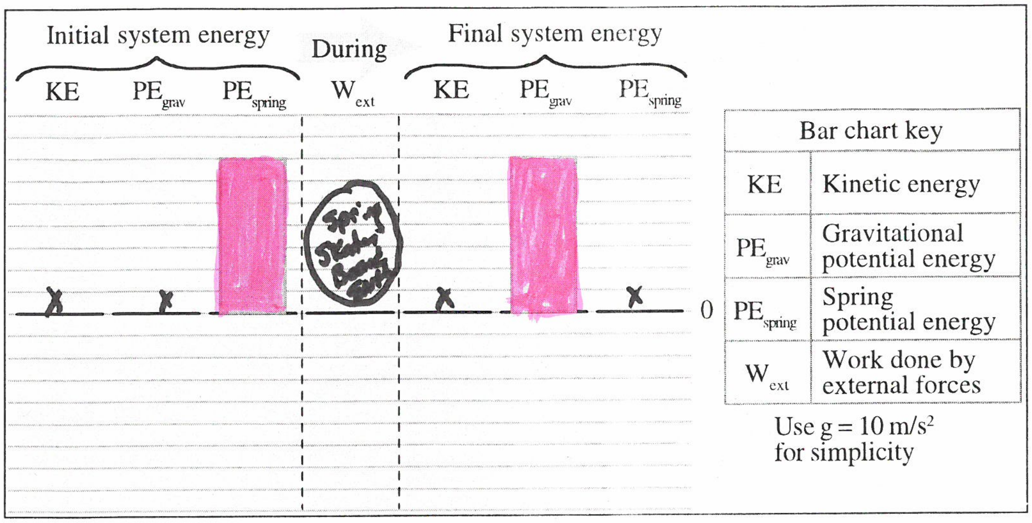
Tipper #2 - Unit 4 - KEY

#1



Explain your reasoning.

Answer: The performer is initially at rest and at the zero gravitational potential energy height, so the only initial system energy is the potential energy of the compressed spring. Since the spring is part of the system, the push of the spring on the performer is not external work; there is no external work done on our system. The final state is the performer at his highest point in the air. Here he has no kinetic energy (momentarily) and since the spring is no longer compressed there is no spring potential energy. All of the initial system energy has been converted into gravitational potential energy.

#2

Answer: B > C > A > D.

The product of the stopping (average) force and the distance through which it acts is the work done on the cars. That work will go into changing the kinetic energy of the cars. Since they are all stopping, i.e., zero final kinetic energy, in the same distance the ranking is based on the initial kinetic energies of the cars

$\frac{1}{2} m v^2$

A
$\frac{1}{2}(1000 kg)(6 m/s^2)^2$
= 18,000 J

B
$\frac{1}{2}(1600 kg)(8 m/s)^2$
= 512,800 J

C
$\frac{1}{2}(1200 kg)(8 m/s)^2$
= 384,00 J

D
$\frac{1}{2}(1600 kg)(4 m/s)^2$
= 128,000 J

B > C > D > A

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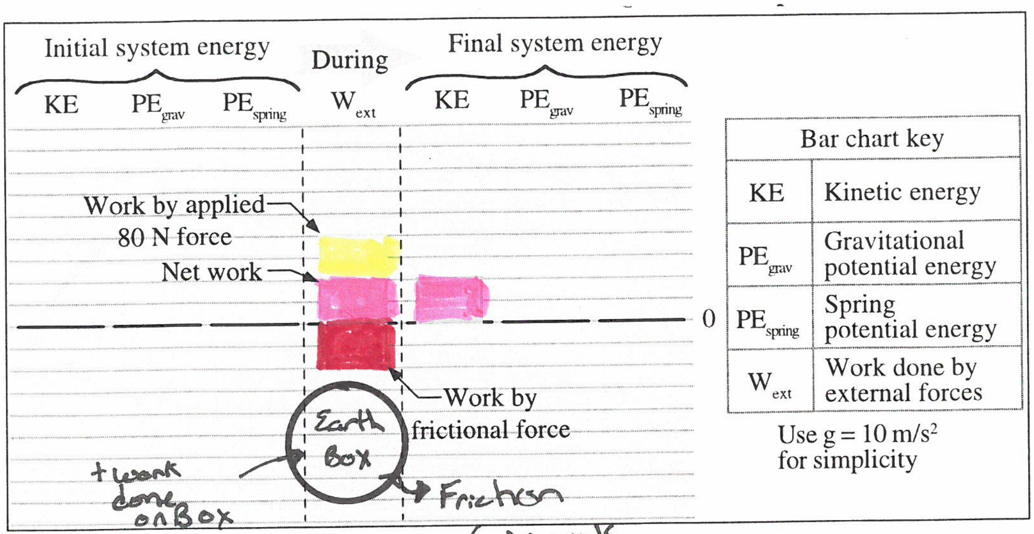
#3



Explain your reasoning.

Answer: There is no initial kinetic energy since the box is initially at rest. There is no change in gravitational potential energy since the box doesn't change height so we can make the gravitational potential energy zero at points A and B. Since the applied force is in the same direction as the motion, the work done by the applied force is positive. The friction force acts in the opposite direction to the displacement, so the work done by friction is negative. The difference between the (positive) work done by the applied force and the (negative) work done by friction is the net work done by external forces. The final kinetic energy will be greater than the initial kinetic energy by the net amount of work done.

$W_{net} = F_A - F_f$

$= 80N - 40N$

$W_{net} = 40N$

#4

A

$= \frac{1}{2} m v^2$

$= \frac{1}{2}(2m)(v^2)$

$= mv^2$

B

$= \frac{1}{2}(2m)(2v^2)$

$= 4mv^2$

C

$= \frac{1}{2} 4mv^2$

$= 2mv^2$

D

$= \frac{1}{2} m (2v)^2$

$= 2mv^2$

KE is scaler!

B > D = D > A

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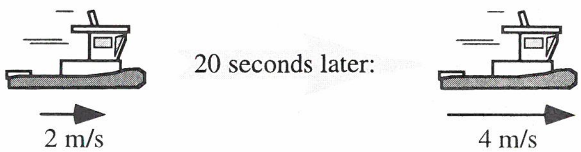
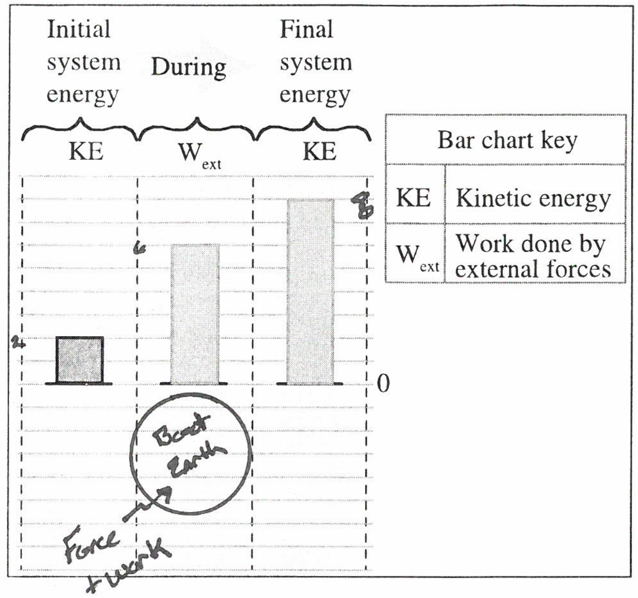
#5

B4-BCT14: TUGBOAT CHANGING VELOCITY I—WORK & KINETIC ENERGY BAR CHART

(a) The velocity of a tugboat increases from 2 m/s to 4 m/s in the same direction while a force is applied to the tugboat for 20 seconds.

Complete the work and kinetic energy bar chart for this process. The bar heights should be in correct proportion to one another.

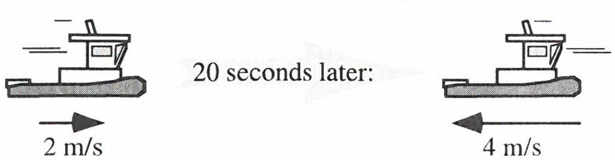


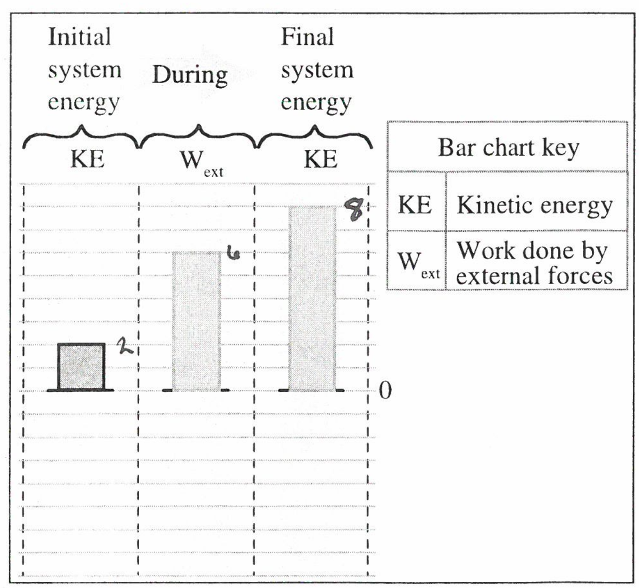


Explain.

(b) The velocity of a tugboat changes from 2 m/s to 4 m/s in the opposite direction while a force is applied to the tugboat for 20 seconds.

Complete the work and kinetic energy bar chart for this process. The bar heights should be in correct proportion to one another.





Explain.

Answers (a) and (b) will have the same bar chart graphs. In both cases, the speed of the tugboat doubles and so the kinetic energy quadruples. In both cases, the same net work will have been done on the tugboat.

KE = Scaler

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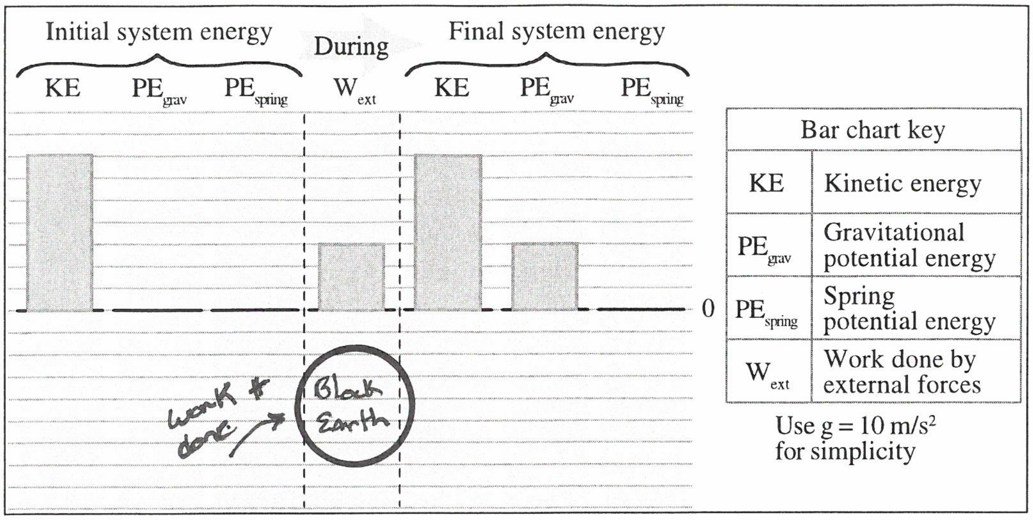
#6



Explain your reasoning.

Answer: Since the block is moving at constant speed, there is no change in the kinetic energy. The push on the block has a component in the same direction as the displacement from A to B, so positive work is done on the block from A to B. Since the block is higher at B than at A, there is an increase in gravitational potential energy for the block-earth system.

Constant speed ∴ No change in a or V ∴ $\Delta KE = 0$

#7

$\Delta W = \Delta KE$

$W = \frac{1}{2} m (v_f^2 - v_i^2)$

Same Mass for all cars

(A) $W = \frac{1}{2}((20)^2 - (10)^2) m$

$W = 150 m$

(B) $W = \frac{1}{2} m (0^2 - (10)^2)$

$W = -50 m$

(C) $W = \frac{1}{2} m ((-10)^2 - (10)^2)$

$W = 0$

(D) $W = \frac{1}{2} m ((20)^2 - (20)^2)$

$W = 0$

$A > C = D > B$

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#8 C = E > A > B = D

This is an application of conservation of energy. All have the same kinetic energy at the start because they all are fired at the same speed. All arrows have zero gravitational potential energy at end of their flight, so those with greatest gravitational potential energy at start will have greatest kinetic energy and speed at bottom.

$$\cancel{KE_1}^{0} + PE_1 = KE_f^{?} + \cancel{PE_f}^{0}$$

$$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$$

$$v^2 = 2g\,h$$

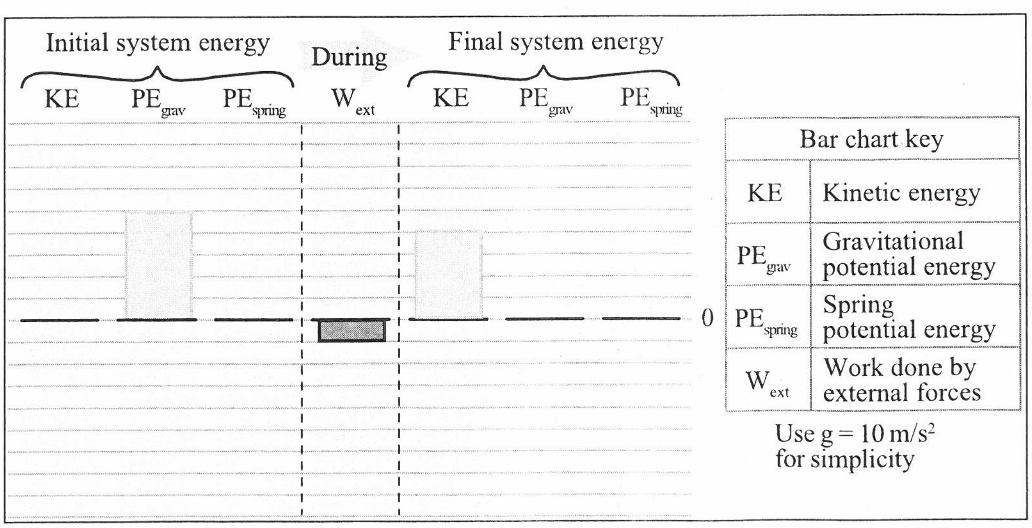
#9

Answer: A = B > D > C

The speed depends on the starting height only. The initial gravitational potential energy of the toboggan will be proportional to the starting height, and without friction, all of this potential energy will be converted into kinetic energy at the bottom.

#10

Answer: Both the bar chart drawn by the first student and the second student's statement are wrong. The problem with the bar chart is that the gravitational potential energy and the kinetic energy should both be positive. The problem with the second student's statement is that kinetic energy can never be negative, which then means the initial graviational potential energy needs to be positive also and the energy exchange via working is correct as negative. This is shown in the appropriate bar chart below.



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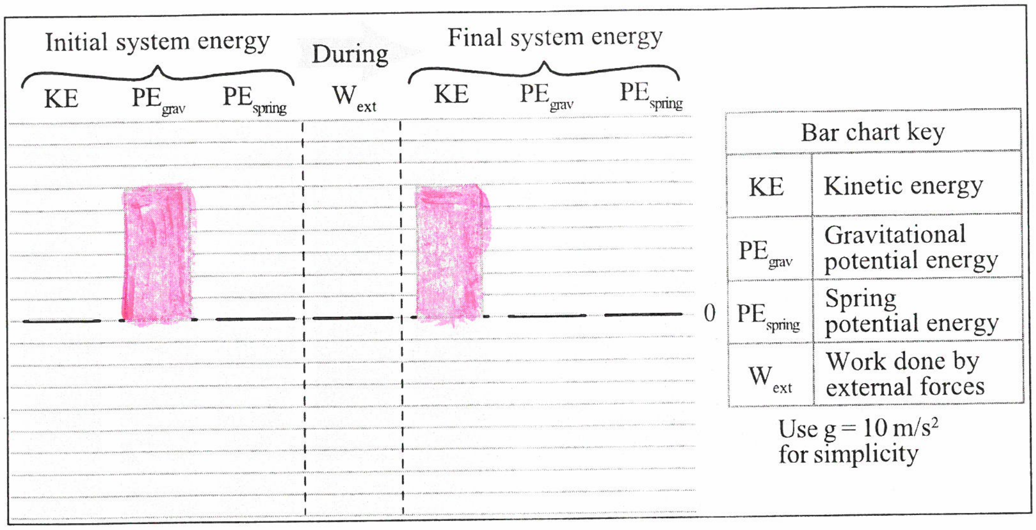
#12



Explain your reasoning.

Answer: Since the ground is now the gravitational potential energy zero the rock initially had positive gravitational potential energy, all of which is converted to kinetic energy just before the rock hits the ground.