No clickers & yes calculators.

Please get the notes from the brown table.

Apr 27-11:31 AM

CALCULATING MORE WORK!! 10.1

Other agents exert forces on the pushed car as well.

Earth's gravity acts downward, the ground exerts a normal force upward, and friction exerts a horizontal force opposite the direction of motion.

The upward and downward forces are perpendicular to the direction of motion and do no work. For these forces, $\theta = 90°$, which makes $\cos\theta = 0$, and thus, $W = 0$.

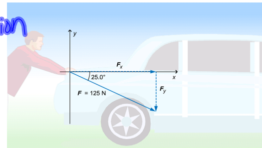
$\cos 90° =$

Gravity / friction

The work done by friction acts in the direction opposite that of motion — at an angle of 180°. Because $\cos 180° = -1$, the work done by friction is negative.

Opposite direction

Negative work done by a force exerted by something in the external world reduces the kinetic energy of the system.



Apr 27-10:52 AM

If the person in the figure were to stop pushing, the car would quickly stop moving if the car in on a flat surface.

Positive work done by a force increases the energy, while negative work decreases it.

$W = Fd$ only if force is in 1 direction

Force is Not all in 1 direction

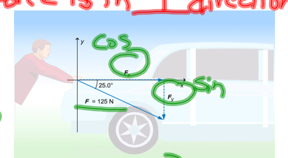
∴ Angles of Arms

$F_x = F(\cos\theta)$

$125N(\cos 25)$ 113N 1.13×10^2 N

$F_y = 125N(\sin\theta) = 52.8N$ or 53N

5.3×10 N



Apr 27-10:58 AM

Work (Angle Between Force and Displacement):

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

pg. 260 Problem Solving Strategies

Example 1: A sailor pulls a boat a distance of 30.0 m along a dock using a rope that makes a 25.0 degree angle with the horizontal. How much work does the sailor do on the boat if he exerts a force of 255 N on the rope?

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

6,933.25 J

6.93×10^3 J

$F = 255N$

$d = 30m$

$\theta = 25$

Apr 27-11:05 AM

Example 2: How much work is done in pushing a tall box 15m with a force of 4.0 X 10^2 N that is applied slightly upward at an angle of 10.0 degrees from horizontal?

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

$400 \cdot 15 \cdot \cos 10$

$= 5,908.85 J$

$5.9 \times 10^3 J$

Apr 27-11:09 AM

Example 3: Andrew won a trip to Hawaii. His plane is flying out of Detroit. Andrew carries a 210 N suitcase up the stairs, a displacement of 5.2 m vertically, and 4.3 m horizontally.

A) How much work does Andrew do?

$W = F \cdot d$

$210 \cdot (5.2)$

$W = 1092 J$

$= 1.09 \times 10^3 J$

B) When Andrew returns he carries the same suitcase back down the same set of stairs. How much work does he do now?

$W = F \cdot d$

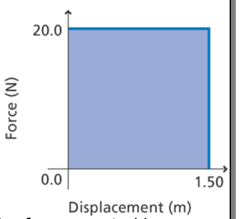
$210 \cdot (5.2)(\cos 180)$

$-1092 J$

$-1.09 \times 10^3 J$

Apr 27-11:13 AM

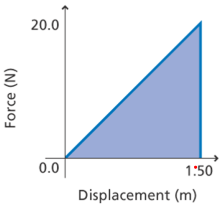
A graph of force versus displacement lets you determine the work done by a force. This graphical method can be used to solve problems in which the force is changing.



The adjoining figure shows the work done by a constant force of 20N that is exerted to lift an object a distance of 1.5m

$W = F \cdot d = 20(1.5) = 30 J$

The work done by this constant force is represented by $W = Fd$



The figure shows the force exerted by a spring, which varies linearly from 0 N to 20 N as it is compressed 1.5 m.

The work done by the force that compressed the spring is the area under the graph, which is the area of a triangle, ½ (base) (altitude),

$.5(1.5)(20) = 15 J$

Apr 27-11:20 AM

Do pg. 262 4 - 8 all

Apr 27-11:23 AM

Power:

Power is the work done, divided by the time taken to do the work.

$W = F \cdot d$

Who is doing more work? Same/Equal

Who is more powerful?

Girl is more powerful

Formula: $P = \frac{W}{T}$

Unit: Watt

Apr 27-11:34 AM

A watt is a relatively small unit of power. For example, a glass of water weighs about 2 N. If you lift the glass 0.5 m in 1 s, you are doing work at the rate of

$W = 2 \cdot .5 = 1\,J$

$P = \frac{1\,J}{1\,s} = 1\,watt$

Because a watt is such a small unit, power often is measured in kilowatts (kW). One kilowatt is equal to 1000 W.

$1\,W = .001\,kW$

When force and displacement are in the same direction, *P = Fd/t*. However, because the ratio d/t is the speed, power also can be calculated using *P = Fv*.

Using P = Fd/t What if you had to solve for the force?

$t \cdot P = \frac{Fd}{t} t \quad \frac{t \cdot P}{d} = \frac{F \cdot d}{d} \quad F = \frac{t \cdot P}{d}$

What if you had to solve for time?

$t \cdot P = \frac{F \cdot d}{t} t$

$\frac{t \cdot P}{P} = \frac{F \cdot d}{P} \quad t = \frac{F \cdot d}{P}$

Apr 27-11:39 AM

Example 4: An electric motor lifts an elevator 9.00 m in 15.0 s by exerting an upward force of 1.20 x 10^4 N. What power does the motor produce in kW?

$P = \frac{F \cdot d}{t} = \frac{12000 \cdot 9}{15}$

$= 7{,}200\,W$

7.2 Kw

Apr 27-11:44 AM

Example 5: A net force of 2.80 x 10^3 N accelerates a 1250-kg vehicle for 8.0 s. The vehicle travels 80.0 m during this time. What power output does this represent in kW?

$P = \frac{F \cdot d}{s} = \frac{(2800)(80)}{8}$

$= 28000\,W$

28 KW

Apr 27-11:46 AM

Example 6: An electric motor developes 56 kW of power as it lifts a loaded elevator 15.7m in 42 s. How much force does the motor exert?

$$F = \frac{Pt}{d} = \frac{56 \cdot 42}{15.7}$$

149.8 N

150 N 1.5×10^2 N

Apr 27-11:51 AM

① Launch Lab
② Pg. 262 (4-8)
③ Pg. 264 9, 10, 12, 13
④ Pg. 265 15-22

Apr 27-1:31 PM

Apr 27-1:34 PM