Nuclear and organic review:

1) Which is the most complete and best description of a covalent bond?

(A) a system of two nuclei with a pair of electrons located exactly midway between both nuclei

(B) the attractive force between two atoms of opposite charge

(C) a donor bond in which one atom donates an unshared pair to the other

(D) a system of two nuclei where each atom donates one electron to the other atom, thus forming a bond

 2) Which one of the following processes results in an increase in the atomic number?

|  |  |
| --- | --- |
| (A) | gamma emission |
| (B) | positron emission |
| (C) | beta emission |
| (D) | alpha emission |
| (E) | corrosion |

 3) What is the missing product from this reaction?

P  S + \_\_\_\_\_

|  |  |
| --- | --- |
| (A) | He |
| (B) | e |
| (C) |  |
| (D) | e |
| (E) | p |

 4) Carbon-11 decays by \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| (A) | alpha emission |
| (B) | beta emission |
| (C) | positron emission |
| (D) | electron capture |
| (E) | neutron capture |

 5) Which one of the following can be done to shorten the half-life of the radioactive decay of uranium-238?

|  |  |
| --- | --- |
| A) | freeze it |
| B) | heat it |
| C) | convert it to UF6 |
| D) | oxidize it to the +2 oxidation state |
| E) | none of the above |

 6) The half-life of 218Po is 3.1 minutes. How much of a 155 gram sample remains after 0.40 hours?

|  |  |
| --- | --- |
| A) | 0.00067 g |
| B) | 0.0072 g |
| C) | 0.72 g |
| D) | 0.0047 g |
| E) | none of the above |

 7) When two atoms of 2H are fused to form one atom of 4He, the total energy evolved is 3.83  10-12 J. What is the total change in mass (in kg) for this reaction? (C = 3.00  108 m/s)

|  |  |
| --- | --- |
| (A) | 1.28  10-17 |
| (B) | 4.26  10-26 |
| (C) | 3.45  108 |
| (D) | 1.15 |
| (E) | 4.26  10-29 |

 8) The mass of a proton is 1.00728 amu and that of a neutron is 1.00867 amu. What is the binding energy (in J) of a Co nucleus? (The mass of a cobalt-60 nucleus is 59.9338 amu.)

|  |  |
| --- | --- |
| (A) | 2.74  10-19 |
| (B) | 9.12  10-28 |
| (C) | 4.94  10-13 |
| (D) | 8.20  10-11 |
| (E) | 2.74  10-16 |

 9) In terms of binding energy per nucleon, what element divides fission and fusion processes?

|  |  |
| --- | --- |
| (A) | H |
| (B) | He |
| (C) | C |
| (D) | Fe |
| (E) | U |

 10) The missing product from this reaction is \_\_\_\_\_\_\_\_\_\_.

I ? \_\_\_\_\_ + e

|  |  |
| --- | --- |
| (A) | Te |
| (B) | Xe |
| (C) | Te |
| (D) | e |
| (E) | none of the above |

 11) The missing product from this reaction is \_\_\_\_\_\_\_\_\_\_.

Np  Pa + \_\_\_\_\_

|  |  |
| --- | --- |
| (A) | He |
| (B) | e |
| (C) | n |
| (D) | e |
| (E) |  |

 12) The three radioactive series that occur in nature end with what element?

|  |  |
| --- | --- |
| (A) | Bi |
| (B) | U |
| (C) | Po |
| (D) | Pb |
| (E) | Hg |

 13) The structure of 2,3-dimethylheptane is \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| (A) |  |
| (B) |  |
| (C) |  |
| (D) |  |
| (E) |  |

 14) Which statement about hydrocarbons is false?

|  |  |
| --- | --- |
| (A) | The smallest alkane to have structural (constitutional) isomers has 4 carbon atoms. |
| (B) | Cyclic alkanes are structural isomers of alkenes. |
| (C) | Alkanes are more reactive than alkenes. |
| (D) | Alkanes can be produced by hydrogenating alkenes. |
| (E) | Alkenes can be polymerized. |

 15) The following reaction would produce a(n) \_\_\_\_\_\_\_\_\_\_.

R-OH + R'COOH 

|  |  |
| --- | --- |
| (A) | ketone |
| (B) | ether |
| (C) | aldehyde |
| (D) | alcohol |
| (E) | ester |

 16) Which structure below represents an amine?

|  |  |
| --- | --- |
| (A) |  |
| (B) |  |
| (C) |  |
| (D) |  |
| (E) |  |

 17) Which structure in 16 is not correctly drawn?

 (A) A

 (B) B

 (C) C

 (D) D

 (E) E

 18) Which one of the following molecules is chiral?

|  |  |
| --- | --- |
| (A) |  |
| (B) |  |
| (C) |  |
| (D) |  |
| (E) |  |

 19) What is the name of the compound below?



|  |  |
| --- | --- |
| (A) | 2,4-methylbutene |
| (B) | 2,5-dimethylpentane |
| (C) | 2,4-ethylbutene |
| (D) | 2,4-dimethyl-1-pentene |
| (E) | 2,4-dimethyl-4-pentene |

 20) The name of CH3-CH=C=CH-CH-CH=CH- CH3 is \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| A) | 2, 3, 5 - octatriene |
| B) | 2, 5, 6 - octatriene |
| C) | 2, 3, 6 - octatriene |
| D) | 3, 5, 6 - octatriene |
| E) | 3, 4, 7 - octatriene |

 21) In general, \_\_\_\_\_\_\_\_\_\_ are the most reactive hydrocarbons.

|  |  |
| --- | --- |
| A) | alkenes |
| B) | alkynes |
| C) | alkanes |
| D) | cycloalkanes |
| E) | olefins |

 22) The addition of HBr to 2-butene produces \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| A) | 1-bromobutane |
| B) | 2-bromobutane |
| C) | 1,2-dibromobutane |
| D) | 2,3-dibromobutane |
| E) | no reaction |

 23) Optically active molecules that are mirror images of each other are called \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| A) | allotropes |
| B) | geometrical isomers |
| C) | enantiomers |
| D) | cofactors |
| E) | chiral compounds |

1989 D

The carbon isotope of mass 12 is stable. The carbon isotopes of mass 11 and mass 14 are unstable. However, the type of radioactivity decay is different for these two isotopes. Carbon-12 is not produced in either case.

(a) Identify a type of decay expected for carbon-11 and write the balanced nuclear reaction for that decay process.

(b) Identify the type of decay expected for carbon-14 and write the balanced nuclear reaction for that decay process.

(c) Gamma rays are observed during the radioactive decay of carbon-11. Why is it unnecessary to include the gamma rays in the radioactive decay equation of (a)?

(d) Explain how the amount of carbon-14 in a piece of wood can be used to determine when the tree died.

1991 D

Explain each of the following in terms of nuclear models.

(a) The mass of an atom of 4He is less than the sum of the masses of 2 protons, 2 neutrons, and 2 electrons.

(b) Alpha radiation penetrates a much shorter distance into a piece of material than does beta radiation of the same energy.

(c) Products from a nuclear fission of a uranium atom such as 90Sr and 137Ce are highly radioactive and decay by emission of beta particles.

(d) Nuclear fusion requires large amounts of energy and to get started, whereas nuclear fission can occur spontaneously, although both processes release energy.

1972

What types of isomerism are possible among the molecules that can be obtained by substituting a chlorine atom and a bromine atom for two of the hydrogen atoms in each of the following?

(a) Ethane, C2H6

(b) Ethene, C2H4

Show structures to illustrate each of the types of isomerism you name for each of these compounds.

1978

Dehydration of 3-hexanol yields a mixture of four isomers each with the molecular formula C6H12. Draw structures of the four isomers and name each of them.

1974 D (5 points)

A measure of the rate of a reaction is its half-life. One method of determining the half-life of a first order reaction is to plot certain appropriate data. Sketch a graph that illustrates the application of such a method. Label each axis with its name and appropriate units, and show how the half-life can be obtained from the graph.

MC answers

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

1989 Answer:

(a) Positron decay: 

 OR

 Electron capture: 

(b) Beta decay: 

(c) Gamma rays have no mass or charge (or they are energy) so they need not be shown in nuclear equations.

(d) Measure the amount of C-14 in the dead wood. Compare with the amount of C-14 in a similar living object.

1991 Answer:

(a) When nucleons are combined in nuclei, some of their mass (mass defect) is converted into energy (binding energy) which is released and stabilizes the nucleus.

(b) Alpha particles have a greater mass than beta particles. Thus, their speed (penetrating potential) is less.

(c) The neutron/proton ratio in Sr-90 and Cs-137 is too large and they emit beta particles (converting neutrons into protons) to lower this ratio.

(d) Large amounts of energy are needed to initiate fusion reactions in order to overcome the repulsive forces between the positively charged nuclei. Large amounts of energy are not required to cause large unstable nuclei to split apart.

1972 Answer:

(a) positional (structural) isomers



 optical isomer:



(b) positional (structural) isormers



 cis - trans isomers



1978 Answer:

 trans-3-hexene cis-3-hexene



 trans-2-hexene cis-2-hexene



1974 Answer



The slope of the line is k, t1/2 = 0.693/*k*