# Forces Study Guide
Newton's Laws & Circular Motion
(Topics are highlighted in yellow)

1. For a winter fair, some students decide to build 30.0-kg wooden pull-carts on sled skis. If two 90.0-kg passengers get in, how much force will the puller have to exert to move a pull-cart? The coefficient of maximum static friction between the cart and the snow is 0.15. FRICTION
   a. 180 N   b. 310 N   c. 2100 N   d. 14000 N

2. A string exerts a force of 18 N on a box at an angle of 34° from the horizontal. What is the horizontal component of the force on the box? VECTOR RESOLUTION
   a. 10 N   b. 15 N   c. 21.7 N   d. 32 N

3. Sukey is riding her bicycle on a path when she comes around a corner and sees that a fallen tree is blocking the way 42 m ahead. If the coefficient of friction between her bicycle's tires and the gravel path is 0.36, and she is traveling at 50 km/hr, how much stopping distance will she require (assume the only horizontal force acting on her is friction)? Sukey and her bicycle, together, have a mass of 95 kg. FRICTION
   a. 3.00 m   b. 4.00 m   c. 8.12 m   d. 27.3 m

4. What is the acceleration of the cart described by the graph below? v-t GRAPH (slope)
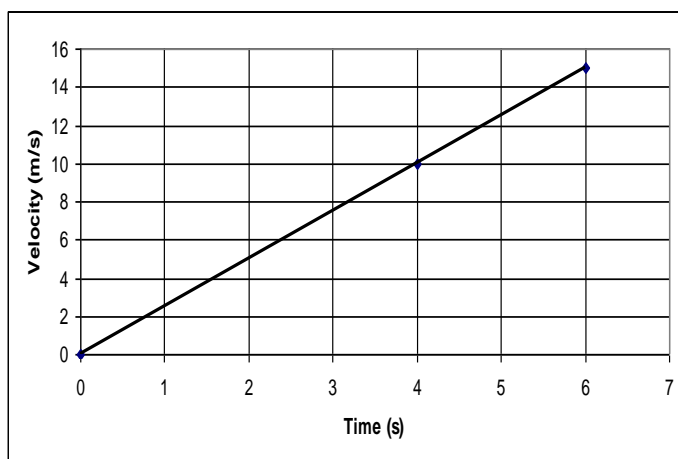
   a. 0.20 m/s^2 b. 0.40 m/s^2 c. 1.0 m/s^2 d. 2.5 m/s^2

5. According to the graph above, what is the force being exerted on the 25-kg cart? NEWTON'S SECOND LAW
   a. 62.5 N   b. 10 N   c. 25 N   d. 5 N

6. What distance will the cart described by the graph in #4 have traveled after 4.0 s?
   v-t GRAPH (area under curve)
   a. 20 m   b. 40 m   c. 80 m   d. 90 m

7. In a tug-of-war, 13 children, with an average mass of 30 kg each, pull westward on a rope with an average force of 150 N per child. Five parents, with an average mass of 60 kg each, pull eastward on the other end of the rope with an average force of 475 N per adult. Assuming that the whole mass accelerates together as a single entity, what is the acceleration of the system?
   NEWTON'S SECOND LAW (ATWOOD TYPE PROBLEM)
   a. 0.62 m/s^2, E   b. 2.8 m/s^2, W   c. 3.4 m/s^2, E   d. 6.3 m/s^2

8. A 45-kg child sits on a 3.2-kg tire swing. What is the tension in the rope that hangs from a tree branch? FORCES AND EQUILIBRIUM
   a. 310 N   b. 4.4x10^2 N   c. 4.5x10^2 N   d. 4.7x10^2 N

9. Draw a FBD of a dog sitting on a scale in an elevator at rest. Describe what happens to the apparent weight of the dog when: the elevator accelerates upward, the elevator travels at a constant speed downward, and the elevator falls freely downward. Calculate the scale's reading for a 25-kg dog when the elevator is accelerating upward at 3.0 m/s^2.
   NEWTON'S SECOND LAW/ELEVATOR PROBLEM

10. Two horizontal forces, one 180.0 N and the other 200.0 N, are exerted in opposite directions on a boat on a lake. What is the net horizontal force on the boat?
    NET FORCE
    a. 380.0 N   b. 200.0 N   c. 180.0 N   d. 20.0 N

11. What is the force of gravity on a person who has a mass of 80.0 kg?
    <mark>WEIGHT EQUATION</mark>
    a. 176 N   b. 686 N   c. 784 N   d. 801 N
12. Two people are paddling together in a canoe. Each exerts a horizontal force of 238 N toward the back of the canoe. What is the net horizontal force on the canoe?
    <mark>NET FORCE</mark>
    a. 119 N   b. 238 N   c. 476 N   d. 952 N
13. Refer to item 12 above. If the combined mass of the canoe and two paddlers is 190 kg, what is the acceleration of the canoe? <mark>NEWTON'S SECOND LAW</mark>
    a. 0.63 m/s^2 b. 1.3 m/s^2 c. 2.5 m/s^2 d. 5.0 m/s^2
14. Draw the FBD and calculate the magnitude of the net force for each case shown below:
    <mark>NET FORCE/VECTOR RESOLUTION</mark>
    a. An upward force of 4 N + westward force of 2 N + eastward force of 5 N
    b. A rightward force of 7 N + a 10 N force directed 45° South of West.
15. As a parachuter falls faster and faster through the air, her acceleration
    a. increases   b. decreases   c. remains the same
    <mark>AIR RESISTANCE</mark>
16. Two smooth balls of exactly the same size, one made of wood and the other of iron, are dropped from a high building to the ground below. The ball to encounter the greater force of air resistance on the way down is the
    <mark>AIR RESISTANCE</mark>
    a. wooden ball   b. iron ball   c. both the same
17. If a Mack truck and a Volkswagen have a head-on collision, which vehicle will experience the greater impact force?
    <mark>NEWTON'S 3RD LAW</mark>
    a. Mack truck   b. Volkswagen   c. both the same   d. it depends on other factors
18. <mark>18.</mark> Arnold Strongman and Suzie Small pull on opposite ends of a rope in a tug of war. The greatest force exerted on the rope is by (assume the rope's mass is negligible)
    <mark>NEWTON'S 3RD LAW</mark>
    a. Arnold   b. Suzie   c. both the same
19. You place a 7.50-kg television on a spring scale. If the scale reads 78.4 N, what is the acceleration due to gravity at that location? <mark>WEIGHT EQUATION</mark>
    a. 9.8 m/s^2 b. 73.5 m/s^2 c. 10.5 m/s^2 d. 8 m/s^2
20. A 1000-kg car enters an 80.0-m radius curve at 20.0 m/s. What centripetal force must be supplied by friction so the car does not skid? <mark>CIRCULAR MOTION</mark>
    a. 5.0 N   b. 2.5x10^2 N   c. 5.0x10^3 N   d. 1.0x10^3 N
21. A 873-kg (1930-lb) dragster, starting from rest, attains a speed of 26.3 m/s (58.9 mph) in 0.59 s. <mark>KINEMATICS, NET FORCE</mark>
    a. Find the average acceleration of the dragster during this time interval.
    b. What is the magnitude of the average net force on the dragster during this time?
22. A 0.50-kg guinea pig is lifted up from the ground. What is the smallest force needed to lift it? Describe its resulting motion. <mark>NET FORCE</mark>
23. A 6.0-kg block rests on top of a 7.0-kg block, which rests on a horizontal table.
    <mark>NEWTON'S 3RD LAW</mark>
    a. What is the force (magnitude and direction) exerted by the 7.0-kg block on the 6.0-kg block?
    b. What is the force (magnitude and direction) exerted by the 6.0-kg block on the 7.0-kg block?
24. <mark>24.</mark> If you use a horizontal force of 30.0 N to slide a 12.0-kg wooden crate across a floor at a constant velocity, what is the coefficient of kinetic friction between the crate and the floor? <mark>FRICTION</mark>
25. You are driving a 2500.0-kg car at a constant speed of 14.0 m/s along a wet, but straight, level road. As you approach an intersection, the traffic light turns red. You slam on the brakes. The car's wheels lock, the tires begin skidding, and the car slides to a halt in a distance of 25.0 m. What is the coefficient of kinetic friction between your tires and the wet road? <mark>FRICTION</mark>
26. A 1.13-kg ball is swung vertically from a 0.50-m cord in uniform circular motion at a speed of 2.4 m/s. What is the tension in the cord at the bottom of the ball's motion? <mark>CIRCULAR MOTION</mark>
27. When you fire a gun, the bullet accelerates forward at a much greater rate than the acceleration (recoil) of the gun backwards. According to Newton's third law of motion, the force on the bullet must be equal and opposite to the force on the gun. Why then, does the gun accelerate at a smaller rate than the bullet?
    <mark>NEWTON'S 2ND AND 3RD LAWS COMBINED</mark>

Answers:

1. b   2. B   3. D   4. D   5. A   6. A   7. A   8. D

9. Apparent weight increases because it has a net upward force. That means normal must be greater than weight.
   Apparent weight is the actual weight because the net force is zero (constant velocity). Therefore, normal must equal weight.
   Apparent weight is 0 N (weightlessness) because the net force is just the weight. Therefore, the normal force is 0.
   75 N

10. d   11. C   12. C   13. C

14. a. 5 N   b. 8.7 N

15. b   16. B   17. C   18. C   19. 10.5 m/s^2 20. C   21. a. 44.6 m/s^2 b. 39,000 N

22. 4.9 N

23. a. 58.8 N   b. 58.8 N

24. 0.26   25. 0.40   26. 13 N

27. They have the same magnitude of force, but since the gun has a greater mass it has a smaller acceleration ($F_{net}=ma$)