Work

Normally, we would do a lab of some form to introduce a new idea or concept. While we will do a lab very soon, I want to introduce a new term to you that has a very specific definition: work. Tomorrow, we will get into why we care about work and what it does, but for today, let's just get used to doing some calculations based on the following initial definition of work:


The work W done by a force F (as a function of position) that acts on an object from x_i to x_f is

$$W = \int_{x_i}^{x_f} \vec{F} \cdot d\vec{x}$$

A. What are the units of work?

B. Is work a vector or a scalar?

C. Math-Land! What is the dot product of two vectors?

D. Math-Land! How does the above equation relate to a graph of F vs x?

E. If the force F was constant, and <u>parallel</u> to the displacement (Δx), what would be the work done by F?

F. If the force F was constant, and <u>perpendicular</u> to the displacement (Δx), what would be the work done by F?

G. Can work be a negative number?
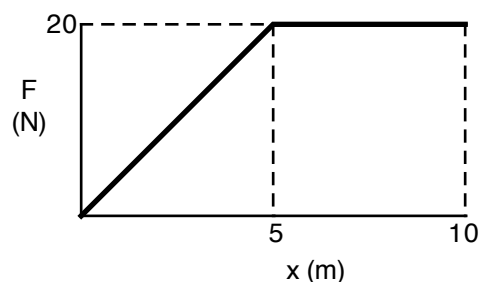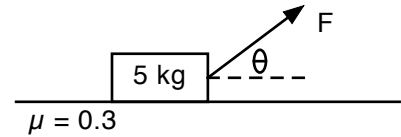
Work

Calculations

5 kg ⟶ F

$\mu = 0.3$
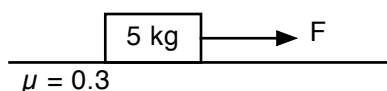
The diagram above shows a block being pulled across a floor or table by a horizontal force F.

1. If the applied force was a constant 20 N, how much work was done by the force pulling the object 5 m?

2. How much work did friction do in question number 1?

3. Careful! How much work did gravity do in question number 1?

4. How much work did the normal force do in question number 1?

5. If the applied force was a constant 20 N, how much work was done by the force pulling the object 15 m?

6. How much work would the force shown in the graph to the right do between x = 0 and x = 5?

7. How much work would the force shown in the graph to the right do between x = 5 and x = 10?

Now imagine a force is pulling up at an angle, as shown to the right. The object moves horizontally.

8. How much work does a constant force of 25 N at an angle of 30° do when the object moves 5 m?

F

5 kg θ

$\mu = 0.3$

9. How much work does a constant force of 25 N at an angle of 60° do when the object moves 5 m?

10. How much work does a constant force of 35 N at an angle of 20° do when the object moves 10 m?

11. How much work does the normal force do when there is a constant force of 25 N at an angle of 30° do when the object moves 5 m?

12. How much work does the friction do when there is a constant force of 25 N at an angle of 30° do when the object moves 5 m?

13. How much work would gravity do on a 7 kg object that fell 15 meters? How about 25 meters?

14. How much work would gravity do on a 7 kg object that was lifted straight up 15 meters? How about 25 meters?

Work

Answers:

1) 100 J	*2) –75 J*	*3) 0 J*	*4) 0 J*	*5) 300 J*	*6) 50 J*	*7) 100 J*
8) 108.3 J	*9) 62.5 J*	*10) 329 J*	*11) 0 J*	*12) –56.25 J*		*13) 1050 J, 1750 J*
14) –1050 J, –1750 J						