OBJECTIVES – RSPT 1060

I. INTRODUCTION

A. Specific topics covered

1. History of Anatomy and Physiology
2. History of Respiratory Care

B. OBJECTIVES: The student will be able to:

1. State the significant historical facts associated with each of the following:
   a. Hippocrates
   b. Aristotle
   c. Galen
   d. Andreas Vesalius
   e. Paracelsus
   f. William Harvey
   g. Robert Boyle
   h. Joseph Black
   i. Joseph Priestley
   j. Carl Scheele
   k. Antoine Lavoisier
   l. Thomas Beddoes
   m. Alvin L. Barach
2. State the purpose of each of the following organizations
   a. American Association for Respiratory Care (AARC)
   b. Michigan Society for Respiratory Care (MSRC)
   c. National Board for Respiratory Care (NBRC)
   d. Committee on the Accreditation for Respiratory Care (CoARC)
3. List the significance of each of the following credentials
   a. Certified Respiratory Therapist (CRT)
   b. Registered Respiratory Therapist (RRT)
   c. Certified Pulmonary Function Technologist (CPFT)
   d. Registered Pulmonary Function Technologist (RPFT)
   e. Neonatal-Pediatric Specialist (NPS)
   f. Certified Asthma Educator (AE-C)

II. MODULE A - MATHEMATICS

A. Specific topics covered

1. Working with positive & negative numbers
2. Rounding rules
3. Working with decimals
4. Order of operation
5. Working with fractions
6. Introduction to proportions
7. Introduction to ratios

8. Measurement systems
9. Scientific notation & exponents
10. Conversions and Canceling
11. Setting up formulas
12. Rearranging formulas

B. OBJECTIVES: The student will be able to:

1. Define terms associated with positive and negative numbers.
2. List the rules for solving problems associated with positive and negative numbers.
3. Given a mathematical problem involving positive or negative numbers, derive the correct answer.
4. List the rules for rounding numbers when performing calculations.
5. Given a mathematical problem, round the answer correctly.
6. List the rules for working with decimals.
7. Given a mathematical problem involving decimals, add, subtract, multiply or divide decimals with and without a calculator and derive the correct answer.
8. List the rules for order of operation when performing calculations.
9. Given a mathematical problem, determine the proper order of operation for problems containing addition, subtraction, multiplication and division with and without a calculator and derive the correct answer.
10. Define terms associated with fractions.
11. List the rules for working with fractions.
12. Given a mathematical problem involving fractions, add, subtract, multiply or divide fractions with and without a calculator and derive the correct answer.
13. List the rules for working with percentages.
14. Given a mathematical problem involving percentages, add, subtract, multiply or divide percentages with and without a calculator and derive the correct answer.
15. Define terms associated with ratios and proportions.
16. Describe how ratios and proportions are used in solving clinical problems.
17. Given a mathematical problem involving ratios or proportions, derive the correct answer.
18. Identify and compare the systems of measurement used in the clinical setting.
19. Identify the standard prefixes used in the metric system.
20. State the metric units of length, mass, volume, time, and temperature.
21. Distinguish between the metric units for liquid (mL) and solid volume (cc) measurements.
22. Given a mathematical problem requiring conversion between measurements systems and the appropriate conversion factors, derive the correct answer.
23. Given a mathematical problem requiring conversion within the metric system, derive the correct answer.
24. Define the following terms:
    a. Direct
    b. Indirect

25. State the three rules for rearranging formulas.
26. Given a mathematical problem requiring rearranging of the equation, derive the correct answer.
27. Distinguish between a direct and an indirect relationship.
28. Given a number in scientific notation, distinguish between the base number and the exponent.
29. Given a number expressed as a decimal, convert it to scientific notation.
30. Given a number expressed in scientific notation, express it as a decimal.

III. MODULE B - BASIC CHEMISTRY

A. Specific topics covered:

1. Characteristics of matter
2. Divisions of matter
3. Physical and chemical changes
4. Periodic Table
5. Inert or stable gas
6. Elements of human life
7. Compounds
8. Bonding
9. Electrolytes
10. Naming Ions
11. Naming Compounds

B. OBJECTIVES: The student will be able to:

1. Define terms associated with atomic and sub-atomic matter.
2. Differentiate between the types of matter.
3. Describe what each item in an element's box on the periodic table represents.
4. Compare the composition of the elements of the universe, the earth's crust and the human body.
5. Differentiate between an atom, elements, molecules and compounds.
6. Describe the components of an atom and the purpose of each.
7. Differentiate between atomic number, atomic mass and mass number.
8. Explain what an isotope is.
9. Explain what determines physical and chemical properties of an element.
10. Define terms associated with the period table and electron transfer.
11. Identify the chemical symbol of the following elements commonly used in respiratory care (H, Li, Be, Na, Mg, Fe, K, Ca, Cu, Ag, Au, Zn, C, N, O, F, He, Ne, Si, P, S, Cl, Ar, Kr, Xe, Rn, Hg).
12. Identify the macronutrients and micronutrients found in the human body.
13. Describe the methods used to put elements in order on the periodic table.
14. Explain the periodic law.
15. Differentiate between the two classification-schemes commonly used in describing elements.
16. Describe the method of classification called "Groups of Elements".
17. Identify the noble or inert gases, representative elements, transition metals and inner transition metals
18. Describe the classification scheme called "Classes of Elements".
19. Using the periodic chart is able to identify an element as a metal, metalloid or non - metal.
20. Describe the significance of the "Rows" or Periods.
21. Describe the significance of the "Columns" also known as groups or families.
22. State the purpose of valence electrons.
23. Differentiate between a neutral and a stable atom

24. Explain the significance of location on the periodic tale and the movement of electrons.
25. Define terms associated with chemical bonding.
26. Explain what an electron dot structure or Lewis diagram is used for.
27. Define what a fixed weight ratio is.
28. Describe how a chemical reaction takes place.
29. Explain the “Rule of eights” and state the exception to the rule.
30. Explain the difference between a compound and a polyatomic ion.
31. Explain how molecular and ionic compounds are different.
32. Define covalent and ionic bonding.
33. Explain electronegativity.
34. Define electrolyte and explain their purpose and how they are measured.
35. Define terms associated with the naming of organic compounds and oxidation-reduction reactions.
36. Describe the steps for naming inorganic compounds, (ionic compounds, covalent compounds, and compounds with polyatomic ions).
37. Define the components of a chemical reaction.
38. Give an example of an oxidation-reduction reaction in Respiratory Therapy.
39. Explain how the different chemical reactions take place.

IV. MODULE C - APPLIED PHYSICS

A. Specific Topics:

1. Equation of motion
2. Pressure Gradients
3. Surface Tension
4. Surfactant
5. La Place's Law
6. Compliance
7. Resistance
8. Matter
9. States of matter
10. Measurement of matter
11. Properties of gases
12. Avogadro's Law
13. Density of gases
14. Atmospheric pressure
15. Dalton's Law
16. Calculation of partial pressures
17. Boyle's Law
18. Charles's Law
19. Gay-Lussac's Law
20. Combined Gas Law
21. Fluid Dynamics
22. Patterns of Flow
23. Fluid Entrainment
24. Jet Mixing
25. Bernoulli Effect
26. Venturi Effect
27. Temperature Conversion
28. Heat
29. Heat transfer
30. Humidity
31. Critical Points
32. Cylinder Duration Types of mixtures
33. Characteristics of solutions
34. Drug calculations

B. OBJECTIVES: The student will be able to:

1. Mechanics
   a. Define terms associated with pulmonary mechanics.
   b. Differentiate between respiration and ventilation.
   c. Differentiate between internal and external respiration.
   d. Describe the equation of motion.
   e. Differentiate between a spontaneous and a mechanical breath.
   f. Define work of breathing.
   g. Differentiate between elastic and non-elastic forces associated with work of breathing.

h. Define compliance.
i. Differentiate between dynamic and static compliance.
j. Given the appropriate information, calculate the static compliance.
k. Given a pressure-volume (P-V) loop, distinguish the following:
    i. Low compliance P-V loop
    ii. High compliance P-V loop
    iii. Normal P-V loop
l. State the relationship between compliance and elastance.
m. Differentiate between the elastance and compliance with each of the following disease states:
    i. Emphysema
    ii. Pneumonia
    iii. Pulmonary Edema
    iv. Pulmonary Fibrosis
    v. ARDS
n. Describe the respiratory pattern of a patient with reduced lung compliance.
o. Differentiate between lung compliance and chest wall compliance.
p. Given a clinical scenario, use compliance measurements to determine if it is becoming easier or harder to ventilate the lungs.
q. State the normal value for Total Lung Compliance.
r. Explain the effects of surface tension on a liquid.
s. Define LaPlace's Law
t. Explain the relationship between pressure, surface tension and radius if one of the variables is held constant.
u. Define surfactant.
v. Explain the purpose of surfactant in the lung.
w. List two clinical causes for decreased surfactant in the lung.
x. Define resistance.
y. List two types of frictional resistance to ventilation.
z. List two factors that can cause an increase in airway resistance.
aa. State Poiseuille's law.
bb. State the effect of reducing the radius of a tube by ½ on the resistance to gas flow through the tube.
cc. Given the appropriate information, calculate the airway resistance.
dd. List pulmonary diseases or disorders which will result in an increased airway resistance.
ee. Given a clinical scenario, use airway resistance measurements to determine if it is becoming easier or harder to ventilate the lungs.

2. States of Matter
    a. Define terms associated with matter.
    b. List the three states of matter and describe their characteristics.
    c. Compare and contrast the three states of matter.
    d. Differentiate between a gas and a vapor.
    e. Describe how matter is classified.
    f. Explain how matter can be changed both physically and chemically.
    g. Describe the methods for measuring matter.
3. Properties of gases and gas mixtures
    a. Define terms associated with the properties of gases and gas mixtures.

b. Identify abbreviations used during expressions of the properties of gases or gas mixtures.
c. State the six principle assumptions that explain the unique properties of gases.
    i. State the effect of gas particle size on gas density.
    ii. State the effect of the distance between particles of a gas on its compressibility.
    iii. State the effect of kinetic energy of a gas on diffusion of that gas through an environment.
    iv. State the effect of molecular attraction of a gas on its physical properties.
    v. State the effect of kinetic energy of a gas on the pressure it exerts.
    vi. State the relationship between the kinetic activity of a gas, the temperature of the gas and the pressure it exerts.
d. List the major gases that comprise the atmosphere and their fractional concentrations.
e. Describe the clinical significance of hyperbaric & hypobaric conditions.
f. State Dalton's Law.
g. Given the barometric pressure, calculate the partial pressure of a gas.
h. Explain how changes in altitude will affect partial pressure and fractional concentration of the gas.
i. Describe why gases need to be converted to Standard Conditions.
j. Given a table of conversion factors, convert between the following standard conditions:
    i. ATPS
    ii. STPD
    iii. BTPS
k. Describe how gases in the atmosphere differ from gases in the lungs and blood.
l. State the partial pressure of water vapor at body temperature (37 C) with a relative humidity of 100%.
m. List the normal values for the following partial pressures in the lungs and blood:
    i. PIO_2
    ii. $PICO_2$
    iii. PAO_2
    iv. PaO_2
    v. $PaCO_2$
    vi. $P\bar{v}O_2$
    vii. $P\bar{v}CO_2$
n. Given appropriate information, determine the following oxygenation indices:
    i. PAO_2
    ii. PaO_2/PAO_2
    iii. $A\text{-}aDO_2$
o. State how pressure is measured.
p. Express one atmosphere in the following units:

i. mm Hg
ii. cm H_2O
iii. psi
iv. torr
v. Kpa

q. Convert between the following units of pressure measurements:
i. mm Hg
ii. cm H_2O
iii. psi
iv. torr
v. Kpa

r. Explain the significance of Avogadro's Law and number.
s. Calculate the gram-molecular weight of a gas.
t. Calculate the density of:
i. Oxygen (O_2)
ii. Carbon dioxide (CO_2)
iii. Helium (He)
iv. Nitrogen (N_2)
v. Room air (79% N_2 + 21% O_2)
vi. He/O_2 mixtures (70/30% & 80/20%).

u. Given a periodic table, calculate the gram molecular weight of any substance.
v. Given a periodic table, calculate the density of one mole of any gas.
w. Explain the relationship between density, mass and volume.

4. Gas Laws
a. Define terms associated with gas laws.
b. Define Boyle's Law.
c. Describe the relationship between volume, pressure, mass and temperature as it relates to Boyle's Law.
d. Describe how Boyle's Law can be used to explain normal ventilation.
e. Given appropriate information, use the mathematical formula for Boyle's Law to solve for an unknown.
f. Define Charles's Law.
g. Describe the relationship between volume, pressure, mass and temperature as it relates to Charles's Law.
h. State a clinical example of when Charles Law is applied in respiratory therapy.
i. Given appropriate information, use the mathematical formula for Charles's Law to solve for an unknown.
j. Define Gay-Lussac's Law.
k. Describe the relationship between volume, pressure, mass and temperature as it relates to Gay-Lussac's Law.
l. Give a clinical example of when Gay-Lussac's Law is applied in respiratory therapy
m. Given appropriate information, use the mathematical formula for Gay-Lussac's Law to solve for an unknown.
n. State the combined gas law.
o. Given appropriate information, use the mathematical formula for the Combined Gas Law to solve for an unknown.

p. State the Universal (Ideal) Gas Law.

5. Gas Movement
   a. Define terms associated with gas movement.
   b. Differentiate between flow, velocity and speed.
   c. Describe how flow is measured.
   d. Describe how velocity is measured.
   e. Describe how velocity is measured.
   f. Describe the relationship between flow, cross-sectional area, and velocity.
   g. Differentiate between the types of flow.
   h. State how Poiseuille's law is used to define the amount of pressure needed to move a fluid through a tube.
   i. State the Reynold's number where a transition from laminar to turbulent flow occurs.
   j. Differentiate between a low-flow oxygen delivery system and a high-flow oxygen delivery system.
   k. List three examples of low-flow oxygen delivery systems.
   l. List three examples of high-flow oxygen delivery systems.
   m. State the normal inspiratory flow rate.
   n. State the effect on an increase in minute volume on oxygen delivery percentage with a low-flow oxygen delivery system.
   o. Given appropriate data, determine the following:
      i. Spontaneous tidal volume
      ii. Inspiratory flow rate
      iii. Minute volume
      iv. Patient flow needs
      v. Total flow
   p. Differentiate between
      i. Jet mixing
      ii. Bernoulli principle.
      iii. Venturi principle
   q. State the effect of changes in jet orifice size on the amount of air entrained in a system utilizing jet mixing.
   r. State the effect of changes in entrainment port size on the amount of air entrained in a system utilizing jet mixing.
   s. State the effect on an increase in minute volume on oxygen delivery percentage with a high-flow oxygen delivery system.
   t. State the effect of downstream back pressure on oxygen delivery percentage with a high-flow oxygen delivery system.
   u. Given an FIO_2, determine the air: oxygen ratio.
   v. Given an FIO_2 and an oxygen flow rate, determine the total flow.
   w. Given an FIO_2, an oxygen flow rate, and a patient's minute volume, determine if the total flow is adequate.
   x. Given an air and an oxygen flow rate, determine the FIO_2.

6. Solutions, Concentrations, and Medications
   a. Define terms associated with solutions, concentrations and medication delivery.
   b. Describe the relationship between matter and mixtures.
   c. Differentiate between a homogeneous and heterogeneous solution.

d. Give an example of a colloid, suspension and solution found in the human body.
e. Identify the components of a solution.
f. Give an example of each of the following solutions:
    i. Gas dissolving in a liquid.
    ii. Solid dissolving in a liquid.
g. List the things that affect solids or liquids dissolving in a liquid.
h. List the things that affect gases dissolving in a liquid.
i. Differentiate between a dilute, saturated and a supersaturated solution and a precipitate.
j. Differentiate between osmosis and diffusion.
k. Explain osmotic pressure and give examples of how it works.
l. Describe the different forms of tonicity.
m. Explain the effects of a hypertonic, hypotonic and isotonic solution as it is injected into the blood stream.
n. Explain the effects of a hypertonic, hypotonic and isotonic solution as it is inhaled into the tracheobronchial tree.
o. Explain the reason for performing drug calculations in respiratory therapy.
p. Given a bottle of medication, identify the concentration of the drug.
q. Convert a ratio (dilution) solution and a % solution to mg/mL.
r. Perform drug calculations given %weight/volume solutions (%).
s. Perform drug calculations given ratio solutions (1:100).
t. Perform calculations using the Universal Formula for solving w/v solutions.
u. Calculate drug dilution problems.
v. Given a medication and a physician order, calculate the dosage or volume required to deliver the ordered amount of medication.
w. Differentiate between Young's Rule, Clarks Rule, Fried's Rule and Body Surface Area for calculating pediatric dosages.
x. Given an adult dose of medication, use an infant's age in months, child's age in years, weight or body surface area to determine the correct dosage.

7. Thermodynamics and Humidity
    a. Define terms associated with thermodynamics.
    b. List the following on the Fahrenheit, Celsius, and Kelvin temperature scales:
        i. Freezing point
        ii. Boiling point
        iii. Body temperature
        iv. Absolute zero.
    c. Convert between the following scales:
        i. Fahrenheit and Celsius temperature scales.
        ii. Celsius and Kelvin temperature scales.
    d. Define heat.
    e. Differentiate between a calorie and a kilocalorie.
    f. State the number of kilocalories obtained for 1 gram of each of the following substances:
        i. Carbohydrate
        ii. Fat

iii. Protein

g. Given a breakdown of the number of carbohydrates, fats, and protein in a compound, determine the number of calories.
h. Compare and contrast the four methods of heat transfer.
i. State the water vapor pressure of alveolar gas in the following units:
   i. mm Hg
   ii. mg/L
j. Differentiate between the following:
   i. Absolute humidity
   ii. Relative humidity
   iii. Humidity deficit
k. Explain the relationship between surface area and evaporation.
l. Given appropriate information and conversion factors, determine the relative humidity of a gas.
m. Given appropriate information and conversion factors, determine the humidity deficit of a gas.
n. Describe how properties of gases may change under extreme temperatures and pressures.
o. Describe what the critical point is and how it is used in gas therapy.
p. Given appropriate information, determine the duration of use of a liquid cylinder of gas.
q. Given appropriate information determine the duration of use of a gaseous cylinder of gas.