Work and Power Notes and Projectile Motion Practice Problems

Name: _____Hr._____

Work : Amount of energy transferred by a force acting though a distance

Work = force x distance $\quad W = F\ d$

Unit : Newton-meter (N·m) also known as a Joule (J)

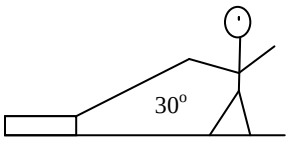
Fill in Unit Box:

Units of F = _____
Units of d = _____
Units of work = _____
1 N·m = 1 _____

#1: Sam lifts a 34- kg rock upward a distance of 1.5 meters to impress his girlfriend. How much work did he do? *To find F use F= ma with a=-9.8 m/s^2 .(ans. -499.8 J, it is negative because he is doing work against gravity)*

***The only work done is that in the direction of motion!**

#2: A child pulls a sled with a force of 50 N. If the rope makes a 30^o angle with the ground, and she pulls it 2 meters, how much work is done? *Because the sled will move in the x direction, it is only the **x component of the force** that counts. 50 Newtons is vector F. Use cosine to find the x component and multiply by the distance. (ans. 86.6 J)*



Power : The rate at which work is done or energy is transferred

Power = $\frac{\text{work}}{\text{time}}$ $\quad P = \frac{W}{\Delta t}$ **or** $P = \frac{F\ d}{\Delta t}$

Unit : Joule per second = **a Watt (W)**
1 horsepower (hp) = 746Watts

Fill in Unit Box:

Units of work = _____
Units of Δt = _____
Units of P = _____
1 J/sec = 1 _____
1 hp = _____ W

#3 Convert the following: A 5 horsepower motor = _____ W

#4 One of the world's strongest men carries a 904-pound motorcycle a distance of 30 m. If he does this in 17.25 seconds, what is his **horsepower**? *(ans. -9.4 hp) Hint: Use F= ma to find the force with a=-9.8 m/s^2 since he is lifting it against gravity, then find watts to turn into horsepower.*

Unit VI) Work and Energy

$W = F\,d$ $\quad P = \frac{W}{\Delta t}$ $\quad P = \frac{F\,d}{\Delta t}$ $\quad$ **1 hp = 746 Watts**

Problems for Work and Power:

1. a. A tugboat pulls a ship with 5.0×10^3 N. How much work is done if it is pulled 3.0 km? ***(ans. 1.5×10^7 J)***

Given:

Unknown:

Equation:

b. Calculate the tugboat's power if it does this in 0.3 hour. ***(ans. 1.39×10^4 W)***

2. A shopper pulls a shopping cart with 35 N of force at a 25^o angle to the horizontal. Find the work done as the shopper walks 50 meters down the aisle. ***(ans. 1,585 Nm or J)***

3. In 4.2 seconds, a crane lifts a 225-lb bucket of soil up 21 ft. (1 meter = 3.28 ft). Calculate the work the crane performs and its horsepower. ***(-6416 Nm or J & -2.055 hp)***

4. A 1,500-kg car accelerates from 0 to 10.0 m/s in 3.00 seconds. What is the horsepower delivered by the engine during the acceleration? ***(about 33.5 hp , Hint: This is a multi-stepped problem which involves 1-D Motion. You will need to solve for the acceleration and the distance, then W, P, and hp…Wow!)***

Extra Practice Problems for Projectile Motion

We will be combining Work/Energy with Projectile Motion!

1. A shiny new sports car sits in the parking lot of a car dealership. Above is a cargo plane, flying horizontally at 40 m/s. At the exact moment the plane is 125 m directly above the car, a heavy crate accidentally falls from its cargo doors. Relative to the car, where will the crate hit? *(ans. approx. 202 m)*

Sketch: *Given:* *Horizontal:* *Vertical:*

2. A skier goes off a ramp with a velocity of 20 m/s at 40° N of E.
   a. What will his maximum height be off the ground? *(ans. approx. 8.4 m)*

Sketch: *Given:* *Horizontal:* *Vertical:*

   b. How far away will he land? *(ans. approx. 40 meters)*

The Horsepower Lab and Problems

10 pts, due _____ Name: _____Hr. ___

The Horsepower Mini Lab
The world's strongest man can work at a horsepower of _____

Working in groups of 2 or 3, choose any 3 activities from the following list:

lift a weight	jump rope
Running up/down flight of stairs	step aerobics (up and down 1 stair)
sit-ups	push-ups (on your knees or regular ones)
climb stairs	jumping jacks

Data: ***YOU MUST SHOW YOUR WORK IN THE BOXES OR YOU WILL LOSE POINTS!***
Do each activity for **one minute.** Record the force, the distance and the time required below.
After you finish with the activities, complete the calculations and answer the questions.

Activity-	**#1- _____**	**#2- _____**	**#3- _____**
Time (total) (sec)			
Distance (total) (Use total distance covered)			
Force (total) F= m x a			

Now calculate the work and the power needed for each of the above activities. Show your work!

Work W = F x d			
Power P = W/Δt Or P = F x d / Δt			
Your horsepower:			

James Watt came up with a calculation of horsepower by watching a horse pull a grinder around a circle. He found it to be 33,000 lb·ft/min. Change this to our units of watts (N·m/sec) using dimensional analysis. (1 N = 0.225 lb)