Quantitative 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 20% of your final grade.

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 (2.1)
   b. acceleration (2.3-2.4)
   c. Newton's 1^{st} Law (4.1-4.2)
   d. Newton's 2^{nd} Law (4.3,4.4)
   e. Newton's 3^{rd} Law (4.3)
   f. gravitational force (7.2)

2. **Momentum and Energy** [*Standard 2*]
   a. momentum (6.1)
   b. conservation of momentum (6.2)
   c. elastic & inelastic collisions (6.3)
   d. work (5.1)
   e. potential energy (5.2)
   f. kinetic energy (5.2)
   g. conservation of energy (5.3)

Standards Review Questions

Read through the standards at the front of your book, "Unpacking Physics Standards p. CA4-CA10". Skip any standard with a *. Answer the review questions in the spaces below. **Check your answers with the ones given in the book at the bottom of the page.** Use scratch paper for calculations.

Standard 1	Investigation & Experimentation
1a. ________	a. ________
1b. ________	b. ________
1c. ________	c. ________
1d. (skip)	d. (skip)
1e. ________	e. (skip)
	f. ________
Standard 2	g. ________
2a. ________	j (skip)
2b. ________	k. ________
2c. ________	l. (skip)
2d. ________	m. (skip)
2e. ________	n. ________

Directions: Answer all of the questions below. You will be turning in this review packet on the day of the final. The answers to some of the problems can be found on page 4.

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)

A1. Define *average speed* using words. How is it different from *instantaneous speed*?

A2. True or False: If a student runs at a speed of 2 m/s for 15 seconds and 6 m/s for 5 seconds, her average speed will be (2 m/s + 6 m/s) / 2 = 4 m/s. Explain.

A3. Describe the difference between average *speed* and average *velocity*. Which is more useful when driving on the freeway? Explain.

A4. What does negative velocity mean?

A5. On a 24-mile bike ride, Chris rode for 10 minutes at a speed of 20 mi/h, stopped for a 5 minute rest, rode for 45 minutes at 16 mi/h, ate lunch for 20 minutes, and rode for another 40 minutes at 12 mi/h. What was her average speed for the entire trip? (Hint: This problem is easier than it looks; you are told the distance and you can add up the times to find the total time; then use the formula for average speed.)

A6. Draw a *position versus time* graph and a *velocity 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. *Remember, velocity is the slope of a position versus time graph.*

p. 44 #2, 4 p. 74 #1-3

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).*

B1. Define acceleration in words and show the formula for how it is calculated.

B2. Draw a *position versus time* graph and a *velocity versus time* graph for a bowling ball rolling down a ramp, starting from rest and accelerating at a constant rate.

B3. Can acceleration be negative when a car is getting faster? Explain. (Hint: Think about direction.)

B4. 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.

B5. a) Draw and label the forces acting on a car that is travelling with a constant velocity. The length of the force vectors that you draw should be proportional to the magnitude of the force.

b) Draw and label the forces acting on a car that is accelerating.

c) In which of the situations above is the object in equilibrium – (a) only, (b) only, both, or neither?

B6. Define terminal velocity. When a falling object reaches its terminal velocity, what two forces acting on it are balanced?

p. 65 #3

p. 129 #1, 2 (Hint: constant velocity means zero acceleration; zero acceleration means there must be 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.*

C1. Explain Newton's 2nd law in words.

p. 132 #2 p. 134 #1 p. 146 #20, 21

C2. Distinguish between mass and weight? Show the formula for weight. (Hint: weight is directly proportional to mass and gravity)

C3. Using the formula for weight: 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).*

D1. Draw an example to illustrate this and explain it. Draw and label the two action-reaction forces.

D2. In a collision between a car and a bug which experiences more force? more acceleration? Explain.

D3. Two students stand facing each other on skateboards. They then touch hands and push off each other, and one accelerates away more slowly than the other. Give two possible reasons why one could accelerate more slowly than the other.

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 = ½ mv^2)

2A1. 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)?

2A2. How does the kinetic energy of a car change when the car's speed triples? Why?

p. 185 #19, 20

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

p. 185 #24 (draw a picture to help you visualize the problem)

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.)*

2C1. A 6.0 kg bowling ball hanging on a chain attached to the ceiling sits 0.50 meter above the floor. If the chain breaks, how much kinetic energy will the ball have as it hits the ground? (Hint: You first need to know how much potential energy it had.)

2C2. How much work was done on the bowling ball to get it hanging on the chain above in the first place?

2C3. When loading a box into the back of a truck, which method involves more work being done on the box: lifting the box directly up into the truck or pushing the box up a frictionless ramp? Explain

p. 186 #27, 33

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

2D1. Explain momentum in your own words.

2D2. If a person riding their bicycle 9.0 m/s has a momentum of 680 kg•m/s, how much is the combined mass of the rider and bicycle?

p. 199 #1

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

2E1. What does it mean to say that momentum is conserved during collisions?

2E2. 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? Where did the kinetic energy that they had before the collision go during the collision? Was momentum conserved? Was kinetic energy conserved?

F. *An unbalanced net force on an object changes the object's momentum according to the equation* F•Δt = Δp.

2F1. 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.

p. 223 #13 Hint: $\Delta p = m (v_f - v_i)$

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* $(m_1v_1 + m_2v_2)_{Before} = (m_1v_1 + m_2v_2)_{After}$

2G1. 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 collision is 2 m/s, how much was the mass of the second blob of putty?

p. 224 #28

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 it.

Review your notes on types of measurement error and significant figures

p. 32 #3-8

Answers

A5. 12 mi/h

p. 44 2) 3.1 km 4) 3.00 h

p. 74 1) B 2) F 3) D

p. 65 3) at top v=0, a = –9.8 m/s; at bottom a = –9.8 m/s

p.129 1) zero, no acceleration 2) –3674 N

p. 59 2) positive 3) a. 5.0 m/s^2 b. 16 m c. 6.4 m/s

p. 132 2) 1.4 m/s^2 north p. 134 1) a. 12 N b. 3.0 m/s^2 p. 146 20) 3.52 m/s^2 21) 55 N to the right

C3. 736 N, 81.5 kg

p. 185 19) 7.6×10^4 J 20) 1.7×10^4 m/s 24) a. -19.6 J b. 39.2 J c. 0 J 33) 12.0 m/s

2C1. 29 J PE at top = 29 J KE at bottom 2C2. work = Δenergy = 29 J

p. 186 27) KE into elastic PE into gravitational PE 33) 12.0 m/s

2D2. 76 kg

p. 199 1) 2.5×10^3 kg·m/s south

p. 223 13) 18 N p. 224 28) 1.0 m/s

p. 32 3) A 4) H 5) C 6) G 7) C 8) J