9. Person X pushes twice as hard against a stationary brick wall as person Y. Which one of the following statements is correct?

A) Both do positive work, but person X does four times the work of person Y.
B) Both do positive work, but person X does twice the work of person Y.
C) Both do the same amount of positive work.
D) Both do zero work.
E) Both do positive work, but person X does one-half the work of person Y.

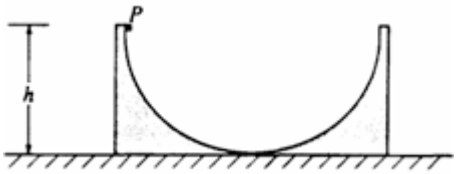
10. Three cars (car L, car M, and car N) are moving with the same speed and slam on their brakes. The most massive car is car L, and the least massive is car N. If the tires of all three cars have identical coefficients of kinetic friction with the road surface, for which car is the amount of work done by friction in stopping it the greatest?
A) The amount of work done by friction is the same for all cars.
B) Car L
C) Car M
D) Car N

11. When you drop a pebble from height H, it reaches the ground with kinetic energy K if there is no air resistance. From what height should you drop it so it will reach the ground with twice as much kinetic energy?
A)$2H$
B) 2H
C) 4H
D) 8H
E) 16H

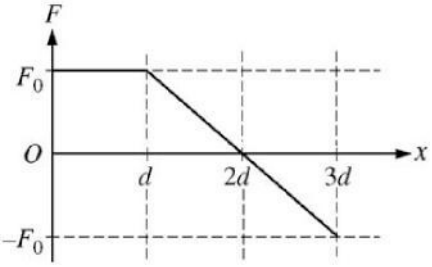
12. When you throw a pebble straight up with initial speed V, it reaches a maximum height H with no air resistance. At what speed should you throw it up vertically so it will go twice as high?
A) 16V
B) 8V
C) 4V
D) 2V
E)$2V$

13. Two objects, one of mass m and the other of mass 2m, are dropped from the top of a building. If there is no air resistance, when they hit the ground
A) both will have the same kinetic energy.
B) the heavier one will have twice the kinetic energy of the lighter one.
C) the heavier one will have four times the kinetic energy of the lighter one.
D) the heavier one will have half the kinetic energy of the lighter one.

E) the heavier one will have one-fourth the kinetic energy of the lighter one.
14. An egg falls from a bird's nest in a tree and experiences air resistance. As it falls,
A) only its kinetic energy is conserved.
B) only its momentum is conserved.
C) both its kinetic energy and its momentum are conserved.
D) only its mechanical energy is conserved.
E) momentum and mechanical energy are not conserved.



15. The figure shows a rough semicircular track whose ends are at a vertical height h. A block placed at point P at one end of the track is released from rest and slides past the bottom of the track. Which of the following is true of the height to which the block rises on the other side of the track?
(A) It is equal to h/4 (B) It is equal to h/2 (C) It is equal to h
(D) It is between zero and h; the exact height depends on how much energy is lost to friction.



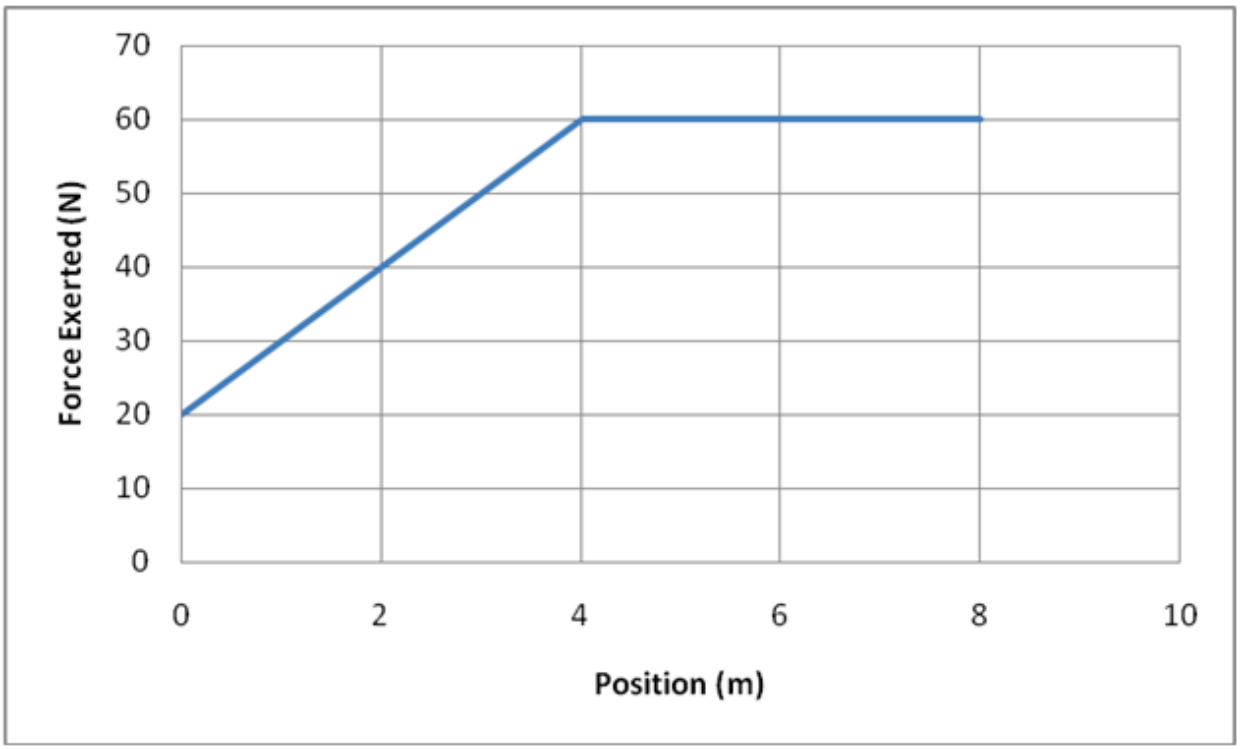
16. An object is moving in the positive x-direction while a net force directed along the *x*-axis is exerted on the object. The figure above shows the force as a function of position. What is the net work done on the object over the distance shown?
F_0d
3 F_0d /2
2 F_0d
4 F_0d

17. George is pulling the sled up a **steeper** hill of the **same** height as the original hill. How will the speed of the sled at the bottom of the hill (after it has slid down) compare to that of the sled at the bottom of the original hill? Choose the best answer below.

A. The speed at the bottom is greater for the steeper hill.
B. The speed at the bottom is the same for both hills.
C. The speed at the bottom is greater for the original hill because the sled travels further.
D. There is not enough information given to say which speed at the bottom is faster.

E. None of these descriptions is correct.

Questions 18 and 19: Lia pushes her little sister who is sitting on a sled. Lia's sister and sled are initially at rest on a frozen lake. The system is Lia's sister and the sled. Lia pushes her sister for 8 m. ***In each case friction and air resistance are so small they can be ignored.*** The graph below represents the force Lia exerts on her sister and the sled for a certain displacement. Use the graph to answer the questions below.



18. Use the graph to determine the work done by Lia on the system while she is exerting the force on the sled.

A. 160 J
B. 240 J
C. 320 J
D. 400 J

19. The combined mass of Lia's sister and the sled is 20 kg, Lia's mass is 50 kg. Determine the final speed of the system.

A. 4 m/s
B. 4.9 m/s
C. 5.7 m/s
D. 6.3 m/s

20. How does the kinetic energy of the two-block system after the collision compare with its kinetic energy before the collision, and why?
It is less, because the blocks have the same velocity after the collision, so some of their kinetic energy was transformed into internal energy.
It is less, because the blocks have velocities in opposite directions before the collision, so some of their kinetic energy cancels.
It is the same, because the collision was instantaneous, so the effect of external forces during the collision is negligible.
It is the same, because the blocks have the same velocity after the collision, and there is no friction acting on them.

21. A spring is compressed between two objects with unequal masses, m and M, and held together. The objects are initially at rest on a horizontal frictionless surface. When released, which of the following is true?
(A) The total final kinetic energy is zero.
(B) The two objects have equal kinetic energy.
(C) The speed of one object is equal to the speed of the other.
(D) The total final momentum of the two objects is zero

22. An object of mass M travels along a horizontal air track at a constant speed v and collides elastically with an object of identical mass that is initially at rest on the track. Which of the following statements is true for the two objects after the impact?
(A) The total momentum is Mv and the total kinetic energy is $\frac{1}{2} Mv^2$
(B) The total momentum is Mv and the total kinetic energy is less than $\frac{1}{2} Mv^2$
(C) The total momentum is less than Mv and the total kinetic energy is $\frac{1}{2} Mv^2$
(D) The momentum of each object is $\frac{1}{2} Mv$