

Regents Chemistry Exam Prep

August 8 – 11, 2017

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In this packet, you will find:

- Guided notes to various topics in Regents Chemistry
- Each topic is followed by sets of questions taken from previous Regents exams

Chemistry Regents Exam

Wednesday August 16

8 – 11 am

Room #2022

Additional resources to prepare for the exam:

- Check out Miss Virga's website! (missvirga.weebly.com)
- Castle Learning (tons of Regents practice questions)

MATTER

Can it be separated physically?

NO!

YES!

PURE SUBSTANCE

MIXTURE

(aq) : H₂O + dissolved solid

Can it be separated chemically?

NO!

YES!

ELEMENT

COMPOUND

* made up of 1 type of atom
* CANNOT be broken down

* made up of 2 or more different atoms bonded together
* CAN be broken down (decomposed)

VOCAB

^{gr}
allotrope: 2 forms of the same element in the same phase
↳ diamond, graphite (both C) *diff. structure and properties

Matter

1. The list below shows four samples: A, B, C, and D.

- (A) HCl(aq)
- (B) NaCl(aq)
- (C) HCl(g)
- (D) NaCl(s)

Which samples are substances?

- A. A and B B. A and C C. C and B D. C and D

2. Which type of matter is composed of two or more different elements that are chemically combined in a definite ratio?

- A. a solution B. a compound
C. a homogeneous mixture D. a heterogeneous mixture

3. Which terms are used to identify pure substances?

- A. an element and a mixture B. an element and a compound
C. a solution and a mixture D. a solution and a compound

4. Which two substances can *not* be broken down by chemical change?

- A. C and CuO B. C and Cu
C. CO₂ and CuO D. CO₂ and Cu

5. Matter that is composed of two or more different elements chemically combined in a fixed proportion is classified as

- A. a compound B. an isotope C. a mixture D. a solution

6. Which sample of matter is a single substance?

- A. air B. ammonia gas
C. hydrochloric acid D. salt water

7. Two solid samples each contain sulfur, oxygen, and sodium, only. These samples have the same color, melting point, density, and reaction with an aqueous barium chloride solution. It can be concluded that the two samples are the same

- A. compound B. element C. mixture D. solution

8. Which substance can be broken down by chemical means?

- A. CO B. Ce C. Ca D. Cu

9. Every water molecule has two hydrogen atoms bonded to one oxygen atom. This fact supports the concept that elements in a compound are

- A. chemically combined in a fixed proportion
 B. chemically combined in proportions that vary
C. physically mixed in a fixed proportion
D. physically mixed in proportions that vary

10. Which substance can *not* be broken down by a chemical change?

- A. methane B. propanal C. tungsten D. water

11. Base your answer(s) to the following question(s) on the information below.

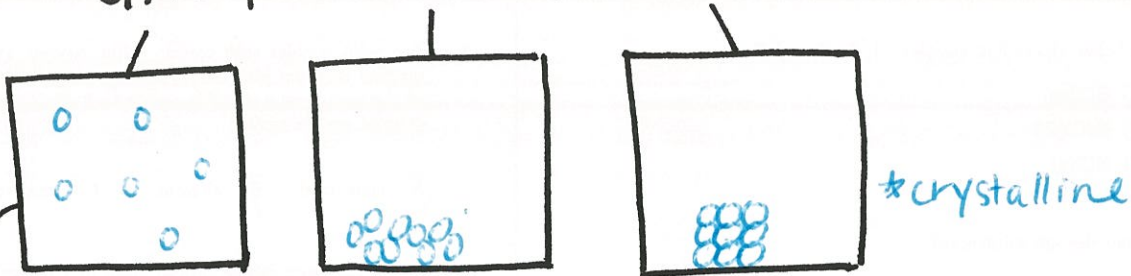
Archimedes (287-212 BC), a Greek inventor and mathematician, made several discoveries important to science today. According to a legend, Hiero, the king of Syracuse, commanded Archimedes to find out if the royal crown was made of gold, only. The king suspected that the crown consisted of a mixture of gold, tin, and copper.

Archimedes measured the mass of the crown and the total amount of water displaced by the crown when it was completely submerged. He repeated the procedure using individual samples, one of gold, one of tin, and one of copper. Archimedes was able to determine that the crown was not made entirely of gold without damaging it.

Identify *one* physical property that Archimedes used in his comparison of the metal samples.

mass, volume, density

GAS, LIQUID, SOLID



← entropy (disorder) increases

→ Kinetic Molecular Theory - to describe gas particles

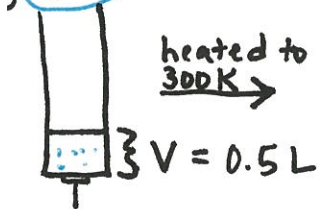
* random, constant, straightline motion

* negligible (insignificant) volume

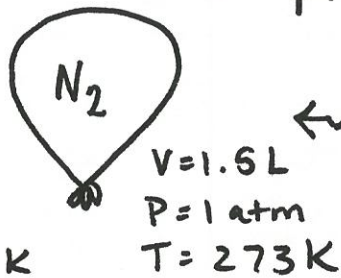
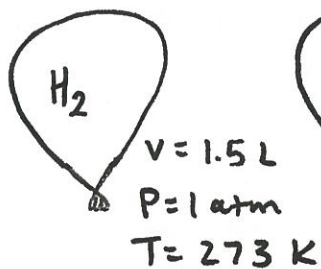
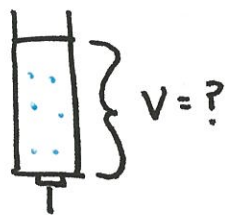
* gases behave most like "ideal" gases at high temperature & low pressure

WHAT HAPPENS IF....?

STP Table A



heated to 300K →



← 2 different types of gases at the same volume, pressure, and temperature have the same # of molecules

Table T

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{(1)(0.5)}{273} = \frac{(1) V_2}{300}$$

volume ↑ as T ↑
 $V_2 = 0.55 \text{ L}$

Gas, Liquid, Solid

1. Base your answer(s) to the following question(s) on the information below.

A weather balloon has a volume of 52.5 liters at a temperature of 295 K. The balloon is released and rises to an altitude where the temperature is 252 K.

How does this temperature change affect the gas particle motion?

particles slow down

2. Samples of $\text{SO}_2(\text{g})$ and $\text{N}_2(\text{g})$ contain equal numbers of molecules. If the gases are at STP, the samples have

- A. equal numbers of atoms B. equal volumes
C. the same molecular mass D. the same density

3. Equal volumes of $\text{SO}_2(\text{g})$ and $\text{NO}(\text{g})$ at the same temperature and pressure would have the same

- A. number of atoms B. number of molecules
C. mass D. density

4. Under the same conditions of temperature and pressure, a liquid differs from a gas because the particles of the liquid

- A. are in constant straight-line motion
B. take the shape of the container they occupy
C. have no regular arrangement
 D. have stronger forces of attraction between them

5. As the temperature of a given sample of a gas is increased at constant pressure, the volume of the gas will

- A. decrease B. increase C. remain the same

6.

Sample	Substance	Temp. (K)	Pressure (atm)	Volume (L)
A	He	273	1	22.4
B	O_2	273	1	22.4
C	Ne	273	2	22.4
D	N_2	546	2	44.8
E	Ar	546	2	44.8

The table here shows the temperature, pressure, and volume of five samples. Which sample contains the same number of molecules as sample A?

- A. E B. B C. C D. D

7. An assumption of the kinetic theory of gases is that the particles of a gas have

- ~~A. little attraction for each other and a significant volume~~
 B. little attraction for each other and an insignificant volume
~~C. strong attraction for each other and a significant volume~~
~~D. strong attraction for each other and an insignificant volume~~

8. Under which conditions does a real gas behave most like an ideal gas?

- A. at low temperatures and high pressures
B. at low temperatures and low pressures
C. at high temperatures and high pressures
 D. at high temperatures and low pressures

9. The kinetic molecular theory assumes that the particles of an ideal gas

- A. are in random, constant, straight-line motion
~~B. are arranged in a regular geometric pattern~~
~~C. have strong attractive forces between them~~
~~D. have collisions that result in the system losing energy~~

10. At STP, which sample contains the same number of molecules as 11.2 liters of $\text{CO}_2(\text{g})$ at STP?

- A. 5.6 L of $\text{NO}_2(\text{g})$ B. 7.5 L of $\text{H}_2(\text{g})$
 C. 11.2 L of $\text{N}_2(\text{g})$ D. 22.4 L of $\text{CO}(\text{g})$

11. A cylinder with a movable piston contains a sample of gas having a volume of 6.0 liters at 293 K and 1.0 atmosphere. What is the volume of the sample after the gas is heated to 303 K while the pressure is held at 1.0 atmosphere?

- A. 9.0 L B. 6.2 L C. 5.8 L D. 4.0 L

$$\frac{(1)(6)}{293} = \frac{(1)V_2}{303}$$

12. When the vapor pressure of a liquid in an open container equals the atmospheric pressure, the liquid will
- A. freeze B. crystallize C. melt **D. boil**
13. The boiling point of water at standard pressure is $100^{\circ}\text{C} + 273$
- A. 0.000 K B. 100 K C. 273 K **D. 373 K**
14. According to Reference Table H, what is the vapor pressure of propanone at 45°C ?
- A. 22 kPa B. 33 kPa **C. 70. kPa** D. 98 kPa
15. Using your knowledge of chemistry and the information in Reference Table H, which statement concerning propanone and water at 50°C is true?
- A. Propanone has a higher vapor pressure and stronger intermolecular forces than water.
- B. Propanone has a higher vapor pressure and weaker intermolecular forces than water.**
- C. Propanone has a lower vapor pressure and stronger intermolecular forces than water.
- D. Propanone has a lower vapor pressure and weaker intermolecular forces than water.
16. Which substance has the *lowest* vapor pressure at 75°C ?
- A. water **B. ethanoic acid**
- C. propanone D. ethanol
17. Which liquid has the highest vapor pressure at 75°C ?
- A. ethanoic acid B. ethanol
- C. propanone** D. water

18. Base your answer(s) to the following question(s) on the information below and on your knowledge of chemistry.

Cylinder A has a movable piston and contains hydrogen gas. An identical cylinder, B, contains methane gas. The diagram below represents these cylinders and the conditions of pressure, volume, and temperature of the gas in each cylinder.

Cylinder A



Hydrogen gas
 $P = 1.2 \text{ atm}$
 $V = 1.25 \text{ L}$
 $T = 293 \text{ K}$

Cylinder B



Methane gas
 $P = 1.2 \text{ atm}$
 $V = 1.25 \text{ L}$
 $T = 293 \text{ K}$

Show a numerical setup for calculating the volume of the gas in cylinder B at STP.

$$\frac{(1.2)(1.25)}{293} = \frac{(1) \times}{273}$$

19. Base your answer(s) to the following question(s) on the information below and on your knowledge of chemistry.

Ethane, C_2H_6 , has a boiling point of -89°C at standard pressure. Ethanol, $\text{C}_2\text{H}_5\text{OH}$, has a much higher boiling point than ethane at standard pressure. At STP, ethane is a gas and ethanol is a liquid.

A liquid boils when the vapor pressure of the liquid equals the atmospheric pressure on the surface of the liquid. Based on Table H, what is the boiling point of ethanol at standard pressure?

79°C

20. Base your answer(s) to the following question(s) on the information below.

In a laboratory, a glass tube is filled with hydrogen gas at a very low pressure. When a scientist applies a high voltage between metal electrodes in the tube, light is emitted. The scientist analyzes the light with a spectroscope and observes four distinct spectral lines. The table below gives the color, frequency, and energy for each of the four spectral lines. The unit for frequency is hertz, Hz.

Visible Spectrum of Hydrogen

Color	Frequency ($\times 10^{14}$ Hz)	Energy ($\times 10^{-19}$ J)
red	4.6	3.0
blue green	6.2	4.1
blue	6.9	4.6
violet	7.3	4.8

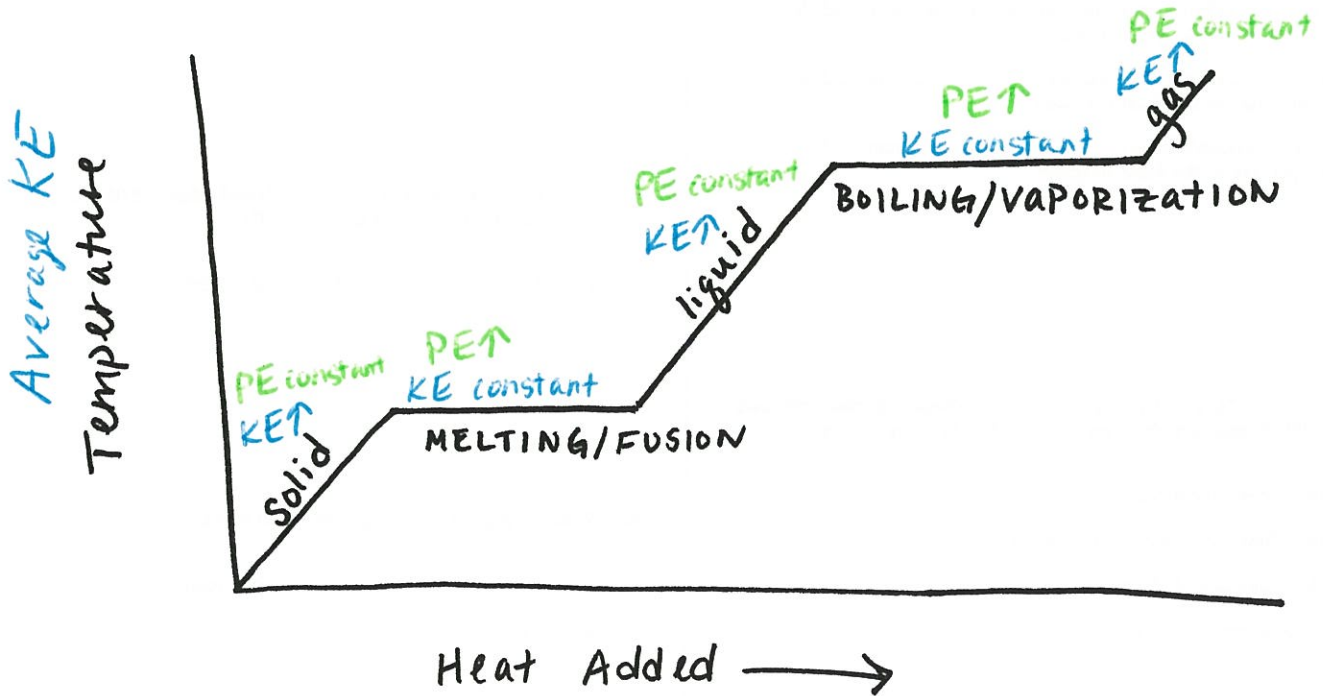
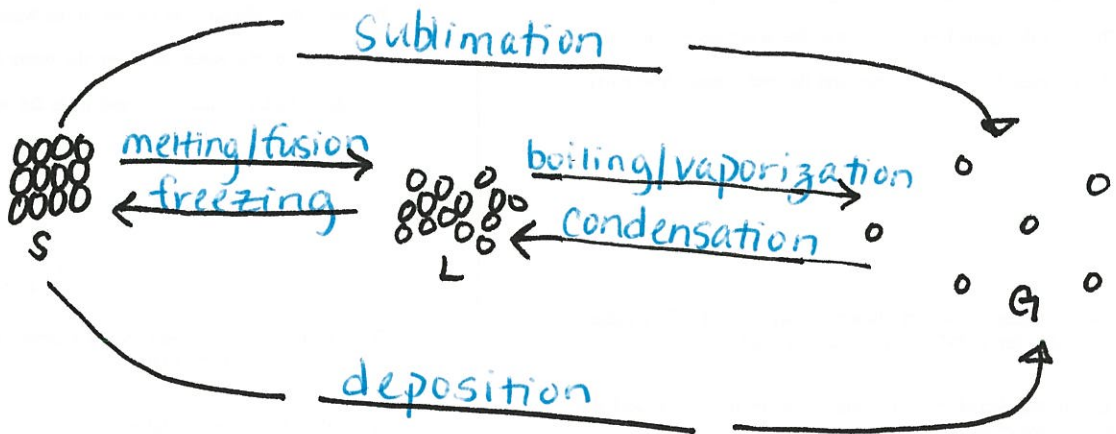
Identify *one* condition *not* mentioned in the passage, under which hydrogen gas behaves most like an ideal gas.

high temperature

HEAT & TEMPERATURE

↓
flows from
high to low
temperatures

↕
" AVERAGE KINETIC ENERGY "



$$q = m c \Delta T$$

↑
Table B
* change in T

$$q = m H_f$$

↑
Table B
* melting/freezing

$$q = m H_v$$

↑
Table B
* boiling/vaporization

Heat & Temperature

1. As the average kinetic energy of a substance increases, the temperature of the sample

- A. decreases **B. increases** C. remains the same

2. Which statement describes the transfer of heat energy that occurs when an ice cube is added to an insulated container with 100 milliliters of water at 25°C?

- ~~A. Both the ice cube and the water lose heat energy.~~
~~B. Both the ice cube and the water gain heat energy.~~
 C. The ice cube gains heat energy and the water loses heat energy.
D. The ice cube loses heat energy and the water gains heat energy.

3. What occurs when a 35-gram aluminum cube at 100°C is placed in 90. grams of water at 25°C in an insulated cup?

- A. Heat is transferred from the aluminum to the water, and the temperature of the water decreases.
B. Heat is transferred from the aluminum to the water, and the temperature of the water increases.
~~C. Heat is transferred from the water to the aluminum, and the temperature of the water decreases.~~
~~D. Heat is transferred from the water to the aluminum, and the temperature of the water increases.~~

4. Object A at 40°C and object B at 80°C are placed in contact with each other. Which statement describes the heat flow between the objects?

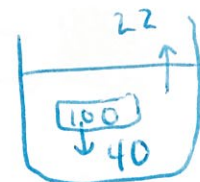
- A. Heat flows from object A to object B
B. Heat flows from object B to object A
 C. Heat flows in both directions between objects.
 D. No heat flow occurs between

5. Which sample has particles with the lowest average kinetic energy?

- A. 1.0 g of I₂ at 50.°C B. 2.0 g of I₂ at 30.°C
 C. 7.0 g of I₂ at 40.°C **D. 9.0 g of I₂ at 20.°C**

6. In a laboratory where the air temperature is 22°C, a steel cylinder at 100°C is submerged in a sample of water at 40°C. In this system, heat flows from

- ~~A. both the air and the water to the cylinder~~
~~B. both the cylinder and the air to the water~~
~~C. the air to the water and from the water to the cylinder~~
D. the cylinder to the water and from the water to the air



7. What is the amount of heat energy released when 50.0 grams of water is cooled from 20.0°C to 10.0°C?

- A. 5.00×10^2 J **B. 2.09×10^3 J** C. 1.67×10^5 J D. 1.13×10^6 J

$$q = m c \Delta T$$

$$= (50)(4.18)(10)$$

$$= 2090$$

8. What is the total number of joules released when a 5.00-gram sample of water changes from liquid to solid at 0°C?

- A. 334 J **B. 1,670 J** C. 2,260 J D. 11,300 J

$$q = m H_f$$

$$= (5)(334)$$

9. Which change of phase represents sublimation?

- A. solid to liquid **B. solid to gas**
 C. liquid to gas D. liquid to solid

10. Which sample of iodine will sublime?

- A. $I_2(g)$ B. $I_2(\ell)$ C. $I_2(aq)$ D. $I_2(s)$

11. Which element is a solid at STP?

- A. fluorine B. iodine C. bromine D. chlorine

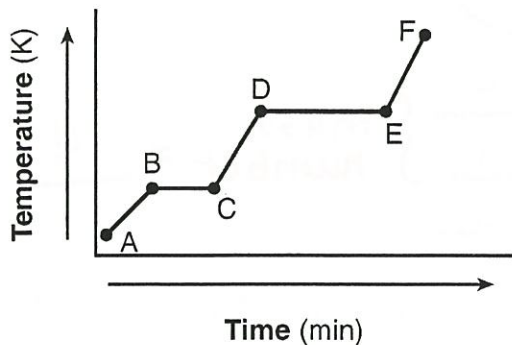
12. Base your answer(s) to the following question(s) on the information below.

Heat is added to a 200.-gram sample of $H_2O(s)$ to melt the sample at $0^\circ C$. Then the resulting $H_2O(\ell)$ is heated to a final temperature of $65^\circ C$.

Compare the amount of heat required to vaporize a 200.-gram sample of $H_2O(\ell)$ at its boiling point to the amount of heat required to melt a 200.-gram sample of $H_2O(s)$ at its melting point.

It takes more heat to vaporize than melt.

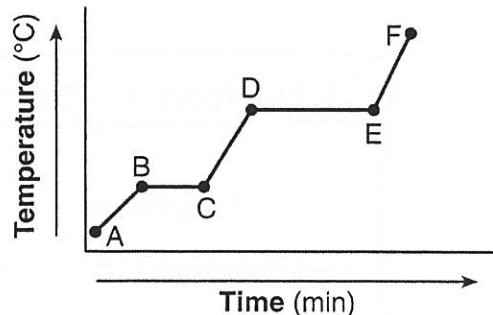
13. Base your answer(s) to the following question(s) on the heating curve below, which represents a substance starting as a solid below its melting point and being heated at a constant rate over a period of time.



What is happening to the average kinetic energy of the particles during segment BC ?

constant

14. The graph below represents the uniform heating of a sample of a substance starting as a solid below its melting point.



Which statement describes what happens to the energy of the particles of the sample during time interval DE ?

- A. Average kinetic energy increases, and potential energy remains the same.
B. Average kinetic energy decreases, and potential energy remains the same.
C. Average kinetic energy remains the same, and potential energy increases.
D. Average kinetic energy remains the same, and potential energy decreases.

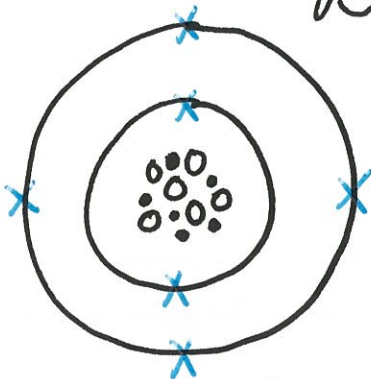
THE MIGHTY ATOM

Subatomic particle	MASS	CHARGE	LOCATION
proton (atomic #)	1	+1	nucleus
neutron	1	0	nucleus
electron	0	-1	orbitals

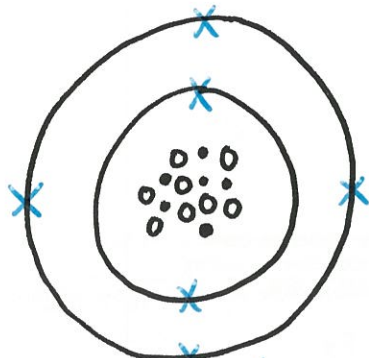
Isotopes: atoms of same element w/ different masses (p+n)

Key: ● : proton ○ : neutron x : electron

Question: Are these atoms isotopes?



#p: 6
 #n: 6 } mass number = 12
 #e: 6



#p: 6
 #n: 8 } mass number = 14
 #e: 6

Answer: Yes! Both are carbon atoms, but one is C-12 and one is C-14

What is the charge of the atom? 0

What is the charge of the nucleus? +6

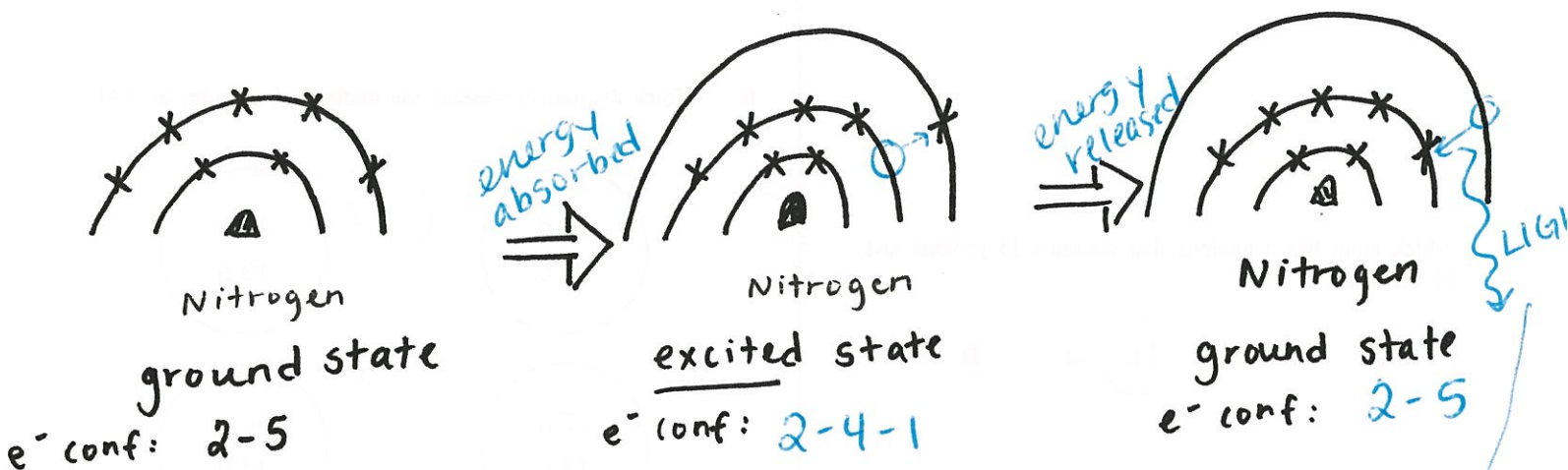
How is atomic mass determined? weighted average of all naturally occurring isotopes

↳ do #14

electron configuration

↳ ground state : on P.T.

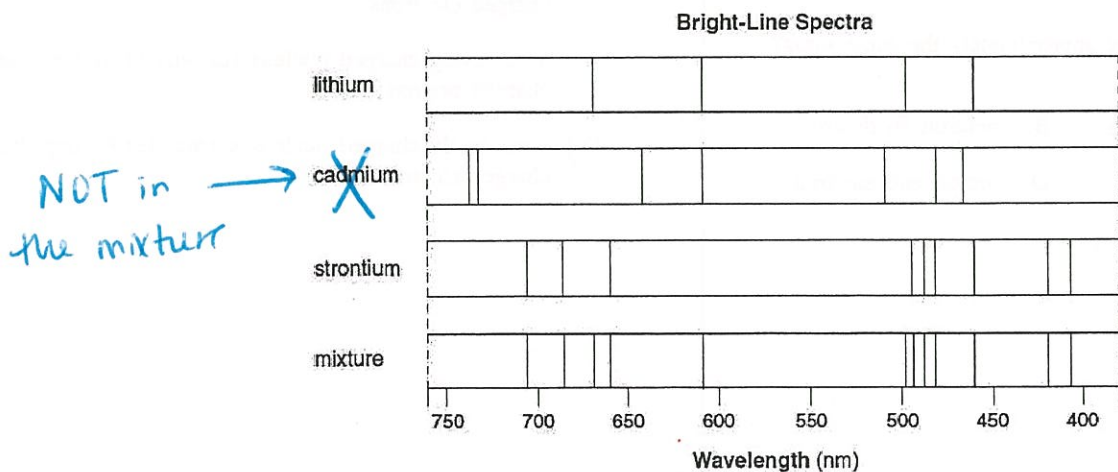
↳ excited state : when e^- move to further shells (no change in e^- #)



BRIGHT LINE SPECTRA: used to identify an element

* each element has their own unique "fingerprint"

* all lines need to match to identify element



the Mighty Atom

1. The atomic number of an atom is always equal to the total number of

- A. neutrons in the nucleus
- B. protons in the nucleus
- C. neutrons plus protons in the atom
- D. protons plus electrons in the atom

2. Which atom has a nucleus that contains 13 protons and 14 neutrons?

- A. Mg
- B. Be
- C. Al
- D. N

3. Which of the following atoms has the greatest nuclear charge?

- A. Al
- B. Ar
- C. Si
- D. Na

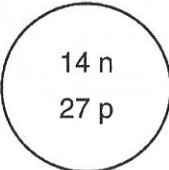
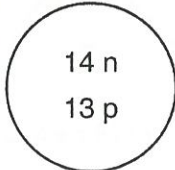
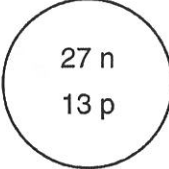
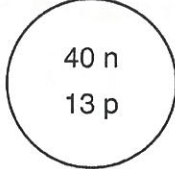
4. Which two particles have approximately the same mass?

- A. neutron and electron
- B. neutron and deuteron
- C. proton and neutron
- D. proton and electron

5. What is the charge of the nucleus in an atom of oxygen -17?

- A. 0
- B. -2
- C. +8
- D. +17

6. Which diagram represents the nucleus of an atom of ${}^{27}_{13}\text{Al}$?

- A. 
- B. 
- C. 
- D. 

7. Which phrase describes an atom?

- A. a negatively charged nucleus surrounded by positively charged protons
- B. a negatively charged nucleus surrounded by positively charged electrons
- C. a positively charged nucleus surrounded by negatively charged protons
- D. a positively charged nucleus surrounded by negatively charged electrons

8. The atomic mass of magnesium is the weighted average of the atomic masses of
- A. all of the artificially produced isotopes of Mg
 - B. all of the naturally occurring isotopes of Mg
 - C. the two most abundant artificially produced isotopes of Mg
 - D. the two most abundant naturally occurring isotopes of Mg

9. The light produced by signs using neon gas results from electrons that are
- A. moving from a higher to a lower principal energy level
 - B. moving from a lower to a higher principal energy level
 - C. being lost by the Ne(g) atoms
 - D. being gained by the Ne(g) atoms

10. Which is an electron configuration for an atom of chlorine in the excited state?
- A. 2-8-7
 - B. 2-8-8
 - C. 2-8-6-1
 - D. 2-8-7-1

11. The bright-line spectrum of an element in the gaseous phase is produced as
- A. protons move from lower energy states to higher energy states
 - B. protons move from higher energy states to lower energy states
 - C. electrons move from lower energy states to higher energy states
 - D. electrons move from higher energy states to lower energy states

12. Base your answer(s) to the following question(s) on the information below.

The accepted values for the atomic mass and percent natural abundance of each naturally occurring isotope of silicon are given in the data table below.

Naturally Occurring Isotopes of Silicon

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance (%)
Si-28	27.98	92.22
Si-29	28.98	4.69
Si-30	29.97	3.09

Determine the total number of neutrons in an atom of Si-29.

$$29 - 14 = 15$$

13. Base your answer(s) to the following question(s) on the data table below, which shows three isotopes of neon.

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance
²⁰ Ne	19.99	90.9%
²¹ Ne	20.99	0.3%
²² Ne	21.99	8.8%

In terms of *atomic particles*, state one difference between these three isotopes of neon.

Diff. # of neutrons

14. Base your answer(s) to the following question(s) on the information below.

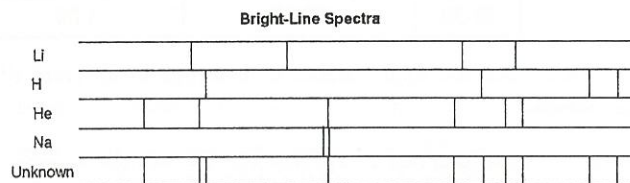
Naturally Occurring Isotopes of Copper

Isotope Notation	Percent Natural Abundance (%)	Atomic Mass (atomic mass units, u)
Cu-63	69.17	62.930
Cu-65	30.83	64.928

In the space below, show a correct numerical setup for calculating the atomic mass of copper.

$$(0.6917 \times 62.93) + (0.3083 \times 64.928)$$

15. Base your answer(s) to the following question(s) on the diagram below, which shows bright-line spectra of selected elements.



Explain how a bright-line spectrum is produced, in terms of excited state, energy transitions, and ground state.

Electrons go from excited state back down to ground state.

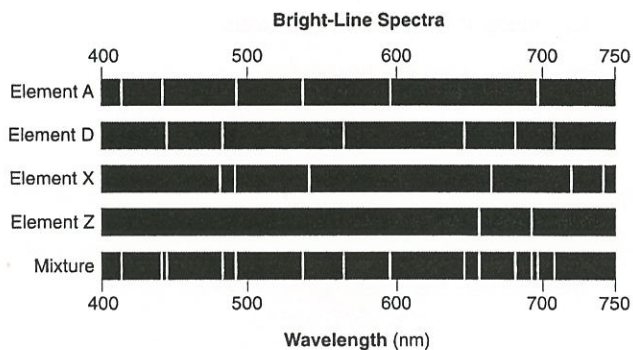
16. Base your answer(s) to the following question(s) on the information below.

In living organisms, the ratio of the naturally occurring isotopes of carbon, C-12 to C-13 to C-14, is fairly consistent. When an organism such as a woolly mammoth died, it stopped taking in carbon, and the amount of C-14 present in the mammoth began to decrease. For example, one fossil of a woolly mammoth is found to have $\frac{1}{32}$ of the amount of C-14 found in a living organism.

State, in terms of subatomic particles, how an atom of C-13 is different from an atom of C-12.

C-13 has 1 more neutron than C-12.

17. The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of three of these elements.



Which element is *not* present in the mixture?

- A. A B. D C. X D. Z