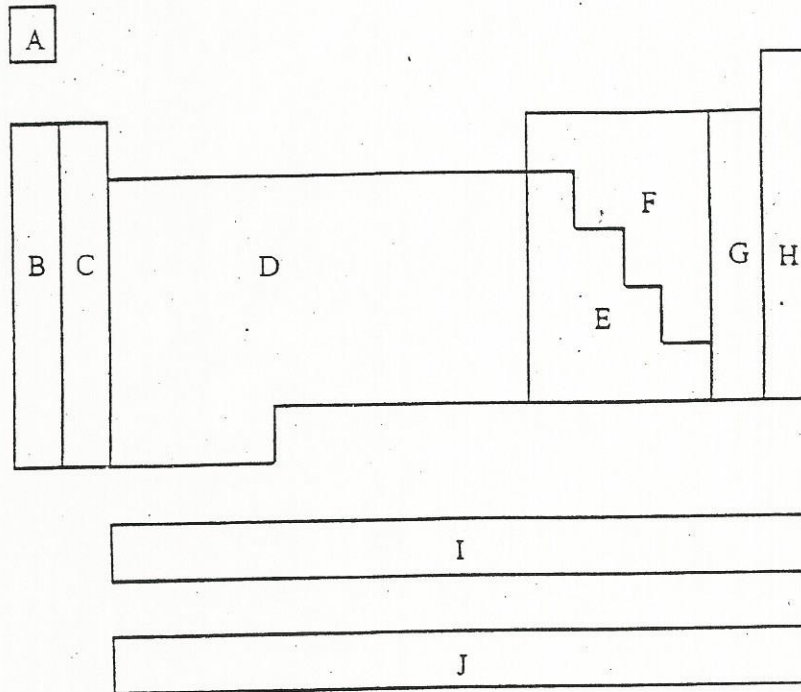


PSC - 4010

REVIEW FOR EXAM

1. The following is a periodic table without the symbols for the elements. This table has been divided into several sections, each designated by a letter. (3 marks)



In which section(s) would you find:

a) the metals? _____

b) the nonmetals? _____

c) the halogens? _____

d) the alkaline earth metals? _____

e) the actinides? _____

f) the noble gases? _____

2. Match each statement below with the related atomic model (i.e. Ancient Greeks, Dalton, Thomson, Rutherford, Bohr, or current simplified model). (3 marks)

a) All matter is made up of earth, air, water, and fire, in varying combinations.

b) The movement of electrons around the nucleus affects the behavior of an atom.

c) Scientists determined that nuclei are positively charged by bombarding thin sheets of Au foil with He nuclei.

c) At this point in history, public debates focused on the question: What is the nature of matter?

d) Scientists confirmed the presence of electrons by deflecting cathode rays with magnets.

e) During the Industrial Revolution, he built on Democritus' atomic theory, based on his own observations.

3. Referring to the periodic table, complete the following information chart for sulphur: (3 marks)

<u>Information on Sulphur</u>	
Symbol: _____	Atomic number: _____
Atomic mass: _____	Number of protons: _____
Number of electrons: _____	Number of neutrons: _____
Group number: _____	Period number: _____
Number of energy levels: _____	
Number of electrons in the outermost energy level: _____	

3. Referring to the periodic table, complete the following information chart for magnesium: (3 marks)

<u>Information on Magnesium</u>	
Symbol: _____	Atomic number: _____
Atomic mass: _____	Number of protons: _____
Number of electrons: _____	Number of neutrons: _____
Group number: _____	Period number: _____
Number of energy levels: _____	
Number of electrons in the outermost energy level: _____	

3. Referring to the periodic table, complete the following information chart for fluorine: (3 marks)

<u>Information on Fluorine</u>	
Symbol: _____	Atomic number: _____
Atomic mass: _____	Number of protons: _____
Number of electrons: _____	Number of neutrons: _____
Group number: _____	Period number: _____
Number of energy levels: _____	
Number of electrons in the outermost energy level: _____	

3. Referring to the periodic table, complete the following information chart for beryllium: (3 marks)

<u>Information on Beryllium</u>	
Symbol: _____	Atomic number: _____
Atomic mass: _____	Number of protons: _____
Number of electrons: _____	Number of neutrons: _____
Group number: _____	Period number: _____
Number of energy levels: _____	
Number of electrons in the outermost energy level: _____	

3. Referring to the periodic table, complete the following information chart for sodium: (3 marks)

<u>Information on Sodium</u>	
Symbol: _____	Atomic number: _____
Atomic mass: _____	Number of protons: _____
Number of electrons: _____	Number of neutrons: _____
Group number: _____	Period number: _____
Number of energy levels: _____	
Number of electrons in the outermost energy level: _____	

4. In a sample of pure oxygen: (3 marks)

99.76 % of the atoms have a mass of 16
0.04 % of the atoms have a mass of 17
0.20 % of the atoms have a mass of 18

Using the above information, calculate the atomic mass of oxygen. Show all steps.

4. In a sample of pure lithium:

(3 marks)

7.5 % of the atoms have a mass of 6
92.5 % of the atoms have a mass of 7

Using the above information, calculate the atomic mass of lithium. Show all steps.

4. In a sample of pure uranium:

(3 marks)

99.27 percent of the atoms have a mass of 238.
0.72 percent of the atoms have a mass of 235
0.01 percent of the atoms have a mass of 234

Using the above information, calculate the atomic mass of uranium. Show all steps in the solution.

5. a) Which new feature was added to Bohr's model to arrive at the current atomic model?

b) Identify three features from Bohr's model that are used in the simplified atomic model.

5. a) Which two features of Thomson's model are repeated in Rutherford's model?

- b) Name three features that are different in Thomson's and Rutherford's models.

6. Five fictitious elements have been assigned the symbol 'Z' and identified using atomic notation.

(5 marks)



- a) Which are isotopes of the same element?
- b) What is similar about the atomic structures for the isotopes that you have listed in a)?
- c) What is different about the atomic structures of the isotopes that you have listed in a)?

6. Five fictitious elements have been assigned the symbol "C" and identified using atomic notation. (5 marks)



- a) Which are isotopes of the same element?
- b) What is similar about the atomic structures for the isotopes that you have listed in a)?
- c) What is different about the atomic structures of the isotopes that you have listed in a)?
7. Fill in the blanks below using these words:

curie rem becquerel gray sievert rad

- a) The _____ is the smallest unit used to measure the quantity of energy absorbed per kilogram of living tissue.
- b) The _____ is the largest unit used to measure the quantity of energy absorbed per kilogram of living tissue.
- c) The _____ is the smallest unit used to measure the number of disintegrations per second undergone by a radioactive substance.
- d) The _____ is the largest unit used to measure the number of disintegrations per second undergone by a radioactive substance.
- e) The _____ is the smallest unit used to measure the biological damage resulting from a dose of ionizing radiation absorbed by living matter.
- f) The _____ is the largest unit used to measure the biological damage resulting from a dose of ionizing radiation absorbed by living matter.

8. Place a T (true) or a F (false) next to each of the following statements:

- _____ a) The greater the mass defect, the less energy that was released during the formation of the nucleus.
- _____ b) The greater the mass defect, the more stable the resulting atom.
- _____ c) The more nucleons in a nucleus, the more stable the nucleus.
- _____ d) The more energy released during the formation of the nucleus, the greater the mass defect.
- _____ e) The more unstable the nuclei, the greater the number of nucleons in the nucleus.
- _____ f) The more stable the atom, the smaller the mass defect.
- _____ g) The more unstable the nuclei, the smaller the number of nucleons.

9. a) Identify each of the following as:

(3 marks)

(C) – a chemical change

(P) – a physical change,

OR

(N) – a nuclear reaction.

- _____ i) The smell of perfume on an individual spreads throughout the room.
- _____ ii) Lithium and hydrogen combine to form two atoms of helium.
- _____ iii) Sodium and chlorine combine to form table salt.
- _____ iv) A beta particle is attracted to the positive pole of a magnetic field.
- _____ v) Food is irradiated with Co-60.
- _____ vi) A copper statue turns greenish over time.
- _____ vii) Your breath fogs up a cold window.
- _____ viii) The transmutation of U-238 into Pb-206.

- _____ ix) The body breaks down glucose, $C_6H_{12}O_6$, in the process of cellular respiration, to produce CO_2 and H_2O .
- _____ x) A paper clip becomes magnetized when it is rubbed with a magnet.
- _____ xi) Medical equipment is sterilized using Co-60 irradiation.
- _____ xii) A silver spoon rusts when used to stir a raw egg.

c) Explain how you can identify:

- i) a chemical change
- ii) a physical change
- iii) a nuclear reaction

10. Indicate whether the following statements are true (T) or false (F). (3 marks)

- _____ a) All wave radiation is massless.
- _____ b) Light rays are part of the electromagnetic spectrum.
- _____ c) γ rays and x rays are forms of ionizing radiation.
- _____ d) α and β particles have mass, but γ rays and x rays do not.
- _____ e) Mass is conserved in a nuclear reaction.
- _____ f) Artificial radioactivity is emitted spontaneously.
- _____ g) The fusion of a given quantity of matter produces more energy than the fission of the same quantity of matter.
- _____ h) In a nuclear fusion reaction, the total mass of the resulting atoms is equal to the total mass of the initial atoms.
- _____ i) The decay of U-238 occurs more quickly at higher temperatures.

- _____ j) The following equation represents a nuclear fusion reaction:

$${}^7_3\text{Li} + {}^1_1\text{H} \rightarrow {}^4_2\text{He} + {}^4_2\text{He}$$
- _____ k) The decay of powdered U-238 occurs more quickly than the decay of a block of U-238.
- _____ l) The decay of powdered U-238 occurs more quickly at high pressures.
- _____ m) Radioactivity produced by natural radioactive elements is emitted spontaneously.
- _____ n) The following equation represents a nuclear fusion reaction:

$${}^2_1\text{H} + {}^2_1\text{H} \rightarrow {}^3_2\text{He} + {}^1_0\text{n}$$
- _____ o) The following equation represents a nuclear fusion reaction:

$${}^3_1\text{H} + {}^1_1\text{H} \rightarrow {}^4_2\text{He}$$
11. Lead-209 has a half-life of 3.3 hours. If one tonne of lead-209 is stored away, how long will it be until there is only 0.0625 tonne of lead-209 left? Show all work.
 (3 marks)
11. A sample from a tree contains 100g of carbon-14. How much carbon-14 will be left in the sample after 34 380 years? The half-life of C-14 is 5730 years.
 (3 marks)

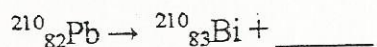
11. How long will it take for 0.1 gram of carbon-14 to decay to 0.00625 g ? It has a half-life of 5 730 years. (3 marks)

11. A one-kilogram bone contains 220 milligrams of Sr-90. How much strontium-90 will be left in this bone after 140 years? The half-life of Sr-90 is 28 years. (3 marks)

12. Alpha radiation (α), beta radiation (β), gamma radiation (γ) and X-rays (x) affect matter in certain ways and have specific characteristics. Match each statement with the corresponding type(s) of radiation by checking off the appropriate box(es). (6 marks)

Statement	Type of Radiation			
	α	β	γ	x
a) It consists of electrons				
b) It is the most penetrating.				
c) It consists of helium nuclei.				
d) It can be stopped by a sheet of paper.				
e) It travels at the speed of light.				
f) It consists of particles.				
g) It is not produced by radioactive elements.				
h) It is not deflected by an electric field.				

13. a) Complete the following nuclear equation for the decay of lead-210: (5 marks)



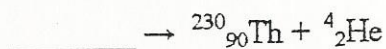
- b) What type of radiation is emitted during this decay process?
- c) Using the principle of conservation of mass, explain your answer to # 13. a).

13. a) Complete the following nuclear equation: (5 marks)



- b) What type of radiation is emitted during this decay process?

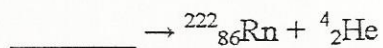
13. a) Complete the following nuclear equation: (5 marks)



- b) What type of radiation is emitted during this decay process?

- c) Using the principle of conservation of mass, explain your answer to # 13. a).

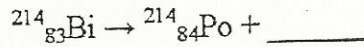
13. a) Complete the following nuclear equation: (5 marks)



- b) What type of radiation is emitted during this decay process?

- c) Using the principle of conservation of mass, explain your answer to # 13. a).

13. a) Complete the following nuclear equation: (5 marks)



- b) What type of radiation is emitted during this decay process?

- c) Using the principle of conservation of mass, explain your answer to # 13. a).

13. Write the nuclear equation for each of the following transmutations: (5 marks)

- a) The alpha decay of Ra-226.

- b) The beta decay of Bi-210

14. Place a T (true) or a F (false) next to each of the following statements which pertain to a CANDU nuclear reactor: (3 marks)

- _____ a) Heavy water contains tritium or deuterium.
- _____ b) Fission of uranium occurs inside the condenser.
- _____ c) The control rods slow down neutrons.
- _____ d) The moderator slows down the neutrons.
- _____ e) The rate of fissions in a CANDU reactor changes as the demand for electricity changes.
- _____ f) The coolant circulates in a closed system.
- _____ g) When fuel bundles are changed the reactor must be temporarily shut down.

- _____ h) Water pumped in from an outside source is used as a cooling agent in the condenser unit.
- _____ i) The coolant is used to convert water into steam in the boiler.
- _____ j) After steam drives the turbine it is condensed.
- _____ k) All uranium in the fuel bundles is used.
- _____ l) Residue from the nuclear reaction is discarded.
- _____ m) Heavy water is used as a coolant.
- _____ n) Heavy water is used as a moderator.
- _____ o) There is heavy water in the reactor core.
- _____ p) There is heavy water in the boiler.
- _____ q) The control rods are made of graphite.
15. a) List the benefits of producing electricity through fusion compared to fission. (3 marks)
- b) What is the difficulty involved with nuclear fusion?
16. If there is an "unlimited number of fission reactions" in a nuclear reactor core, then what does this mean? (3 marks)
16. List three dangers to people living near a uranium mine. (3 marks)

17. List three risks related to the everyday operation of a nuclear power plant. (3 marks)
17. Give one reason why the human body cannot eliminate the harmful radioisotopes (iodine-131, cesium-134, strontium-90) found in contaminated food. (3 marks)
18. Leaving aside the problem of radioactive waste, why can it be said that nuclear energy is a clean source of energy? (3 marks)
18. Despite the risks involved in using uranium to operate nuclear power stations, Canada continues to invest in uranium production. Give one economic advantage which justifies this investment. (3 marks)
19. Place an A (for A-bomb), or a H (for H-bomb) next to each of the following statements. (3 marks)
- _____ a) This type of bomb was dropped on Hiroshima and Nagasaki.
 - _____ b) This bomb was developed in 1952, after WW1.
 - _____ c) This bomb is less powerful than the other one.
 - _____ d) This bomb involves fission, but no fusion.
 - _____ e) This bomb uses both fission and fusion.
 - _____ f) This bomb uses uranium or plutonium.
 - _____ g) This bomb contains deuterium and lithium.

- _____ h) Tritium is formed in this bomb.
- _____ i) This bomb contains two separate blocks, each with a mass less than critical mass.
- _____ j) This is a thermonuclear bomb.
- _____ k) The other type of bomb is required to detonate this bomb.
20. A hydroelectric power station, a conventional thermal power station and a nuclear power station all produce electricity. Give one other similarity and one difference between a conventional thermal power station and a nuclear power station.
(3 marks)
- a) Similarity:
- b) Difference:
20. Radioisotopes like iodine-131 are used in medicine to detect abnormalities in various organs. Give one reason for using radioisotopes that have a short half-life.
(3 marks)
21. Complete the following chart which compares Canadian, American, and Russian nuclear power stations:
(3 marks)

	Canada	Russia	United States
Type of Fuel			
Moderator			
Coolant			

21. A hydroelectric power station, a conventional thermal power station and a nuclear power station have one thing in common: they produce electricity. (3 marks)

The following statements pertain to these three types of power stations.

- a) Coal is used to operate this type of power station.
- b) A great deal of flooding of land masses is necessary in order to build this type of power station.
- c) A flow of water drives the turbines in this type of power station.
- d) This type of power station has a boiler unit.
- e) Pressurized steam drives the turbine in this type of power station.
- f) Nearby lakes used for cooling can become warmer – posing a danger to local wildlife.
- g) This type of power station does not produce waste.
- h) Mercury has been known to leech into local waters during the building of this type of power station.
- i) This type of power station does not have a condenser.
- j) This type of power station uses a relatively small volume of fuel.

Match each statement with the corresponding type of power station.

In the table below, classify the above statements by writing the appropriate letter in the corresponding column. A given statement may apply to more than one type of power station.

Hydroelectric Power Station	Conventional Thermal Power Station	Nuclear Power Station

22. Why does irradiation prevent food from spoiling?

(3 marks)