Read 6.6-6.7

Exam Monday 7:30 A.M

- Practice Questions
- Answers
- solutions
- Equation sheet on class web page

H.W Due Friday
solutions posted Friday morning

ex) A Box of $m = 23\,kg$ slides down an incline plane at $25°$ at a constant velocity. The box slides 1.5 m

a) what is work done by normal?

b) Gravity?

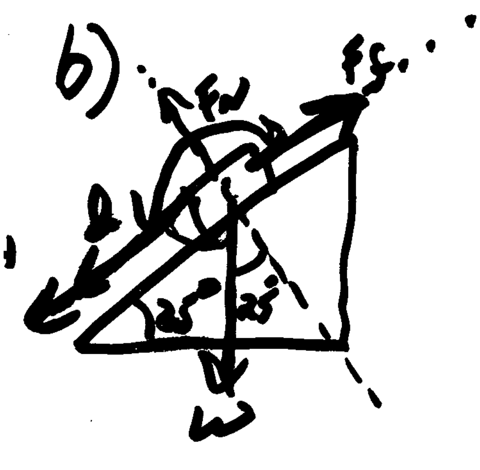
c) Friction?

d) Total work done on the box?

$\boxed{W = Fd\cos\theta}$

a) $\underline{\text{Work} = 0\,J}$ Normal force perpendicular to motion $\theta = 90°$

b)



$F = mg$

$d = 1.5\,m$

$\theta = 90° - 25° = 65°$

$W = mg \cdot 1.5\,m \cdot \cos 65°$

$\boxed{140\,J}$

c) $-F_f + mg\sin 25° = 0$

$F_f = mg\sin 25°$

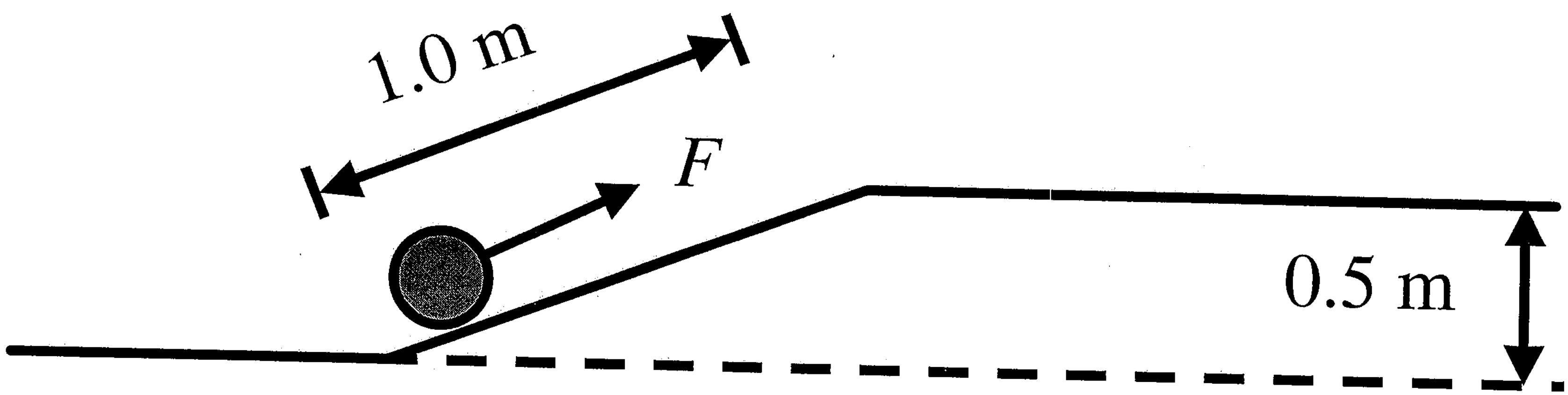
$W = (mg\sin 25°)(1.5\,m)\cos 180°$

$\boxed{-140\,J}$

d) $0\,J + 140\,J - 140\,J = \boxed{0\,J}$

Interactive Question

At a bowling alley, the ball feeder must exert a force to push a 5.0 kg bowling ball up a 1.0 m long ramp. The ramp raises the ball 0.5 m above the base of the ramp. Approximately how much force must be exerted on the bowling ball.



A) 200 N
B) 50 N
C) 25 N
D) 5.0 N
E) Not enough info to tell

Kinetic Energy

→ Energy of motion

Relate kinetic Energy to work using Newton's 2nd law and kinematic equations

$\vec{F}_{net} = m\vec{a}$ $\qquad$ $v_f^2 = v_i^2 + 2a\Delta x$

$W_{net} = F_{net}\, d$ $\quad$ if Force in same direction as displacement ($\cos\theta = \cos 0° = 1$)

$W_{net} = m a d$ $\qquad$ $a = \dfrac{v_f^2 - v_i^2}{2\underbrace{\Delta x}_{\text{same as } d}}$

$W_{net} = m\left(\dfrac{v_f^2 - v_i^2}{2\cancel{d}}\right)\cancel{d}$

$W_{net} = \underbrace{\frac{1}{2}mv_f^2}{} - \frac{1}{2}mv_i^2$

$\boxed{\text{Define kinetic energy } (K) = \frac{1}{2}mv^2}$

W_{net} = change in kinetic Energy &

$= K_f - K_i$

ex) How much work does it take to stop a 1000 kg car traveling at 28 m/s?

$W_{net} = \cancel{F_{net} d \cos\theta}$

$W_{net} = K_f - K_i$ $\qquad K = \frac{1}{2} m v^2$

$K_f = 0 \qquad v = 0$

$K_i = \frac{1}{2}(1000\,kg)(28\,m/s)^2$

$W_{net} = 0 - \frac{1}{2}(1000\,kg)(28\,m/s)^2$

$= \boxed{-3 \times 10^5\,J}$

Interactive Question

A weightlifter lifts a heavy weight over his head and then sets it back down. The work that the weightlifter does on the bar is:

A) Greater than 0 since he applies a force in the direction of the displacement

B) Equals 0 since the change in Kinetic Energy = 0

C) Equals 0 since he does not apply any force while lifting the bar

D) Less than 0 since the force he applies is opposite in direction to the displacement

E) Equals 0 since the work he does in lifting the bar up is equal and opposite to the work he does setting it down

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E) None of the above

WE found a relationship between work and kinetic Energy

$W_{net} = \Delta K$

2 forms of energy, kinetic and potential

→ Relationship between work and potential energy

Gravity

Suppose I raise a ball to a height $h = y_f - y_i$

$$h \left\{ \begin{array}{l} \cdot \; y_f \\ \\ \cdot \; y_i \end{array} \right.$$

How much work has been done by me on the ball?

$$W = F d \cos\theta$$

$$W_{ME} = mgh = mg(y_f - y_i)$$

$$\Delta K = 0 \quad \text{so net work} = 0$$

Only me and gravity are doing work on the ball and net work $= 0$ so work done by gravity must be <u>equal</u> and <u>opposite</u> to work I have done.

$W_{ME} = mgh = mg(y_f - y_i)$

therefore

$W_G = -mgh = mg(y_i - y_f)$

$W_G = mgy_i - mgy_f$

$= U_i - U_f$ Define as potential energy (U)

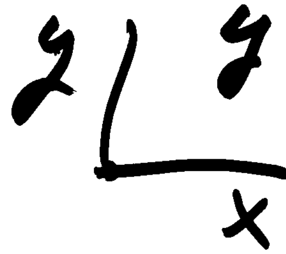
$$\boxed{U_G = mgh}$$

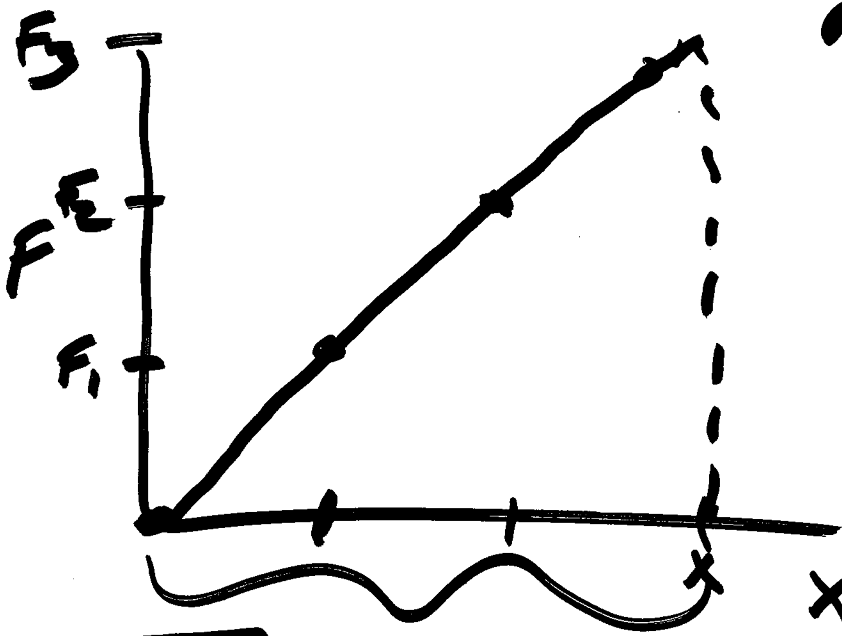
Define $\Delta U = U_f - U_i$

$W_G = -\Delta U$

Spring

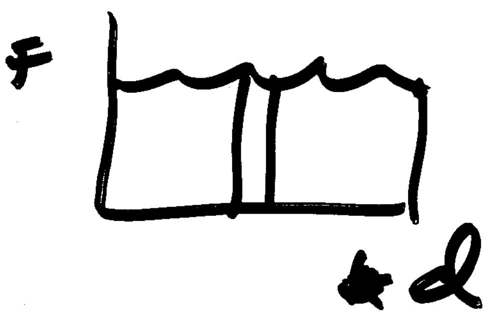
$y = mx + b$





x = stretch

$\boxed{F = kx}$ k = spring constant



Area under curve
$F \cdot d$ = work

$$\text{Area Triangle} = \frac{1}{2} b h$$
$$= \frac{1}{2} x (kx)$$
$$= \frac{1}{2} k x^2 \Rightarrow \text{work}$$

potential energy of a spring

$$= \boxed{\frac{1}{2} k x^2}$$