Question 7.2d  Tension and Work

A ball tied to a string is being whirled around in a circle. What can you say about the work done by tension?

a) tension does no work at all
b) tension does negative work
c) tension does positive work

No work is done because the force acts in a perpendicular direction to the displacement. Or using the definition of work ($W = F \Delta r \cos \theta$), because $\theta = 90^\circ$, then $W = 0$.

Follow-up: Is there a force in the direction of the velocity?
Question 7.3  Force and Work

A box is being pulled up a rough incline by a rope connected to a pulley. How many forces are doing work on the box?

- a) one force
- b) two forces
- c) three forces
- d) four forces
- e) no forces are doing work

Any force not perpendicular to the motion will do work:
- \( N \) does \textit{no work}
- \( T \) does \textit{positive work}
- \( f \) does \textit{negative work}
- \( mg \) does \textit{negative work}
Question 7.5a  Kinetic Energy I

By what factor does the kinetic energy of a car change when its speed is tripled?

a) no change at all  b) factor of 3  c) factor of 6  d) factor of 9  e) factor of 12

Because the kinetic energy is $\frac{1}{2}mv^2$ if the speed increases by a factor of 3, then the KE will increase by a factor of 9.

Follow-up: How would you achieve a KE increase of a factor of 2?
A child on a skateboard is moving at a speed of 2 m/s. After a force acts on the child, her speed is 3 m/s. What can you say about the work done by the external force on the child?

a) positive work was done
b) negative work was done
c) zero work was done

The kinetic energy of the child increased because her speed increased. This increase in KE was the result of positive work being done. Or, from the definition of work, because \( W = \Delta KE = KE_f - KE_i \), and we know that \( KE_f > KE_i \) in this case, then the work \( W \) must be positive.

Followup: What does it mean for negative work to be done on the child?
**Question 7.11a Time for Work I**

**Mike** applied 10 N of force over 3 m in **10 seconds**. **Joe** applied the same force over the same distance in **1 minute**. Who did more work?

- a) Mike
- b) Joe
- c) both did the same work

Both exerted the **same force over the same displacement**. Therefore, both did the **same amount of work**. Time does not matter for determining the work done.
Mike performed 5 J of work in 10 secs. Joe did 3 J of work in 5 secs. Who produced the greater power?

a) Mike produced more power
b) Joe produced more power
c) both produced the same amount of power

Because power = work / time, we see that Mike produced 0.5 W and Joe produced 0.6 W of power. Thus, even though Mike did more work, he required twice the time to do the work, and therefore his power output was lower.
**Question 7.12a  Electric Bill**

When you pay the electric company by the kilowatt-hour, what are you actually paying for?

- a) energy
- b) power
- c) current
- d) voltage
- e) none of the above

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We have defined:  

\[ \text{Power} = \frac{\text{energy}}{\text{time}} \]

So we see that:  

\[ \text{Energy} = \text{power} \times \text{time} \]

This means that the unit of \( \text{power} \times \text{time} \) (watt-hour) is a unit of \( \text{energy} \)!!
Question 7.12b Energy Consumption

Which contributes more to the cost of your electric bill each month, a 1500-Watt hair dryer or a 600-Watt microwave oven?

a) hair dryer
b) microwave oven
c) both contribute equally
d) depends upon what you cook in the oven
e) depends upon how long each one is on

We already saw that what you actually pay for is energy. To find the energy consumption of an appliance, you must know more than just the power rating—you have to know how long it was running.