Student Review Sheet

Physics Semester A Examination

Test Description

Length: 2 hours
Items: 50 SR (~85%), 2 BCRs (~15%)

Unit	Approximate Number of Selected Response Items
Physics Skills and Processes	8
Kinematics	16
Force	11
Momentum	7
Energy	8
Totals	**50**

The vocabulary terms and objectives are grouped into units for your convenience. Some items may occur in multiple units during the semester. The vocabulary includes terms that students may encounter when reading examination items.

Some Vocabulary for the Exam:

acceleration
air resistance
collision
component
constant
dependant variable
direction
displacement
distance
duration
elastic collision
elliptical
energy
force
free fall
friction/ frictionless
gravitational field strength
gravitational potential energy
horizontally
hypothesis
impulse
independent variable
initial
investigation
inelastic collision
joules
kilogram
kinetic
kinetic energy
law of conservation of momentum
magnitude
mass
momenta
momentum
net force
net impulse
newtons
normal force
pendulum
potential energy
projectile
power
radius
resistance
scientific notation
static
stationary
vectors
velocity
vertically
volume
weight
work
Y-intercept

Student Review Sheet

Upon successful completion of Semester A the student should be able to:

Physics Skills and Processes

- interpret graphs and diagrams.
- identify trends revealed by data.
- analyze data to form conclusions.
- defend the need for verifiable data.
- read and interpret a technical passage.
- identify the hypothesis of an experiment.
- identify meaningful, answerable, scientific questions.
- identify appropriate methods for conducting an investigation.
- use ratio and proportion in appropriate situations to solve problems.
- distinguish between a dependent variable and an independent variable.
- describe similarities and differences when explaining concepts and/or principles.

Physics Concepts

- given the forces acting on an object and the mass of the object, determine the magnitude of the net force.
- given the forces acting on an object and the mass of the object, determine the acceleration.
- given a vector diagram of an object's velocity, determine the magnitude of its components.
- interpret a position versus time graph to determine the velocity and initial position of an object.
- given velocity versus time graphs, determine changes in direction, distance traveled, displacement, initial velocity, and acceleration.
- identify the path that an object would take when dropped from a moving object.
- describe how the magnitudes of components of velocities change during projectile motion.
- describe the magnitude of force on objects in elastic and inelastic collisions.
- given mass and speed, determine kinetic energy.
- given mass and the force of gravity, determine weight.
- given mass, distance, and the force of gravity, determine the net force on an object in free fall.
- determine the kinetic energy of an object in free fall.
- determine the speed and distance traveled of an object in free fall at a given time.
- given a description of the movements of objects, identify vector diagrams that describe the final velocities of the objects.
- calculate relative velocity.
- given initial height and distance traveled, determine the time of flight and speed of a projectile.
- determine the acceleration of an object in one dimension.
- given a diagram showing forces on a moving object, determine the size of a frictional force.
- distinguish between mass and weight.
- use Newton's third law of motion to solve problems.
- quantitatively describe how gravitation force on an object changes with distance.
- given distance, time, and amount of work, determine the magnitude of force and average power.
- identify the relationship among force, time, and momentum.
- describe the forces acting on an object in a circular orbit.
- given a diagram, describe force responsible for acceleration.

- given force, mass, distance, and time, determine work.
- describe the forces that act on a conical pendulum.
- identify appropriate units for quantities.
- describe the effect of a force on an object in space.
- describe the relationship between mass and velocity in elastic collisions.
- identify factors that limit the acceleration of an object in free fall.
- use vectors to represent forces of different magnitudes.
- given speed and time, determine average acceleration.
- compare velocity and acceleration of an object thrown vertically.
- compare the location of a plane and an object dropped from a plane.
- determine the magnitudes of velocity and acceleration for objects in free fall.
- given the mass, direction, and speed of an object in a collision, determine the magnitude of the net impulse.
- given a force versus time graph, determine impulse.
- determine the relationship among mass, kinetic energy, and work.
- describe relationships among force, work, and gravitational potential energy.
- describe how momentum changes in an inelastic collision.
- state the law of conservation of momentum.
- state the law of conservation of energy.
- state Newton's 2^{nd} Law.
- solve a problem using Newton's 2^{nd} Law.
- describe how Newton's 2^{nd} and 3^{rd} Laws relate to impulse.
- describe the relationship among speed, acceleration, force, and mass.
- describe the magnitudes of velocity and acceleration of a rocket.
- solve problems using the law of conservation of energy.
- solve problems using the law of conservation of momentum.

BCRs were put on the exam review sheets to encourage appropriate student collaboration and review of concepts in preparation for the entire exam (not just the BCRs). Teachers should <u>not</u> address these BCRs during the course of their instruction nor should they assist in preparing students for the BCRs during exam review. Students are able to collaborate and use other resources to review and solidify concepts. Students should be prepared to answer any of the following BCRs. Teachers will select TWO from the list below on the day of the exam:

BCR: MASS OF THE BLOCK

A student applies a force of 5.0 N to a wooden block as it slides across a horizontal floor at a constant speed of 2.0 m/s. When the student replaces the force 5.0 N force with a 12.0 N force, the block accelerates from 2.0 m/s to 3.5 m/s in 3.0 seconds.

Describe how a student could find the mass of the block. Be sure to include:

- a statement of the law that applies to this problem
- the logical steps with the equations used to solve for the mass
- the calculated mass
- a diagram showing all of the forces on the block

BCR: MARBLE MASS VS SPEED

Students in physics class want to determine if the mass of a marble affects its speed. They decide to roll a marble down an incline and allow it to travel a distance of two meters on the classroom floor.

Design an investigation to help the students determine the effect of mass on the speed of a marble.

When describing the appropriate parts of the investigation, be sure to include

- a hypothesis
- the materials needed
- a step-by-step procedure
- a data table that shows data you would collect
- sources of error that might limit the accuracy of your data

BCR: FORCE AND WORK

When you load a heavy box into a truck, it is often easier to push it up a ramp to the back of the truck than to lift it directly up into the truck. However, the change in the gravitational potential of the box is the same no matter how you get it from the ground into the truck.

Compare the amount of work that you must do to lift the box directly into the truck with the amount of work you need to do to push the box up the ramp.

Be sure to include

- the relationship between force and work
- the relationship between work and gravitational potential energy
- the reasons for any differences in the amount of work you do on the box

BCR: THE ROCKET

A toy rocket is sitting on its launch pad. Approximately 90% of its mass is fuel. When the engine is fired, the fuel is burned and the resulting exhaust gas is pushed out the base of the rocket. The rocket will rise off the launch pad and accelerate from the time the engine starts until the fuel is consumed. The force of the engine on the rocket is constant during the firing of the rocket.

Describe the motion of the rocket from the time of launch until a few seconds after all the fuel is gone. Be sure to include

- a statement of Newton's 2nd law
- a description and explanation of the magnitude of acceleration of the rocket
    - just after launch
    - as the fuel is burning and the rocket is rising
    - just after the fuel is completely burned

BCR: GOING BOWLING

A student holds a bowling ball in his right hand, preparing to throw it toward bowling pins at the other end of the alley. The surface of the alley is polished to a high gloss. He brings his right arm back in a smooth arc, and then swings it forward, releasing the ball so it rolls down the center of the alley toward the pins at the other end. After the student releases the ball, the ball rolls in a straight line at a constant velocity until it hits the pins.

Describe the motion of the ball from the top of the arc until it hits the pins. Be sure to include:

- a statement of Newton's 1st Law
- an application of Newton's 1st Law in explaining
  - the motion of the ball from the top of the arc until the bowler releases it
  - why the ball moves down the alley at a constant velocity in a straight line
  - why the motion of the ball changes when it hits the pins

BCR: RACE TO THE GROUND

As part of a demonstration, a teacher fires a projectile at a falling target. The air gun is parallel to the ground and aimed at the center of the target. Both the center of the gun barrel and the center of the target are at height h. The target is dropped from a rest at the same instant that the projectile leaves the gun. The students observe that the projectile hits the target. The teacher states that assuming gravity is 10 m/s^2 and the distance permits the projectile to reach the target before the target strikes the floor, it will always hit it!

Explain why the teacher is correct. Be sure to include:

- a description of the paths of the projectile and target
- a description of the forces acting on each object and the resulting acceleration of each object
- a description of the changes in the position and velocity of each object as it falls

The following information will be provided in the test book for students to use during their exam:

- Science Rubric for BCRs
- Formula Sheet

Formula Sheet

Motion

$$speed = \frac{\text{distance}}{\text{time}}$$

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

$$v_f = v_i + at$$

$$\Delta x = v_i t + \tfrac{1}{2} a t^2$$

$$a = \frac{v^2}{r}$$

Work, Power, and Energy

$W = F_{||}\, d$
(where $F_{||}$ is the part of F parallel to d)

$$PE_G = mgh$$

$$KE = \tfrac{1}{2} mv^2$$

$$\Delta KE = -\Delta PE$$

$$P = \frac{W}{t}$$

$$W = \Delta KE$$

Momentum

$$p = mv$$

$$F\Delta t = mv_f - mv_i$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

Forces

$$F = k\frac{q_1 q_2}{r^2}$$

$$F = G\frac{m_1 m_2}{r^2}$$

$$\Sigma F = ma$$

W = mg

Constants

$g = 9.8\ m/s^2$

Mathematical Equations

$$\sin\theta = \frac{opp}{hyp}$$

$$\cos\theta = \frac{adj}{hyp}$$

$$\tan\theta = \frac{opp}{adj}$$

$$a^2 + b^2 = c^2$$