

DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

In the meantime, read this...

- Write your answers to Free-Response questions directly on the “Free-Response Answer Sheet.” Record your answers to multiple-choice questions on the Scantron card provided.
- At the end of the exam, turn in **your entire test booklet, with Answer Sheet, and your Scantron card.**

 Write your name:

-  on every page of the exam, and
-  on the Scantron card.

**Exams will be taken apart for processing**, so it is important that you have your name on every page.

You may use your calculator and a pen or pencil. Please do not use green or red. Any other aids are prohibited.

Put all notes, books, etc away and out of sight. Turn off the ringers of electronic devices and put them away and out of sight. **Electronic devices (other than calculators) must be silenced and put away. Use of calculator functions on communication devices is not permitted. Sharing calculators is not permitted.** Points will be deducted for electronic devices in view or making noise, and devices will be confiscated.

No outside paper is allowed. If you need more scratch paper, ask one of the proctors.

Strategy hint: take a quick look over the whole exam before you start. If you see something that looks easy for you, go for it! Get a few points in the bag right away.

Strategy hints for multiple choice:

- When you have determined that an option is not correct, mark it off so you don't have to check it again!
- Even if you think you have found the right answer, look at the remaining answers to see if any of them are a better match.
- On calculation problems, show your work somewhere on the page. Even if you miss the problem, it certainly will be easier to see later where mistakes were made.

**Looking at another student's work, intentionally or accidentally, will not be tolerated. Students who seem to have trouble keeping their eyes on their own papers will be moved to the front of the room. Students who cheat earn a failing grade.**

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**Check back over your exam and make sure you have completed all parts before turning in your paper!**

### Periodic Table of the Elements

<b>1A</b>		<b>2A</b>																		<b>3A</b>	<b>4A</b>	<b>5A</b>	<b>6A</b>	<b>7A</b>	<b>8A</b>		
1 H 1.008																						1 H 1.008	2 He 4.003				
3 Li 6.941	4 Be 9.012																					5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31																					13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80										
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3										
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po [209]	85 At [210]	86 Rn [222]										
87 Fr [223]	88 Ra [226]	89 Ac [227]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [277]	109 Mt [268]	110 Ds [281]	111 Rg [272]	112 [285]	113 [284]	114 [289]	115 [288]	116 [292]												

Lanthanides

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]	103 Lr [262]

Actinides

You may remove this page and use it as scratch paper and a cover sheet. If you need more scratch paper, you may get it from the proctor.

Potentially useful information:

$$1 \text{ mole} = 6.022 \times 10^{23}$$

**Free-Response ANSWER SHEET**

(MC score \_\_\_\_\_ FR score \_\_\_\_\_ Total raw \_\_\_\_\_ total % \_\_\_\_\_)

1. Give the symbol of an element that fits each description. In some cases, there may be more than one acceptable answer; choose **one**. [2 each]

\_\_\_\_\_ the Period 4 halogen

\_\_\_\_\_ an element that commonly forms a -1 ion

\_\_\_\_\_ a transition metal that forms a constant-charge ion

\_\_\_\_\_ an element whose neutral atoms have 3 valence electrons

2. [9 pts] In the space below, **give the structure of 4,4-diethyl-cis-2-heptene**.

3. Give a **reasonable** estimate, with **appropriate metric** unit, for each of the following attributes of a **new #2 wooden pencil**. [2 each]

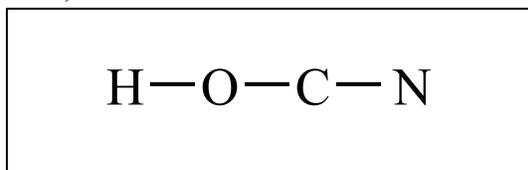
a. the mass of the pencil. \_\_\_\_\_

b. the length. \_\_\_\_\_

c. the volume of the eraser. \_\_\_\_\_

d. its temperature, in use in this room. \_\_\_\_\_

4. [4 pts] **Complete the structure:** Add lone pair electrons, or turn single bonds into double or triple bonds, as needed so that every atom has its normal electron arrangement. (**Do not** add any atoms to the molecule.)



5. Give the correct **chemical formula** for each substance named. [2 each]

\_\_\_\_\_ aluminum sulfate

\_\_\_\_\_ magnesium phosphide

\_\_\_\_\_ disulfur hexachloride

\_\_\_\_\_ propyne

\_\_\_\_\_ ammonia

\_\_\_\_\_ copper(I) carbonate

6. Give a **correct systematic name** for each formula. [2 each]

\_\_\_\_\_  $\text{NF}_3$ \_\_\_\_\_  $\text{Fe}(\text{OH})_3$ \_\_\_\_\_  $\text{CH}_2=\text{CH}_2$ \_\_\_\_\_  $\text{Na}_2\text{O}$ \_\_\_\_\_  $\text{KH}$ 

7. [4 pts] In the space below, sketch the hydrogen bonding interaction between two molecules of water.

**Multiple Choice** [3 points each]. Choose the **best** answer and record it on your Scantron card.

- 1 Mark **B** on the Scantron card. (This item is a form identifier and will not be scored.)
- 2 Which of the following is a characteristic of a sample of a **compound**?
  - A All atoms have the same number of protons
  - B All atoms have the same number of neutrons
  - C Is made up of other, simpler substances in a fixed ratio
  - D Is made up of other, simpler substances in a variable ratio
  - E Appears in the periodic table
- 3 Which of the following properties is generally true of a **transition element**?
  - A conducts electricity
  - B usually gas at room temperature
  - C forms anions in ionic compounds
  - D combines with other elements to form covalent compounds
  - E relatively unreactive and does not form compounds
- 4 Coffee is commonly sold in 12-ounce bags. Express this weight in **grams**. (Be careful with the units, please.) (1 ounce = 28.35 g)
  - A 0.0029 g
  - B 0.42 g
  - C 2.4 g
  - D 28.35 g
  - E 340 g
- 5 The **amp** is a unit of electrical current. 1 amp = how many milliamps?
  - A 0.001
  - B 0.01
  - C 0.1
  - D 100
  - E 1000
- 6 From the following list, which statement could possibly be **correct** based on the size of the measurement?
  - A A computer mouse weighs 19 mg.
  - B My coffee cup holds 550 dL of coffee.
  - C This exam paper is 9 cm thick.
  - D A penny has a diameter of 19 mm.
- 7 What is the mass of 0.50 mol of carbon?
  - A 0.042 g
  - B 0.42 g
  - C 2.4 g
  - D 6.0 g
  - E 24 g
- 8 You have an atom that contains 16 protons, 17 neutrons, and 18 electrons. What is its **atomic number**?
  - A -2
  - B 16
  - C 17
  - D 32.07
  - E 33
- 9 What is the major significance of the **number of protons** in an atom?
  - A It allows the mass of the atom to be predicted.
  - B It gives the charge of the ion formed by the atom.
  - C It determines the element identity of the atom.
  - D It identifies the isotope of the element.
  - E It is the number of valence electrons present in the atom.

Problems 10-20 refer to the following five options. You may use each option once, more than once, or not at all.

A Li

B Al

C Cl

D Ca

E La

- 10 Which element has chemical behavior similar to that of sodium?
- 11 Which element combines in a 1:1 ratio with sodium to form an ionic compound?
- 12 Which element is in Period 2?
- 13 Which element probably forms cations that need Roman numerals to specify their charges in the names of compounds?
- 14 Which element forms covalent compounds?
- 15 Which is an alkaline earth element?
- 16 Which element forms a +2 ion exclusively?
- 17 Which of the elements is a transition metal?
- 18 Which element has one valence electron in its neutral atoms?
- 19 If you have a 1.0-g sample of each element, which sample contains the largest number of atoms?
- 20 Which element has the highest electronegativity?

The descriptions in Problems 21-25 refer to the following five options. You may use each option once, more than once, or not at all.

A carbon disulfide

B lithium sulfide

C cyclohexane

D methanol, CH<sub>3</sub>OHE O<sub>2</sub>

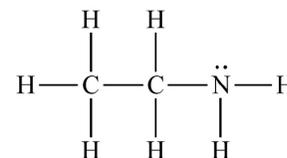
- 21 A hydrocarbon
- 22 A an organic compound that is not a hydrocarbon
- 23 Contains an anion with a -2 charge
- 24 A diatomic molecule
- 25 An ionic compound

26 In which of the bonds below would C have a  $\delta^-$  charge?

- A B—C      B C—C      C C=C      D C=N      E C—O

27 In the molecule shown at right, how many electrons are used in bonding?

- A 2      B 4      C 9      D 18      E 20

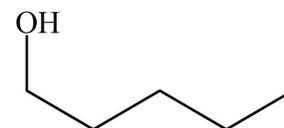


28 Which of the following statements is the most accurate description of the substance  $N_2O$ ?

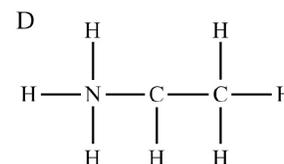
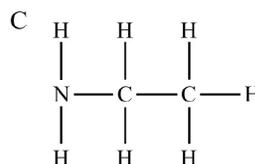
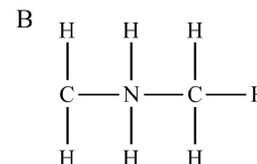
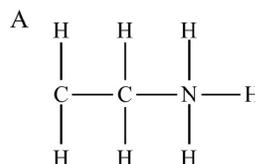
- A  $N_2O$  is an ionic compound, containing  $N^+$  and  $O^{2-}$  ions.  
 B  $N_2O$  is an ionic compound, containing  $N^{3-}$  and  $O^{2-}$  ions.  
 C  $N_2O$  is a covalent compound, containing  $N_2$  molecules and O atoms.  
 D  $N_2O$  is a covalent compound, in which N and O are connected through polar bonds.  
 E  $N_2O$  is a covalent compound, in which N and O are connected through nonpolar bonds.

29 How many **carbon atoms** are there in the molecule shown at right?

- A 0 (this molecule does not contain carbon)      B 5      C 6  
 D 10      E 22



30 Based on the normal bonding patterns of the atoms involved, which of the structures shown is most likely to exist?



31 What is the molar mass of sodium oxide?

- A 38.99      B 40.00      C 48.07      D 54.99      E 61.98

32 What unit or units are most appropriate for the molar mass of sodium oxide?

- A mol      B atoms      C molecules      D g/mol      E mol/L