Electronic Supplementary Material (ESI) for Chemistry Education Research and Practice.

Appendix 2

Phase 1 Inter-Rater Reliability Items

_____ 1. A wooden boat discovered just south of the Great Pyramid in Egypt has 72.5% of the original carbon-14 expected. The half-life of carbon-14 is 5,730 years. How old is the boat?

(a) 4,154 years

(b) 1,576 years

(c) 10,672 years

(d) 3,541 years

(e) 2,658 years

_____ 2. Which of the following are key differences between chemical and nuclear reactions?

I. Atoms do not change identity in chemical reactions, whereas in nuclear reactions they do

II. Nuclear reactions release a greater amount of energy than chemical reactions

III. Nuclear reactions have rates that depend on temperature, concentration, and catalysts, whereas chemical reactions do not

(a) I

(b) I, II

(c) II, III

(d) I, III

(e) I,II,III

____3. What is the molarity of a 35.0 mL solution of 9.00 *M* H_2SO_4 diluted to 0.500 L?

(a) 6.30 *M*

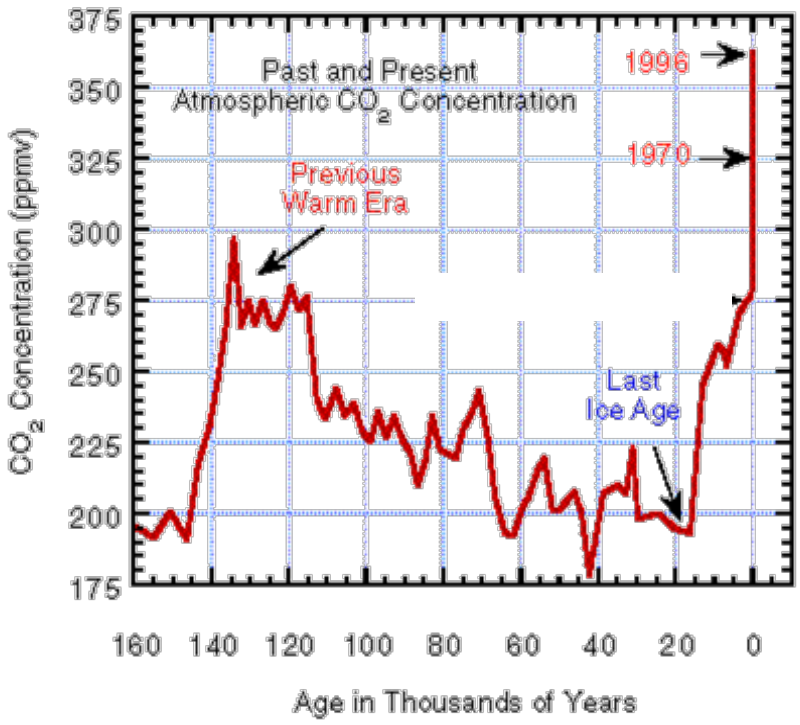
(b) 0.624 *M*

(c) 61.1 *M*

(d) 630. *M*

(e) 0.630 *M*

_____ 4. Answer the following question based on the graph provided.



Which of the following **cannot** be determined based on the provided graph?

(a) 42,000 years ago the CO2 concentration was at an all time low

(b) CO_2 levels increase during warm periods

(c) There was a sharp increase in the CO_2 concentration after the last ice age

(d) There were no warm eras prior to 160,000 years ago

(e) 135,000 years ago the CO_2 level was about 33% higher than it was 35,000 years ago

_____ 5. A solution of caffeine ($C_8H_{10}N_4O_2$, 194.20 g/mol) in chloroform ($CHCl_3$, 119.37 g/mol) as a solvent has a concentration of 0.500 *m*. Calculate the percent caffeine by mass.

a. 33.3%
b. 16.3%
c. 5.63%
d. 8.85%
e. 31.0%

_____ 6. Why are molecular oxygen and molecular nitrogen **not** considered to be greenhouse gases?

(a) The atoms are so light that the bond vibrations absorb in the UV.
(b) They have only two atoms and therefore cannot undergo asymmetric stretching.
(c) They lack a dipole moment.
(d) They are too dilute in the stratosphere, where the greenhouse effect takes place.
(e) The ozone layer filters radiation from these gases.

_____ 7. Electronegativity:

(a) has no periodic trends.
(b) is generally greatest for the transition metals.
(c) generally decreases left to right across a period and increases down a group.
(d) generally increases left to right across a period and decreases down a group.
(e) is the term for a common attitude among pessimistic electrons.

_____ 8. The electronic configuration of Ca^{+2} in its ground state is:

(a) $1s^2\ 2s^2\ 2p^6\ 2d^{10}$
(b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2$
(c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
(e) $1s^2\ 2s^2\ 2p^8\ 3s^2\ 3p^4$

_____ 9. Which compound has a higher lattice energy, LiCl or CsCl? Why?

(a) LiCl because it is more soluble than CsCl.
(b) LiCl because Li has a smaller ionic charge than Cs.
(c) LiCl because it has a smaller internuclear distance than CsCl.
(d) CsCl because it has a smaller internuclear distance than LiCl.
(e) CsCl because Cs has a smaller first ionization energy than Li.

_____ 10. Carbon dioxide gas and methane gas are often called “greenhouse gases”. Greenhouse gases

(a) are the primary cause of acid rain.
(b) catalyze the destruction of the earth’s ozone layer.
(c) are the primary constituents of what is called “smog”.
(d) are linked to global warming by many models.
(e) None of the above statements is correct.

Key

1. E
2. B
3. E
4. A or D
5. D
6. C
7. D
8. D
9. C
10. D