HW09 - Nuclear

Question 1 1.5 pts

How does a nuclear reaction differ from a chemical reaction?

- ◯ There is no actual difference between the two reactions except that a nuclear reaction emits radiation while a chemical reaction emits heat.
- ◯ In a chemical reaction, elements are created and destroyed while all elements are conserved in a nuclear reaction.
- ◯ Entropy is increased in a nuclear reaction while it is decreased in a chemical reaction.
- ◯ In a nuclear reaction, the elements change identities while in a chemical reaction they do not.
- ◯ Entropy is increased in a chemical reaction while it is decreased in a nuclear reaction.

Question 2 1.5 pts

The key requirement for a chain reaction is that...

- ◯ the uranium hexafluoride fuel must be in its solid state.
- ◯ the entropy of the system must decrease.
- ◯ each event must produce more than one particle capable of initiating subsequent events.
- ◯ the number of beta particles emitted must be equal to or greater than the number of gamma particles emitted.

Question 3 1.5 pts

Which component of a nuclear power plant is responsible for controlling the fission reaction by absorbing neutrons?

Question 4 1.5 pts

An explosion at a Chernobyl power plant caused radioactive material to spread across the air and land leading to increased cancer risks for nearby people. What is the best explanation for the cause of that explosion?

- ◯ Hydrogen gas igniting.
- ◯ Chain reaction of the nuclear fuel.
- ◯ Pressure build-up of steam inside the plant.
- ◯ Sparks caused when the nuclear reaction heated up, melted the reactor core, and melted the plastic on the electrical wiring nearby.

Question 5 1.5 pts

Which of the following characteristics apply to fusion but NOT fission?

- ◯ Radiation is emitted during the process.
- ◯ Neutrons are required to continue the chain reaction.
- ◯ A process that is used to generate electrical power.
- ◯ Involves transmutation of elements.
- ◯ High temperature is required to initiate the process.

Question 6 1.5 pts

How many protons, neutrons, and electrons respectively are in a neutral atom of iron-55?

- ◯ 26, 29, 29
- ◯ 55, 26, 55
- ◯ 29, 26, 29
- ◯ 26, 29, 26

Question 7 1.5 pts

In a nuclear power plant, heat created by _____ is used to generate steam which drives a turbine that produces electricity. An example of this type of reaction is _____.

- ◯ nuclear fission, $^{235}U + {}^{1}n \longrightarrow {}^{142}Ba + {}^{91}Kr + 3{}^{1}n$
- ◯ nuclear fusion, $^{2}H + {}^{3}H \longrightarrow {}^{4}He + {}^{1}n$
- ◯ nuclear fission, $^{2}H + {}^{3}H \longrightarrow {}^{4}He + {}^{1}n$
- ◯ nuclear fusion, $^{235}U + {}^{1}n \longrightarrow {}^{142}Ba + {}^{91}Kr + 3{}^{1}n$

Question 8 1.5 pts

Identify the missing isotope in the nuclear reaction below:

$$? \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$$

- ◯ ${}^{14}_{6}O$
- ◯ ${}^{14}_{6}C$
- ◯ ${}^{14}_{8}C$
- ◯ ${}^{14}_{8}O$

Question 9 1.5 pts

When ^{131}I emits a β particle, what nuclide is produced?

- ^{127}Sb
- ^{131}Te
- ^{130}Te
- ^{131}Xe
- ^{130}I

Question 10 1.5 pts

A nuclide undergoes α decay and forms ^{110}I. What is the nuclide?

- ^{114}I
- ^{110}Te
- ^{114}Cs
- ^{110}Xe
- ^{112}Cs

Question 11 1.5 pts

O-15 decays by positron emission. What is the product of this decay?

- $^{14}_{8}O$
- $^{15}_{7}N$
- $^{15}_{9}F$
- None of the other answer choices are correct.
- $^{11}_{6}C$

Question 12 1.5 pts

Which of the following types of radiation has the greatest penetrating ability?

- γ
- β
- All of these types of radiation have the same penetrating ability.
- α

Question 13 1.5 pts

Gamma radiation is typically considered the most dangerous form of radiation because...

- it is the only form of ionizing radiation.
- it can penetrate most substances, and, therefore, is very difficult to shield against.
- it is the only form of radiation that can affect organic molecules.
- it typically generates further nuclear decay.
- This is a trick question. Gamma radiation is not actually considered to be very dangerous when compared to other forms of radiation.

Question 14 1.5 pts

What is the neutron : proton ratio for the nucleus $^{16}_{8}O$? Determine where this nucleus lies in relation to the band of stability.

- 1:1, outside
- 1:2, outside
- 1:2, within
- 2:1, outside
- 1:1, within
- 2:1, within

Question 15 1.5 pts

Why does the band of stability curve upward at high atomic numbers?

- If we have too many protons, not enough electrons will be orbiting the atom to keep it electrically neutral overall.
- Excess protons are required to help keep the neutrons from sticking together as neutrons have no charge.
- Atoms with high atomic numbers have a large number of electrons orbiting the nucleus. This increased number of electrons requires a lot of extra mass in the nucleus to keep the electrons in their orbit.
- Excess neutrons are required due to the repulsion between the protons.

Question 16 1.5 pts

Which type of nuclear decay is the following radioactive isotope likely to undergo?

$^{6}_{2}He$

- positron emission or electron capture
- This isotope is already stable and will not undergo any type of nuclear decay.
- alpha decay
- beta decay

Question 17 1.5 pts

The half-life of radon-222 is 3.824 days. After what time will one-fourth of a given amount of radon-222 remain?

- 7.648 days
- 4.736 days
- 5.736 days
- 9.560 days

Question 18 1.5 pts

Calculate the time required for the activity of a 9.0 mCi cobalt-60 source to decay to 8.5 mCi. The half-life of cobalt-60 is 5.26 years.

- 5.2 months
- 4.6 months
- 0.090 months
- 2.3 months

Question 19 1.5 pts

Iridium-192 is one radioisotope used in brachytherapy in which a radioactive source is placed inside a patient's body to treat cancer. Brachytherapy allows the use of a higher than normal dose to be placed near the tumor while lowering the risk of damage to healthy tissue. Iridium-192 is often used in the head or breast.

If a sample of iridium-192 is initially 3.25g and 1.21g remains after 105 days, estimate the half-life of the radioisotope.

- 70 days
- 78 days
- 67 days
- 74 days

Question 20 1.5 pts

For the following fusion reaction, calculate the change in energy of the reaction in units of joules per mole.

$${}_1^2H + {}_1^2H \longrightarrow {}_2^3He + {}_0^1n$$

Atom or Particle	Mass (amu)
H-1	1.00782
H-2	2.01410
H-3	3.01605
He-3	3.01603
He-4	4.00260
n	1.00866

- -3.15×10^{8} J/mol
- -3.15×10^{11} J/mol
- -3.51×10^{-6} J/mol
- -3.15×10^{14} J/mol