↑ E, ν
↓ λ

Radio Micro Infrared Visible Ultraviolet X-ray Gamma

Absorption → think e⁻

21. N_2 molecules absorb ultraviolet light but not visible light. I_2 molecules absorb both visible and ultraviolet light. Which of the following statements explains the observations?

(A) More energy is required to make N_2 molecules vibrate than is required to make I_2 molecules vibrate. false

(B) More energy is required to remove an electron from an I_2 molecule than is required to remove an electron from a N_2 molecule. false

(C) Visible light does not produce transitions between electronic energy levels in the N_2 molecule but does produce transitions in the I_2 molecule. true

(D) The molecular mass of I_2 is greater than the molecular mass of N_2. true, but wouldn't deal w/ absorption

Essential Knowledge	1.D.3 The interaction of electromagnetic waves or light with matter is a powerful means to probe the structure of atoms and molecules and to measure their concentration.
Science Practice	4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question.
Learning Objective	1.15 The student can justify the selection of a particular type of spectroscopy to measure properties associated with vibrational or electronic motions of molecules.

22.

Element	Metallic Radius (pm)	Melting Point (°C)	Common Oxidation State
Au	144	1064	1+, 3+
Cu	128	1085	1+, 2+
Ag	144	961	1+

To make Au stronger and harder, it is often alloyed with other metals, such as Cu and Ag. Consider two alloys, one of Au and Cu and one of Au and Ag, each with the same mole fraction of Au. If the Au/Cu alloy is harder than the Au/Ag alloy, then which of the following is the best explanation based on the information in the table above?

(A) Cu has two common oxidation states, but Ag has only one. maybe, but is this the best answer

(B) Cu has a higher melting point than Au has, but Ag has a lower melting point than Au has. deals w/ changing phase

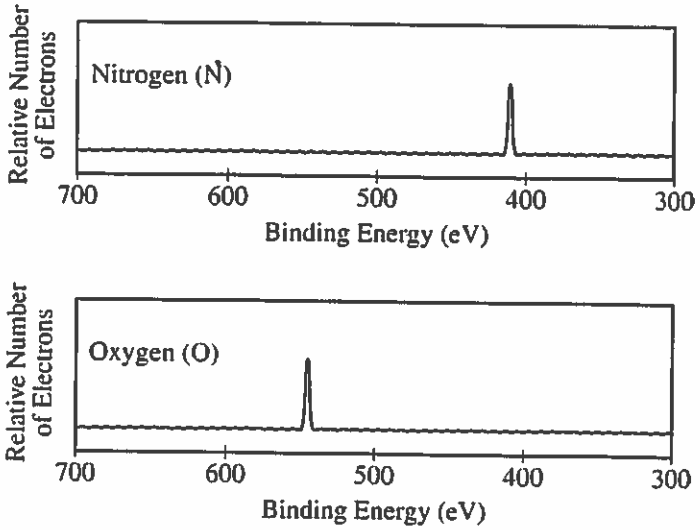
(C) Cu atoms are smaller than Ag atoms, thus they interfere more with the displacement of atoms in the alloy. smaller means able to pack more tightly making it stronger

(D) Cu atoms are less polarizable than are Au or Ag atoms, thus Cu has weaker interparticle forces. weaker IMFs means lower M.P.

Return to the Table of Contents

Essential Knowledge	2.D.2 Metallic solids are good conductors of heat and electricity, have a wide range of melting points, and are shiny, malleable, ductile, and readily alloyed.
Science Practice	7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
Learning Objective	2.25 The student is able to compare the properties of metal alloys with their constituent elements to determine if an alloy has formed, identify the type of alloy formed, and explain the differences in properties using particulate level reasoning.

23.



The photoelectron spectra above show the energy required to remove a 1*s* electron from a nitrogen atom and from an oxygen atom. Which of the following statements best accounts for the peak in the upper spectrum being to the right of the peak in the lower spectrum?

(A) Nitrogen atoms have a half-filled *p* subshell. yeah, so...

(B) There are more electron-electron repulsions in oxygen atoms than in nitrogen atoms. yeah, but that would make more likely to leave

(C) Electrons in the *p* subshell of oxygen atoms provide more shielding than electrons in the *p* subshell of nitrogen atoms. we think of shielding happening btw. core e⁻ and valence e⁻ and val. e⁻ being repelled

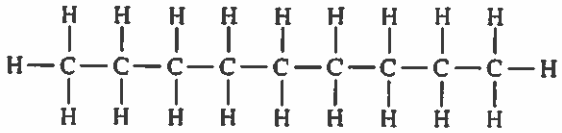
(D) Nitrogen atoms have a smaller nuclear charge than oxygen atoms.

Essential Knowledge	1.B.1 The atom is composed of negatively charged electrons, which can leave the atom, and a positively charged nucleus that is made of protons and neutrons. The attraction of the electrons to the nucleus is the basis of the structure of the atom. Coulomb's law is qualitatively useful for understanding the structure of the atom.
Science Practice	6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices.
Learning Objective	1.5 The student is able to explain the distribution of electrons in an atom or ion based upon data.

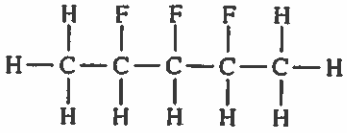
The smaller the charge, the tighter the nucleus will pull e⁻ towards itself.

Return to the Table of Contents

24.



Nonane



2,3,4-trifluoropentane

Consider the molecules represented above and the data in the table below.

Compound	Molecular Formula	Molar Mass (g/mol)	Boiling Point (°C)
Nonane	C_9H_{20}	128	151
2,3,4-trifluoropentane	$C_5H_9F_3$	126	89

Nonane and 2,3,4-trifluoropentane have almost identical molar masses, but nonane has a significantly higher boiling point. Which of the following statements best helps explain this observation?

(A) The C–F bond is easier to break than the C–H bond. • ↑ Surf. area leads to ↑ IMFs

(B) The C–F bond is more polar than the C–H bond.

(C) The carbon chains are longer in nonane than they are in 2,3,4-trifluoropentane. • ↑ IMFs mean ↑ b.p.

(D) The carbon chains are farther apart in a sample of nonane than they are in 2,3,4-trifluoropentane. no they aren't.

Essential Knowledge	2.B.3 Intermolecular forces play a key role in determining the properties of substances, including biological structures and interactions.
Science Practice	6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices.
Learning Objective	2.16 The student is able to explain the properties (phase, vapor pressure, viscosity, etc.) of small and large molecular compounds in terms of the strengths and types of intermolecular forces.

Return to the Table of Contents

25.

	NaF	MgO
Boiling Point (°C)	1695	3600

	Na^+	Mg^{2+}	F^-	Cl^-	O^{2-}
Ionic Radius (pm)	76	72	133	181	140

Based on the data in the tables above, which of the following statements provides the best prediction for the boiling point of NaCl?

(A) NaCl will have a lower boiling point than NaF because the coulombic attractions are weaker in NaCl than in NaF. due to size (r)

(B) NaCl will have a boiling point between that of NaF and MgO because the covalent character of the bonds in NaCl is intermediate between that of MgO and NaF. Ionic substances

(C) NaCl will have a higher boiling point than MgO because the ions are spaced farther apart in NaCl.

(D) NaCl will have a higher boiling point than MgO because the energy required to transfer electrons from the anion to the cation is larger in NaCl than in MgO.

Coulomb's Law

$\frac{Q_1 Q_2}{r^2}$

NaCl will have ↓ b.p. due to smaller charges.

Big Idea	2 Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.
Science Practice	7.1 The student can connect phenomena and models across spatial and temporal scales.
Learning Objective	2.1 Students can predict properties of substances based on their chemical formulas and provide explanations of their properties based on particle views.

26. $$2\,N_2O_5(g) \rightarrow 4\,NO_2(g) + O_2(g)$$

A sample of N_2O_5 was placed in an evacuated container, and the reaction represented above occurred. The value of $P_{N_2O_5}$, the partial pressure of $N_2O_5(g)$, was measured during the reaction and recorded in the table below.

Time (min)	$P_{N_2O_5}$ (atm)	$\ln(P_{N_2O_5})$	$\frac{1}{P_{N_2O_5}}$ (atm^{-1})
0	150	5.0	0.0067
100	75	4.3	0.013
200	38	3.6	0.027
300	19	2.9	0.053

Which of the following correctly describes the reaction?

(A) The decomposition of N_2O_5 is a zero-order reaction.

(B) The decomposition of N_2O_5 is a first-order reaction.

ln P vs time = straight line.

(C) The decomposition of N_2O_5 is a second-order reaction.

(D) The overall reaction order is 3.

Essential Knowledge	4.A.2 The rate law shows how the rate depends on reactant concentrations.
Science Practice	5.1 The student can analyze data to identify patterns or relationships.
Learning Objective	4.2 The student is able to analyze concentration versus time data to determine the rate law for a zeroth-, first-, or second-order reaction.

Plot in graphing if able.

Return to the Table of Contents