Name: _____ Period: _____

WEP-Energy

1. A 1-kilogram rock is dropped from a cliff 90 meters high. After falling 20 meters, the kinetic energy of the rock is approximately
   1. 20 J
   2. 200 J
   3. 700 J
   4. 900 J

2. If the speed of a car is doubled, the kinetic energy of the car is
   1. quadrupled
   2. quartered
   3. doubled
   4. halved

3. A constant force is used to keep a block sliding at constant velocity along a rough horizontal track. As the block slides, there could be an increase in its
   1. gravitational potential energy, only
   2. internal energy, only
   3. gravitational potential energy and kinetic energy
   4. internal energy and kinetic energy

4. As an object falls freely, the kinetic energy of the object
   1. decreases
   2. increases
   3. remains the same

5. An object weighing 15 newtons is lifted from the ground to a height of 0.22 meter. The increase in the object's gravitational potential energy is approximately
   1. 310 J
   2. 32 J
   3. 3.3 J
   4. 0.34 J

6. 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.]
   1. 2.6 m
   2. 5.1 m
   3. 13 m
   4. 25 m

7. A 45-kilogram boy is riding a 15-kilogram bicycle with a speed of 8 meters per second. What is the combined kinetic energy of the boy and the bicycle?
   1. 240 J
   2. 480 J
   3. 1440 J
   4. 1920 J

8. The work done in moving a block across a rough surface and the heat energy gained by the block can both be measured in
   1. watts
   2. degrees
   3. newtons
   4. joules

Base your answers to questions 9 through 11 on the information below.

A 50-kilogram child running at 6 meters per second jumps onto a stationary 10-kilogram sled. The sled is on a level frictionless surface.

9. Calculate the speed of the sled with the child after she jumps onto the sled. [Show all work, including the equation and substitution with units.]

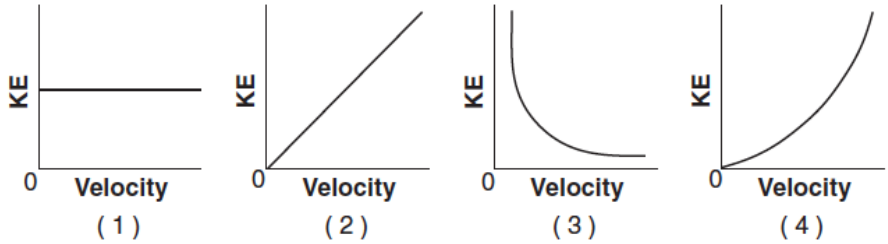
10. Calculate the kinetic energy of the sled with the child after she jumps onto the sled. [Show all work, including the equation and substitution with units.]

11. After a short time, the moving sled with the child aboard reaches a rough level surface that exerts a constant frictional force of 54 newtons on the sled. How much work must be done by friction to bring the sled with the child to a stop?

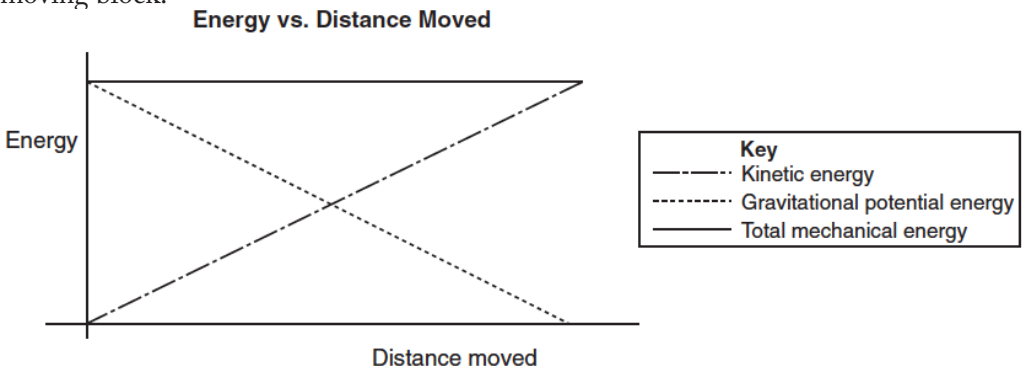
Name: _____ Period: _____

WEP-Energy

12. Which graph best represents the relationship between the kinetic energy, KE, and the velocity of an objct accelerating in a straight line?



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

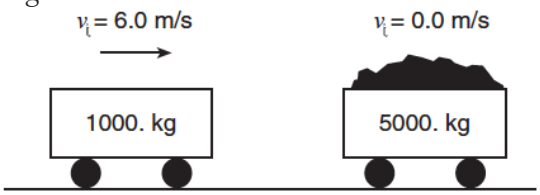


Which best describes the motion of the block?

1. accelerating on a flat horizontal surface
2. sliding up a frictionless incline
3. falling freely
4. being lifted at constant velocity

Base your answers to questions 14 through 16 on the information and diagram below.

A 1000-kilogram empty cart moving with a speed of 6 meters per second is about to collide with a stationary loaded cart having a total mass of 5000 kilograms, as shown. After the collision, the carts lock and move together. [Assume friction is negligible.]



14. Calculate the speed of the combined carts after the collision. [Show all work, including the equation and substitution with units.]

15. Calculate the kinetic energy of the combined carts after the collision. [Show all work, including the equation and substitution with units.]

16. How does the kinetic energy of the combined carts after the collision compare to the kinetic energy of the carts before the collision?

Name: _____ Period: _____

WEP-Energy

17. When a force moves an object over a rough, horizontal surface at a constant velocity, the work done against friction produces an increase in the object's
    1. weight
    2. momentum
    3. potential energy
    4. internal energy

Base your answers to questions 18 through 21 on the information below.

The driver of a car made an emergency stop on a straight horizontal road. The wheels locked and the car skidded to a stop. The marks made by the rubber tires on the dry asphalt are 16 meters long, and the car's mass is 1200 kilograms.

18. Determine the weight of the car

19. Calculate the magnitude of the frictional force the road applied to the car in stopping it. [Show all work, including the equation and substitution with units.]

20. Calculate the work done by the frictional force in stopping the car. [Show all work, including the equation and substitution with units.]

21. Assuming that energy is conserved, calculate the speed of the car before the brakes were applied. [Show all work, including the equation and substitution with units.]

22. A 60-kilogram runner has 1920 joules of kinetic energy. At what speed is she running?
    1. 5.66 m/s
    2. 8.00 m/s
    3. 32.0 m/s
    4. 64.0 m/s

23. As a block slides across a table, its speed decreases while its temperature increases. Which two changes occur in the block's energy as it slides?
    1. a decrease in kinetic energy and an increase in internal energy
    2. an increase in kinetic energy and a decrease in internal energy
    3. a decrease in both kinetic energy and internal energy
    4. an increase in both kinetic energy and internal energy

24. If the direction of a moving car changes and its speed remains constant, which quantity must remain the same?
    1. velocity
    2. momentum
    3. displacement
    4. kinetic energy

25. What is the gravitational potential energy with respect to the surface of the water of a 75.0-kilogram diver located 3.00 meters above the water?

    1. 2.17×10^4 J
    2. 2.21×10^3 J
    3. 2.25×10^2 J
    4. 2.29×10^1 J

26. As a ball falls freely (without friction) toward the ground, its total mechanical energy
    1. decreases
    2. increases
    3. remains the same

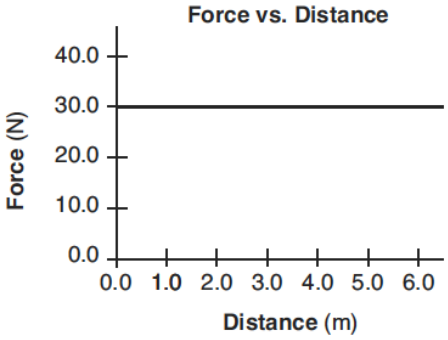
27. The gravitational potential energy, with respect to Earth, this is possessed by an object is dependent on the object's
    1. acceleration
    2. momentum
    3. position
    4. speed

Name: _____ Period: _____

WEP-Energy

Base your answers to questions 28 and 29 on the information below.

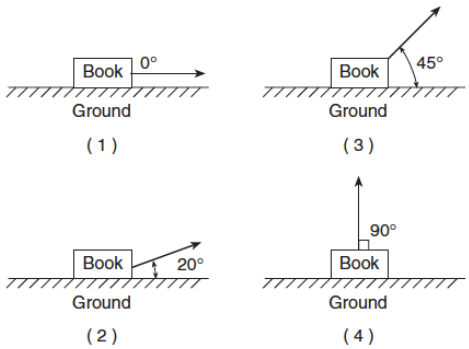
A boy pushes his wagon at constant speed along a level sidewalk. The graph below represents the relationship between the horizontal force exerted by the boy and the distance the wagon moves.



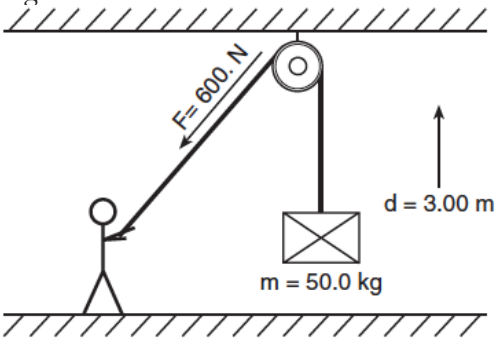
28. What is the total work done by the boy in pushing the wagon 4.0 meters?
    1. 5.0 J
    2. 7.5 J
    3. 120 J
    4. 180 J

29. As the boy pushes the wagon, what happens to the wagon's energy?
    1. Gravitational potential energy increases.
    2. Gravitational potential energy decreases.
    3. Internal energy increases.
    4. Internal energy decreases.

30. A 1.0-kilogram book resting on the ground is moved 1.0 meter at various angles relative to the horizontal. In which direction does the 1.0-meter displacement produce the greatest increase in the book's gravitational potential energy?



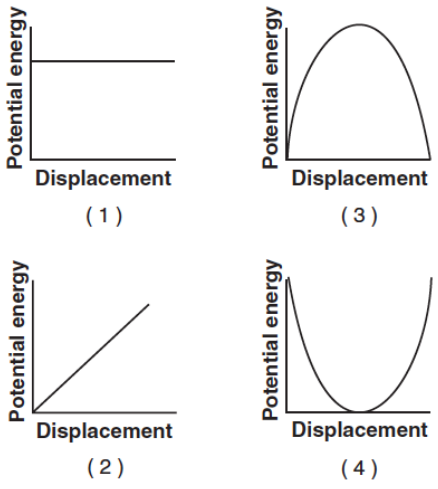
31. As shown in the diagram below, a student exerts an average force of 600 newtons on a rope to lift a 50-kilogram crate a vertical distance of 3 meters.



Compared to the work done by the student, the gravitational potential energy gained by the crate is
    1. exactly the same
    2. 330 J less
    3. 330 J more
    4. 150 J more

32. A book sliding across a horizontal tabletop slows until it comes to rest. Describe what change, if any, occurs in the book's kinetic energy and internal energy as it slows.

33. A pendulum is pulled to the side and released from rest. Which graph best represents the relationship between the gravitational potential energy of the pendulum and its displacement from its point of release?

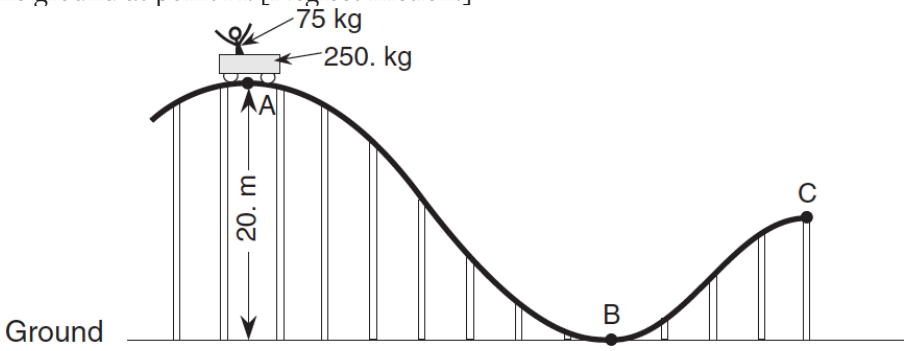


Name: _____ Period: _____

WEP-Energy

Base your answers to questions 34 through 36 on the information and diagram below.

A 250-kilogram car is initially at rest at point A on a roller coaster track. The car carries a 75-kilogram passenger and is 20 meters above the ground at point A. [Neglect friction.]

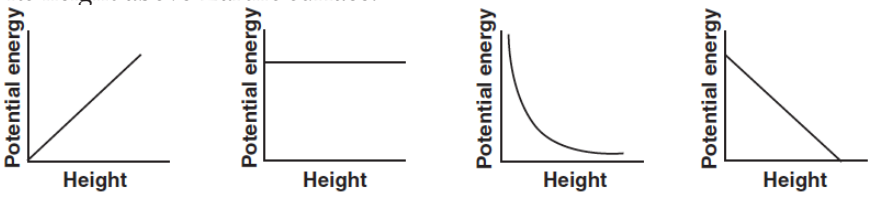


34. Calculate the total gravitational potential energy, relative to the ground, of the car and the passenger at point A. [Show all work, including the equation and substitution with units.]

35. Calculate the speed of the car and passenger at point B. [Show all work, including the equation and substitution with units.]

36. Compare the total mechanical energy of the car and passenger at points A, B, and C.

37. Which graph best represents the relationship between the gravitational potential energy of an object near the surface of Earth and its height above Earth's surface?



38. A horizontal force of 5.0 newtons acts on a 3.0-kilogram mass over a distance of 6.0 meters along a horizontal, frictionless surface. What is the change in kinetic energy of the mass during its movement over the 6.0-meter distance?
    1. 6.0 J
    2. 15 J
    3. 30 J
    4. 90 J

39. As a ball falls freely toward the ground, its total mechanical energy
    1. decreases
    2. increases
    3. remains the same

Name: _____ Period: _____

WEP-Energy

Base your answers to questions 40 through 42 on the information below.

A roller coaster car has a mass of 290 kilograms. Starting from rest, the car acquires 3.13×10^5 joules of kinetic energy as it descends to the bottom of a hill in 5.3 seconds.

40. Calculate the height of the hill. [Neglect friction. Show all work, including the equation and substitution with units.]

41. Calculate the speed of the roller coaster car at the bottom of the hill. [Show all work, including the equation and substitution with units.]

42. Calculate the magnitude of the average acceleration of the roller coaster car as it descends to the bottom of the hill. [Show all work, including the equation and substitution with units.]

43. The table below lists the mass and speed of each of four objects.

Data Table

Objects	Mass (kg)	Speed (m/s)
A	1.0	4.0
B	2.0	2.0
C	0.5	4.0
D	4.0	1.0

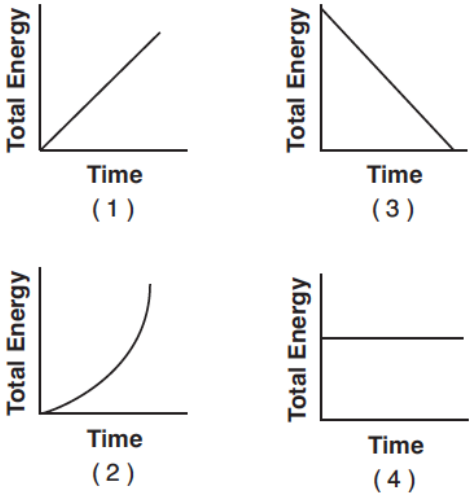
Which two objects have the same kinetic energy?
1. A and D
2. B and D
3. A and C
4. B and C

44. A 1.00-kilogram ball is dropped from the top of a building. Just before striking the ground, the ball's speed is 12.0 meters per second. What was the ball's gravitational potential energy, relative to the ground, at the instant it was dropped? [Neglect friction.]
1. 6.00 J
2. 24.0 J
3. 72.0 J
4. 144 J

45. A person weighing 6.0×10^2 newtons rides an elevator upward at an average speed of 3.0 meters per second for 5.0 seconds. How much does this person's gravitational potential energy increase as a result of this ride?
1. 3.6×10^2 J
2. 1.8×10^3 J
3. 3.0×10^3 J
4. 9.0×10^3 J

46. Which combination of fundamental units can be used to express energy?
1. kg·m/s
2. kg·m^2/s
3. kg·m/s^2
4. kg·m^2/s^2

47. 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.]

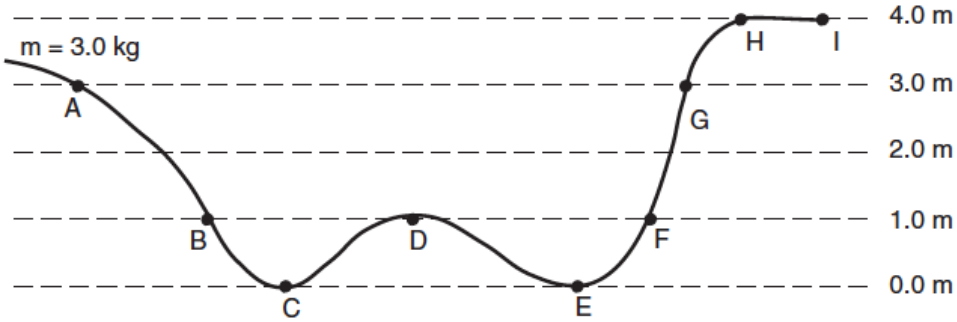


Name: _____ Period: _____

WEP-Energy

Base your answers to questions 48 through 50 on the information and diagram below.

A 3.0-kilogram object is placed on a frictionless track at point A and released from rest. (Assume the gravitational potential energy of the system to be zero at point C.)



48. Calculate the gravitational potential energy of the object at point A. [Show all work, including the equation and substitution with units.]

49. Calculate the kinetic energy of the object at point B. [Show all work, including the equation and substitution with units.]

50. Which letter represents the farthest point on the track that the object will reach?

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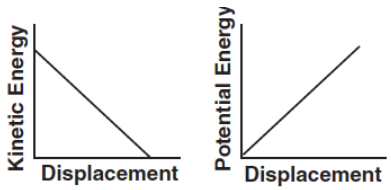
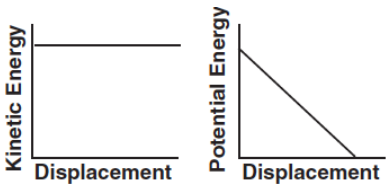
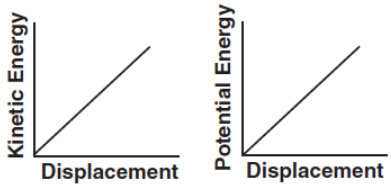
51. An object is thrown vertically upward. Which pair of graphs best represents the object's kinetic energy and gravitational potential energy as functions of displacement while it rises?



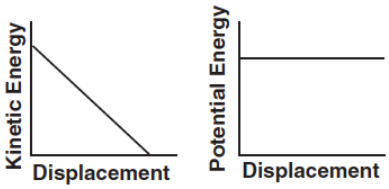
(1)



(3)



(2)

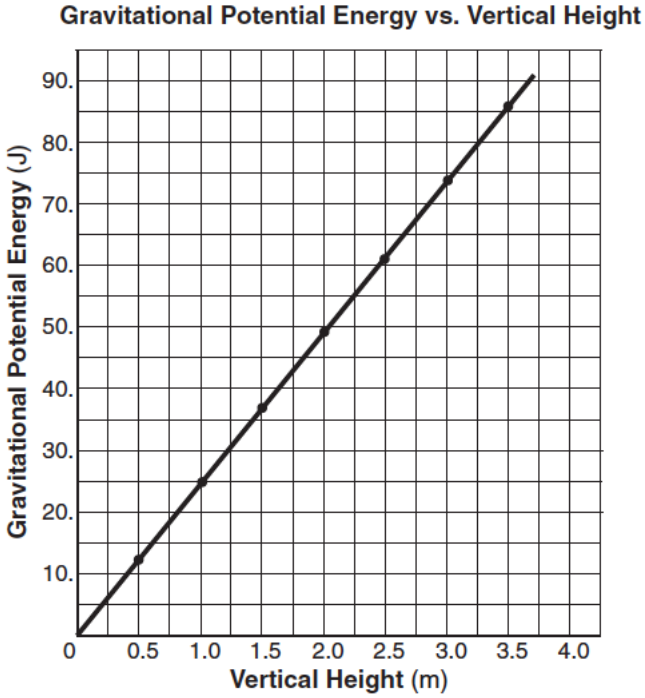


(4)

Name: _____ Period: _____

WEP-Energy

Base your answers to questions 52 through 55 on the graph below, which represents the relationship between vertical height and gravitational potential energy for an object near Earth's surface.



52. Based on the graph, what is the gravitational potential energy of the object when it is 2.25 meters above the surface of Earth?

53. Using the graph, calculate the mass of the object. [Show all work, including the equation and substitution with units.]

54. What physical quantity does the slope of the graph represent?

55. Using a straightedge, draw a line on the graph to represent the relationship between gravitational potential energy and vertical height for an object having a greater mass.

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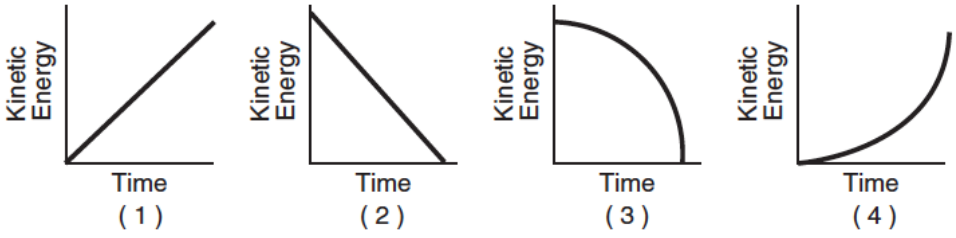
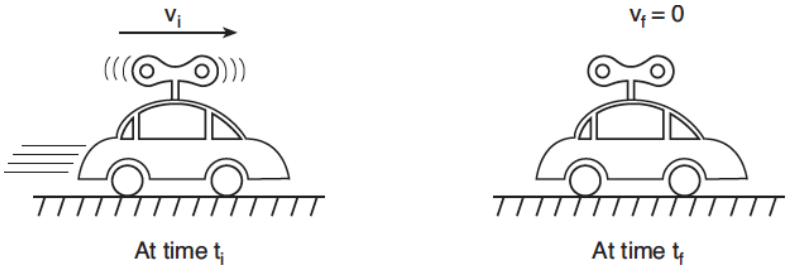
56. An object falls freely near Earth's surface. Which graph best represents the relationship between the object's kinetic energy and its time of fall?



Name: _____ Period: _____

WEP-Energy

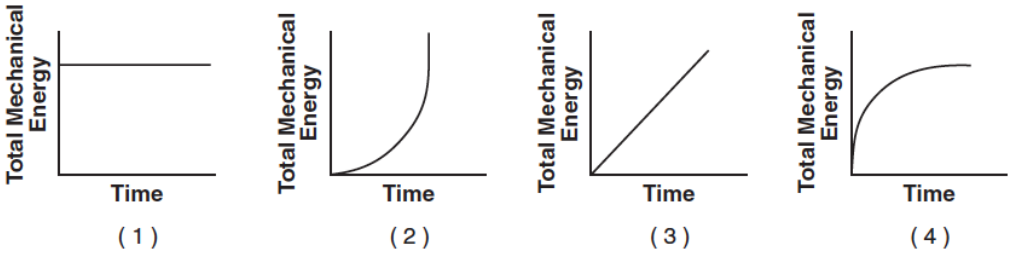
57. A wound spring provides the energy to propel a toy car across a level floor. At time t_i, the car is moving at speed v_i across the floor and the spring is unwinding, as shown below. At time t_f, the spring has fully unwound and the car has coasted to a stop.



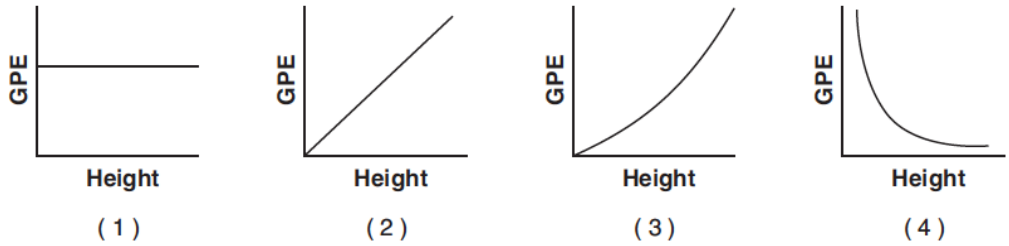
Which statement best describes the transformation of energy that occurs between times t_i and t_f?

1. Gravitational potential energy at t_i is converted to internal energy at t_f.
2. Elastic potential energy at t_i is converted to kinetic energy at t_f.
3. Both elastic potential energy and kinetic energy at t_i are converted to internal energy at t_f.
4. Both kinetic energy and internal energy at t_i are converted to elastic potential energy at t_f.

58. A wooden crate is pushed at constant speed across a level wooden floor. Which graph best represents the relationship between the total mechanical energy of the crate and the duration of time the crate is pushed?



59. Which graph represents the relationship between the gravitational potential energy (GPE) of an object near the surface of Earth and its height above the surface of Earth?



Base your answers to questions 60 and 61 on the information below.

A 75-kilogram athlete jogs 1.8 kilometers along a straight road in 1.2×10^3 seconds.

60. Determine the average speed of the athlete in meters per second.

61. Calculate the average kinetic energy of the athlete. [Show all work, including the equation and substitution with units.]

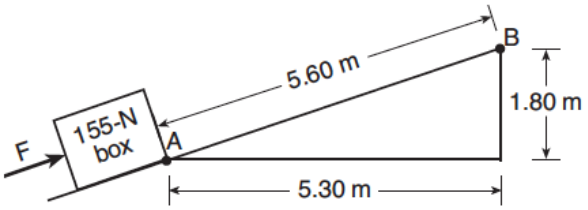
Name: _____ Period: _____

WEP-Energy

62. A 6.8-kilogram block is sliding down a horizontal, frictionless surface at a constant speed of 6.0 meters per second. The kinetic energy of the block is approximately
    1. 20 J
    2. 41 J
    3. 120 J
    4. 240 J

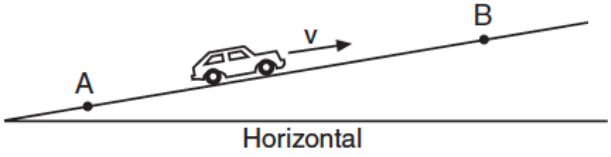
63. If the speed of a moving object is doubled, the kinetic energy of the object is
    1. halved
    2. doubled
    3. unchanged
    4. quadrupled

64. The diagram below represents a 155-newton box on a ramp. Applied force F causes the box to slide from point A to point B.



What is the total amount of gravitational potential energy gained by the box?
    1. 28.4 J
    2. 279 J
    3. 868 J
    4. 2740 J

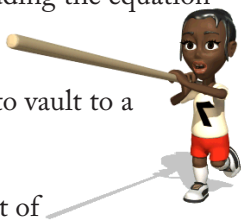
65. A car travels at constant speed v up a hill from point A to point B, as shown in the diagram below.



As the car travels from A to B, its gravitational potential energy
    1. increases and its kinetic energy decreases
    2. increases and its kinetic energy remains the same
    3. remains the same and its kinetic energy decreases
    4. remains the same and its kinetic energy remains the same

66. A student makes a simple pendulum by attaching a mass to the free end of a 1.50-meter length of string suspended from the ceiling of her physics classroom. She pulls the mass up to her chin and releases it from rest, allowing the pendulum to swing in its curved path. Her classmates are surprised that the mass doesn't reach her chin on the return swing, even though she does not move. Explain why the mass does *not* have enough energy to return to its starting position and hit the girl on the chin.

Base your answers to questions 67 and 68 on the information below. [Show all work, including the equation and substitution with units.]



A 65-kilogram pole vaulter wishes to vault to a height of 5.5 meters.

67. Calculate the minimum amount of kinetic energy the vaulter needs to reach this height if air friction is neglected and all the vaulting energy is derived from kinetic energy.

68. Calculate the speed the vaulter must attain to have the necessary kinetic energy.

69. Which pair of quantities can be expressed using the same units?
    1. work and kinetic energy
    2. power and momentum
    3. impulse and potential energy
    4. acceleration and weight

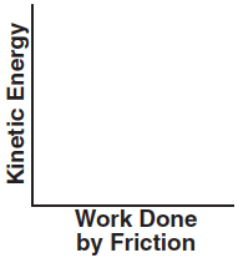
Name: _____ Period: _____

WEP-Energy

70. A car with mass m possesses a momentum of magnitude p. Which expression correctly represents the kinetic energy, KE, of the car in terms of m and p?
    1. KE=p/2m
    2. KE=$mp^2/2$
    3. KE=mp/2
    4. KE=$p^2/2m$

71. Which statement best explains why a "wet saw" used to cut through fine optical crystals is constantly lubricated with oil?
    1. Lubrication decreases friction and minimizes the increase of internal energy.
    2. Lubrication decreases friction and maximizes the increase of internal energy.
    3. Lubrication increases friction and minimizes the increase of internal friction.
    4. Lubrication increases friction and maximizes the increase of internal energy.

72. A car, initially traveling at 30 meters per second, slows uniformly as it skids to a stop after the brakes are applied. On the axes below, sketch a graph showing the relationship between the kinetic energy of the car as it is being brought to a stop and the work done by friction in stopping the car.



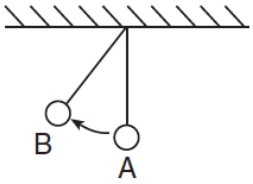
73. The work done on a slingshot is 40 joules to pull back a 0.10-kilogram stone. If the slingshot projects the stone straight up in the air, what is the maximum height to which the stone will rise? [Neglect friction.]
    1. 0.41 m
    2. 41 m
    3. 410 m
    4. 4.1 m

74. Calculate the kinetic energy of a particle with a mass of 3.34×10^{-27} kg and a speed of 2.89×10^{5} meters per second.

75. A 55-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.
    1. PE=1620 J and KE=0 J
    2. PE=1080 J and KE=540 J
    3. PE=810 J and KE=810 J
    4. PE=540 J and KE=1080 J

76. As a box is pushed 30 meters across a horizontal floor by a constant horizontal force of 25 newtons, the kinetic energy of the box increases by 300 joules. How much total internal energy is produced during this process?
    1. 150 J
    2. 250 J
    3. 450 J
    4. 750 J

77. The diagram below shows an ideal simple pendulum.



    As the pendulum swings from position A to position B, what happens to its total mechanical energy? [Neglect friction.]
    1. It decreases.
    2. It increases.
    3. It remains the same.

78. Which situation describes a system with *decreasing* gravitational potential energy.
    1. a girl stretching a horizontal spring
    2. a bicyclist riding up a steep hill
    3. a rocket rising vertically from Earth
    4. a boy jumping down from a tree limb

79. A 2.0-kilogram block sliding down a ramp from a height of 3.0 meters above the ground reaches the ground with a kinetic energy of 50 joules. The total work done by friction on the block as it slides down the ramp is approximately
    1. 6 J
    2. 9 J
    3. 18 J
    4. 44 J

Name: _____ Period: _____

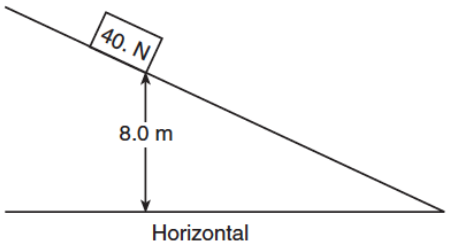
WEP-Energy

80. Which statement describes the kinetic energy and total mechanical energy of a block as it is pulled at constant speed up an incline?
    1. Kinetic energy decreases and total mechanical energy increases.
    2. Kinetic energy decreases and total mechanical energy remains the same.
    3. Kinetic energy remains the same and total mechanical energy increases.
    4. Kinetic energy remains the same and total mechanical energy remains the same.

81. A 75-kilogram bicyclist coasts down a hill at a constant speed of 12 meters per second. What is the kinetic energy of the bicyclist?
    1. 4.5×10^2 J
    2. 9.0×10^2 J
    3. 5.4×10^3 J
    4. 1.1×10^4 J

82. An electrical generator in a science classroom makes a lightbulb glow when a student turns a hand crank on the generator. During its operation, this generator converts
    1. chemical energy to electrical energy
    2. mechanical energy to electrical energy
    3. electrical energy to mechanical energy
    4. electrical energy to chemical energy

83. A block weighing 40 newtons is released from rest on an incline 8 meters above the horizontal, as shown in the diagram below.



    If 50 joules of heat is generated as the block slides down the incline, the maximum kinetic energy of the block at the bottom of the incline is
    1. 50 J
    2. 270 J
    3. 320 J
    4. 3100 J

84. 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.]
    1. 0.71 m
    2. 1.4 m
    3. 2.5 m
    4. 3.5 m

85. Two students of equal weight go from the first floor to the second floor. The first student uses an elevator and the second student walks up a flight of stairs. Compared to the gravitational potential energy gained by the first student, the gravitational potential energy gained by the second student is
    1. less
    2. greater
    3. the same

86. During an emergency stop, a 1.5×10^3-kilogram car lost a total of 3.0×10^5 joules of kinetic energy. What was the speed of the car at the moment the brakes were applied?
    1. 10 m/s
    2. 14 m/s
    3. 20 m/s
    4. 25 m/s

87. While riding a chairlift, a 55-kilogram skier is raised a vertical distance of 370 meters. What is the total change in the skier's gravitational potential energy?
    1. 5.4×10^1 J
    2. 5.4×10^2 J
    3. 2.0×10^4 J
    4. 2.0×10^5 J

88. A book of mass m falls freely from rest to the floor from the top of a desk of height h. What is the speed of the book upon striking the floor?
    1. $\sqrt{2gh}$
    2. 2gh
    3. mgh
    4. mh

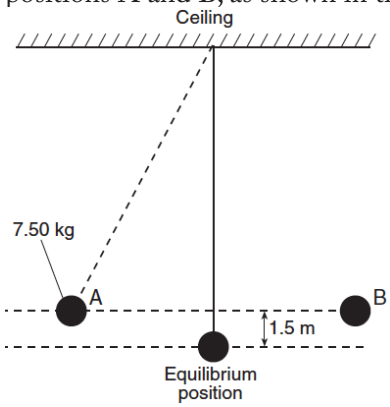
89. A box at the top of a rough incline possesses 981 joules more gravitational potential energy than it does at the bottom. As the box slides to the bottom of the incline, 245 joules of heat is produced. Determine the kinetic energy of the box at the bottom of the incline.

Name: _____ Period: _____

WEP-Energy

90. A car uses its brakes to stop on a level road. During this process, there must be a conversion of kinetic energy into
    1. light energy
    2. nuclear energy
    3. gravitational potential energy
    4. internal energy

91. 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.



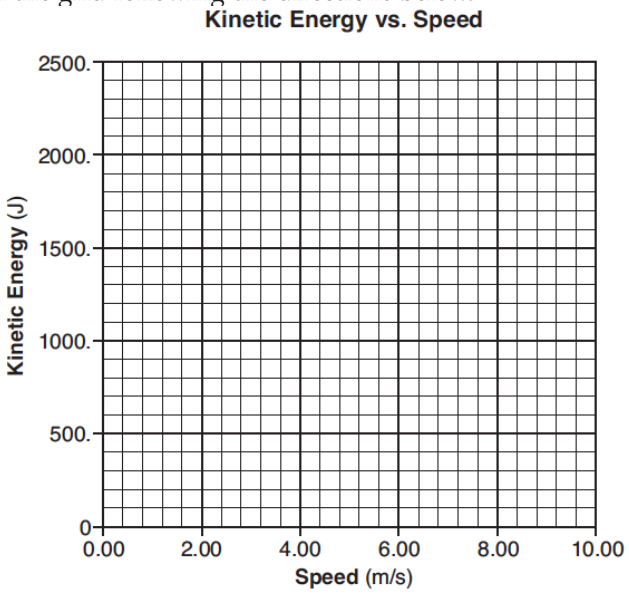
What is the total amount of kinetic energy that the mass has as it swings freely through its equilibrium position? [Neglect friction.]
    1. 11 J
    2. 94 J
    3. 110 J
    4. 920 J

Base your answers to questions 92 through 95 on the information below.

A runner accelerates uniformly from rest to a speed of 8 meters per second. The kinetic energy of the runner was determined at 2-meter-per-second intervals and recorded in the data table.

Speed (m/s)	Kinetic Energy (J)
0.00	0.00
2.00	140
4.00	560
6.00	1260
8.00	2240

Using the information in the data table, construct a graph on the grid following the directions below.



92. Plot the data points for kinetic energy of the runner versus his speed.

93. Draw the line or curve of best fit.

94. Calculate the mass of the runner [Show all work, including the equation and substitution with units.]

95. A soccer player having less mass than the runner also accelerates uniformly from rest to a speed of 8 meters per second. Compare the kinetic energy of the less massive soccer player to the kinetic energy of the more massive runner when both are traveling at the same speed.