

# CHEM 118-03 Midterm Exam

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Fall 2024

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## Question 1

Which state of matter is characterized by a fixed shape and a fixed volume? (1 point)

- A) Solid
- B) Liquid
- C) Gas
- D) Plasma

**Solution:**

- A) Solid
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## Question 2

Which phase of matter has a definite volume but not a definite shape? (1 point)

- A) Solid
- B) Liquid
- C) Gas
- D) Plasma

**Solution:**

- B) Liquid
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## Question 3

What is the density formula? (1 point)

- A)  $D = mV$
- B)  $D = \frac{m}{V}$
- C)  $D = \frac{V}{m}$
- D)  $D = m + V$

**Solution:**

- B) Density = Mass / Volume
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## Question 4

Convert  $3.6 \times 10^2$  to a decimal number. (1 point)

- A) 36
- B) 3600
- C) 360
- D) 3.6

**Solution:**

C) 360

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## Question 4

**Convert  $9.8 \times 10^{-4}$  to a decimal number.** (1 point)

- A) 0.0098
- B) 0.00098
- C) 0.098
- D) 9.8

**Solution:**

B) 0.00098

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## Question 5

**Convert 0.00056 to scientific notation.** (1 point)

- a)  $5.6 \times 10^{-4}$
- b)  $5.6 \times 10^{-5}$
- c)  $6.5 \times 10^{-4}$
- d)  $5.6 \times 10^{-3}$

**Solution:**

The correct answer is a)  $5.6 \times 10^{-4}$

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## Question 6

**How many significant figures does the number 0.04050 have?** (1 point)

- A) 2
- B) 3
- C) 4
- D) 5

**Solution:**

C) 4

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## Question 7

How many significant figures does the number 3.0890 have? (1 point)

- A) 3
- B) 4
- C) 5
- D) 6

**Solution:**

- C) 5
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## Question 8

What is the correct result of  $8.54 + 2.873$  with the appropriate number of significant figures? (1 point)

- A) 11.413
- B) 11.41
- C) 11.4
- D) 11.4130

**Solution:**

- B) 11.41
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## Question 9

Calculate  $0.00325 \times 1500.00$  and express the answer using the correct number of significant figures. (1 point)

- A) 4.875
- B) 4.88
- C) 4.87500
- D) 4.900

**Solution:**

- B) 4.88
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## Question 10

Convert 5.5 cubic meters to cubic feet. (1 cubic meter = 35.3147 cubic feet) (1 point)

- A) 193.23 cubic feet
- B) 200.23 cubic feet
- C) 194.23 cubic feet
- D) 199.23 cubic feet

**Solution:**

$$5.5 \text{ m}^3 \times \frac{35.3147 \text{ ft}^3}{1 \text{ m}^3} = 194.23085 \text{ ft}^3$$

Therefore, approximately 194.23 cubic feet.

**Correct Answer:** C) 194.23 cubic feet

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## Question 11

**How many liters are in 3.5 gallons? (1 gallon = 3.78541 liters)** (1 point)

- A) 12.89 liters
- B) 13.25 liters
- C) 13.19 liters
- D) 13.28 liters

**Solution:**

$$3.5 \text{ gallons} \times \frac{3.78541 \text{ L}}{1 \text{ gallon}} = 13.248935 \text{ L}$$

Therefore, approximately 13.25 liters.

**Correct Answer:** B) 13.25 liters

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## Question 12

**Convert 45.0°C to Fahrenheit.** (1 point)

- A) 113°F
- B) 95°F
- C) 102°F
- D) 107°F

**Solution:**

- A) 113°F
- 

## Question 13

**Convert 146°F to Celsius.** (1 point)

- A) 69.3°C
- B) 295°C
- C) 63.3°C
- D) 120°C

**Solution:**

- C) 63.3°C
-

## Question 14

**What is pure water ( $\text{H}_2\text{O}$ )?** (1 point)

- A) Element
- B) Compound
- C) Heterogeneous mixture
- D) Homogeneous mixture

**Solution:**

- B) Compound
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## Question 15

**What is granite rock?** (1 point)

- A) Element
- B) Compound
- C) Heterogeneous mixture
- D) Homogeneous mixture

**Solution:**

- C) Heterogeneous mixture
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## Question 16

**What is brass (an alloy of copper and zinc)?** (1 point)

- A) Element
- B) Compound
- C) Heterogeneous mixture
- D) Homogeneous mixture

**Solution:**

- D) Homogeneous mixture
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## Question 17

**Which of the following is an example of a physical change?** (1 point)

- A) Iron rusting
- B) Baking a cake
- C) Evaporating water
- D) Burning coal

**Solution:**

- C) Evaporating water

## Question 18

If wood is burned in a camp fire, what type of change is occurring? (1 point)

- A) Physical change
- B) Chemical change
- C) No change
- D) Reversible change

**Solution:**

B) Chemical change

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## Question 19

A 50 g piece of aluminum (specific heat capacity,  $c = 0.897 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}$ ) is heated from  $20^\circ\text{C}$  to  $60^\circ\text{C}$ .

How much heat is absorbed by the aluminum? (2 points)

- A. 1794 J
- B. 3588 J
- C. 2268 J
- D. 4485 J

**Solution:**

Using ( $q = mc\Delta T$ ), where ( $\Delta T = 60 - 20 = 40^\circ\text{C}$ ):

$$q = (50 \text{ g}) \times (0.897 \text{ J/g}^\circ\text{C}) \times (40^\circ\text{C}) = 1794 \text{ J}$$

A) 1794 J

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## Question 20

If 1000 J of heat is added to a 20 g sample of aluminum (specific heat capacity ( $c = 0.897 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}$ ), by how many degrees Celsius will the temperature increase? (2 points)

- A.  $40^\circ\text{C}$
- B.  $50^\circ\text{C}$
- C.  $56^\circ\text{C}$
- D.  $44^\circ\text{C}$

**Solution:**

Using ( $q = mc\Delta T$ ), solve for ( $\Delta T$ ):

$$1000 \text{ J} = (20 \text{ g}) \times (0.897 \text{ J/g}^\circ\text{C}) \times \Delta T$$
$$\Delta T = \frac{1000 \text{ J}}{(20 \text{ g}) \times (0.897 \text{ J/g}^\circ\text{C})} \approx 55.74^\circ\text{C} \approx 56^\circ\text{C}$$

So, C)  $56^\circ\text{C}$

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## Question 21

An element has an atomic number of 6 and a mass number of 12. Identify its atomic symbol. (1 point)

- A) He
- B) Li
- C) C
- D) N

**Solution:**

The element with 6 protons (atomic number 6) and a mass number of 12 is carbon. Therefore, the correct answer is **C) C**.

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## Question 22

Which atomic symbol represents an element with 11 protons, 12 neutrons, and 11 electrons? (1 point)

- A) Al
- B) Mg
- C) Na
- D) Si

**Solution:**

The element with 11 protons and 11 electrons, which defines it, is sodium. Hence, the correct answer is **C) Na**.

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## Question 23

An ion has 27 protons, 25 electrons, and 32 neutrons. Identify its atomic symbol. (1 point)

- A.  ${}_{25}^{59}\text{Co}$
- B.  ${}_{27}^{59}\text{Co}^{2-}$
- C.  ${}_{29}^{60}\text{Co}^{2+}$
- D.  ${}_{27}^{59}\text{Co}^{2+}$

**Solution:**

- D.  ${}_{27}^{59}\text{Co}^{2+}$
- 

## Question 24

An ion has an atomic number of 11, a charge of 1+, and a mass number of 23. Identify its atomic symbol. (1 point)

- A.  ${}_{11}^{23}\text{Na}^{+}$
- B.  ${}_{11}^{23}\text{Na}^{-}$
- C.  ${}_{11}^{22}\text{Na}^{+}$
- D.  ${}_{10}^{24}\text{Na}^{+}$

**Solution:**

- A.  ${}_{11}^{23}\text{Na}^{+}$
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## Question 25

An ion has 13 protons, 10 electrons, and a mass number of 27. Identify the atomic symbol of this ion. (1 point)

- A.  ${}_{13}^{27}\text{Al}^{3+}$
- B.  ${}_{13}^{27}\text{Al}^{3-}$
- C.  ${}_{14}^{27}\text{Al}^{3+}$
- D.  ${}_{13}^{27}\text{Al}$

**Solution:**

- A.  ${}_{13}^{27}\text{Al}^{3+}$
- 

## Question 26

**Chemical Formula:**  $\text{K}_2\text{Cr}_2\text{O}_7$

**How many atoms of each element are present?** (1 point)

- A) K: 2, Cr: 1, O: 7
- B) K: 2, Cr: 2, O: 7
- C) K: 1, Cr: 2, O: 7
- D) K: 2, Cr: 7, O: 2

**Solution:**

- B) K: 2, Cr: 2, O: 7
- 

## Question 27

**Chemical Formula:**  $\text{C}_6\text{H}_{12}\text{O}_6$

**How many atoms of each element are present?** (1 point)

- A) C: 12, H: 12, O: 6
- B) C: 6, H: 12, O: 6
- C) C: 6, H: 6, O: 12
- D) C: 12, H: 6, O: 6

**Solution:**

- B) C: 6, H: 12, O: 6
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## Question 28

Which ionic compound is formed from the ions  $\text{Na}^+$  and  $\text{SO}_4^{2-}$ ? (1 point)

- A)  $\text{NaSO}_4$
- B)  $\text{Na}_2\text{SO}_4$
- C)  $\text{Na}_2(\text{SO}_4)_2$
- D)  $\text{NaSO}_3$

**Solution:** B)  $\text{Na}_2\text{SO}_4$

**Explanation:** Two  $\text{Na}^+$  ions are needed to balance the 2- charge of one  $\text{SO}_4^{2-}$  ion to form  $\text{Na}_2\text{SO}_4$ .

**Alt text:** Which ionic compound is formed from sodium ion with a 1+ charge and sulfate ion with a 2- charge? Choices are: A) NaSO subscript 4, B) Na subscript 2 SO subscript 4, C) Na subscript 2 (SO subscript 4) subscript 2, D) NaSO subscript 3.

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## Question 29

Which ionic compound is formed from the ions  $\text{Al}^{3+}$  and  $\text{PO}_4^{3-}$ ? (1 point)

- A)  $\text{Al}(\text{PO}_4)_3$
- B)  $\text{Al}_3\text{PO}_4$
- C)  $\text{AlPO}_4$
- D)  $\text{Al}_2(\text{PO}_4)_2$

**Solution:** C)  $\text{AlPO}_4$

**Explanation:** The 3+ charge of  $\text{Al}^{3+}$  and 3- charge of  $\text{PO}_4^{3-}$  balance each other, resulting in  $\text{AlPO}_4$ .

**Alt text:** Which ionic compound is formed from aluminum ion with a 3+ charge and phosphate ion with a 3- charge? Choices are: A) AlPO subscript 4, B) Al subscript 3 PO subscript 4, C) Al(PO subscript 4) subscript 3, D) Al subscript 2 (PO subscript 4) subscript 2.

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## Question 30

Identify the ions that make up the compound  $\text{FeCl}_3$ . (1 point)

- A)  $\text{Fe}^{2+}$  and  $\text{Cl}^-$
- B)  $\text{Fe}^{3+}$  and  $\text{Cl}^-$
- C)  $\text{Fe}^+$  and  $\text{Cl}_3^-$
- D)  $\text{Fe}^{3+}$  and  $\text{Cl}^{3-}$

**Correct Answer:** B)  $\text{Fe}^{3+}$  and  $\text{Cl}^-$

**Alt Text:** This question prompts the selection of ions in iron(III) chloride from options A to D.

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## Question 31

Identify the ions that make up the compound  $\text{NH}_4\text{Cl}$ . (1 point)

- A)  $\text{NH}_3^+$  and  $\text{Cl}^-$
- B)  $\text{NH}_4^+$  and  $\text{Cl}^-$
- C)  $\text{NH}_4^+$  and  $\text{Cl}^{2-}$
- D)  $\text{NH}_4^+$  and  $\text{Cl}^+$

**Correct Answer:** B)  $\text{NH}_4^+$  and  $\text{Cl}^-$

**Alt Text:** The problem requires identifying ions in ammonium chloride, with given choices A through D.

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## Question 32

Determine the formula mass of ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ . You must use proper mathematical notation and units throughout your calculations. (3 points)

**Solution:**

- Nitrogen (N):  $2 \times \text{NH}_4 = 2 \times 1 = 2$  atoms,  $2 \times 14.01 = 28.02$  amu
- Hydrogen (H): 8 atoms,  $8 \times 1.008 = 8.064$  amu
- Sulfur (S): 1 atom,  $1 \times 32.07 = 32.07$  amu
- Oxygen (O): 4 atoms,  $4 \times 16.00 = 64.00$  amu
- Total formula mass =  $28.02 + 8.064 + 32.07 + 64.00 = 132.154$  amu

**Alt Text:** Determine the formula mass of ammonium sulfate with molecular formula  $(\text{NH}_4)_2\text{SO}_4$ .

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## Question 33

Chlorine has two naturally occurring isotopes:  $^{35}_{17}\text{Cl}$  with a mass of 34.969 amu (75.78% abundance) and  $^{37}_{17}\text{Cl}$  with a mass of 36.965 amu (24.22% abundance). Calculate the average atomic mass of chlorine in amu. You must use proper mathematical notation and units throughout your calculations. (3 points)

**Solution:**

The average atomic mass is calculated using:

$$\begin{aligned}\text{Average atomic mass} &= (34.969 \text{ amu} \times 0.7578) + (36.965 \text{ amu} \times 0.2422) \\ &= (26.498 \text{ amu}) + (8.951 \text{ amu}) \\ &= 35.449 \text{ amu}\end{aligned}$$

Thus, the average atomic mass of chlorine is approximately 35.45 amu.

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## Question 34

Answer the following questions in your own words. What subatomic property defines an element's identity? What happens to a neutral atom to yield an ion? What is the *natural abundance* of an isotope? (3 points extra credit)

### Solution:

1. An element's identity is defined by its number of protons, known as the atomic number.
2. For a neutral atom to become an ion, it must either lose or gain electrons. Losing electrons results in a positive ion (cation), and gaining electrons results in a negative ion (anion).
3. Natural abundance of an isotope refers to the relative percentage of a specific isotope present in a sample of the element as naturally found on Earth, compared to other isotopes of the element.