Name: _____
Hour: ____ Date: _____

Physics: *Newton's Laws HW*

1. A _____ kg mass slides across a horizontal surface due to a horizontally-applied force of _____ N. The coefficient of kinetic friction is _____. Draw an FBD and then find the magnitude of the acceleration of the mass. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

2. A _____ kg mass sits at rest on a horizontal surface. A smaller mass sits atop the first mass and applies a force of _____ N downward due to its weight. Draw an FBD for the mass, and then determine the magnitude of the normal force on it. (three force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

3. A ball of mass _____ kg flies through the air. Assuming air resistance can be ignored, draw an FBD and determine the magnitude of the mass's acceleration. (one force vector)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 1. 1.26 m/s^2 2. 376 N 3. 9.81 m/s^2

4. The ball from question 3 is falling straight down, but now consider that there is _____ N of air resistance. Draw an FBD and determine the magnitude of the mass's acceleration. (two force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

5. A submarine of mass _____ kg sits at rest on the ocean floor, supported by a buoyant force of _____ N. Draw an FBD and then determine the magnitude of the normal force on the submarine. (three force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

6. The submarine from question 5 is now moving through the ocean at a constant depth below the surface and at a constant speed. The forward-acting force on the sub by its propellers is _____ N. Draw an FBD and determine the magnitudes of both the buoyant force on the sub AND the drag force due to the sub's motion through the water. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 4. $7.3\ m/s^2$ 5. 2.94×10^8 N 6. $F_{buoy} = 7.21 \times 10^8$ N; $F_{drag} = 5.5 \times 10^6$ N

7. A _____ kg mass sits at rest on the edge of a high shelf. A person below pulls on a rope attached to the mass with a force of _____ N at an angle of _____ degrees below the horizontal. Draw an FBD, and then determine the magnitudes of the normal force AND the friction force on the mass. (five force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

8. A _____ kg mass is accelerating at the rate of _____ m/s^2 up an incline of _____ degrees, due to an applied force that is parallel to the incline. If the coefficient of kinetic friction is _____, determine the magnitude of the applied force. (five force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

9. A bucket filled with water (total mass = _____ kg) is held at rest from a vertical rope tied to its handle. Determine the tension in the rope. (two force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 7. $F_n = 6.0 \times 10^2$ N; $F_s = 92$ N 8. 78.7 N 9. 183 N

10. The bucket from Q9 is now moving upward, accelerating in that direction at the rate of _____ m/s^2. Find the rope's tension. (two force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

11. The bucket from Q10 is nearing its final destination above the ground, so it is slowing down as it continues to be lifted. If the tension in the rope is now _____ N, determine the magnitude and direction of the bucket's acceleration. (two force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

12. A jetliner of mass _____ kg is flying at a constant altitude of _____ m and a constant velocity of _____ m/s north. The engines provide the plane with _____ N of thrust. Determine the magnitudes of the air resistance force and the lift force on the plane. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 10. 215 N 11. 1.20 m/s^2 (down) 12. $F_{lift} = 4.2 \times 10^6$ N; $F_{air} = 9.22 \times 10^7$ N

13. An already-sliding hockey puck of mass _____ grams is pushed horizontally by a hockey stick with a force of _____ N in the direction of its motion. The coefficient of kinetic friction is _____. Find the magnitude of the acceleration of the puck. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

14. The hockey puck of Q13, having been pushed, is now sliding across the ice toward the goal. Find the magnitude of the acceleration of the puck. (three force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

15. A box of mass _____ kg is at rest on a horizontal floor. If the coefficient of static friction is ____, find the magnitude of the applied horizontal force needed to make the box begin moving. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 13. 62 m/s^2 14. 1.2 m/s^2 15. 51 N

16. If the coefficient of kinetic friction is _____, what applied horizontal force is required to keep the box from Q15 moving at a constant speed? (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

17. A box of mass _____ kg is sliding quickly along a horizontal floor to the right. Via a rope, a boy is applying a horizontal force of _____ N to the left in an effort to slow the box down. If the coefficient of kinetic friction is ____, find the magnitude of the acceleration of the box. (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

18. A box of mass _____ kg is moving along a horizontal floor at a constant velocity of _____ m/s to the right. A girl is pushing down-and-to-the-right on the box with a force of _____ N @ _____ degrees below the horizontal. Find the coefficient of kinetic friction. (five force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 16. 33 N 17. 2.9 m/s^2 18. 0.281

19. A sign of mass _____ kg is hanging from two identical ropes, one at each end of the sign. If the ropes hang vertically, find the tension in each rope. (three force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

20. The sign from Q19 hangs from the same two ropes, but now the ropes are both angled outward at an angle of _____ from the vertical. Find the tension in each rope. (five force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

21. A _____ kg mass is sliding up a ____ degree incline, being pulled by a force of _____ N that is parallel to the incline. If the coefficient of kinetic friction is ____, what is the magnitude of the acceleration of the mass? (five force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 19. 315 N 20. 671 N 21. 2.78 m/s^2

22. A _____ kg mass is sliding up an incline of ____ degrees, being pulled by a force of _____ N that is angled upward at _____ degrees, relative to the incline. If the coefficient of kinetic friction is ____, what is the magnitude of the acceleration of the mass? (six force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

23. A _____ kg child-and-sled combination is sliding down a snowy slope at ____ degrees below the horizontal. If the coefficient of kinetic friction is ____, what is the magnitude of the acceleration? (four force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

24. A _____ kg mass sits at rest on a horizontal surface. A boy applies a _____ N force up-and-to-the-left at an angle of ____ degrees above the horizontal. A girl applies a _____ N force up-and-to-the-right at an angle of ____ degrees above the horizontal. If the coefficient of static friction is _____, what force must be applied vertically downward on the mass in order to keep it from moving? (eight force vectors)

FBD:

ΣF = ma EQ(S), IN TERMS OF VARIABLES…

SOLVING **ΣF = ma** EQ(S) USING NUMBERS…

ANSWERS: 22. 2.25 m/s^2 23. 2.68 m/s^2 24. 207 N

Set 2: Hooke's Law

6. A 65 N weight is attached to a vertical spring, causing the spring to stretch 17.5 cm. Find the spring constant.

7. A water-balloon launcher shoots balloons with the aid of two elastic bands. If it takes a 360 N force to stretch the bands 0.94 m, what is the equivalent spring constant of the two bands?

8. Suppose a vertically-suspended spring stretches 21.3 cm from its equilibrium position when a 600. g mass is attached to it.
   a. Find the spring constant.
   b. Compared to a spring having k = 75 N/m, is the spring in Q8a stiffer or less stiff? Explain briefly.

9. How much force is required to pull a spring 6.40 cm from its equilibrium position if the spring constant is 18.4 kN/m?

ANSWERS: 6. 370 N/m 8a. 27.6 N/m 9. 1180 N
7. 380 N/m 8b. less stiff