Physical Science Final Exam Study Guide

Fall 2015

1) An Introduction to Physical Science

- a) An Introduction to The Scientific Method
  - i) Scientific Fact
    - (1) A Definition of Fact
    - (2) Facts Can Change
  - ii) The Scientific Method
    - (1) A Definition of the Scientific Method
  - iii) Scientific Observation
    - (a) A Definition of Observation
    - (b) Two Classifications of Observations
      - (i) Qualitative Observations
      - (ii) Quantitative Observations
    - (c) Two Characteristics of Good Scientific Observation
      - (i) Good Scientific Observation Uses as Much Detail as Possible
      - (ii) Good Scientific Observation Uses as Many of the Five Senses as Possible
  - iv) Hypothesis
    - (1) A Definition of Hypothesis
    - (2) A Definition of *Scientific* Hypothesis
  - v) Scientific Law
    - (1) A Definition of Scientific Law
    - (2) Scientific Laws Can Change
  - vi) Scientific Theory

(1) A Definition of Theory

vii) Experimentation

(1) The Role of Experiment in Science

viii) A Definition of Modern Science

ix) A Definition of Pseudoscience

x) Comparison/Contrast of Science and Philosophy (or Religion)

xi) The Scientific Revolution

b) The SI System of Units

i) What is the SI System of Units?

ii) Who Uses the SI System?

iii) The SI System Versus the Metric System

iv) SI Prefixes

v) An Introduction to Unit Conversion

c) Measurement and Error

i) Random Errors and Systematic Errors

ii) Accuracy Versus Precision

iii) Significant Figures

(1) Counting Significant Figures

(2) Using Significant Figures in Calculations

2) An Introduction to Physics

a) Position, Distance, and Displacement

i) Scalar Quantities

(1) A Definition of Scalar Quantity

(2) A List of Some Common Scalar Quantities

ii) Vector Quantities

(1) A Definition of Vector Quantity

(2) A List of Some Common Vector Quantities

iii) Position

(1) A Definition of Position
(2) An Abbreviation for Position
(3) Position is a Vector Quantity
(4) The SI Unit for Position
(5) Position as Represented in Two Dimensions
(6) Position as Represented in One Dimension

iv) Distance
(1) A Definition of Distance
(2) An Abbreviation for Distance
(3) The SI Unit for Distance
(4) Distance is a Scalar Quantity
(5) Finding Distance Traveled

v) Displacement
(1) A Definition of Displacement
(2) Finding Net Displacement Given Path
(3) An Abbreviation for Displacement
(4) The SI Unit for Displacement
(5) Displacement is a Vector Quantity
(6) A Formula for Displacement
(7) Finding Displacement Mathematically

b) Speed and Velocity

i) Speed
(1) A Definition of Speed
(2) An Abbreviation for Speed
(3) A Formula for Average Speed
(4) The SI Units for Speed
(5) Speed is a Scalar Quantity
(6) Using Average Speed, Distance, and Time in Calculations
(7) Instantaneous Speed Versus Average Speed

ii) Velocity
(1) A Definition of Velocity
(2) An Abbreviation for Velocity
(3) A Formula for Average Velocity
(4) The SI Units for Velocity
(5) Velocity is a Vector Quantity
(6) Using Average Velocity, Displacement, and Time in Calculations
(7) Instantaneous Velocity Versus Average Velocity

c) Acceleration and Relative Motion
i) Constant Acceleration
(1) A Definition of Acceleration
(2) An Abbreviation for Acceleration
(3) A Formula for Average Acceleration
(4) The SI Units for Acceleration
(5) Acceleration is a Vector Quantity
(6) Using Average Acceleration, Change in Velocity, and Time in Calculations
(7) Galileo and Acceleration
(8) Free-Fall Acceleration
(9) Hang Time
ii) Relative Motion

d) An Introduction to Force
i) Systems
(1) A Definition of a System
(2) Identifying Good Systems
ii) Net Force
(1) Finding Net Force in One Dimension
(a) Finding Net Force in One Dimension Mathematically

(b) Finding Net Force in One Dimension by Using Vector Addition/Subtraction

(2) Finding Net Force in Two Dimensions

(a) Finding Net Force in Two Dimensions (in Component Form) Mathematically

(b) Finding Net Force in Two Dimensions by Using Vector Addition/Subtraction

iii) Mechanical Equilibrium

(1) Net Force on an Object in Mechanical Equilibrium is Equal to Zero (for an Non-Rotating System)

(2) Two Types of Mechanical Equilibrium

(a) Static Equilibrium

(b) Dynamic Equilibrium

iv) Some Types of Forces

(1) Weight

(2) Support Force

(3) Frictional Force

e) Newton's Three Laws of Motion

i) Newton's First Law of Motion

(1) Inertia

(2) Mass

(3) A Description of Newton's First Law of Motion

ii) Newton's Second Law of Motion

(1) A Description of Newton's Second Law of Motion

(2) Free-Fall Acceleration and Newton's Second Law of Motion

(3) Non-Free-Fall Motion and Newton's Second Law of Motion

(a) Terminal Velocity/Speed

iii) Newton's Third Law of Motion
(1) Interaction
(a) Action/Reaction Pairs of Forces
(2) A Description of Newton's Third Law of Motion
iv) Newton's Second and Third Laws Involving Different Size Masses

f) Momentum and Impulse
i) Momentum
(1) Momentum is "Inertia in Motion"
(2) An Abbreviation for Momentum
(3) A Formula for Momentum
(4) The SI Units for Momentum
(5) Momentum is a Vector Quantity
(6) Using Momentum, Mass, and Velocity in Calculations
ii) Impulse
(1) Impulse is "Change in Momentum"
(2) An Abbreviation for Impulse
(3) A Formula for Impulse
(4) The SI Units for Impulse
(5) Impulse is a Vector Quantity
(6) Using Impulse (or Change in Momentum), Force, and Time in Calculations
(7) Examples of Impulse Changing Momentum
(a) Impulse Increasing Momentum
(b) Impulse Decreasing Momentum

g) The Law of Conservation of Linear Momentum
i) English Statement of the Law of Conservation of Linear Momentum
ii) A Definition of a Closed System

(1) Linear Momentum is Conserved Only for a Closed System

iii) Mathematical Statement of the Law of Conservation of Linear Momentum

iv) Using the Law of Conservation of Linear Momentum to Find Momentum, Mass, and/or Velocity of Objects in a Closed System

h) Energy and Work

i) Energy

(1) A Definition of Energy

(2) An Abbreviation for Energy

(3) Some Common Forms of Energy

(a) Kinetic Energy

(i) A Definition of Kinetic Energy

(ii) A Formula for Kinetic Energy

(b) Potential Energy

(i) A Definition of Potential Energy

(ii) Some Common Forms of Potential Energy

1. Elastic Potential Energy
2. Gravitational Potential Energy
    a. A Formula for Gravitational Potential Energy

(4) The SI Unit for Energy

(5) Energy is a Scalar Quantity

(6) Using Energy and Other Quantities in Calculations

ii) Work

(1) Work is "Change in Energy"

(2) An Abbreviation of Work

(3) A Formula for Work

(4) The SI Unit for Work

(5) Work is a Scalar Quantity

(6) Using Work (Change in Energy), Force, and Distance in Calculations

i) The Law of Conservation of Energy

i) English Statement of the Law of Conservation of Energy

(1) Energy for a System is Conserved Only when Net Work Done on or by the System is Equal to Zero

ii) Using the Law of Conservation of Energy in Calculations

j) Power, Efficiency, and Machines

i) Power

(1) A Definition of Power

(2) An Abbreviation for Power

(3) A Formula for Power

(4) The SI Units for Power

(5) Power is a Scalar Quantity

(6) Using Power, Work (Change in Energy), and Time in Calculations

ii) Efficiency

(1) A Definition of Efficiency

(2) An Abbreviation for Efficiency

(3) A Formula for Efficiency

(4) Efficiency is Dimensionless (It Has No Units)

(5) Efficiency is a Scalar Quantity

(6) Using Efficiency, Work Input (or Energy Input), and Work Output (or Energy Output) in Calculations

iii) Machines

(1) A Definition of Machine

(2) Machines Follow the Law of Conservation of Energy

k) Gravity, Projectiles, and Satellites

i) Gravity

(1) Newton's Law of Universal Gravitation
  (a) Mathematical Statement of Newton's Law of Universal Gravitation
  (b) The Inverse Square Law
  (c) How Changing Mass and/or Distance Affect Gravitational Force
(2) Weight
  (a) A Definition of Weight
(3) Apparent Weight
  (a) A Definition of Apparent Weight
  (b) Some Cases in Which Apparent Weight is not Equal to Actual Weight
    (i) Apparent Weight is Greater than Actual Weight for an Object Which is Accelerating Upward
    (ii) Apparent Weight is Less than Actual Weight for an Object Which is Accelerating Downward
    (iii) An object is Weightless When it has No Support Force (When it is Accelerating Downward at g)

ii) Projectile Motion
  (a) A Definition of a Projectile
  (b) The Velocity of a Projectile has Two Components
    (i) Vertical Component of Velocity Undergoes an Acceleration of g Downward (for Negligible Air Resistance)
    (ii) Horizontal Component of Velocity is Constant (for Negligible Air Resistance)

iii) Satellite Motion
(1) Energy is Conserved for Satellite Motion

(2) Escape Speed

I) Temperature and Thermal Energy

i) Temperature

(1) A Definition of Temperature

(2) An Abbreviation for Temperature

(3) The SI Unit for Temperature

(4) Temperature is a Scalar Quantity

(5) Absolute Zero

ii) Thermal Energy

(1) A Definition of Thermal Energy

(2) An Abbreviation for Thermal Energy

(3) Some Acceptable Units for Thermal Energy

(4) Thermal Energy is a Scalar Quantity

iii) Heat

(1) A Definition of Heat

(2) An Abbreviation for Heat

(3) Some Acceptable Units for Heat

(4) Heat is a Scalar Quantity

iv) Specific Heat Capacity

(1) A Definition of Specific Heat Capacity

(2) An Abbreviation for Specific Heat Capacity

(3) The SI Units for Specific Heat Capacity

(4) Specific Heat Capacity is a Scalar Quantity

(5) Using Specific Heat Capacity, Thermal Energy, Mass, and Change in Temperature in Calculations

v) Thermal Expansion

(1) A Definition of Thermal Expansion

(2) Typical Behavior of Substances Undergoing Changes in Temperature

(3) The Thermal Expansion of Water

vi) Phase Changes

(1) The Five Known Phases of Matter

(a) Bose-Einstein Condensate

(b) Solid

(c) Liquid

(d) Gas

(e) Plasma

(2) Common Types of Phase Changes

(a) Melting and Freezing

(b) Evaporation and Condensation

(c) Sublimation and Deposition

vii) Energy and Phase Changes

m) Thermal Energy Transfer

i) The Three Processes of Heat Transfer

(1) Conduction

(a) A Definition of Conduction

(b) Conduction can Occur in Matter in Certain Phases

(c) Good Conductors

(d) Poor Conductors a.k.a. Insulators

(2) Convection

(a) Definition of Convection

(b) Convection can Occur in Matter in Certain Phases

(3) Radiation

(a) A Definition of Radiation

(b) Radiation can Occur in Any Phase of Matter

(c) The Electromagnetic Spectrum

ii) The Greenhouse Effect

iii) Reducing Heat Transfer in a Thermos

n) Static Electricity
   i) Electric Charge
   ii) Coulomb's Law
   iii) Electric Field
   iv) Electric Potential
   v) Voltage Sources
o) Current Electricity
   i) Electric Current
   ii) Electrical Resistance
   iii) Ohm's Law
   iv) Electric Circuits
   v) Electric Power
p) Magnetism
   i) Magnetic Poles
   ii) Magnetic Fields
   iii) Magnetic Domains
   iv) Electric Currents and Magnetic Fields
   v) Magnetic Forces on Moving Charges
   vi) Electromagnetic Induction
   vii) Generators and Alternating Current
   viii) Power Production
   ix) The Transformer—Boosting or Lowering Voltage
   x) Field Induction

3) An Introduction to Chemistry

a) An Introduction to Chemical Concepts
   i) Sizes
      (1) Submicroscopic
      (2) Microscopic
      (3) Macroscopic

- ii) Physical and Chemical Properties
- iii) Physical and Chemical Changes
- iv) Elements Versus Compounds
- v) Naming Compounds
  - (1) Naming Type I Ionic Compounds
  - (2) Naming Covalent Compounds

b) Atoms
- i) Parts of the Atom
  - (1) The Electron
  - (2) The Atomic Nucleus
    - (a) Protons
    - (b) Neutrons
- ii) Bohr's Model of the Atom

c) The Periodic Table of Elements
- i) Organizing the Elements
  - (a) Metals, Nonmetals, and Metalloids
  - (b) Atomic Groups
  - (c) Atomic Periods

d) Chemical Bonding
- i) Electron-Dot Structures
- ii) Ions
- iii) Types of Chemical Bonds
  - (1) Ionic Bonds
  - (2) Covalent Bonds
- iv) Chemical Equations
  - (1) The Mole
  - (2) Balancing Simple Chemical Equations

4) Weather

a) An Introduction to Weather

i) Atmospheric Moisture
ii) Weather Variables
iii) Cloud Development
iv) Air Masses, Fronts, and Storms
v) Violent Weather
vi) Weather Forecasting

5) A Brief Introduction to Astronomy

a) The Solar System
   i) How Did the Solar System Form?
   ii) Objects in the Solar System
      (1) The Sun
      (2) The Planets and Moons
         (a) The Inner Planets
            (i) Earth's Moon
         (b) The Outer Planets
      (3) Other Objects
         (a) Comets
         (b) Asteroids
         (c) Meteoroids, Meteors, and Meteorites

b) Stars and Galaxies
   i) Stars
      (1) The Life of a Star
         (a) The Hertzsprung-Russell Diagram
         (b) The Birth of a Star
         (c) The Life of a Star
         (d) The Death of a Star
   ii) Galaxies