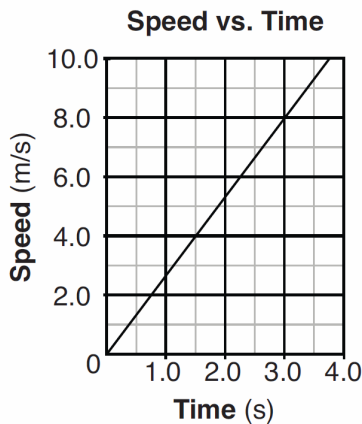


Christmas Takehome 2011

Show all work on the answer sheet.

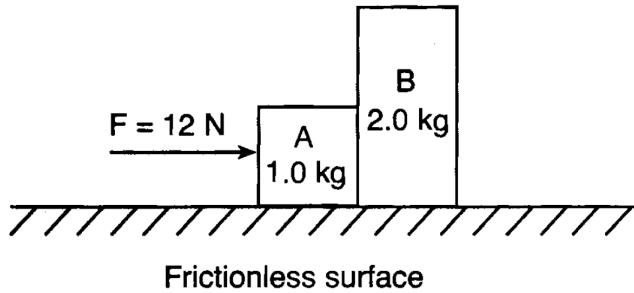
1. A motorboat, which has a speed of 5.0 meters per second in still water, is headed east as it crosses a river flowing south at 3.3 meters per second. What is the magnitude of the boat's resultant velocity with respect to the starting point?
2. A car traveling on a straight road at 15.0 meters per second accelerates uniformly to a speed of 21.0 meters per second in 12.0 seconds. The total distance traveled by the car in this 12.0-second time interval is
3. An object accelerates uniformly from 3.0 meters per second east to 8.0 meters per second east in 2.0 seconds. What is the magnitude of the acceleration of the object?
4. A ball is thrown vertically upward with an initial velocity of 29.4 meters per second. What is the maximum height reached by the ball? [Neglect friction.]
5. A 5.0-kilogram sphere, starting from rest, falls freely 22 meters in 3.0 seconds near the surface of a planet. Compared to the acceleration due to gravity near Earth's surface, the acceleration due to gravity near the surface of the planet is approximately
6. The graph below shows the relationship between the speed and elapsed time for an object falling freely from rest near the surface of a planet.



What is the total distance the object falls during the first 3.0 seconds?

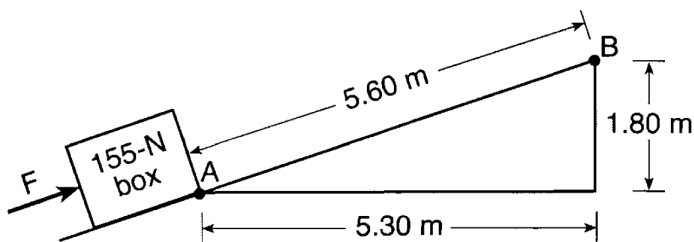
7. A 75-kilogram hockey player is skating across the ice at a speed of 6.0 meters per second. What is the magnitude of the average force required to stop the player in 0.65 second?
8. A 0.149-kilogram baseball, initially moving at 15 meters per second, is brought to rest in 0.040 second by a baseball glove on a catcher's hand. The magnitude of the average force exerted on the ball by the glove is

9. A 3.1 kilogram gun initially at rest is free to move. When a 0.015-kilogram bullet leaves the gun with a speed of 500. meters per second, what is the speed of the gun?
10. The diagram below shows a horizontal 12-newton force being applied to two blocks, *A* and *B*, initially at rest on a horizontal, frictionless surface. Block *A* has a mass of 1.0 kilogram and block *B* has a mass of 2.0 kilograms.



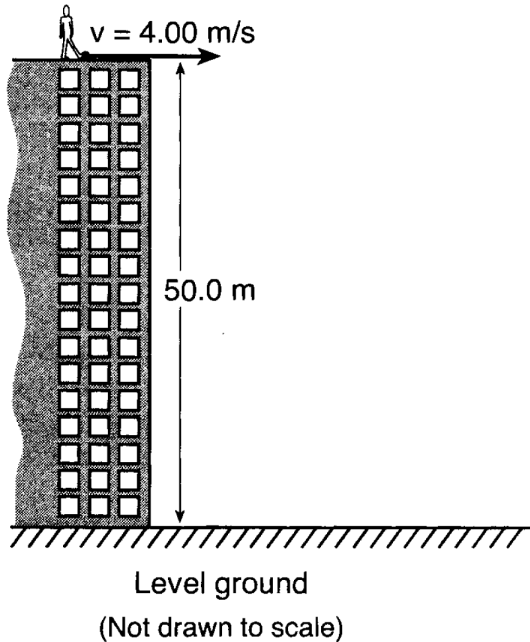
The magnitude of the acceleration of block *B* is

11. A 15.0-kilogram mass is moving at 7.50 meters per second on a horizontal, frictionless surface. What is the total work that must be done on the mass to increase its speed to 11.5 meters per second?
12. 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?
13. A small electric motor is used to lift a 0.50-kilogram mass at constant speed. If the mass is lifted a vertical distance of 1.5 meters in 5.0 seconds, the average power developed by the motor is
14. What is the power output of an electric motor that lifts a 2.0-kilogram block 15 meters vertically in 6.0 seconds?
15. 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?

16. The total work done in lifting a typical high school physics textbook a vertical distance of 0.10 meter is approximately
17. 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?
18. As shown in the diagram below, a student standing on the roof of a 50.0-meter-high building kicks a stone at a horizontal speed of 4.00 meters per second.



How much time is required for the stone to reach the level ground below? [Neglect friction.]

19. How long will it take an object to move 100 meters if the object is traveling with an average speed of 0.5 meter per second?
20. What is the speed of a 1.0×10^3 -kilogram car that has a momentum of 2.0×10^4 kilogram • meters per second east?