Solutions to Dynamics –What Causes Motion Homework problems

1. The 200gram ball has more inertia because it has more mass.

2. The more massive knife is more effective because, once it is moving, it is more difficult to stop and will "sail" through the vegetables with less "effort" on the part of the person doing the chopping.

3. The full roll has more mass, thus more inertia, so it takes more force to get it accelerate it from rest. So when you give one sheet that is connected to the roll a pull. The force to break off that one piece is less than the force it takes to accelerate the whole roll.

4. and 12

For case A: F_{net} = 42 N –30 N = 12 N to the right.

Since m = 3.0 kg $\frac{F_{net}}{m} = a = \frac{12\,N}{3.0\,kg} = 4\,m/s^2$

For case B: F_{net} = 18 N + 12 N = 30 N to the left

Since m = 5.0 kg $\frac{F_{net}}{m} = a = \frac{30\,N}{5.0\,kg} = 6\,m/s^2$

For case C: F_{net} = -8 N + -15 N + 25 N + 12 N = 14 N to the right .

Note: to solve algebraically a force to the left is treated as "-" negative, and a force to the right is "+" positive. You could just solve by adding all the forces acting in one direction and subtracting all the forces acting in the opposite direction. Then you would have to use observation to indicate the direction of the net force.

Since m = 7.0 kg $\frac{F_{net}}{m} = a = \frac{14\,N}{7.0\,kg} = 2\,m/s^2$

5. Ask the question what is ? so make this equation true.
For case A) F_{net} = -50 + ? = 0. Solving for ? we get ? = + 50 N which means 50 N to the right.

For case B) F_{net} = -36 N + 17 N + ? = 0. Solving for ? we get ? = + 19 N which means 19 N to the right.

6A. Ask the question what is $F_{addtional}$ so make this equation true.
F_{net} = -28 N + -6 N + 12 N + $F_{addtional}$ = 0.
Solving for $F_{addtional}$ we get $F_{addtional}$ = + 22 N which means to the right.

6B Ask the question what is $F_{addtional}$ so make this equation true.
F_{net} = -28 N + -6 N + 12 N + $F_{addtional}$ = + 19 N
Solving for $F_{addtional}$ we get $F_{addtional}$ = + 41 N which means to the right.

7. D, similar explanation to that of problem 3. Also see course note for more detailed explanation.

8. A, see page Mech 2.4

9. A, since there are no forces acting on the puck due to the ice, friction, then the object won't need any force to keep it sliding at CONSTANT velocity

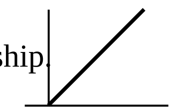
10. There could be another force acting on it, An example of this would be an object you are holding in your hand. There is a gravitational force acting on it but it doesn't move because you are supplying a force upward that is equal to its weight.

11. Since F = ma, if the weight is less, because of less fuel upon arrival after a long flight, the pilot doesn't need to supply as much force from the engines when the plane is moving around at the arrival airport. See also page Mech 2.7 at the top of the page.

12. see solution to number 4

13. Since F_{net} = ma and we want uniform motion, no acceleration a = 0, we can solve this equation, maybe in your head, F_{net} = 0 = 5 N -? = 0 N so ? – 5 N in the direction opposite the friction, whatever that is.

14. B from F_{net} = ma if F_{net} is doubled then a must double, its a linear relationship.



15. A, from F_{net} = ma if F_{net} is doubled along with mass then a would be unchanged.

16. B, the force is constant but the small car now has to pull 3 times the mass (m + 2m =3m) so the acceleration would be one-third of its original value.

17. 4500 N is the net force. You first need to find the acceleration which is

$$a = \frac{\Delta v}{\Delta t} = \frac{6\,m/s - 0\,m/s}{2\ \text{sec}onds} = 3\,m/s^2 \text{ so}$$

using F_{net} = ma, F_{net} = (1500 kg)(3 m/s^2)= 4500 kgm/s^2 or 4500 N.

18. Using the relationship for impulse: $F \cdot \Delta t = \Delta mv$ we can solve for Δv since the mass doesn't change.
$F \cdot \Delta t = 500N \cdot 5\text{sec} = 2500N \cdot s$ so 2500 = mΔv thus Δv =2500 N s/1000 kg = 2.5 m/s

19. The force applied to each cart is the same by Newton's third law. Since one cart is twice the mass of the other the heavier cart's acceleration will be _ that of the smaller cart.

20. Technically, she isn't ever in free fall unless she was in a vacuum, not a Hoover or Eureka but a vacuum in the sense of an absence of air where there would be no air resistance. When she reaches terminal velocity, the case would be the same, not in free fall.

21 Since they both accelerate at the same rate g (9.8 meters/sec each second) their air resistance will increase due to increase in velocity at the same rate. But, the woman has less weight or downward force so "her" upward force due to air resistance will balance out or become zero before that of the heavier man. In essence F_{net} for the lighter person becomes zero before that happens to the heavier person.

22. Since the skydiver has reached terminal velocity we know that $F_{air} = W_{gravity}$

So F_{air} = 500N

23. The mass of the skydiver is 100 kg so their weight is W = mg = (100 kg)(9.8 m/s2) = 980 N. So F_{net} = Wg –Fair = 980 N –500 N = 580 N so F_{net} is only about _ their weight so they would be experiencing an acceleration of _ g or 0.5 g, Mathematically, F_{net}=ma or F_{net}=100a, solving for a we get 580N/100 = 5.8 m/s^2 or about _ of 9.8m/s^2.

24. From the course notes, page Mech 2.7, 1 pound = 4.45 N so you could use a proportion to solve for you weight in Newtons. $\frac{1\,pound}{4.45\,N} = \frac{your\ weight\ in\ pounds}{your\ weight\ in\ Newtons}$

25. Your weight would be 1/6 of your weight on the earth.

26. Since the barbell is not accelerating the net force is zero. If he drops it then he isn't supplying an upward force so the net force is 1000 N downward, the weight of the barbell.

27. Yes, the floor exerts an upward force, otherwise you would accelerate downward into the floor, yikes!

28. C, the ball exerts a force on the racquet. You would know this because if you were holding the racquet you would feel it.

29. A, by Newtons 3rd Law.

30. B, same reasoning as problem 27

31. C, by Newtons 3rd Law.

32. C, by Newtons 3rd Law.

33. D, the road pushes back when the tires push against the road, see page Mech 2.10

END