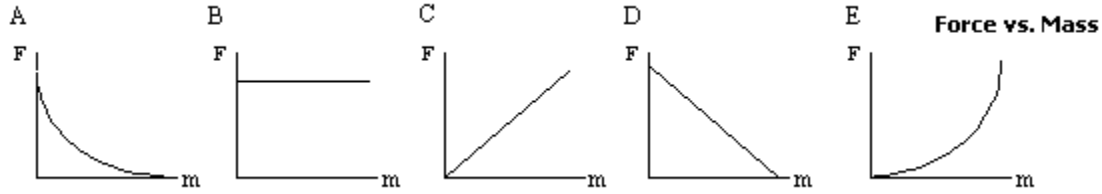
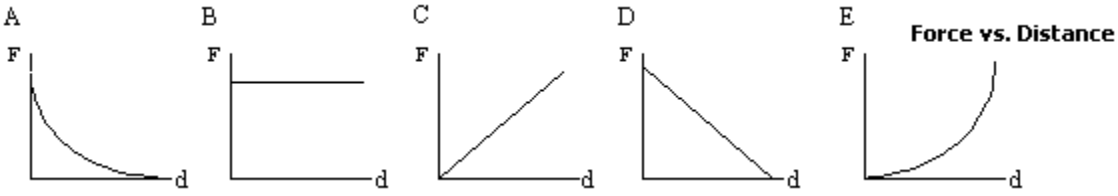
Review: Unit 2 Part 2

1. Which of the following graphs best represents the relationship between the gravitational force, *F*, that Earth exerts and the mass, *m*, of an object sitting at Earth's surface, that the force is exerted upon?



2. Which of the following graphs best depicts the relationship between the gravitational force, *F*, that two masses exert on one another and the distance, *d*, which separates their centres of mass?



3. The gravitational field strength of Earth
   A) has a value of 9.8 N/kg [down] at all locations on its surface
   B) is greater at the equator than at the poles
   C) is smallest at the peak of Mount Everest, the highest elevation
   D) is largest at the deepest spot on the ocean floor
   E) is largest at the poles

4. The value of "*g*" at the surface of Mars is 3.7 N/kg. How much would a 60.0-kg person weigh at an altitude above the Martian surface equivalent to the planet's radius?
   A) 2.2×10^2 N B) 1.6×10^2 N C) 1.1×10^2 N D) 56 N E) 28 N

5. According to Newton's law of universal gravitation, the gravitational force of attraction between two objects would be
   A) half as strong if they're moved twice as far apart
   B) twice as strong if they're moved half as far apart
   C) four times as strong if they're moved twice as far apart
   D) four times as strong if they're moved half as far apart
   E) twice as strong if they're moved twice as far apart

6. If Earth was twice its present mass, but its size was not changed, you would weigh
   A) half as much
   B) twice as much
   C) four times as much
   D) one-quarter as much
   E) the same amount

7. What would the gravitational field strength be on a planet with twice Earth's mass and twice its radius?
   A) 39.2 N/kg B) 19.6 N/kg C) 9.8 N/kg D) 4.9 N/kg

8. Two point masses m and M are separated by a distance d. If the distance between the masses is increased to 3d, how does the gravitational force between them change?
   A) The force will be one-third as great.
   B) The force will be one-ninth as great.
   C) The force will be three times as great.
   D) The force will be nine times as great.
   E) It is impossible to determine without knowing the numerical values of m, M, and

9. What is the magnitude of the gravitational force acting on a 79.5-kg student due to a 60.0-kg student sitting 2.25 m away in the lecture hall?
   A) 3.14×10^{-9} N
   B) 2.82×10^{-8} N
   C) 7.91×10^{-10} N
   D) 1.41×10^{-7} N
   E) 6.29×10^{-8} N

10. Which of the following statements concerning gravitational fields is true?
   A) The strength of an object's gravitational field varies inversely as the square of the distance to its centre.
   B) The strength of an object's gravitational field varies directly as the square of its mass.
   C) The Moon's gravitational field is much smaller than Earth's because the Moon's radius is so much smaller than Earth's.
   D) An object's mass alone dictates the strength of the gravitational field at its surface.
   E) An object's size alone dictates the strength of its gravitational field.

11. A 5.0-kg cat travelling at 1.3 m/s [E] has a momentum of
   A) 6.5 m/s [E] B) 6.5 m/s [W] C) 3.8 m/s [E] D) 3.8 m/s [W]

12. A bobsleigh and its riders have a combined mass of 598 kg. They cross the finish line with a velocity of 125 km/h [forward]. The momentum of the team and the bobsleigh at the finish line is
   A) 4.78 kg m/s [forward]
   B) 17.2 kg m/s [forward]
   C) 2.08×10^{4} kg m/s [forward]
   D) 7.48×10^{4} kg m/s [forward]
   E) 2.69×10^{5} kg m/s [forward]

13. A boy throws a 15-kg ball at 4.7 m/s to a 65-kg girl who is stationary and standing on a skateboard. After catching the ball, the girl is travelling at
   A) 0 m/s B) 0.88 m/s C) 3.2 m/s D) 4.7 m/s

14. A 5.0 kg object experiences a net force of 10 N that changes its velocity from 9.0 m/s to 17 m/s. How long did the force act?
   A) 2.0 s B) 4.0 s C) 4.5 s D) 8.5 s E) 16 s

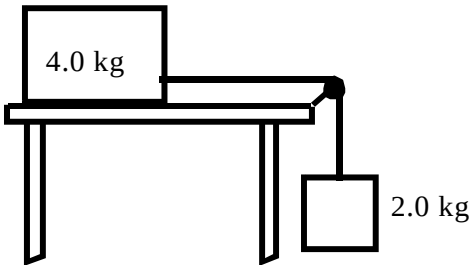
15. A 12.0 N net force acts on a 4.0 kg object for a time of 2.0 s. What is the object's change in velocity?
A) 0.67 m/s B) 1.5 m/s C) 3.0 m/s D) 6.0 m/s

16. An Atwood machine consists of two masses, 3.0 kg and 4.5 kg, that are connected by a rope hanging over a pulley. When the two masses are released, what is the net force that causes the system to move?
A) 9.8 N B) 15 N C) 29 N D) 44 N

17. A dynamics cart, with a mass of 1.2 kg, is attached to a suspended mass of 250 g by a string that passes over a pulley. If friction is not a factor, determine the acceleration of the cart when the mass is released.
A) 1.7 m/s^2 B) 2.0 m/s^2 C) 6.4 m/s^2 D) 7.8 m/s^2 E) 9.8 m/s^2

18. A dynamics cart, with a mass of 1.5 kg, is attached to a suspended mass of 1.3 kg by a string that passes over a pulley. If the coefficient of friction between the lab desk and the cart is 0.68, determine the acceleration of the cart when the mass is released.
A) 1.5 B) 1.8 C) 2.1 D) 4.1 E) 4.9

19. A 4.0 kg block is sitting on a table and is connected to a 2.0 kg block as shown in the diagram. If the 4 kg block begins to slide, what must be true about the coefficient of friction between the 4.0 kg block and the table?
A) it is less than 0
B) it is greater than 2
C) it is greater than 1 but less than 2
D) it is greater than 0.5, but less than 1
E) it is less than 0.5 but greater than 0.

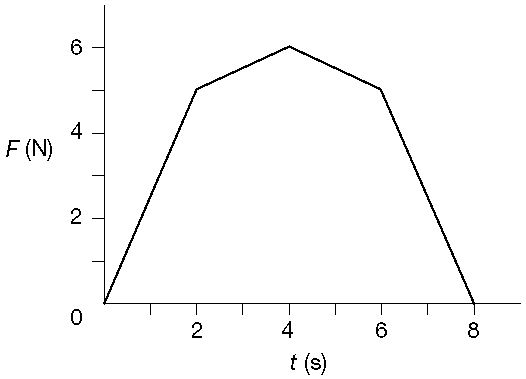


20. Two boxes are placed side by side on a frictionless surface so that they touch each other. Box A has a mass of 4.0 kg. Box B has a mass of 2.0 kg. A constant force of 12 N [right] is applied to box A. What force does box B exert on box A?
A) 4 N [right] B) 4.0 N [left]
C) 8N [right] D) 8 N [left]

21. A 0.1 kg tennis ball moving at 5 m/s[W] is hit by a racquet. If the final velocity of the ball is 5. m/s[E], what is the change of momentum of the ball?
A) 0 kgm/s B) 1 kgm/s[E] C) 1 kgm/s[W] D) 10 kgm/s[E]

22. A 1.0 kg mass, moving at 8.6 m/s[E], collides with a stationary 2.0 kg mass. After collision, the velocity of the 2.0 mass is 1.8 m/s[E]. Find the velocity of the 1.0 kg mass after collision.
A) 1.0 m/s[E] B) 2.0 m/s[E] C) 3.0 m/s[E]
D) 4.0 m/s[E] E) 5.0 m/s[E]

23. The graph shows the force applied to a cart for 8.0 s. What is the change in momentum of the cart?
    A) 32 kgm/s
    B) 34 kgm/s
    C) 36 kgm/s
    D) 40 kgm/s
    E) 42 kgm/s



24. A 1.75 x 10^4 kg loaded mine car speeds down a track at 5.45 m/s and hits an even heavier mine car (2.00 x 10^4 kg) that is waiting on a landing. The cars lock together and continue along the track. What is their velocity along the forward direction of the track?
    A) 1.45 x 10^{-4} m/s B) 2.54 m/s C) 5.45 m/s D) 254 m/s

Short Answer

25. Why does the gravitational field strength at the surface of Earth vary from location to location?

26. Why is "follow-through" so important for maximizing speeds in sporting activities?

27. Distinguish between an elastic and an inelastic collision. In which case is momentum conserved? Kinetic energy? Total energy?

28. In terms of impulse and momentum, why are padded dashboards safer in automobiles?

29. A raw egg dropped from a height of 1.0 m will break if it lands on a concrete floor, but not if it lands on a thin sponge, even though it experiences the same impulse from each type of drop. Explain why.

30. Many vehicles produced today are designed with "crumple zones." How does this feature protect the occupants of the car?

31. A 57-g tennis ball travelling at 28 m/s is hit straight back with the same velocity. Determine the average force on the tennis ball if the racket is in contact with the ball for 4.9 ms.

32. A blazing spike of a 0.290-kg volleyball is blocked at the net. It is originally travelling at 18.3 m/s and bounces straight back at 14.9 m/s after being in contact with the blockers arms for a total of 18.2 ms. What average force did the blocker exert on the ball?

34. A 0.25-kg snowball moving at 15 m/s [E] collides and sticks with a 1.9-kg toy truck travelling at 2.8 m/s [W]. Neglecting friction, calculate the velocity of the snowball–truck system after the collision.

35. A 25-kg bag of cement thrown at 2.5 m/s [E] is caught by a person sliding 1.8 m/s [E] on a frictionless surface. If the velocity after the catch is 2.0 m/s, calculate the mass of the person.

36. An object of mass 40.0 kg rests on the surface of a planet with a mass of 8.2×10^{22} kg and radius 3.6×10^{5} m.
    (a) Calculate the force of gravity acting on the object.
    (b) Determine the gravitational field strength "*g*" at the planet's surface.
    (c) Calculate the force of gravity acting on the object if it is placed at a position 6.4×10^{5} m above the planet's surface.

37. During a free dance program in figure skating, Victor (m = 71 kg) glides at 2.1 m/s to a stationary Shae-Lynn (52 kg) and hangs on. How far will the pair slide after the "collision" if coefficient of kinetic friction μ_K between their skates and the ice is 0.052?

38. Two objects are connected by a rope that runs over a pulley. The first object has a mass of 5.0 kg, and the second object has a mass of 3.5 kg.
    a) Where the two objects are released, what is their acceleration?
    b) What is the tension in the rope?

39. A dynamics cart has a mass of 875 g. It is connected to a suspended 300.0 g mass by a string that is threaded through a frictionless pulley. The coefficient of friction between the lab desk and the dynamics cart is 0.25.
    a) Determine the acceleration of the dynamics cart when the 300.0 g mass is released.
    b) If the dynamics cart takes 1.3 s to reach the pulley, what distance does it travel?

40. A minivan of mass 2000 kg is moving at 72 km/h[E] when it collides and couples with a car of mass 1000 kg moving at 36 km/h[W]. Assume that the collision is elastic.
    a) Find in m/s the common velocity of the vehicles just after collision.
    b) Find in kgm/s the change of momentum of each vehicle.
    c) Find in kgm/s the total change of momentum of the two vehicles.

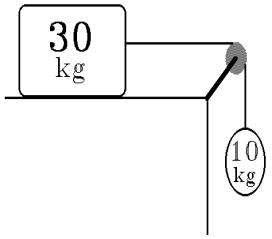
41. A 70.0 kg in-line skater, moving at 4.0 m/s[E], collides with an 80.0 kg runner, moving at 2.0 m/s[W]. If the in-line skater moves at 2.0 m/s[E] after the collision, find the velocity of the 80.0 kg runner just after the collision.

42. A 10.0 kg wooden box rests upon a steel table with a kg box connected to it by a string. The string passes over a frictionless pulley such that the 4.0 kg mass hangs over the side of the table.

    (a) What is the acceleration of this system?
    (b) What is the tension in the string?

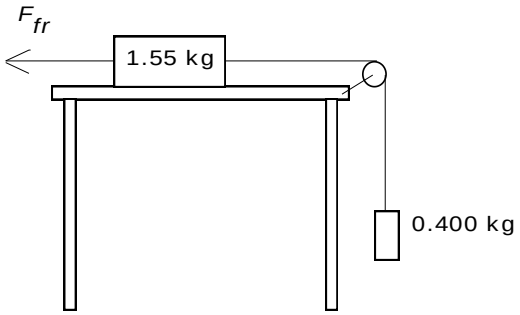
43. You have a mass of 70.0 kg and are on a date with your 55 kg girl-friend. If she is attracted to you with a force of 0.000642 N, how close are the both of you? (i.e. separation distance)

44. A 30.0 kg block is attached to a 10.0 kg rock hanging over the side of a frictionless pulley. When the system is released, it moves with a kinetic friction of 20.0 N between the block and the table.



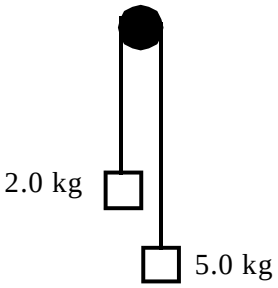
45. A 2.0 kg skateboard is rolling across a smooth, flat floor when a small girl kicks it causing it to speed up to 4.5 m/s in 0.50 s without changing direction. If the average force exerted by the girl on the skateboard in its direction of motion was 6.0 N, with what initial velocity was it moving?

46. Determine the acceleration of the diagram to the right if the frictional force is 8.0 N. What is the tension in the string?

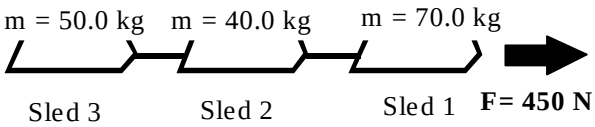


47. A 25 kg object moving with a velocity of 3.0 m/s to the right collides with a 15 kg object moving to the left at 6.0 m/s. Find the velocity of the 25 kg object after the collision, if the 15 kg object
    a) continues to move to the left but only at 0.30 m/s,
    b) rebounds to the right at 0.45 m/s
    c) sticks together with the 25 kg object.

48. A 2.0 kg mass and a 5.0 kg mass are attached to a lightweight cord that passes over a frictionless pulley, as shown.
    a) What is the acceleration of the system?
    b) What is the tension in the cord?

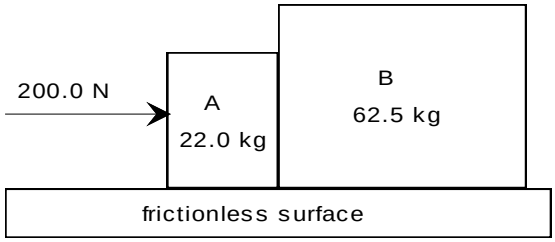


49. For the diagram below, with no friction acting on the sleds and the ropes do not stretch, determine;
    a) the acceleration of the sleds.
    b) the tension in the rope between sled 1 and 2.
    c) the tension in the rope between 2 and 3.



50. Two tankers, one with twice the mass of the other, attract each other with a force of 3.5×10^3 N. If their centers are 85 m apart, what is the mass of each tanker?

51. A force of 200.0 N is applied to the boxes as shown in the figure.



a) Calculate the acceleration of the entire system.
b) Use Newton's 3rd Law of Motion to help you calculate the force of B on A.

52. Two objects, each having a mass *m* are separated by some distance *r*. Assume that the force of gravitational attraction between them is 400.0 N. What will the force of gravitational attraction change to in each instance?
(a) The distance is increased by a factor of 5.
(b) The mass of one of the objects is tripled.
(c) The mass of one object is tripled and the mass of the remaining object is doubled. Th distance between the two objects is quadrupled.
(d) The distance between the objects is halved and the two masses are changed to 4*m*.

53. Calculate the force of gravitational attraction between two objects, each having a mass of 2.77×10^4 kg and separated by 18.00 m.

54. A boy is initially standing on his skateboard. Both are at rest. Suddenly the boy jumps off and moves to the right at 0.80 m/s, If the mass of the boy and the skateboard are, respectively 48.0 kg and 5.1 kg, what will be the recoil velocity of the skateboard?

55. A large rubber ball with a mass of 0.40 kg is moving to the right at 2.2 m/s when it collides with a smaller rubber ball with a mass of 0.050 kg and moving to the right at 1.4 m/s. The smaller ball rebounds at 2.0 m/s. What will be the velocity of the larger ball after the collision?