

Data Driven AP Multiple Choice Questions

Created by amending an original document by Brinn Belyea;

<https://sites.google.com/site/brinnbelyeascience/ap-chem-data-table-practice>

Questions 1-6 refer to the data table below.

Name	Melting point in K	First ionization energy in kJ mol ⁻¹
Lithium	454	519
Sodium	371	494
Potassium	337	418

- Atoms of which element have the highest electronegativity?
 - Li, since they are the most likely to gain electrons
 - Li, since they are most likely to lose electrons
 - K, since they are most likely to gain electrons
 - Na, since it is the most reactive
- Atoms of which element have the largest atomic radius?
 - Li, since it has the fewest number of protons
 - K, since it has the greatest number of occupied principal shells
 - K, since it has the greatest number of protons
 - It is not possible to tell without further information
- From atoms of which element is it easiest to remove an electron?
 - Li, since the first ionization is the highest
 - K, since Coulomb's law predicts the force of attraction between the nucleus and the valence electron to be the lowest
 - Li, since it has the fewest number of protons
 - K, since potassium wants to become 'happy' and achieve a noble gas electronic configuration

4. Atoms of which element have the highest *second* ionization energy?
- A. Li, since its second electron is closest to the nuclear charge
 - B. Li, since it has the highest nuclear charge
 - C. K, since it has the highest nuclear charge
 - D. All second ionization energies are equal
5. The most common ion of which element, will be smaller than the corresponding, parent atom?
- A. Li
 - B. Na
 - C. K
 - D. All three elements
6. Which element has the strongest metallic bonding?
- A. Li since it has the most valence electrons
 - B. Li, since the melting point suggests the strongest attraction between valence electrons and nuclei
 - C. K, since it has the most electrons
 - D. Li, since the melting point suggests the weakest attraction between valence electrons and nuclei



Chemistry Pages

Questions 7-10 refer to the data table below.

Name	Molecular Formula	Approx. molar mass in g mol^{-1}	Structure	Boiling point in $^{\circ}\text{C}$
Pentane	C_5H_{12}	72	$\text{CH}_3(\text{CH}_2)_3\text{CH}_3$	36.3
Hexane	C_6H_{14}	86	$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	70.0
Ethanol	$\text{C}_2\text{H}_6\text{O}$	46	$\text{CH}_3\text{CH}_2\text{-OH}$	78.5
Diethyl ether	$\text{C}_4\text{H}_{10}\text{O}$	74	$\text{C}_2\text{H}_5\text{-O-C}_2\text{H}_5$	35.0

7. Which liquid do you predict will have the lowest vapor pressure at room temperature?
- Hexane
 - Ethanol
 - Diethyl ether
 - It cannot be determined from the data table
8. The variation of boiling points can be explained in terms of
- Molar mass alone
 - Hydrogen bonding alone
 - London dispersion forces alone
 - Molar mass *and* London dispersion forces *and* hydrogen bonding
9. How many of the compounds listed in the table above, exhibit hydrogen bonding between their molecules?
- 0
 - 1
 - 2
 - 3
10. Which two compounds appear to have intermolecular forces that are very similar in size?
- Pentane and hexane
 - Ethanol and pentane
 - Pentane and diethyl ether
 - Ethanol and diethyl ether

Questions 11-13 refer to the data table below.

Name	Molecular Formula	Structure
Dimethyl ether	C_2H_6O	$H_3C-O-CH_3$
Ethanol	C_2H_6O	<pre> H H H H-C - C - O H H H </pre>
Propane	C_3H_8	<pre> H H H H-C - C - C-H H H H </pre>

11. Which of the liquids in the table has the highest boiling point?

- A. Dimethyl ether because it has hydrogen bonding intermolecular forces
- B. Ethanol because it has hydrogen bonding intermolecular forces
- C. Propane because it has London dispersion intermolecular forces
- D. Cannot be determined from the information given

12. Which of the liquids in the table are isomers of one another?

- A. Dimethyl ether and ethanol
- B. Propane and ethanol
- C. Dimethyl ether and propane
- D. There are no molecules that are isomers of one another since each has a different functional group

13. Considering only the C atoms in the structures, what type of hybridization can be found within these compounds?

- A. sp only
- B. sp^2 and sp^3
- C. sp^3 only
- D. sp and sp^3

Question 14

Name	Formula	Boiling point in °C
Methanol	CH ₃ OH	65
Pyridine	C ₅ H ₅ N	115
Pentane	C ₅ H ₁₂	36

Based only on the data in the table above, which compound has the strongest intermolecular forces?

- A. Methanol since it is an alcohol
- B. Pyridine since it has the highest boiling point
- C. Pentane since it has the lowest boiling point
- D. It cannot be determined from the information given



Questions 15-17

	Standard Electrode Reduction Potential
$\text{Li}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Li}(\text{s})$	-3.04 V
$\text{Na}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Na}(\text{s})$	-2.71 V
$\text{K}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{K}(\text{s})$	-2.92 V
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu}(\text{s})$	+0.34 V
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Zn}(\text{s})$	-0.76 V
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0.00 V

15. In a galvanic cell, which of the following will be oxidized most easily?

- A. $\text{Li}^+(\text{aq})$
- B. $\text{Li}(\text{s})$
- C. $\text{K}(\text{s})$
- D. $\text{K}^+(\text{aq})$

16. When combined, which combination of half reactions, will give the greatest E°_{cell} , assuming standard conditions?

- A. The Li and H half-cells
- B. The Zn and Li half-cells
- C. The Zn and H half-cells
- D. The K and Li half-cells

17. Which species is most likely to gain electrons?

- A. $\text{Li}^+(\text{aq})$
- B. $\text{Li}(\text{s})$
- C. $\text{Cu}(\text{s})$
- D. $\text{Cu}^{2+}(\text{aq})$

Question 18

Name	Band gap between valence and conduction bands
Silicon	1.11 eV
Germanium	0.67 eV
Tellurium	0.33 eV

Which substance do you predict will have the greatest conductivity at room temperature?

- A. Si
- B. Ge
- C. Te
- D. It cannot be determined from the information in the table

Question 19

A chemist has the insoluble salt, copper(II) fluoride. He wishes to use a ligand to dissolve the salt by producing a soluble complex ion. Which ligand will be the most effective at dissolving the $\text{CuF}_{2(s)}$?

Ligand name	Complex ion formula	K for the formation of the complex
Cyanide	$[\text{Cu}(\text{CN})_4]^{2-}$	1×10^{25}
Hydroxide	$[\text{Cu}(\text{OH})_4]^{2-}$	1.3×10^{16}
Ammonia	$[\text{Cu}(\text{NH}_3)_4]^{2+}$	5.0×10^{13}

- A. Cyanide
- B. Hydroxide
- C. Ammonia
- D. Cannot tell from the data given

Questions 20-22

Gas	Volume in L	Pressure in atm	Temperature in K
He	1.00	4.00	300.
CH ₄	1.00	2.00	300.
O ₂	1.00	0.500	300.

20. Which container contains the greatest mass of gas?

- A. Helium
- B. Methane
- C. Oxygen
- D. All containers have the same mass

21. The individual particles of which gas are moving with the greatest velocity?

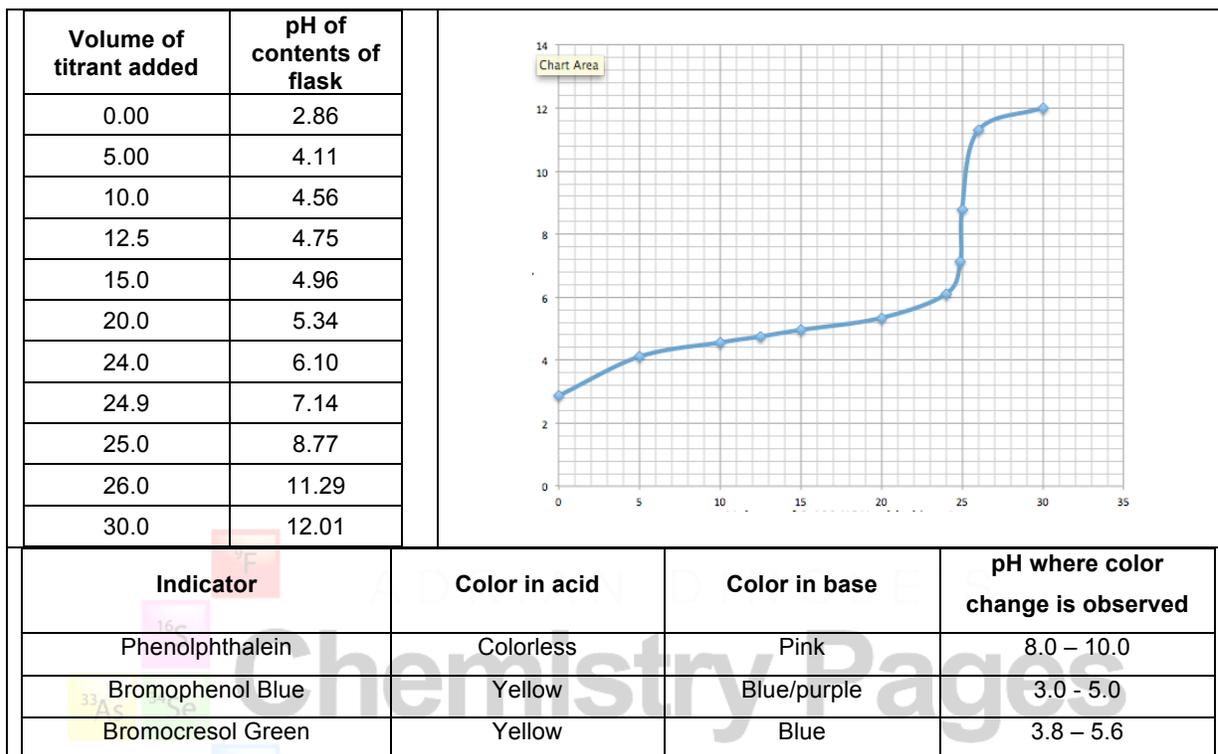
- A. Helium
- B. Methane
- C. Oxygen
- D. All have the same velocity

22. In which vessel do the individual gas particles have the greatest kinetic energy?

- A. Helium
- B. Methane
- C. Oxygen
- D. All have the same kinetic energy

Questions 23-27

A titration is conducted between 25.0 mL of a 0.01 M solution of ethanoic acid and a 0.01 M solution of NaOH. Some data collected during the titration are shown below.



23. From the list of indicators shown, choose one that is suitable for this reaction.

- A. Phenolphthalein
- B. Bromophenol Blue
- C. Bromocresol Green
- D. Any indicator can be used and an accurate result will be obtained

24. Select the correct combination of descriptors of the titration and the data

- A. Ethanoic acid is the titrant and pH is plotted on the x-axis of the titration curve
- B. Sodium hydroxide is the titrant and pH is plotted on the x-axis of the titration curve
- C. Ethanoic acid is the titrant and pH is plotted on the y-axis of the titration curve
- D. Sodium hydroxide is the titrant and pH is plotted on the y-axis of the titration curve

25. A buffer solution exists when the volume of titrant added is
- A. 0.00 mL
 - B. At any point between 0.01 mL and 24.9 mL
 - C. 25.0 mL
 - D. At any point greater than 25.0 mL
26. The pH of the solution when the buffer solution in the flask contains equal concentrations of weak acid and conjugate base is
- A. 2.86
 - B. 4.75
 - C. 8.77
 - D. 12.01
27. The pH of 8.77 that is recorded after 25.0 mL of titrant has been added, can be best described as being caused by which, net ionic reaction?
- A. $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$
 - B. $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{OH}^-$
 - C. $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$
 - D. $\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$