1. The most abundant elements are those that
   
   A. have odd numbers of nucleons.
   B. have noble gas configurations of electrons.
   C. can be produced by $\alpha$-decay.
   D. have even numbers of nucleons.
   E. can be produced by fission reactions.

2. Which of the following is a compound?
   
   A. Cl$_2$  B. Tn  C. S  D. Xe  E. CO$_2$

3. Most of the elements formed by fusion in stars are formed by addition of a ____ to an existing atomic nucleus.
   
   A. neutron
   B. gamma particle
   C. alpha particle
   D. positron
   E. beta particle

4. The heavier elements are formed by a different process than fusion. This process is enhanced in supernovas. What is this process?
   
   A. none of the choices are correct
   B. beta emission
   C. positron emission
   D. alpha decay
   E. Neutron capture
5. Which of the following is an example of a physical property?

A. corrosiveness of sulfuric acid
B. toxicity of cyanide
C. flammability of gasoline
D. neutralization of stomach acid with an antacid
E. lead becomes a liquid when heated to 601°C

6. The key thing that separates scientific models (hypotheses, theories and laws) from non-scientific models is that

A. scientific models are formulated by scientists.
B. scientific models can be tested and potentially proven wrong.
C. scientific models are right.
D. scientific models never change.
E. scientific models are wrong.

7. What is the wavelength of radiation that has a frequency of $6.912 \times 10^{14}$ s$^{-1}$?

A. $1.447 \times 10^{-15}$ nm
B. $4.337 \times 10^2$ nm
C. $2.304 \times 10^6$ nm
D. $2.074 \times 10^{23}$ nm
E. $4.337 \times 10^{-7}$ nm

8. After carrying out the following operations, how many significant figures are appropriate to show in the result?

$(13.7 + 0.027)/8.221$

A. 1
B. 2
C. 3
D. 4
E. 5
9. The isotope with the greatest nuclear binding energy per nucleon is

A. \( \frac{2}{1}H \)
B. \( \frac{4}{2}He \)
C. \( \frac{14}{6}C \)
D. \( \frac{56}{26}Fe \)
E. \( \frac{238}{92}U \)

10. A "critical mass" of uranium-235 is

A. the atomic mass of this, the lightest radioactive isotope.
B. the atomic mass of this (or any other) isotope necessary for it to become radioactive.
C. because it is a very powerful chain reaction.
D. the crowd at a Springfield "Isotopes" game.
E. the mass of the isotope necessary to sustain a nuclear chain reaction.

11. Which type of radiation is the least penetrating?

A. alpha
B. beta
C. gamma

12. Which of the following is not a medical use of radioactive elements?

A. Imaging parts of the body that preferentially take up the radioactive element, by measuring where radioactivity is released.
B. To selectively damage or kill cells that preferentially take up the radioactive element. Usually alpha emitters are used for this.
C. All of the other choices are a valid medical uses of radioactive elements.
D. Using energy released as heat during radioactive decay to cauterize wounds.
E. Killing cancer cells which are more susceptible to damage from ionizing radiation than healthy cells.
13. The scientists controlling the Cassini probe (the one that has been gathering information about the chemical composition of Saturn's moon Titan) had difficulty communicating with the space ship when it arrived near Saturn. The problem was with the radio waves they were sending. The probe had been accelerating toward the outer solar system for a long time. Once they accounted for how fast the probe was going they had no trouble. The problem with the radio waves was

A. their amplitude was too high.
B. their frequency was too low.
C. their frequency was too high.
D. the direction they were travelling was wrong.
E. their amplitude was too low.

14. The SI prefixes *giga* and *micro* represent, respectively:

A. $10^{-9}$ and $10^{-6}$.
B. $10^6$ and $10^{-3}$.
C. $10^3$ and $10^{-3}$.
D. $10^9$ and $10^{-6}$.
E. $10^{-9}$ and $10^{-3}$.

15. What is the nuclear binding energy per nucleon, in joules, for $^{25}\text{Hg}$ (atomic mass 24.985839 amu). Data: $^1\text{H}$ (atomic mass) = 1.007825 amu; $^0\text{n}$ (mass) = 1.008665 amu; 1 kg = $6.022 \times 10^{26}$ amu; $c = 3.00 \times 10^8$ m/s.

A. 0.22076 J/nucleon
B. $3.30 \times 10^{-11}$ J/nucleon
C. $1.32 \times 10^{-12}$ J/nucleon
D. 0.999 J/nucleon
E. None of the above.
16. Estimate the age of a bottled wine that has a tritium, \( ^3H \), content 60% that of freshly bottled wine. Tritium decays by beta decay and has a half-life of 12.3 yr. \( ^3H \rightarrow ^3He + ^0\beta \)

A. 0.029 yr  
B. 7.4 yr  
C. 9.1 yr  
D. 16 yr  
E. 35 yr

17. The only stable isotope of aluminum is aluminum-27. What type of radioactive decay should be expected from \( ^{28}\text{Al} \)?

A. \( ^1\text{H} \)  
B. \( ^0\text{n} \)  
C. \( ^0\beta \)  
D. \( ^0\beta \)  
E. \( ^4\text{He} \)

18. What fraction of radioactive atoms remains in a sample after six half-lives?

A. zero  
B. 1/6  
C. 1/16  
D. 1/32  
E. 1/64

19. Before stars formed what elements existed in our Universe?

A. H and He  
B. C and O  
C. Na and Cl  
D. N and Pb  
E. Fe
20. Lead melts at 601.0°C. What temperature is this in °F?

A. 302°F  
B. 365°F  
C. 1,050°F  
D. 1,082°F  
E. 1,114°F

21. When atoms of beryllium-9 are bombarded with alpha particles, neutrons are produced. What new isotope is also formed? \[ ^2He + ^4Be \rightarrow ^1n + \hfill \]

A. \( ^{12}_6C \)  
B. \( ^{5}_3Li \)  
C. \( ^{8}_4Li \)  
D. \( ^{10}_5B \)  
E. \( ^{12}_5B \)

22. A piece of metal with a mass of 114 g was placed into a graduated cylinder that contained 25.00 mL of water, raising the water level to 42.50 mL. What is the density of the metal?

A. 0.154 g/cm³  
B. 0.592 g/cm³  
C. 2.68 g/cm³  
D. 6.51 g/cm³  
E. 7.25 g/cm³
23. An unknown element was found to have three isotopes with the following masses and abundances. Calculate the average atomic mass of this element:

<table>
<thead>
<tr>
<th>Mass (amu)</th>
<th>Percent abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.985042</td>
<td>78.99</td>
</tr>
<tr>
<td>24.985837</td>
<td>10.00</td>
</tr>
<tr>
<td>25.982593</td>
<td>11.01</td>
</tr>
</tbody>
</table>

A. 24.45 amu  
B. 24.984 amu  
C. 25.98 amu  
D. 24.31 amu  
E. 23.985 amu

24. How many neutrons does the element $^{33}_{16}$S have?

A. 49  
B. 16  
C. 17  
D. 2  
E. 33

25. A level of 47 microcuries of radiation was measured. If 1 Curie is equal to $3.70 \times 10^{10}$ counts per second how many counts are measured in two seconds?

A. $4.52 \times 10^{27}$ counts  
B. $7.9 \times 10^{2}$ counts  
C. $3.5 \times 10^{6}$ counts  
D. $3.5 \times 10^{12}$ counts  
E. $1.5 \times 10^{9}$ counts
Chem 105 Exam 1 S07 Key

1. D
2. E
3. C
4. E
5. E
6. B
7. B
8. C
9. D
10. E
11. A
12. D
13. B
14. D
15. C
16. C
17. C
18. E
19. A
20. E
21. A
22. D
23. D
24. C
25. C