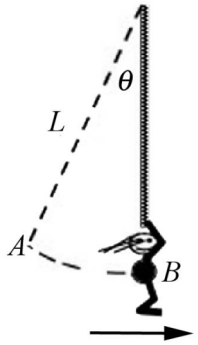
Work and Dot Product
Concept Questions

Question 1

A person swings down on an inextensible rope that is attached to a fixed point. The rope exerts a tension T on the person. The work done by tension on the person as she moves from A to B is:



a) T.

b) $T\,L$.

c) $T\,L\,\theta$.

d) $mgL(1-\cos\theta)$

e) zero.

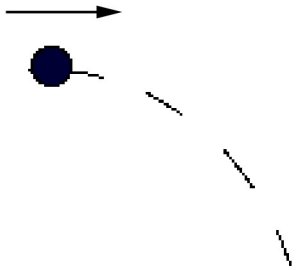
f) Not enough information is given to decide.

Briefly explain your choice of answer.

Answer (e): The tension is perpendicular to the direction of motion so the work done by the tension force is zero.

Question 2: Work and Gravity

A ball is given an initial horizontal velocity and allowed to fall under the influence of gravity, as shown below.



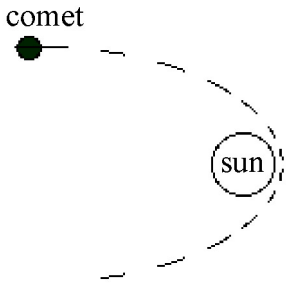
The work done by the force of gravity on the ball is:

1. positive
2. zero
3. negative

Answer: 1. The force of gravity causes the ball to accelerate downward, so the force displacement has a component in the same direction as the force. Hence the work done is positive. (The dot product of the ball's displacement and the downward force of gravity is positive.)

Question 3: Comet Orbit

A comet is speeding along a hyperbolic orbit toward the Sun.



While the comet is moving away from the Sun, the work done by the Sun on the comet is:

1. positive
2. zero
3. negative

Answer: 3. The displacement of the comet has a component in the opposite direction as the force on the comet so the work done is negative. (The comet's acceleration is always toward the Sun; when the comet moves away from the Sun, the work is negative.)

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8.01SC Physics I: Classical Mechanics

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