Physics Practice Test
Newton's Laws

Name: ______________________________

1-8. Complete Newton's Laws:

1st Law: Objects in motion stay in motion in a straight line at a constant speed unless acted upon by an unbalanced force

2nd Law: F = ma

3rd Law: For every action there is an equal and opposite reaction.

Forces

9. Define inertia.

resistance to change in motion

10. 1 Newton = 1/4 pounds 0.224 lbs

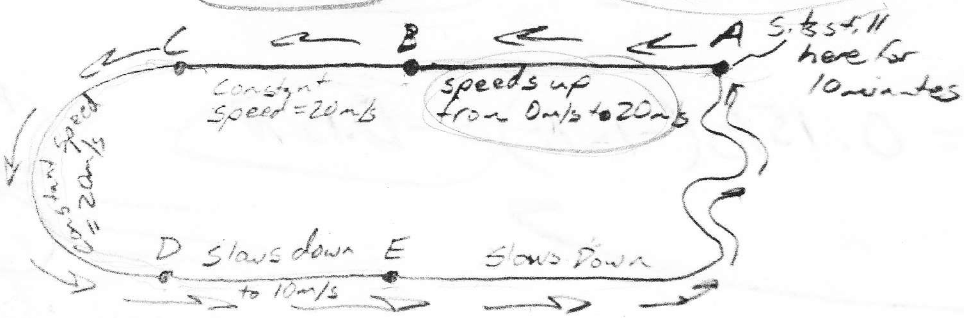
11. 1 Kilogram = 2 pounds 2.2 lbs

12. Newton is a unit of force / weight, and kilogram is a unit of mass.

The diagram below shows the path followed by a car. It also explains what is happening to the car's speed as the car is traveling. For each of the segments of the car's path, tell whether (by circling) the forces acting on the car are balanced or unbalanced.

13. At point A : Balanced Unbalanced
14. Between A & B : Balanced Unbalanced
15. Between B & C : Balanced Unbalanced
16. Between C & D : Balanced Unbalanced
17. Between D & E : Balanced Unbalanced

No change in motion



18. Suppose the forces acting on a car are balanced. If this is true, there are only two things this car could be doing. What are they?

- Sitting Still
- Moving at a constant speed in a straight line

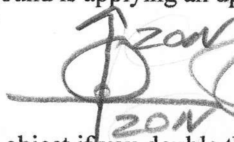
19. Suppose the forces acting on another car are unbalanced. In this case, there are three different things that the car could be doing. What are they?

Accelerating

Decelerating

turning

20. A ball is sitting motionless on the ground. The ground is applying an upward force of 20N to the ball. What do you know about the **NET FORCE** acting on the ball?



Net F = 0N

21. F=ma. If this is true...

a. What should happen to the acceleration of an object if you double the force that you are applying to it?

F=ma Acceleration doubles

b. What should happen to the acceleration of an object if you apply the same force, but you double the object's mass?

F=ma Acceleration decreases by ½

F=Ma

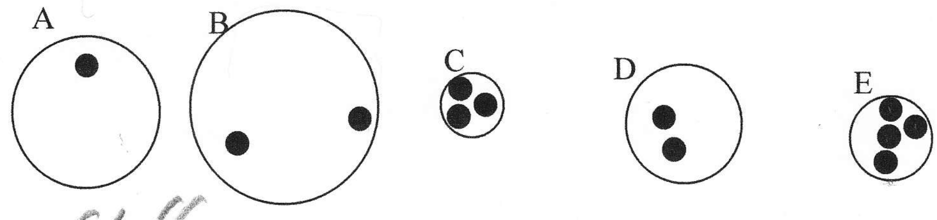
c. If you want accelerate something twice as fast, how much more force should you use?

F=ma Twice as much force

d. If you want an object to accelerate twice as fast when the same force is applied, what should you do to the object's mass?

F=ma Mass must decrease by ½

The circles on the right represent objects with varying masses, volumes, and densities. The dots inside the objects represent identical pieces of "stuff." The rest of the object is empty space.



Stuff

size

22. Which has the most mass? E

23. Which object has the greatest volume? B

24. Which object **weighs the <u>LEAST</u>**? A

Force of gravity

25. Define "weight"

Force of gravity acting on an object

26. A 1000kg car accelerates at a rate of 6m/s/s. What is the net force acting on the car?

$F=ma = 1000kg(6m/s^2) = 6000N$

27. On planet Z, falling objects accelerate at a rate of $32m/s^2$. How much does a 90kg man weigh on the planet Z?

$F = 90kg(32m/s^2) = 2880N$

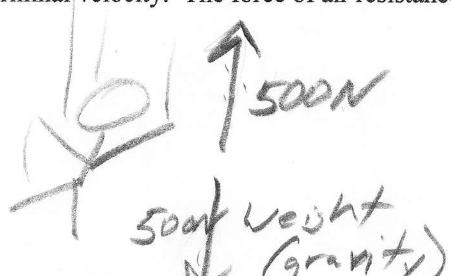
28. A 100kg man is falling from the sky (on Earth). Use F=ma to calculate the weight of the man in Newtons. Remember, weight is the force of gravity, and acceleration due to gravity $\approx 10m/s^2$.

$g = 10m/s^2$

$F = 100kg(10m/s^2) = 1000N$

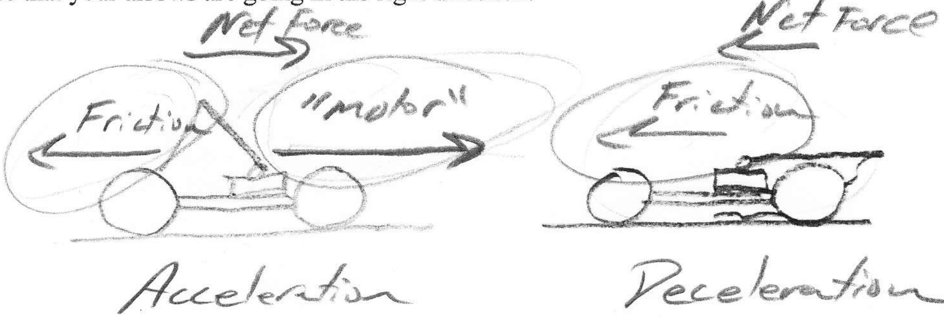
29. A woman is falling at terminal velocity. The force of air resistance pushing her upward is 500N. How much does she weigh?

500N



30. The diagram below shows a mousetrap-powered car during its acceleration and deceleration phases. Use arrows to show all of the forces acting on the car during those phases. Make sure that you include all of the individual forces, plus the net force.

- Label the arrows with the names of their forces.
- Make sure that your arrows are going in the right direction.

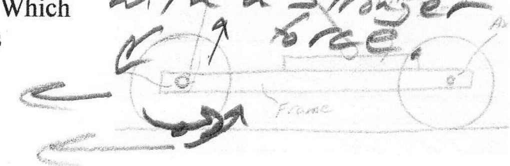


31. You cannot throw a feather with as much force as you can throw a desk. What could you do to prove this? Which of Newton's Laws do you need to use in your proof?

3rd Law

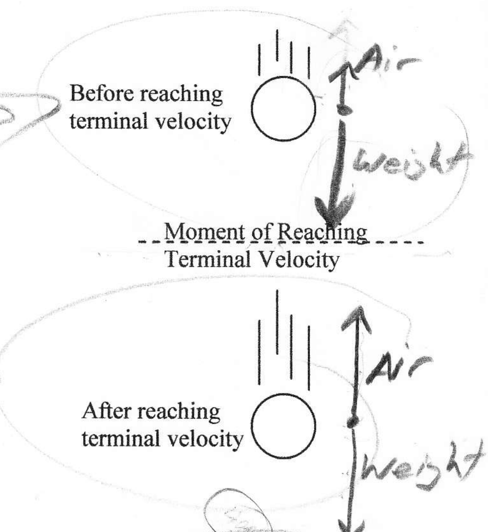
Push a feather away as fast as you can. Do the same with a desk. Only the desk will push you back. The desk pushed you with a stronger force, so you must have pushed the desk with a stronger force.

32. The mousetrap car on the right moves when the spring lifts the "arm" upward. Which way will the car move, left or right? Use Newton's 3rd Law to explain why this happens.



Leftward.
wheel pushes road to right.
Road pushes wheel to left.

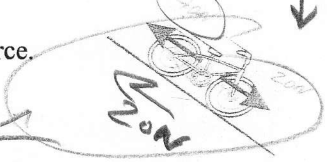
33-34. The diagram on the right depicts the flight of a lightweight ball that is dropped from a tall building. The point at which the ball reaches its terminal velocity is shown as a dotted line.



33. **Circle all that are true:** *Before* the ball reaches terminal velocity…
a. Weight > Air Resistance b. Air Resistance > Weight
c. Air resistance = Weight d. Net force is downward
e. Net force is upward

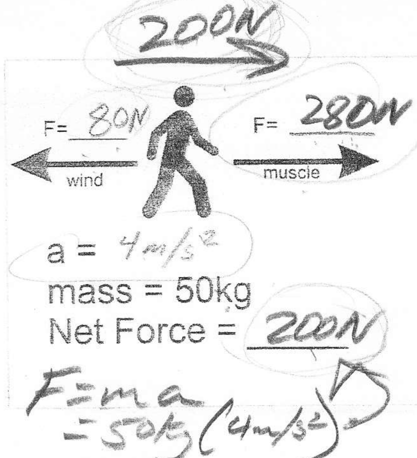
34. **Circle all that are true:** *After* the ball reaches terminal velocity…
a. Weight > Air Resistance b. Air Resistance > Weight
c. Air resistance = Weight d. Net force is downward
e. Net force is upward

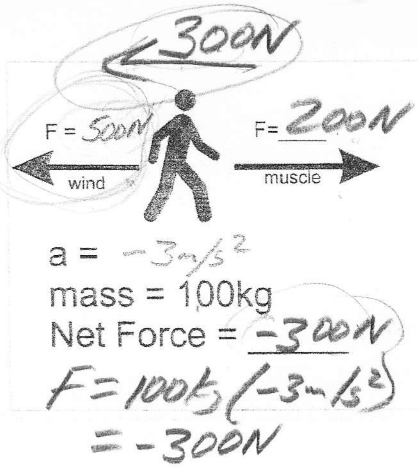
35-36. For the bicycle and the SUV on the right, draw and label a vector representing the net force. Then tell whether the object is accelerating, decelerating, or moving at a constant speed.



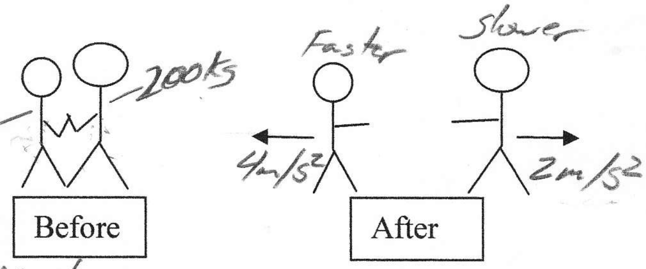
decelerating

37-38. Fill in the missing forces in the two diagrams on the right.





39-42. A 100kg ice skater and a 200 kg ice skater are standing next to one another. One of them pushes the other, causing them both to slide in opposite directions.



39. Who moves faster after they push away?

100kg

40. How do you know?

Same force, 100kg person has less inertia, so motion changes more easily.

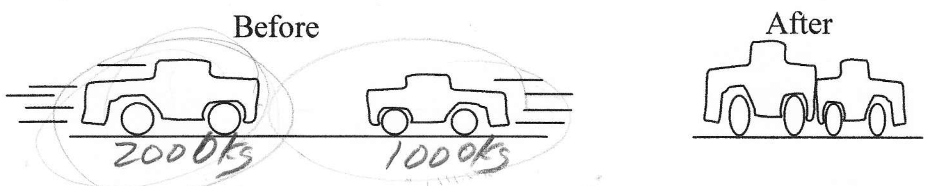
41. Who gets pushed with more force?

Neither. Same force.

42. If the 100kg skater accelerates at a rate of $-4m/s^2$ (to the left), how fast will the 200kg skater accelerate?

$2m/s^2$

43-44. Two cars collide head on. One has a mass of 2000kg, and the other has a mass of 1000kg. When they collide, they stick together.



43. When they collide, which car's velocity changes more?

1000kg

44. Explain why.

Has less inertia.

A 0.15kg mousetrap-powered car is wound up and held motionless at a starting line. When the car is released, its mousetrap "motor" pushes it for the first 3 seconds. During that time, the car travels 12 meters. After the car's motor stops pushing, the car continues to "coast" for another 8 seconds.

m, t_1, d, t_2

45. What is the car's average velocity while the motor is pushing? 4m/s
46. What is the change in velocity during the car's acceleration period? 8m/s
47. What is the car's acceleration while the motor is pushing? 2.67m/s
48. What net force is acting on the car while the motor is pushing? 0.4N
49. What is the change in velocity during the car's *deceleration* period? -8m/s
50. What is the car's acceleration during the car's *deceleration* period? $-1m/s^2$
51. What net force is acting on the car during the car's *deceleration* period? -0.15N
52. What force of friction is acting on the car? -0.15N
53. What force is provided by the car's motor? 0.55N

See next page for work

54. A car's engine is pushing it forward with a force of 400N. The car has a mass of 500kg, and it is moving at a constant velocity. What total force of friction (including air, axles, etc) is acting against the car? 400N

Bonus. If that same car had an acceleration of $0.1m/s^2$, what would the force of friction have to be?

350N

$F = ma = 500kg(0.1m/s^2) = 50N$

45. $\bar{v} = \frac{d}{t} = \frac{12m}{3s} = 4m/s$

average v.

0-0 → 0-0

0m/s 4m/s 8m/s

$\Delta v = 8m/s$

46. Final $V = 4m/s(2) = 8m/s$

ΔV

0-0 → 0-0

8m/s 0m/s

$\Delta v = -8m/s$

47. $a = \frac{\Delta v}{\Delta t} = \frac{8m/s}{3s} = 2.67m/s^2$

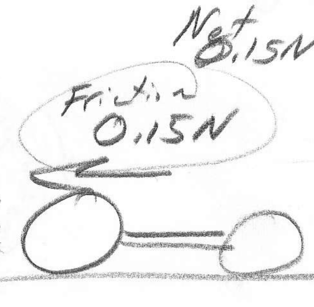
48. $F = ma$

$F = 0.15kg(2.67m/s^2) = 0.4N$

49. Make this negative $= -8m/s$

50. $a = \frac{\Delta V}{\Delta t} = \frac{-8m/s}{8s} = -1m/s^2$

51. $F = 0.15kg(-1m/s^2) = -0.15N$



52.

53.