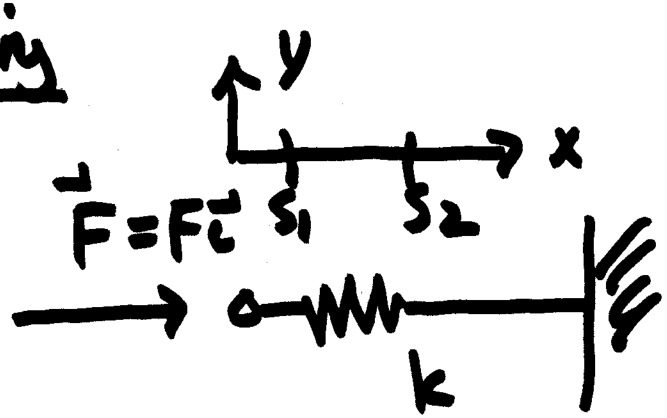
Work Done By a Force on a Spring



For a spring

$F = kx$

$$U_{1-2} = \int_{s_1}^{s_2} (ks\vec{i}) \cdot (ds\vec{i}) = \int_{s_1}^{s_2} ks\,ds = \frac{1}{2}ks^2 \Big|_{s_1}^{s_2}$$

$$= \frac{1}{2}ks_2^2 - \frac{1}{2}ks_1^2$$

Many times, we want to know the work done by a spring on a system $\Rightarrow$ $\boxed{U_{1-2} = -\frac{1}{2}ks_2^2 + \frac{1}{2}ks_1^2}$