Physics 112
Newton's Laws Problem Sheet – Practice Problems

1. If a car is moving at a constant velocity what is the net force on the car?

2. What net force is required in order to accelerate a 3kg object at 5 m/s^2? **(15N)**

3. What is the mass of an object, which can be accelerated at 3.00 m/s^2 by a net force of 125 N? **(41.7kg)**

4. What is the weight of a 24kg stone on earth? **(235.2 N)**

5. What is the mass of a 485 N bag of cement on earth? **(49.5kg)**

6. What net force is required in order to give a projectile weighing 475 N an acceleration of 3000 m/s^2? **($1.45x10^5$N)**

7. A truck weighs $1.0x10^5$ N, what net force will give it an acceleration of 1.5 m/s^2? **($1.5 x10^4$N)**

8. A child exerts a net force of 50 N, what acceleration can she give a cart which weighs 300 N **(1.6 m/s^2)**

9. A large crate has a mass of 200kg and the coefficient of friction between the box and the floor is 0.3. If you apply 400N will it move? What is the minimum force required to start the crate moving? **(588N)**

10. A 400kg sled is being pulled with a force of 1200N. If the coefficient of friction is 0.25 determine a) the force of friction b) the net force c) the acceleration. (**980N, 220N, 0.55m/s^2)**

11. The coefficient of kinetic friction (μ) between a 5 kg wooden block and the floor is .234. What is the force of friction when you slide this block along the floor? **(11.47N)**

12. If you push the block in the previous question with a force of 20 N, what will be its acceleration? (Remember that some of your force is going to be used in order to overcome friction!) **(1.7m/s^2)**

13. A force is being applied to a cart that weighs 1470N. The force that is applied is 813N and gives the cart an acceleration of 1.5m/s^2. a) Determine the force of friction b) Determine the coefficient of friction. **(588N ,0.40)**

14. A sled is coasting along on a frictionless surface when it hits a patch of asphalt. The sled has a mass of 120kg and the coefficient of friction is 0.41. a) Determine the frictional force b) Determine the net force c) Determine the acceleration of the sled. **(482.16N, -482.16N, -4.02m/s^2)**

15. A 60 kg sled is coasting with a constant velocity of 10 m/s over smooth ice. It enters a rough stretch of ice 6.0 m long in which the force of friction is 120 N. A) What is the acceleration during this stretch? B) With what speed does it emerge from the rough patch **(-2m/s^2, 8.7m/s)**

16. The driver of a 600 kg sports car, heading directly for a railway crossing 300 m away, applies the breaks in a panic stop. The car is moving at 40 m/s and the brakes can supply a force of 1500 N. What is the acceleration? How fast will the car be going when it reaches the crossing? **(-2.5m/s^2 ,10m/s)**

17. It has been found (don't ask me how) that it requires about 2000 N in order to start pushing a 1980 Dodge Diplomat along level ground. If the Dodge has a mass of 2300 kg, what is the coefficient of static friction? **(.089)**

18. If a steel ball is placed on top of a level table, what happens to it? What forces are acting on it? Are there any unbalanced forces in this situation?

19. If the ball in the previous question is given a slight push, what happens? When you finish pushing, what forces are present? How does this affect the motion of the ball?

20. A 1500 kg car collides with a heavy truck. The car, which was initially going 20 m/s moves 3.0 m forward while it is being brought to rest. What force is exerted on the car by the truck? **(100 000 N)**

21. A golf ball, mass 60g, is stuck by a golf club and acquires a speed of 80 m/s during the impact, which lasts for $2x10^{-4}$ s, what is the force exerted on the ball? **($2.4X10^4$N)**

22. A vertical Rope is attached to a 35 kg cart, what upward force is required in order to give the cart an upward acceleration of 8.0 m/s^2? (remember that you have to work against gravity to do this) **(623N)**

23. An elevator with mass 1000 kg is supported by a cable which can sustain a force of 12000 N. What is the greatest upward acceleration that can be given to the elevator without breaking the cable? **(2.2 m/s^2)**

24. A 1000 kg elevator has an upward acceleration of 1 m/s^2. What is the tension in its supporting cable? **(10800 N)**

25. A 1000 kg elevator has downward acceleration of 1 m/s^2. What is the tension in its supporting cable? **(8800 N)**

26. A boy, weighing 800 N wishes to reach ground from a treetop by sliding down a rope. The maximum upward force that the rope can exert is 425 N. A) Can the boy slide down the rope at a constant speed? B) what is the minimum acceleration that the boy can slide down the rope with in order to avoid breaking it? **(no, -4.6m/s^2)**

27. A 75kg skydiver in free fall acquires a velocity of 60 m/s and then opens his parachute. After 3s his velocity has been reduced to 8.0 m/s. a) what was the acceleration (actually a *deceleration)* of the skydiver while his chute was opening? b) What is the force exerted by the parachute during this time? **(17.3 m/s^2, 2033 N)**

28. An empty truck whose mass is 2000 kg, has a maximum acceleration of 5.0 m/s^2 . What is its maximum acceleration when it is carrying an additional 1000 kg load? **(3.3 m/s)** (Assume the net force stays constant)

29. A boy weighing 800. N wishes to reach ground from a treetop by sliding down a rope. The maximum upward force the rope can exert without breaking is 325. N. (a) Can the boy slide down the rope at a constant speed? (b) What is the least acceleration with which the boy can slide down the rope? **(NO, 5.82 m/s^2)**

30. A 45 kg sled is coasting with a constant velocity of 15 m/s over smooth ice. It enters a rough stretch of ice 3.2 m long in which the force of friction is 95 N. With what speed does the sled emerge from the rough stretch? **(14.5 m/s)**
31. A 1250kg elevator has an upward acceleration of 2.5 m/s^2. What is the tension in its supporting cable? **(15375 N)**

32. A 1250kg elevator has a downward acceleration of 2.5 m/s^2. What is the tension in its supporting cable? **(9125 N)**

33. A train is hauling 3 boxcars. Each car has a mass of 8000kg and the train itself has a mass of 12000kg. Neglecting friction determine the force felt by each hitch and the force of the rail tracks on the train's wheels, if the acceleration is 1.5m/s^2? **(12kN,24kN,36kN,54kN)**

34. a)How much force is required to accelerate a 6.0 kg object from rest to 15 m/s in 9.0s? **(10 N)** b)How far does the object move while the force is acting on it? **(67.5 m)**

35. A falling ball has a mass of 2.0 kg, and the upward force of air resistance is 11.6 N, what is the acceleration of the ball? **(4.1 m/s^2)**

36. A vertical rope is attached to a 27 kg box. What tension (force) in the rope is needed to cause the box to acquire an upward acceleration of 7.5 m/s^2? **(466 N)**

37. An elevator of mass 1000 kg is supported by a cable that can sustain a force of 12500 N. If a man that has a mass of 115 kg is in the elevator, what is the greatest upward acceleration that can be given to the elevator without breaking the cable? **(1.4 m/s^2)**

38. A 1250 kg car is traveling at 35 m/s and collides with a heavy truck. The car moves 4.8 m forward while it is being brought to rest. What force is exerted on the car by the truck? **(1.6x10^5 N)**

39. The driver of an 800 kg sports car, heading directly for a railway crossing 200 m away, applies the brakes in a panic stop. The car is moving at 40 m/s, and the brakes can supply a force of 2500 N. How fast will the car be moving when it reaches the crossing? **(18.7 m/s)**

40. A net force of 30 N gives an object an acceleration of 4.0 m/s^2. (a) what is the mass of the object? (b) What force is needed to the same object an acceleration of 1 m/s^2? (c) What force is needed to give an acceleration of 8.0 m/s^2? **(7.5 kg, 7.5 N, 60 N)**

41. Helena is traveling at 20m/s on her crazy carpet on flat ground. If she has a mass of 60kg determine the coefficient of friction between the ground and her carpet that would cause her to stop in 50m. **(0.41)**

42. Prove that the force of tension equals the force of gravity when an object moves upward or downward at a constant velocity.

43. Would the rubber compound for winter tires have a higher or lower coefficient of friction than summer tires? What would be the negative effect of using winter tires in the summer? Support your answers.

44. Abraham is playing with his scooter. Draw free body diagrams to represent the following situations (the length of the lines should indicate the greater force.

a) Abe uses his foot to apply a force to make his scooter accelerate.
b) Abe rolls along at a constant velocity for a brief period.
c) Abe starts to slow down.

45. Benji and Charles are trying to push their parent's basement freezer so that they can get their ball from behind it. The freezer weighs 1200N. The boys can push with 1000N. The bottom of the freezer has rubber feet and the floor is concrete. Can they push it? Would it be easier if the floor is wet? (How much force would be required if the floor was wet)

46. You are testing acceleration and braking abilities on cars. The test is to see how quickly you can drive to 400m and then how quickly you can bring the car to a stop. The car you are testing is a little sports car that has a measly mass of 600kg.
    a) The motor can supply 3000N of force and the coefficient of friction for the first 400 m is 0.11. Determine the time to get to 400m. **(14.28 sec)**
    b) Once at the finish line you apply the brakes and the coefficient of friction is 0.71. Determine the braking distance and the time it takes to stop. **(225m, 8 sec)**

47. Explain why it is better to slow your car down by braking hard but not locking up the brakes and dragging the tires. Explain the benefits of anti-lock brakes.