

Midterm Review Short Answer

Base your answers to questions 1 and 2 on the information below.

The accepted values for the atomic mass and percent natural abundance of each naturally occurring isotope of silicon are given in the data table below.

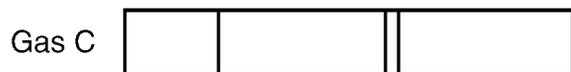
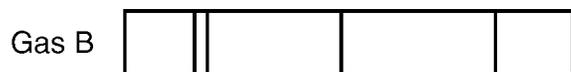
Naturally Occuring Isotopes of Silicon

Isotope	Atomic Mass (atomic mass unit)	Percent Natural Abundance (%)
Si – 28	27.98	92.22
Si – 29	28.98	4.69
Si – 30	29.97	3.09

1. Show a correct numerical setup for calculating the atomic mass of Si.
2. Determine the total number of neutrons in an atom of Si-29.

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3. Write an electron configuration for an atom of aluminum-27 in an excited state.
 4. Draw a Lewis electron-dot diagram for a sulfur atom in the ground state.
 5. Base your answer to the following question on the information and the bright-line spectra represented below.

Many advertising signs depend on the production of light emissions from gas-filled glass tubes that are subjected to a high-voltage source. When light emissions are passed through a spectroscope, bright-line spectra are produced.



Explain the production of an emission spectrum in terms of the *energy states of an electron*.

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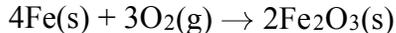
Base your answers to questions 6 through 8 on the information below.

A metal, M , was obtained from a compound in a rock sample. Experiments have determined that the element is a member of Group 2 on the Periodic Table of the Elements.

6. Explain why the radius of a positive ion of element M is *smaller* than the radius of an atom of element M .
7. Explain, in terms of electrons, why element M is a good conductor of electricity.
8. What is the phase of element M at STP?

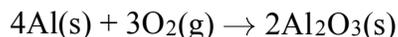
Base your answers to questions 9 through 11 on the information below.

Rust on an automobile door contains $\text{Fe}_2\text{O}_3(\text{s})$. The balanced equation representing one of the reactions between iron in the door of the automobile and oxygen in the atmosphere is given below.



9. Write the IUPAC name for Fe_2O_3 .
10. Determine the gram-formula mass of the product of this reaction.
11. Identify the type of chemical reaction represented by this equation.

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12. Given the balanced equation:



What is the total number of moles of $\text{O}_2(\text{g})$ that must react completely with 8.0 moles of $\text{Al}(\text{s})$ in order to form $\text{Al}_2\text{O}_3(\text{s})$?

13. A student heats a 243 gram sample of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ hydrated crystals?

a What was the percentage by mass of water in the hydrated crystals?[Show all work]

b If all the water was driven out of the crystal, what would be the expected weight of the BaCl_2 sample remaining?[Show all work]

14. Explain, in terms of electronegativity, why a P–Cl bond in a molecule of PCl_5 is more polar than a P–S bond in a molecule of P_2S_5 .
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15. Base your answer to the following question on the table below.

Physical Properties of Four Gases

Name of Gas	hydrogen	hydrogen chloride	hydrogen bromide	hydrogen iodide
Molecular Structure	H-H	H-Cl	H-Br	H-I
Boiling Point (K) at 1 Atm	20.	188	207	237
Density (g/L) at STP	0.0899	1.64	?	5.66

Explain, in terms of intermolecular forces, why hydrogen has a *lower* boiling point than hydrogen bromide.

16. Base your answer to the following question on the information below.

Each molecule listed below is formed by sharing electrons between atoms when the atoms within the molecule are bonded together.

Molecule *A*: Cl₂ Molecule *B*: CCl₄ Molecule *C*: NH₃

Explain why NH₃ has stronger intermolecular forces of attraction than Cl₂.

17. Draw the electron-dot (Lewis) structure of calcium chloride.

Answer Key

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1. $(27.98)(0.9222) +$
 $(28.98)(0.0469) +$
 $(29.97)(0.0309)$

2. 15

3. *Examples:* – 2-7-4 –
1-8-4 – 2-6-2-3

4.



8. solid

9. iron(III) oxide

10. 160.g/mol.

11. *Examples:* – synthesis
– redox – oxidation

12. 6

13. a) $36 / (137 + 71 + 36)$
 $\times 100 = 15\%$ b) 207
grams



14. A P–Cl bond is more
polar than a P–S bond
because the
electronegativity
difference for P–Cl is
1.0 and the
electronegativity
difference for P–S is
0.4.

5. Acceptable responses:
Energy is released
when an electron falls
from a high state
(excited) to a low
state (ground), excited
state to ground state,
high energy to low
energy.

15. *Examples:* –
Hydrogen has weaker
intermolecular forces
than HBr. – hydrogen
– weaker forces.

6. *Examples:* – The ionic
radius is smaller
because the atom
loses two electrons. –
The ion has one less
occupied energy level.

16. *Examples:*
– NH₃ has polar
molecules that attract
each other.
– NH₃ has an
unshared pair of
electrons around the
center atom.
– NH₃ is capable of
hydrogen bonding.
– unequal distribution
of electrons — in
strong attraction

17. *examples:*
[Ca]²⁺ and [:C:]⁻ and [:C:]⁻
[Ca]²⁺ and 2[:C:]⁻