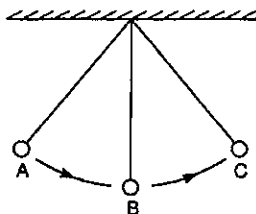


## Skill 31: Conservation of Energy

60. Spider-man swings like a pendulum on his web. The diagram below shows three positions, A, B, and C, in Spider-man's swing, released from rest at point A. [Neglect friction.]



Which statement is true about Spider-man's swing?

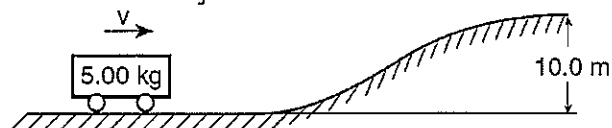
- A) The potential energy at A equals the kinetic energy at C.
- B) The speed of the pendulum at A equals the speed of the pendulum at B.
- C) The potential energy at B equals the potential energy at C.
- ☒ D) The potential energy at A equals the kinetic energy at B.

61. A 0.50-kilogram ball is thrown vertically upward with an initial kinetic energy of 25 joules. Approximately how high will the ball rise? [Neglect air resistance.]

- A) 2.6 m
- ☒ B) 5.1 m
- C) 13 m
- D) 25 m

$$\begin{aligned}
 KE_{\text{bottom}} &= PE_{\text{top}} \\
 25\text{ J} &= mgh \\
 25\text{ J} &= (0.5\text{ kg})(9.8\text{ m/s}^2)h \\
 h &= 5.1\text{ m}
 \end{aligned}$$

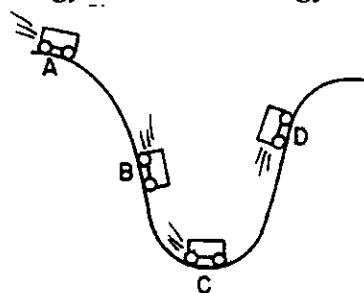
62. The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



- A) 4.91 J
- B) 50.0 J
- C) 250. J
- ☒ D) 491 J

$$KE_{\text{bottom}} = PE_{\text{top}}$$

63. The diagram below shows a cart at four positions as it moves along a frictionless track. At which positions is the sum of the potential energy and kinetic energy of the cart the same?



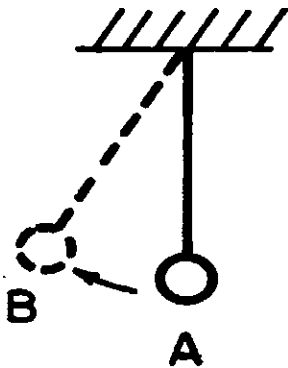
- A) A and B, only
- B) B and C, only
- C) C and D, only
- ☒ D) all positions, A through D

### Skill 31: Conservation of Energy

64. At what point in its fall does the kinetic energy of a freely falling object equal its potential energy?

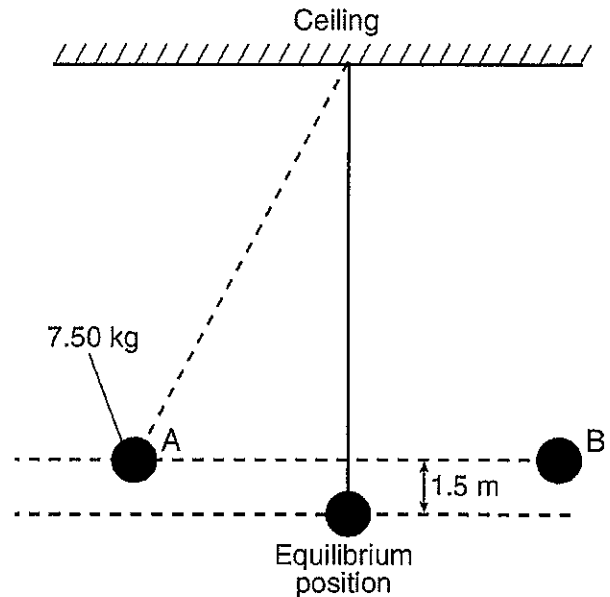
- A) at the start of the fall
- ☒ B) halfway between the start and the end
- C) at the end of the fall
- D) at all points during the fall

65. As a pendulum swings from position *A* to position *B* as shown in the diagram, its total mechanical energy (neglecting friction)



- A) decreases
- B) increases
- ☒ C) remains the same

66. A pendulum is made from a 7.50-kilogram mass attached to a rope connected to the ceiling of a gymnasium. The mass is pushed to the side until it is at position *A*, 1.5 meters higher than its equilibrium position. After it is released from rest at position *A*, the pendulum moves freely back and forth between positions *A* and *B*, as shown in the diagram below.



What is the total amount of kinetic energy that the mass has as it swings freely through its equilibrium position? [Neglect friction.]

- A) 11 J
- B) 94 J
- ☒ C) 110 J
- D) 920 J

67. **This question has only three choices.**

As a ball falls freely toward the ground, its total mechanical energy

- A) decreases
- B) increases
- ☒ C) remains the same

# Skill 31: Conservation of Energy

68. A 55.0-kilogram diver falls freely from a diving platform that is 3.00 meters above the surface of the water in a pool. When she is 1.00 meter above the water, what are her gravitational potential energy and kinetic energy with respect to the water's surface?

- A)  $PE = 1620 \text{ J}$  and  $KE = 0 \text{ J}$   
 B)  $PE = 1080 \text{ J}$  and  $KE = 540 \text{ J}$   
 C)  $PE = 810 \text{ J}$  and  $KE = 810 \text{ J}$   
 D)  $PE = 540 \text{ J}$  and  $KE = 1080 \text{ J}$

$$E_T = PE + KE$$

$$\text{Top } 3\text{m } 1620\text{J} = 1620\text{J} + 0$$

$$1\text{m } (620) = 540\text{J} + (1080\text{J})$$

69. A child, starting from rest at the top of a playground slide, reaches a speed of 7.0 meters per second at the bottom of the slide. What is the vertical height of the slide? [Neglect friction.]

- A) 0.71 m  
 B) 1.4 m  
 C) 2.5 m  
 D) 3.5 m

$$KE_{\text{bottom}} = PE_{\text{top}}$$

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

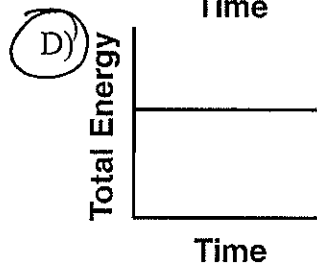
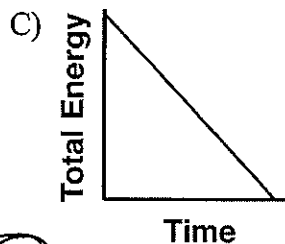
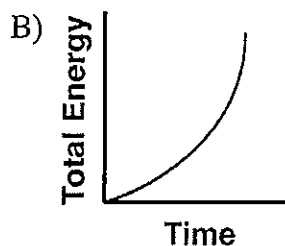
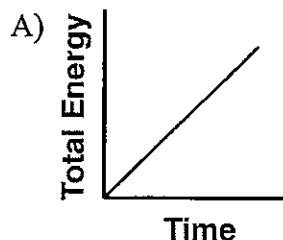
$$\frac{1}{2}(7\text{m/s})^2 = (9.8\text{m/s}^2)h$$

or

$$v_f^2 = v_i^2 + 2ad$$

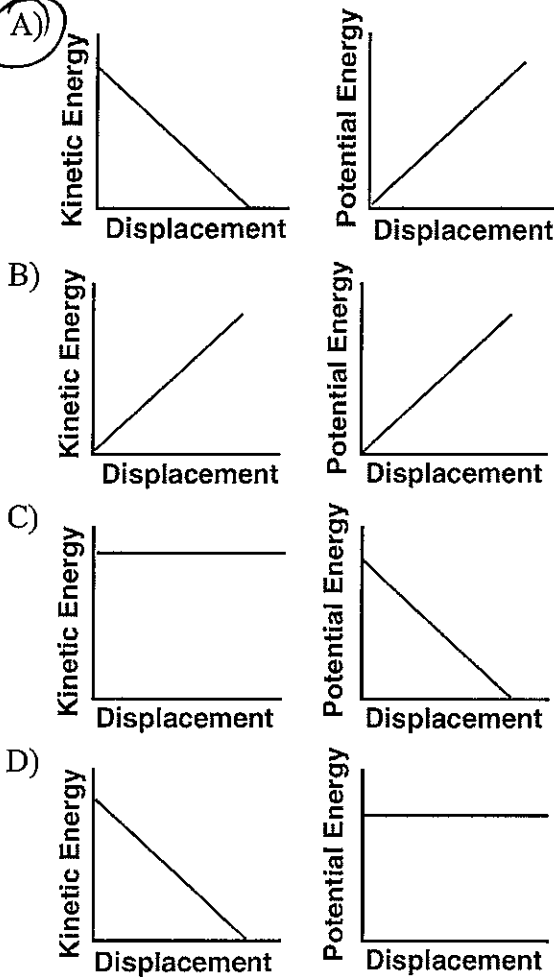
$$0 = (7\text{m/s})^2 + 2(9.8\text{m/s}^2)d$$

70. A ball is dropped from the top of a cliff. Which graph best represents the relationship between the ball's total energy and elapsed time as the ball falls to the ground? [Neglect friction.]



## Skill 31: Conservation of Energy

71. An object is thrown vertically upward. Which pair of graphs best represents the object's kinetic energy and gravitational potential energy as functions of its displacement while it rises?



72. Energy is measured in the same units as

A) force                      B) momentum  
☒ C) work                      D) power

73. A 3.0-kilogram mass is attached to a spring having a spring constant of 30. newtons per meter. The mass is pulled 0.20 meter from the spring's equilibrium position and released. What is the maximum kinetic energy achieved by the mass spring system?

A) 2.4 J                      B) 1.5 J  
 C) 1.2 J                      ☒ D) 0.60 J

$$KE = \Delta PE_s = \frac{1}{2} k x^2$$

$$\frac{1}{2} (30 \text{ N/m}) (0.2 \text{ m})^2$$

74. As an object falls freely, the kinetic energy of the object

A) decreases  
☒ B) increases  
 C) remains the same

*V increase KE*

75. As a ball falls freely (without friction) toward the ground, its total mechanical energy

A) decreases  
 B) increases  
☒ C) remains the same

76. A 1-kilogram rock is dropped from a cliff 90 meters high. After falling 20 meters, the kinetic energy of the rock is approximately

A) 20 J                      ☒ B) 200 J  
 C) 700 J                      D) 900 J

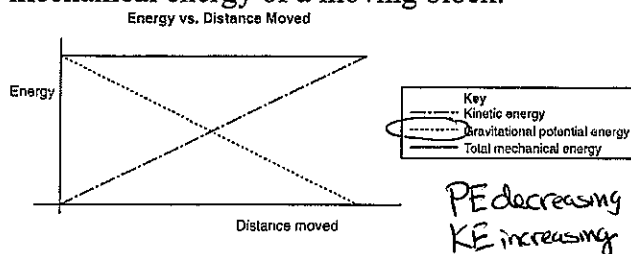
$$E_T = PE + KE$$

$$90\text{m} \quad 883\text{J} = 883\text{J} + 0$$

$$70\text{m} \quad 883\text{J} = 686\text{J} + 197\text{J}$$

### Skill 31: Conservation of Energy

77. The graph below represents the kinetic energy, gravitational potential energy, and total mechanical energy of a moving block.



Which best describes the motion of the block?

- ☒ A) accelerating on a flat horizontal surface  
☐ B) sliding up a frictionless incline  
☒ C) falling freely  
☐ D) being lifted at constant velocity

78. The work done in accelerating an object along a frictionless horizontal surface is equal to the object's change in

- A) momentum      B) velocity  
C) potential energy      ☒ D) kinetic energy

79. A ball is thrown vertically upward. As the ball rises, its total energy (neglecting friction)

- A) decreases  
B) increases  
☒ C) remains the same