Conceptual Physics Name _____

Review for Term 1 Final Exam

The day for the final is _____. It will consist of **50 multiple-choice questions** and will count as a double test.

Resources for studying: textbook, concept guide (yellow sheet), study packets, internet, classmates, teacher

Here's a list of the topics studied this term and the corresponding sections you should review in the book:

1. **Mechanics** [*Standard 1*]
   a. velocity (2.2-2.3)
   b. acceleration (2.4-2.7)
   c. Newton's 1st Law (4.4-4.7)
   d. Newton's 2nd Law (5.1-5.3)
   e. Newton's 3rd Law (6.1-6.4)
   f. gravitational force (12.4-12.5)

2. **Momentum and Energy** [*Standard 2*]
   a. momentum (7.1)
   b. conservation of momentum (7.5)
   c. elastic & inelastic collisions (7.5)
   d. work (8.1)
   e. potential energy (8.4)
   f. kinetic energy (8.5)
   g. conservation of energy (8.6)

Directions: Be sure you can answer the following questions. Discuss them with your partner and concisely record your answers on a separate sheet of paper. Your grade will be determined by how well you and your partner stay on task. This is an excellent opportunity to raise your grade, so try to get to all the questions. You will be turning in your work at the end of the week.

Motion and Forces

1. Newton's laws predict the motion of most objects.

A. *Know how to solve problems that involve average speed:*

Average speed = distance / time (v = d/t)

1. Define *average speed* using words. Give an example. How is it different from *instantaneous speed*?
2. What is the average speed of a football player that runs the 40 meter dash in 5 seconds?
3. If a plane can average 550 mi/h, how far will it go in 3 hours? (Identify the variables, plug them into the formula, and cross-multiply to solve for the unknown variable.)
4. While driving to Ventura your average speed is 60 mi/h. If Ventura is 40 miles away, how much time will it take to get there? (Set the problem up first, like the previous problem. Give your answer in both hours and minutes.)
5. Calculate the average speed of a student (in miles/hour) who runs three miles around the track in 30 minutes. (Hint: How many hours is 30 minutes?)
6. Calculate the average speed of a student (in m/s) of a bicycle track racer that can ride 1 km in 70 seconds. (Hint: How many meters are in a kilometer?)
7. On a 12-mile bike ride, Chris rode for 10 minutes, stopped for a 5 minute rest, and then rode for another 45 minutes. What was her average speed for the entire trip?
8. What does negative velocity mean?
9. .Draw a *position versus time* graph for a student walking at a slow constant speed away from a motion sensor, stopping for a moment, and running back to it at a fast constant speed.

B. *When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed and direction, or stays at rest if at rest (Newton's first law).*

10. Define acceleration in words and using an equation.
11. Draw a position versus time graph for a student starting from rest and accelerating while she is walking away from a motion sensor.
12. Calculate the instantaneous speed (in m/s) of a car that has been accelerating 2.0 m/s^2 for 10 seconds, starting from rest.
13. Calculate the speed (in m/s) of a skateboarder who accelerates from rest for 3 seconds down a ramp at an acceleration of 5 m/s^2.
14. If the skater in the previous problem travels a distance of 22.5 meters in 3 seconds, what was his average speed?
15. Show how a net force of 15 N acting to the right on a box can be generated using a) one force vector, b) two force vectors acting in the same direction, c) two force vectors acting in opposite directions Draw the vectors in each case and label them with the amount of force.
16. a) Draw and label the forces acting on a car that is *at rest*.

    b) Draw and label the forces acting on a car that is moving with a *constant velocity*.
17. Define terminal velocity. When a falling object reaches its terminal velocity, what two forces acting on it are balanced?
18. If you pull on a block with a force of 3 N to make it slide at a constant velocity, how much is the force of friction on the block? (Hint: constant velocity means zero acceleration, zero acceleration means zero net force.)

C. *Newton's 2nd Law,* Force = mass × acceleration (F = ma), *can be used to solve one-dimensional motion problems that involve constant forces.*

19. Explain Newton's 2^{nd} law in words.
20. Calculate the acceleration of a 2000 kg airplane when the engines act on it with a force of 500 N.
21. Calculate the acceleration if you push with a force of 20 N to the right on 2 kg block when there is 4 N of friction resisting. Make a diagram first, then calculate the net force.
22. How much net force must act on an 800 kg stalled car to get it to accelerate 0.5 m/s^2?
23. For the amount of net force you calculated above, how much force would you need to push with if there is 150 N of friction resisting?
24. What must be the mass of a small cart that accelerates 2 m/s^2 when a net force of 10 N is applied?
25. What is the relationship between mass and weight? Show this with an equation (hint: weight is directly proportional to mass and gravity).
26. What is the weight of a 75.0 kg man? What is the mass of an 800. N gorilla?

D. *When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction back on the first object (Newton's third law).*

27. Draw an example to illustrate this, and explain it. Draw and label the two action-reaction forces.
28. In a collision between a car and a bug which experiences more force? more acceleration? Explain.
29. Two students stand facing each other on skateboards. They then push off each other, and one accelerates away more slowly than the other. Give two possible reasons why one accelerates more slowly.

Energy and Momentum

2. The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.

A. *Kinetic energy is calculated using the formula* Kinetic Energy = 1/2 × mass × velocity^2 ($KE = \frac{1}{2}\, mv^2$)

30. Do all moving objects have kinetic energy? Do all moving objects have momentum? Which of these two quantities is a vector (i.e. has direction)?
31. Calculate the kinetic energy of a 1000 kg car traveling with a speed of 12 m/s.
32. How does the kinetic energy of a car change when the car's speed triples? Why?

B. *Gravitational potential energy is calculated using the formula* ΔPotential Energy = mass × gravitational acceleration × change in height. ($PE = mgh$)

33. Draw a picture of a girl at the top of a ladder.
34. If the girl's mass is 50 kg and she is 2 meters above the ground, how much potential energy does she have?

C. *The total amount of energy in a system is always conserved as long as no work is done. (For example, a falling object starting with 100 joules of potential energy will hit the ground with 100 joules of kinetic energy, assuming there is no friction doing work against the object.)*

35. If the girl on the ladder above were to fall, how much kinetic energy would she have when she gets to the ground?
36. How much work was done on the object to get it to the height in your drawing.
37. When loading a box into the back of a truck, how does the amount of work done to lift the box directly in compare to the amount of work it would take to push it up a frictionless ramp?

D. *Momentum is calculated using the formula* momentum = mass × velocity ($p = mv$).

38. Explain momentum in your own words.
39. Calculate the momentum of a 200-kg elephant running 3 m/s.

E. *Total momentum is conserved during all collisions; total kinetic energy is only conserved when collisions are elastic (bouncing).*

40. What does it mean to say that total momentum is conserved during collisions?
41. Consider two cars that come to rest in a gnarly head-on collision. Was the collision elastic or inelastic? After the accident, how much kinetic energy do they have? What happened to all the kinetic energy they had before the collision?

F. *An unbalanced net force on an object changes the object's momentum according to the equation* $F \bullet \Delta t = \Delta p$.

42. Suppose the air bag went off in one of the cars during the collision above. Why would those occupants be safer? Explain in terms of force and time of impact.

G. *The law of conservation of momentum can be used to predict the velocities or masses of objects involved in collisions. The equation for this law is* $(m_1v_1 + m_2v_2)_{Before} = (m_1v_1 + m_2v_2)_{After}$

43. A 6000 kg train car traveling at 2 m/s connects with a 2000 kg train car at rest. What will their velocity be after they connect? (Hint: Use a Before/After chart)
44. A 2 kg blob of putty moving at 3 m/s slams into a second blob of putty at rest. If their velocity after the inelastic collision is 2 m/s, how much was the mass of the second blob of putty? (Hint: Use a Before/After chart)

Investigation & Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations.
Students know…

A. *Random error* is caused by imprecision when measuring; *systematic error* is caused by flaws in the way experiments are set-up or performed; *human error* is caused by making a mistake in measurement or calculations and is usually the cause when very large errors occur.

B. A *hypothesis* is an educated guess that might explain a *specific observation*. A *theory* is a larger explanation that is able to explain *many different types of observations*; a theory becomes stronger when many observations support it and weaker when observations occur that can not be explained by it or which refute i

Answers

Standard 1

2. 8 m/s
3. 1650 mi
4. 0.67 h, 40 min
5. 6 mi/h
6. 14.3 m/s
7. 12 mi/h

12. 20 m/s
13. 15 m/s
14. 22.5 m/ 3 s = 7.5 m/s
17. During terminal velocity, force of gravity is balanced by air resistance
18. 3 N

20. 0.25 m/s^2
21. 8 m/s^2
22. 400 N
23. 550 N
24. 5 kg
25. weight = mass x gravitational accel (9.8 m/s^2)
26. 735 N, 81.6 kg

28. same amount of force, bug has more acceleration because less mass
29. more mass, more friction in skateboard, NOT more force (action-reactionforces are equal)

Standard 2

30. yes, yes, speed
31. 72,000 J
32. x9 because velocity is squared: KE = ½ mv^2

34. 980 J
35. 980 J
36. 980 J

39. 600 kg-m/s

40. "Conserved" means total amount of momentum doesn't change
41. Inelastic, zero KE, KE was used in doing work on the metal to bend it and in the formation of heat on impact
42. More time of impact means less force on their body

43. 1.5 m/s
44. 1 kg