Name _____

Key

SL Score	HL Score
/21	/30

Practice Exam: Paper 1
Topic 2: Atomic Structure

SL

1. Which statement about the numbers of protons, electrons and neutrons in an atom is always correct?

A. The number of neutrons minus the number of electrons is zero.

B. The number of protons plus the number of neutrons equals the number of electrons.

C. The number of protons equals the number of electrons.

D. The number of neutrons equals the number of protons.

2. Which statements about the isotopes of chlorine, $^{35}_{17}Cl$ and $^{37}_{17}Cl$, are correct?

I. They have the same chemical properties.

II. They have the same atomic number.

III. They have the same physical properties.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

3. In the emission spectrum of hydrogen, which electronic transition would produce a line in the visible region of the electromagnetic spectrum?

A. $n = 2 \rightarrow n = 1$

B. $n = 3 \rightarrow n = 2$

C. $n = 2 \rightarrow n = 3$

D. $n = \infty \rightarrow n = 1$

4. Consider the relative abundance of the isotopes of element X.

Isotope	Relative abundance (%)
^{24}X	80
^{25}X	10
^{26}X	10

What is the relative atomic mass of X?

A. 24

B. 25

C. Between 24 and 25

D. Between 25 and 26

5. Which of the following is an isotope of Magnesium – 24.

A. $^{24}_{12}Mg^{2+}$

B. $^{26}_{12}Mg$

C. $^{42}_{13}Mg$

D. $^{26}_{13}Mg$

6. Which describes the visible emission spectrum of hydrogen?

A. A series of lines converging at longer wavelength

B. A series of regularly spaced lines

C. A series of lines converging at lower energy

D. A series of lines converging at higher frequency

7. A sample of element X contains 69% of ^{63}X and 31% of ^{65}X. What is the relative atomic mass of X in this sample?

A. 63.0

B. 63.6

C. 65.0

D. 69.0

8. How many electrons does the ion $^{31}_{15}P^{3-}$ contain?

A. 12 C. 16

B. 15 D. 18

9. What is the electron arrangement of the Mg^{2+} ion?

A. 2.2

B. 2.8

C. 2.8.2

D. 2.8.8

10. Which statement about the species $^{63}Cu^{2+}$ and $^{65}Cu^{+}$ is correct?

A. Both species have the same number of protons.

B. Both species have the same number of electrons.

C. Both species have the same number of neutrons.

D. Both species have the same electron arrangement.

11. Which statement about the isotopes of an element is correct?

A. They have the same mass number.

B. They have a different atomic number.

C. They have the same chemical properties.

D. They are located in different places in the periodic table.

12. How many protons, neutrons and electrons are present in each atom of ^{31}P?

	Protons	Neutrons	Electrons
A.	16	15	16
B.	15	16	15
C.	15	31	15
D.	16	31	16

13. Which is correct for the following regions of the electromagnetic spectrum?

	Ultraviolet (UV)		Infrared (IR)	
A.	high energy	short wavelength	low energy	low frequency
B.	high energy	low frequency	low energy	long wavelength
C.	high frequency	short wavelength	high energy	long wavelength
D.	high frequency	long wavelength	low frequency	low energy

14. What is the atomic number of a neutral atom which has 51 neutrons and 40 electrons?

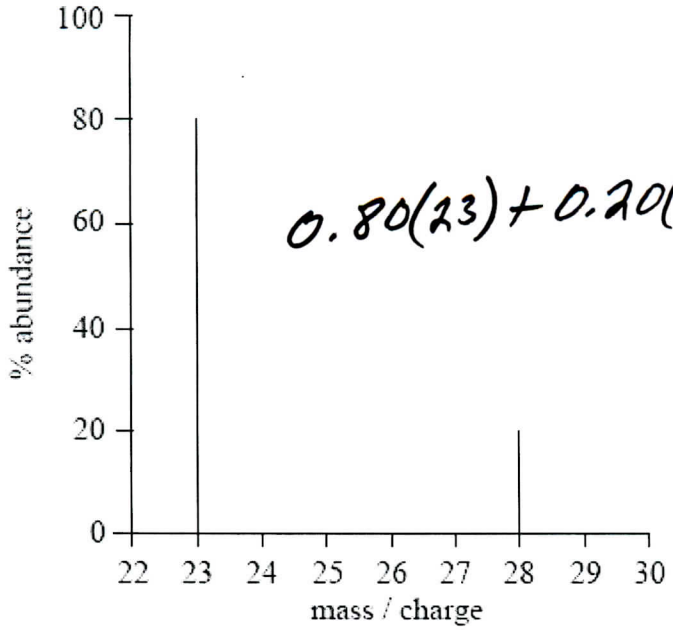
A. 40

B. 51

C. 91

D. 131

15. What is the relative atomic mass of an element with the following mass spectrum?



$0.80(23) + 0.20(28) = 24$

(A) 24 C. 26

B. 25 D. 27

16. Which is the correct definition of the mass number of an atom?

A. The total mass of neutrons and protons in the nucleus of the atom

B. The total mass of neutrons, protons and electrons in the atom

C. The number of protons in the nucleus of the atom

(D.) The total number of neutrons and protons in the nucleus of the atom

17. The table below shows the number of protons, neutrons and electrons present in five species.

Species	Number of protons	Number of neutrons	Number of electrons
X	6	8	6
Y	7	7	7
Z	7	7	8
W	8	8 ✓	8
Q	8	10 ✓	8

An isotope must have a different # of neutrons!

Which **two** species are isotopes of the same element?

A. X and W

B. Y and Z

C. Z and W

(D.) W and Q

18. Which species have the same number of electrons?

I. S^{2-} 16-(-2)=18

II. Cl^- 17-(-1)=18

III. Ne 10

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

19. Which gives the correct order of these processes in a mass spectrometer?

A.	ionization	deflection	acceleration
B.	ionization	acceleration	deflection
C.	acceleration	ionization	deflection
D.	deflection	acceleration	ionization

20. **20.** Which species has 54 electrons and 52 protons?

A. $^{128}_{52}Te^{2-}$

B. $^{132}_{54}Xe^{2+}$

C. $^{132}_{54}Xe^{2-}$

D. $^{128}_{52}Te^{2+}$

21. What is the correct sequence for the processes occurring in a mass spectrometer?

A. vaporization, ionization, acceleration, deflection

B. vaporization, acceleration, ionization, deflection

C. ionization, vaporization, acceleration, deflection

D. ionization, vaporization, deflection, acceleration

HL

1. What is the electron configuration of vanadium?

A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^3$

B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^1$

D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

2. Values for the successive ionization energies for an unknown element are given in the table below.

First ionization energy / kJ mol^{-1}	Second ionization energy / kJ mol^{-1}	Third ionization energy / kJ mol^{-1}	Fourth ionization energy / kJ mol^{-1}
420	3600	4400	5900

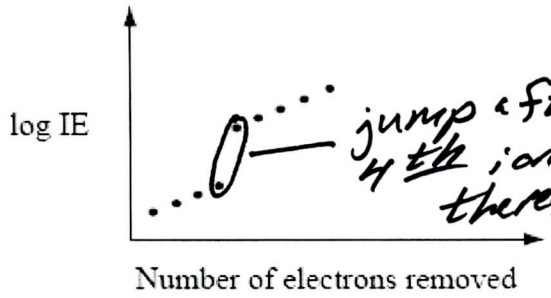
In which group of the periodic table would the unknown element be found?

A. 1 C. 3

B. 2 D. 4

A large jump after the first ionization, therefore a group 1 element.

3. The graph represents the energy needed to remove nine electrons, one at a time, from an atom of an element. Not all of the electrons have been removed.



jump after the 4th ionization, therefore a group 4 (4a) element.

Which element could this be?

A. C

B. Si

C. P

D. S

4. An ion has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$. Which ion could it be?

A. Ni^{2+} C. Cu^{2+}

B. Cu^+ D. Co^{3+}

loses its one valence electron: 4s'

5. Which species possesses only two unpaired electrons?

A. Zn

B. Mg

C. Ti^{2+} — $[Ar]3d^2$ (lost two valence electrons: $4s^2$)

D. Fe^{2+}

↑↓ ↑↓ ↑ ↑ ↑

6. What is the order of increasing energy of the orbitals within a single energy level?

A. d < s < f < p

B. s < p < d < f

C. p < s < f < d

D. f < d < p < s

7. What is the electron configuration of the Cr^{2+} ion?

A. [Ar] $3d^5\ 4s^1$

B. [Ar] $3d^3\ 4s^1$

C. [Ar] $3d^6\ 4s^1$

D. [Ar] $3d^4\ 4s^0$

$_{24}Cr$: $[Ar]4s^1 3d^5$ (−2e⁻)

$_{24}Cr^{2+}$: $[Ar]4s^0 3d^4$ (or $3d^4 4s^0$)

8. Between which ionization energies of boron will there be the greatest difference?

A. Between 1st and 2nd ionization energies — Group 3 (3A)

B. Between 2nd and 3rd ionization energies

C. Between 3rd and 4th ionization energies

D. Between 4th and 5th ionization energies

9. What is the electron configuration for the copper(I) ion, ($Z = 29$)?

A. $[Ar]4s^2 3d^9$

B. $[Ar]4s^1 3d^{10}$

C. $[Ar]4s^1 3d^9$

D. $[Ar]3d^{10}$

Loses the $4s^1$ electron.