Before doing anything, fill in the following on your ParSCORE form:

1) **Write your name**

2) Bubble in **FORM A**

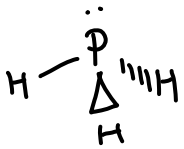
3) **Bubble in your PERM** number (7 digits only—no extra numbers)

Instructions: No hats or hoods allowed. No books or notes allowed. No sharing of calculators. Cell phones, iPods, headsets/headphones, and any other electronic devices must be turned off and put away.

There are a total of seven pages (18 questions) on the exam. **All questions are equal in point value.**

You may work out the problems and write your answers on this exam; however, you must completely fill in the appropriate bubble(s) on your ParSCORE form. Turn in the ParSCORE form only. **Only the answers indicated on your ParSCORE will be graded**, so please be very careful bubbling in your ParSCORE. No credit will be awarded for an incorrectly-bubbled answer. The correct answers to the exam will be posted on our course web page.

1. Determine the molecular geometry of PH_3



a) Trigonal planar ✗
b) T-shaped ✗
c) Trigonal pyramidal
d) Trigonal bipyramidal
e) Bent

C

2. Increasing the temperature of an ideal gas at constant volume will _____ the collision frequency (Z).

a) decrease
b) not change
c) increase

C

3. Which of the following has the largest radius?

a) F^- 10/9
b) Ne 10/10
c) Na^+ 10/11
d) All have the same radius

A

4. According to experiments concerned with the photoelectric effect, which of the following will increase the kinetic energy of an electron ejected from a metal surface?

I. Decreasing the wavelength of the light striking the surface ✓
II. Decreasing the frequency of the light striking the surface ✗
III. Increasing the intensity of the light striking the surface ✗

a) I. only
b) II. only
c) III. only
d) I. and II.
e) I. and III.

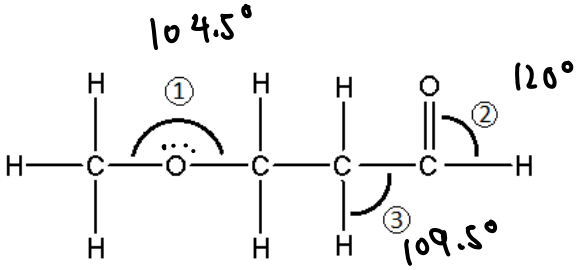
A

5. Which of the following is expected to have the smallest ionization energy?

a) Li
b) Cs
c) F
d) At

B

6. Rank bond angles ①, ②, and ③ in the following molecule from **<u>smallest to largest</u>**. Note: Lone pairs have not been shown in this Lewis structure.

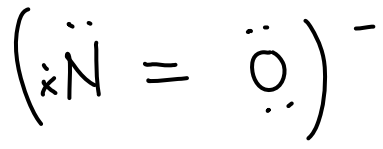


a) ③ < ② < ①
b) ① < ② < ③
c) ② < ③ < ①
d) ① < ③ < ②
e) none of these

D

7. Determine the formal charge on the oxygen atom in the Lewis structure of NO^-

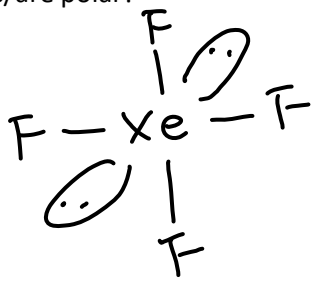
a) –1/2
b) +1
c) –1
d) +2
e) 0



E

8. Which of the following molecules is/are polar?

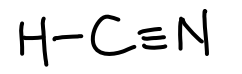
a) OF_2 ✓
b) XeF_4
c) Both OF_2 and XeF_4
d) Neither OF_2 nor XeF_4

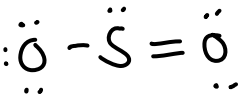


A

9. Which of the following has resonance structures?

a) HCN
b) SO_2 (obeys octet rule) ✓
c) NF_3
d) More than one of these
e) None of these





B

10. In a ground-state Nb atom, what is the total number of electrons that are in d orbitals?

a) 3
b) 10
c) 13
d) 5
e) 41

$3+10=13$

C

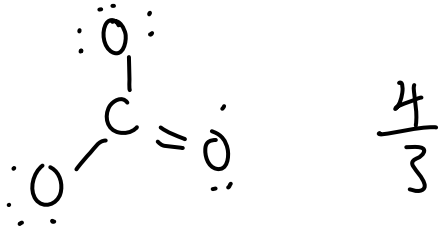
11. Determine which molecule has the longest carbon-oxygen bond length.

a) CO_2
b) CO_3^{2-}
c) CO

$O=C=O$ $\frac{4}{2}$

$C=O$ $\frac{2}{2}$

B



$\frac{4}{3}$

12. Calculate the de Broglie wavelength of a marble (3.76 grams) traveling at 4.5 m/s.

a) 3.9×10^{-35} m
b) 3.9×10^{-38} m
c) 3.9×10^{-27} m
d) 3.9×10^{-30} m
e) 3.9×10^{-32} m

$\frac{h}{mv}=\lambda$

E =

N_2

13. Calculate the density of nitrogen gas at STP.

a) 0.625 g/L
b) 1.25 g/L
c) 0.312 g/L
d) 1.60 g/L
e) 0.800 g/L

Assume 1 L

$PV = nRT$

$\frac{101}{8.31 \times 273} = n$

$n = 0.04452\,g$

B

1.246

14. Use the Bohr model to calculate the ground-state ionization energy for 0.55 moles of Cu^{28+}

a) 1.01×10^{-15} J
b) 1.68×10^{-39} J
c) 1.10×10^{9} J
d) 6.07×10^{8} J
e) 7.22×10^{5} J

$0.55 \times 6.02\times10^{23} \times E$

$E = 2.18\times10^{-18} \times Z^2 \times 1$

$= 6.07\times10^{8}$

D

1.43mol 3.5mol

15. A mixture of gas contains 40 grams of N_2 gas and 56 grams of CH_4 gas. If the total pressure of the mixture is 860 torr, what is the partial pressure of the N_2 gas?

a) 249 torr
b) 358 torr
c) 387 torr
d) 105 torr
e) 57 torr

A

$$\frac{860}{1.43+3.5} \times 1.43 = 249$$

16. When an electron in He^+ relaxes from an initial state of n = 8, a photon with a wavelength of 9.35×10^{-7} m is emitted. What is the final state of the electron?

a) n = 4
b) n = 3
c) n = 6
d) n = 5
e) n = 10

D

$$\Delta E = \frac{hc}{\lambda}$$

$$\frac{hc}{\lambda} = 2.18\times10^{-18}\left(\frac{1}{n_f} - \frac{1}{64}\right)\times 2^2$$

$$0.0243 = \frac{1}{n_f^2} - \frac{1}{64}$$

$$n_f = 4.99 \approx 5$$

17. At what temperature will oxygen gas have an average root-mean-squared speed (u_{rms}) of 610 m/s?

a) 353 K
b) 238698 K
c) 239 K
d) 477 K
e) 48368 K

$$\sqrt{\frac{3 \times 8.31 \times T}{32/1000}} = 610$$

$$T = 477\ K$$

D

18. Consider the following reaction which takes place in a rigid container at a constant temperature of 400K and constant volume of 6.6 L: $C_2H_5OH\ (g) + 3\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + 3\ H_2O\ (g)$

1.826 2.594 1.729 2.594

If 84 g of C_2H_5OH (46 g/mol) is combusted with 83 g of O_2 (32 g/mol), what will be the total pressure in the container after the reaction goes to completion?

a) 13 atm
b) 51 atm
c) 45 atm
d) 21 atm
e) 26 atm

$1.826 - \frac{2.594}{3} = 0.9613$

O_2 limiting

5.28 mol total

$PV = nRT$

E

Answers:	1) C	2) C	3) A	4) A	5) B	6) D
	7) E	8) A	9) B	10) C	11) B	12) E
	13) B	14) D	15) A	16) D	17) D	18) E

Notes: Question 10 is based on book problem 12.88b, Question 11 is based on book problem 13.80, Question 12 is based on book problem 12.34, Question 16 is based on book problem 12.51. Many of the other problems here are based on other recommended book problems, problems from ALEKS, and problems done in lecture (both on the board and in iclicker)