

## Honors Freshman Physics

## Newton's Laws

Show "K-U-E-S" where necessary, otherwise answer completely. All work needs to be done on your own paper.

### NO CREDIT GIVEN FOR WORK DONE ON THIS SHEET!

#### Conceptual Questions - First Law of Motion (Sept 8<sup>th</sup>-10<sup>th</sup>)

1. Which is more fundamental, mass or weight? Does an object with mass have weight? Does an object with weight have mass?
2. Could an object have mass without having weight? Could an object have weight without having mass?
3. Why does a 2 kg brick have twice the inertia of a 1 kg brick?
4. In the orbiting space station you are handed two identical boxes, one filled with sand the other filled with feathers. How can you tell which is which without opening the boxes?
5. In tearing a paper towel or plastic bag from a roll, why is a sharp jerk more effective than a slow pull?
6. If a car moving along a ramp with a velocity of 20 cm/s has no net force acting on it, considering the ramp is long enough, what will its velocity be after 4 seconds.
7. An astronaut in space has a "weightless" anvil. Is it more difficult, less difficult, or just as difficult to shake the anvil back and forth in space as it is on Earth?

#### Conceptual Questions – Second Law of Motion (Sept. 11<sup>th</sup> – 15<sup>th</sup>)

8. To pull a wagon across a lawn with a constant velocity, you have to exert a steady force. Reconcile this fact with Newton's first two laws, which state that motion at constant velocity requires no net force.
9. If the net force on a sliding block is tripled, by how much does the acceleration increase? *3 times*
10. If the mass of a sliding box is tripled while a constant force is applied, by how much does the acceleration decrease? *3 times*
11. If the mass of a moving object is tripled just as the net force on it is tripled, how is the acceleration effected? *No effect*
12. What is the net force on an apple that weighs 1 N as you hold it at rest above your head? What is the net force on it after you release it? *Zero*      *1 N*

#### Calculation Problems – Second Law & Forces (Sept. 12<sup>th</sup> – 16<sup>th</sup>)

13. Find the acceleration of a  $2.0 \times 10^3$  kg, single engine airplane just before takeoff when the force of the engine is 500.0 N forward. *0.25 m/s<sup>2</sup>*
14. Calculate the acceleration if you push with a 20.0 N horizontal force on a 2.00 kg block of wood on a friction-free air table. *10.0 m/s<sup>2</sup>*
15. A cart is pulled to the left with a force of 100 N, and to the right with a force of 30 N. What is the net force on the cart? *70 N to the left*
16. What is the mass of a kiwi fruit thrown with an acceleration of 142 cm/s<sup>2</sup>? The thrower applied a force of 0.35 N to the kiwi fruit. *0.25 kg*

17. Calculate the horizontal force that must be applied to produce an acceleration of  $9.8 \text{ m/s}^2$  for a  $1.0 \text{ kg}$  puck experiencing no friction.  $9.8 \text{ N}$

18. What is the mass of an object that is accelerated at a rate of  $1.8g$  by a net force of  $21.2 \text{ N}$ ?  $1.20 \text{ kg}$

### Conceptual Questions – Third Law (Sept. 17<sup>th</sup> - 19<sup>th</sup>)

19. Consider hitting a baseball with a bat. If the force of the bat pushing on the ball is the action force, what is the reaction force?

20. Do action and reaction pairs of forces not cancel/balance one another?

21. If the forces that act on a bullet and the recoiling gun from which the bullet is fired are equal in size, why do the bullet and gun have very different speeds?

22. Consider the forces acting on you as you sit in your seat, the downward pull of gravity and the upward support of your seat. Are these forces equal and opposite? How do you know? Do they form an action - reaction pair? Explain.

23. For each of the following forces, what is the equal and opposite force required by Newton's third law? (a) The force of a hammer on a nail. (b) the force of gravity pulling down on a book? (c) the force of a helicopter blade pushing down on the air. (d) the force of air resistance acting on a falling baseball.

24. You hold an apple over your head. (a) Identify all the forces acting on the apple and their reaction forces. (b) When you drop the apple, identify all the forces acting on it as it falls and the corresponding reaction forces.

25. If a Mack truck and a Honda Civic have a head-on collision, upon which vehicle is the impact force greater? Which vehicle experiences the greater acceleration? Explain each answer.

26. A horse pulls a heavy wagon with a certain force. The wagon, in turn, pulls back with an opposite but equal force on the horse. Doesn't this mean the forces cancel one another, making acceleration impossible? Why or why not?

### Non-freefall (Sept. 19<sup>th</sup> – 23<sup>rd</sup>)

27. What is the net force on a  $10 \text{ N}$  falling object that encounters  $4 \text{ N}$  of air resistance?  $10 \text{ N}$  of air resistance?  $6 \text{ N down}$        $zero$

28. What two principal factors effect the force of air resistance on a falling object?

29. What is the acceleration of a falling object that has reached its terminal velocity?

30. Why does a heavy parachutist fall faster than a lighter one who wears the same size parachute? This is referring to after the parachute is opened.

31. Is a skydiver who has reached terminal speed in freefall? Explain

32. How does the weight of a falling body compare with the air resistance it encounters before it reaches terminal velocity? After?

33. Why is it that a cat that falls from the top of a 50 story building will hit the ground at the same speed as it would if it fell from the 20th story?

34. What is the acceleration of a rock at the top of its flight when thrown straight upward? Explain  $9.8 \text{ m/s}^2$

35. What will be the acceleration of a skydiver when air resistance builds up to be half her weight?