Honors Physics
Worksheet: Newton's Laws

Name:_____
Per:_____Date:_____

FOR YOUR PRACTICE: NEWTON'S LAWS OF MOTION

1) What net force would be required in each case to accelerate a 0.5kg car at:
   a) 4m/s/s b) 6m/s/s c) 12m/s/s

2) What acceleration would a net force of 42 N produce on each of the following masses?
   a) 4.2kg b) 8.4kg c)12.6kg

3) According to a simplified model of a mammalian heart, at each pulse approximately 20g of blood is accelerated from 0.25m/s to 0.35m/s during a period of 0.1s. What is the magnitude of the force exerted by the heart muscle?

4) A typical high-powered rifle fires a 10g bullet which attains a muzzle velocity of 900m/s. The bullet accelerates uniformly from rest and remains in the barrel for 1.5 milliseconds. What average force does the expanding gas exert on the bullet?

5) A speed boat has a mass of 500kg. It starts from rest and travels 200m in 3s. The boat undergoes uniform acceleration during the 3 seconds. What is the net force on the boat?

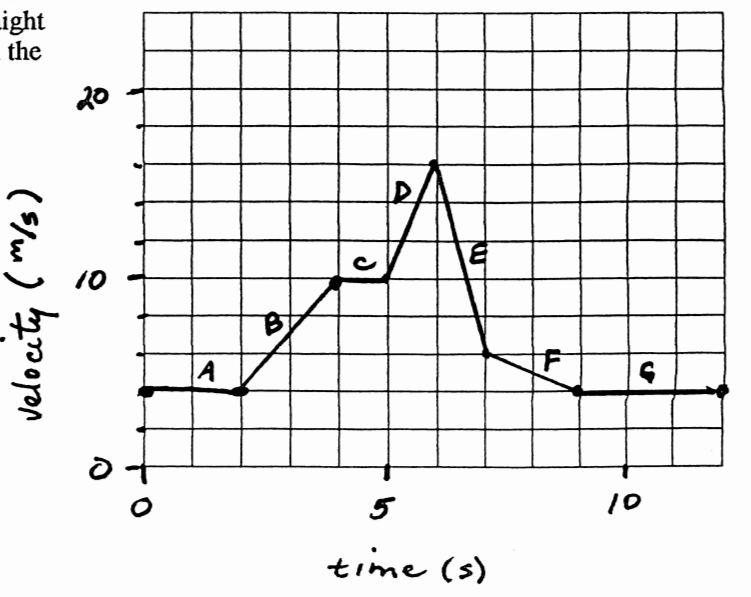
6) A 1kg mass, starting from rest, acquires a speed of 12m/s when a net force is applied for a distance of 0.5m. What is the magnitude of the net force applied?

7) Tom and his bicycle has a total mass of 1.5kg. What force is needed to bring him to rest when he is traveling at 25m/s and MUST stop in time to avoid a tree 5m in front of him?

8) A block of wood (mass = 6kg) slides at 12.5m/s along a smooth skating rink where the net force on the block is zero. It then slides onto a rough part of the ice, which exerts a 30N friction force on the block. Calculate:
   a) the acceleration of the block on the rough ice.
   b) the time it takes the block to stop.

9) Jennifer (mass = 90kg) is coasting on perfectly smooth snow at 7m/s and crosses over a rough patch of snow 35m long. If the friction force exerted on her while she is on the rough snow is 5N, what is her speed as she leaves the patch of rough snow?

10) The velocity-time graph describes the motion of a 5kg radio-controlled toy car, moving in a straight line toward the east. Calculate the net force on the car during intervals **A, B, C, D, E, F,** and **G.**



11) A $2x10^{-4}$kg spider is suspended from a thin strand of spider web. The greatest tension the strand can withstand without breaking is $2x10^{-3}$N. What is the maximum upward acceleration with which the spider can safely ascend the strand?

12) A rope can support a maximum of 1000N, what is the maximum upward acceleration a 70kg boy climbing the rope can attain without breaking the rope?

13) Jason wants to escape from a boring party by sliding down a rope which can only support 400N. If he weighs 800N, what is the smallest acceleration he can have without worrying about breaking the rope?

14) How much force must be applied to pull a 100kg crate along a rough floor at **constant velocity**, given each of the following coefficients of friction:
a) 0.1 b) 0.2 c) 0.5 d) 0.8

15) How much force must be applied to pull each of the following masses along a rough desk with a coefficient of 0.25 at **constant velocity**?
a) 25kg b) 15kg c) 200kg d) 0.1kg

16) How much force must be applied to pull each mass in question #15 at a constant **acceleration** of 1m/s/s?

17) It takes a 5N force to pull a 2kg block of wood along the ground at constant velocity.
a) What is the coefficient of friction at the contacting surface?
b) If starting from rest with a 10N force applied, how far will the block move in 12s?

18) An object on planet Xeno acquired a speed of 25m/s after falling from rest a distance of 25m.
a) What is the acceleration due to gravity on planet Xeno?
b) If Sally weighs 200N on earth, what would Sally weigh on the planet Xeno?
c) What would Sally's mass be on the planet Xeno?

19) What is the force of gravitational attraction between two 1000kg cars, side-by-side, 2m apart?

20) Two 50kg objects are on the surface of the earth and are 1m apart. Compare the gravitational force of these objects to each other, with the gravitational force exerted on each of them by earth.

21) The earth's radius is 6400km. Jim (mass = 25kg) flies to 6400km ABOVE the earth's surface. Calculate:
a) his mass at this height.
b) the value of **g** at this height.
c) his weight at this height.

PROBLEMS

1. In Chapter 4 you calculated the braking acceleration for a car based on data in a drivers' handbook. The acceleration was $-12.2\ m/s^2$.
   a. If the car has a mass of 925 kg, find the frictional force and state the direction.
   b. Find the coefficient of friction for this car's tires on the road.
2. In Chapter 4 you found that when a karate strike hits wooden blocks, the hand undergoes an acceleration of $-6500\ m/s^2$. Medical data indicates the mass of the forearm and hand to be about 0.7 kg. What is the force exerted on the hand by the blocks?
3. A person weighing 490 N stands on a scale in an elevator.
   a. What does the scale read when the elevator is at rest?
   b. The elevator starts to go up and accelerates the person at $+2.2\ m/s^2$. What does the scale read now?
   c. What is the reading on the scale when the elevator rises at a constant velocity?
   d. The elevator slows down at $-2.2\ m/s^2$ as it reaches the proper floor. What does the scale read?
   e. The elevator descends, accelerating at $-2.7\ m/s^2$. What does the scale read?
   f. What does the scale read when the elevator descends at a constant velocity?
   g. Suppose the cable snapped and the elevator fell freely. What would the scale read?
4. A student takes a bathroom scale into an elevator on the 64th floor of a building. The scale reads 836 N.
   a. As the elevator moves up, the scale reading increases to 935 N, then decreases back to 836 N. Find the acceleration of the elevator.
   b. As the elevator approaches the 64th floor, the scale reading drops as low as 782 N. What is the acceleration of the elevator?
   c. Using your results from parts a and b, explain which change in velocity, starting or stopping, would take the longer time.
   d. Explain the changes in the scale you would expect on the ride back down.
5. Safety engineers estimate that an elevator can hold 20 persons of 75-kg average mass. The elevator itself has a mass of 500 kg. Tensile strength tests show that the cable supporting the elevator can tolerate a maximum force of 29 600 N. What is the greatest acceleration that the elevator's motor can produce without breaking the cable?
6. A 2.0-kg mass and a 3.0-kg mass are attached to a lightweight cord that passes over a frictionless pulley. The hanging masses are left free to move.
   a. In what direction does the smaller mass move?
   b. What is its acceleration?

Force

Name: _____

SIMPLE FORCES

Date: _____ 12

1. A hockey player exerts a force of 80 N with his hockey stick on a stationary puck of mass 500 g.

   a. At what rate will the puck accelerate while in contact with the stick?

   $a =$ _____

   b. If the stick exerts the force on the puck for 0.7 seconds, at what speed will the puck leave the face of the hockey stick?

   $v =$ _____

2. A woman exerts 100 N of force to lift a laundry basket weighing 75 N. At what rate is the basket accelerated upward?

   $a =$ _____

3. A box that weighs 2,000 N is accelerated uniformly over a horizontal surface at a rate of 8.00 m/s^2. The opposing force of friction between the box and the surface is 27.4 N.

   a. How much force is being exerted horizontally on the box?

   $F_h =$ _____

   b. How much force would be required to *lift* the box upward with an acceleration of 8.00 m/s^2?

   $F_v =$ _____

4. A small rocket is powered upward on lift-off by an engine thrust of 12,000 N. If the resulting upward acceleration is 6.4 m/s^2, what is the mass of the rocket?

   $m =$ _____

5. A person whose mass is 75 kg is lowered with a rope down the side of a cliff. The rope being used can support a maximum of 595 N. In order to prevent the rope from breaking, at what minimum rate must the person accelerate downward?

   $a =$ _____

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Force

Name: _____

ADVANCED FORCES

Date: _____ 13

Note: **Please use separate paper to solve these problems.**

1. A sky diver weighing 588 N reaches a velocity of 45 m/s before opening her parachute. After falling an additional 30 meters, her velocity has decreased to 25 m/s.

   a. What is the acceleration of the sky diver over the 30-meter distance?

   b. What was the upward force exerted on the parachute during that time?

2. In figure 1, the surface and pulley are considered to be frictionless.

   a. What is the acceleration of block A?

   b. What is the acceleration of block B?

   c. What is the tension, F_T, in the rope?

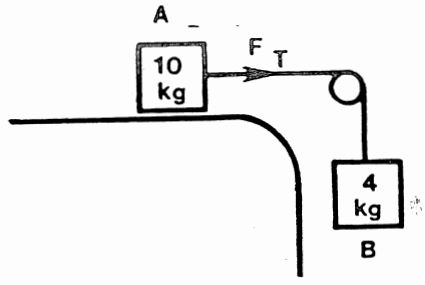

Fig. 1

3. Consider an opposing force of friction of 10 N to be present between block A and the surface in figure 1.

   a. What is the acceleration of block A?

   b. What is the acceleration of block B?

   c. What is the tension, F_T, in the rope?

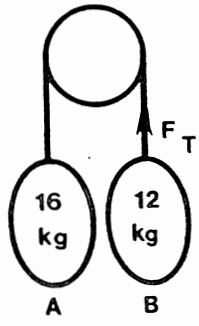

Fig. 2

4. Consider the pulley in figure 2 to be frictionless.

   a. What is the acceleration of block A?

   b. What is the acceleration of block B?

   c. What is the tension, F_T, in the rope?

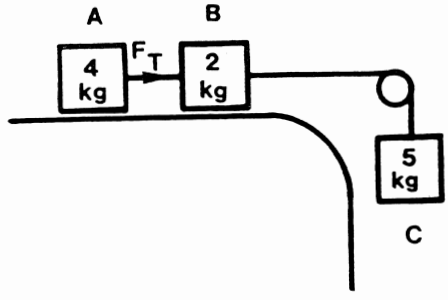

Fig. 3

5. Assume the surface in figure 3 to be frictionless. What is the tension, F_T, in the rope pulling block A?

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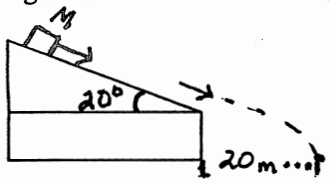
INCLINE PLANE PROBLEMS

Answer the following problems on a separate piece of notebook paper! SHOW YOUR WORK!

1. A book cover is lifted up just high enough so that a coin placed on it moves down the cover with constant velocity. The cover makes a 38^0 angle with the horizontal when this occurs. What is the coefficient of sliding friction? _____

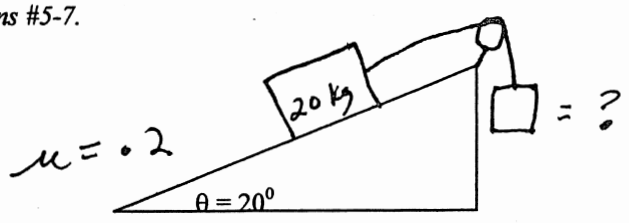
2. A car weighing 1.2×10^4N is parked on a 36^0 slope.
   a) Find the force tending to cause the car to roll down the hill. _____
   b) What is the force the car exerts perpendicular to the hill?_____

3. A mass **M** starts from rest and slides down the frictionless incline plane shown. As it leaves the incline, its speed is 24.0 m/s.
   a) What is the acceleration of the mass while on the incline? _____
   b) What is the length of the incline?_____
   c) How long does it take to reach the floor from its initial position at rest? _____



4. In order to slide a 325N trunk **up** a 20.0^0 inclined plane at a constant speed, a force of 211N is exerted parallel to the plane.
   a) What is the component of the weight parallel to the plane?_____
   b) The sum of the force parallel, the applied force, and friction must total what?_____
   c) What is the net force parallel to the plane?_____
   d) What is the force of friction?_____
   e) What is the coefficient of sliding friction?_____
   f) If the incline is 2.85m long, how long will it take the trunk, starting at rest at the top of the incline, to reach the bottom of the incline if it is released?_____
   g) What will be its final speed if it is released?_____

Diagram for questions #5-7.



5. Imagine you have a pulley on top of an incline plane which makes a 20^0 angle to the horizontal. A rope connecting a large crate (mass = 20kg), sitting on the incline, to hanging weights is placed over the pulley. If the coefficient of sliding friction between the crate and the incline is .2, calculate how much weight must be hanging to allow the crate to move **up** the incline at a constant velocity. _____

6. How much weight must be hanging to allow the crate to slide **up** the incline with the acceleration of $3.0 m/s^2$?_____

7. If 90.0N were hanging, describe the motion of the crate (include the value of acceleration *if* it is accelerating, and the direction of motion). _____