

CHE 105 SU17 Exam 3

Your Name: _____

Your ID: _____

Question #: 1

Which statement is a postulate of kinetic molecular theory?

- A. The size of a gas particle is negligibly small compared to the distance between gas particles.
 - B. The average kinetic energy of a gas particle is inversely proportional to the temperature in Kelvins.
 - C. Gas particles do not collide with each other.
 - D. All gas molecules are attracted to each other.
-

Question #: 2

Select the container which will have the fastest root-mean-square speed for the molecules.

- A. A 1 L vessel of He(*g*) at 300 K.
 - B. A 1 L vessel of Ne(*g*) at 300 K.
 - C. A 2 L vessel of He(*g*) at 100 K.
 - D. A 2 L vessel of Ne(*g*) at 100 K.
-

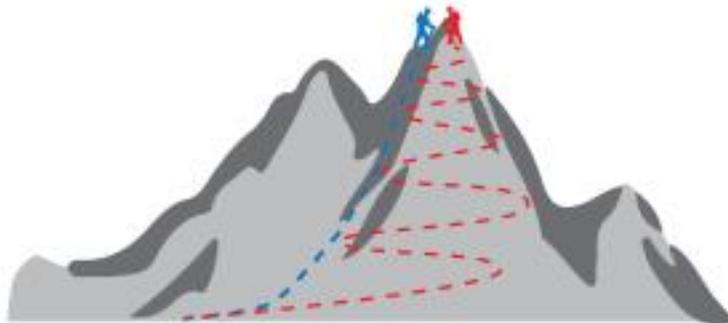
Question #: 3

Select the conditions that would lead to the **least** ideal (most real) gas behavior for oxygen gas.

- A. O₂ at 150 °C and 8.0 atm
- B. O₂ at 150 °C and 0.90 atm
- C. O₂ at -17 °C and 8.0 atm
- D. O₂ at -17 °C and 0.90 atm

Question #: 4

Consider the image below. Two hikers started and finished their hike at the same point. The "blue" hiker followed the blue path. The "red hiker" followed the red path up the mountain. Which property is a state function and why?



- A. Altitude is a state function because the path taken does not affect the change in altitude.
- B. The distance traveled is a state function because the path taken does not affect the distance traveled.
- C. Work is a state function because work is path dependent.
- D. Altitude, distance, and work are all three state functions because they do not depend upon the path taken.

Question #: 5

When the **system** is the reference, select the **two** correct statements below.

- A. When work is done by the system on the surroundings, the sign of work is positive (+).
 - B. When work is done by the system on the surrounding, the sign of work is negative (-).
 - C. When heat is transferred from the system to the surroundings, the sign of heat is positive (+).
 - D. When heat is transferred from the system to the surroundings, the sign of heat is negative (-).
-

Question #: 6

If a system absorbs 375 J of energy from the surroundings while it does 96.0 J of work, what is the change in internal energy of the system?

Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1 J

1. _____

Question #: 7

A balloon inflates from 1.68 L to 2.55 L against a constant external pressure of 3.00 atm. How much work is done by the balloon? (1 L·atm = 101.3 J)

- A. +2.68 J
 - B. +283 J
 - C. -0.290 J
 - D. -264 J
-

Question #: 8

Which sample of metal will require the most energy to raise the temperature by 5 °C?

$C_s(\text{Cu}) = 0.385 \text{ J/g}\cdot^\circ\text{C}$

$C_s(\text{Fe}) = 0.449 \text{ J/g}\cdot^\circ\text{C}$

- A. 5 grams of copper
 - B. 5 grams of iron
 - C. 10 grams of copper
 - D. 10 grams of iron
-

Question #: 9

It was determined that a 50.0-gram sample of the alloy required 188 J of heat to raise the temperature of the alloy by 10.0 °C. What is the specific heat of the alloy?

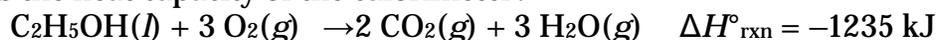
$$C_s = \underline{1} \text{ J/g}\cdot^\circ\text{C}$$

Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. _____

Question #: 10

A 46.07 g sample of ethanol ($\text{C}_2\text{H}_5\text{OH}$, 46.07 g/mol) is burned in a bomb calorimeter, according to the following reaction equation. If the temperature of the calorimeter rises from 13.0 °C to 62.3 °C, what is the heat capacity of the calorimeter?



- A. 26.3 kJ/°C
 - B. 32.7 kJ/°C
 - C. 25.1 kJ/°C
 - D. 8.02 kJ/°C
-

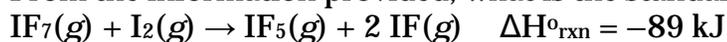
Question #: 11

The enthalpy of formation, ΔH_f° , of sodium chloride (NaCl) = -411.2 kJ/mol . Which reaction is the formation reaction of NaCl and corresponds to this energy value?

- A. $2 \text{Na}(s) + \text{Cl}_2(g) \rightarrow 2 \text{NaCl}(s)$
 - B. $\text{Na}(s) + 1/2 \text{Cl}_2(g) \rightarrow \text{NaCl}(s)$
 - C. $\text{NaCl}(s) \rightarrow \text{Na}(s) + 1/2 \text{Cl}_2(g)$
 - D. $\text{Na}^+(g) + \text{Cl}^-(g) \rightarrow \text{NaCl}(s)$
-

Question #: 12

From the information provided, what is the standard enthalpy of formation, ΔH°_f , for $\text{IF}(g)$?

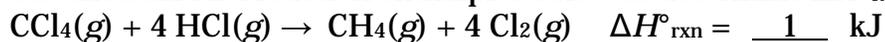


	ΔH°_f
$\text{IF}_7(g)$	-941 kJ/mol
$\text{IF}_5(g)$	-840 kJ/mol

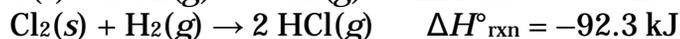
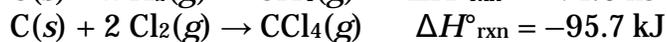
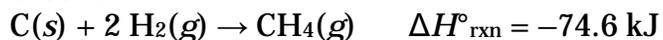
- A. 24 kJ/mol
- B. 101 kJ/mol
- C. -95 kJ/mol
- D. -146 kJ/mol
- E. -191 kJ/mol

Question #: 13

Use the standard reaction enthalpies below to determine $\Delta H^\circ_{\text{rxn}}$ for the reaction:



Given:

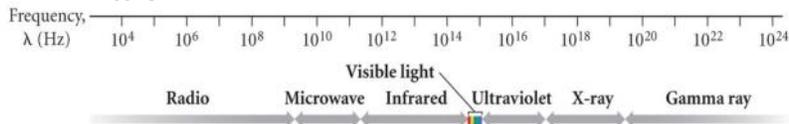


Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. _____

Question #: 14

Compare **x-ray** and **gamma ray** radiation from the electromagnetic spectrum and answer the following questions:



- 1 have longer wavelength (Answer **x-ray** or **gamma ray**)
2 have more energy per photon. (Answer **x-ray** or **gamma ray**)

1. _____
2. _____
-

Question #: 15

What is the energy of a photon of orange light ($\lambda = 623 \text{ nm}$)?

- A. $3.19 \times 10^{-19} \text{ J}$
B. $4.82 \times 10^{-14} \text{ J}$
C. 187 J
D. $3.75 \times 10^{-26} \text{ J}$
-

Question #: 16

A laser used to weld detached retinas produces radiation with a frequency of $4.69 \times 10^{14} \text{ Hz}$. What is the wavelength of the radiation in **nanometers**?

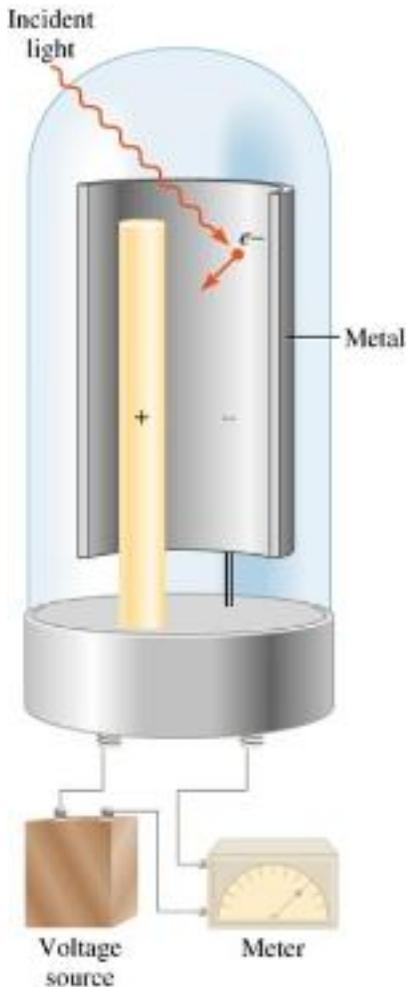
1 nm

Report your answer with **three** significant figures. Do **NOT** include units in your answer. Use the format 2.22E2 or 2.22E-2 for answers in scientific notation.

1. _____
-

Question #: 17

The image below illustrates the photoelectric effect. Match each sentence beginning, with the correct sentence conclusion by putting the **letter** in the blank.



Sentence Beginning
Below some minimum
frequency (ν_0), called the
threshold
frequency 1

Above the threshold
frequency (ν_0), as the
frequency
increases 2

Above the threshold
frequency (ν_0), as the
intensity of light
increases 3

The binding energy of
the electron is 4

Sentence Conclusion

A. the kinetic energy of
the emitted electrons
increases.

B. no electrons can be
emitted from the metal
surface.

C. photons.

D. the number of
electrons emitted
increases.

Sentence Beginning

The experiment was used to hypothesize the existence of 5

Sentence Conclusion

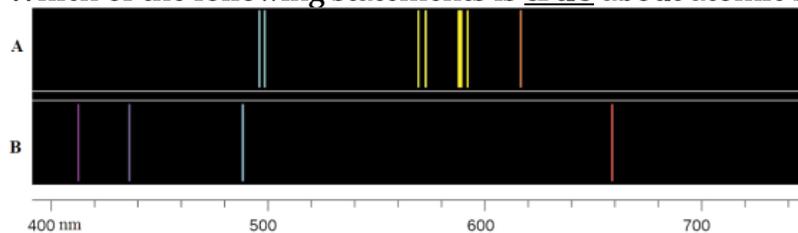
E. the minimum energy required to remove an electron from the metal surface.

F. wave nature of light.

1. _____
2. _____
3. _____
4. _____
5. _____

Question #: 18

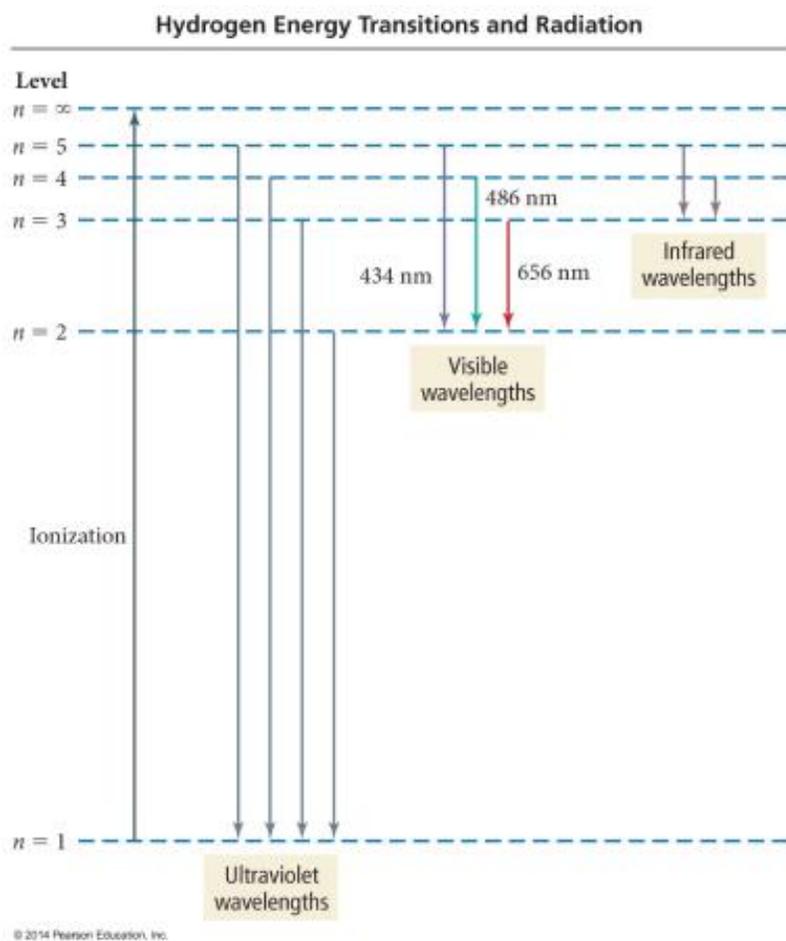
Which of the following statements is **true** about atomic spectra **A** and **B**?



- A. Spectra **A** and **B** are emission spectra for the same element but at different wavelengths.
 - B. Spectra **A** and **B** are emission spectra for two different elements.
 - C. Spectra **A** and **B** are absorption spectra for two different elements.
 - D. **A** is an absorption spectrum and **B** is an emission spectrum for two different elements.
-

Question #: 19

A hydrogen atom releases the **least** energy when it undergoes which of the following electronic transitions?



- A. $n = 2$ to $n = 1$
 - B. $n = 3$ to $n = 1$
 - C. $n = 3$ to $n = 2$
 - D. $n = 4$ to $n = 2$
-

Question #: 20

How much energy must a hydrogen atom absorb to make the transition from the $n = 1$ ground state to the $n = 4$ excited state?

1 J

Report your answer with **two** significant figures. Do **NOT** include units in your answer. Use the format 2.2E2 or 2.2E-2 for answers in scientific notation.

1. _____

Question #: 21

What is the velocity of a marble (mass = 9.66 grams) with a de Broglie wavelength of 3.46×10^{-33} m?

- A. 11.3 m/s
 - B. 19.8 m/s
 - C. 38.8 m/s
 - D. 45.2 m/s
 - E. 52.9 m/s
-

Question #: 22

An electron has quantum numbers $n = 3$, $l = 1$, and $m_l = -1$

Which orbital (sublevel or subshell) is this electron in? 1

(Your answer must consist of one number and one letter. For example 2s, 2p, 4f)

1. _____

Question #: 23

How many **orbitals** in an atom can have the quantum numbers $n = 4$ and $m_l = 0$?

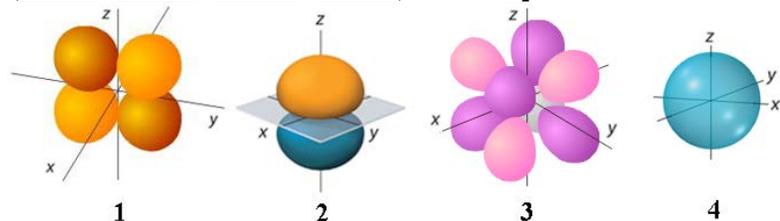
1

1. _____

Question #: 24

Identify each of these atomic orbitals by filling in each numbered blank

(1, 2, 3, 4) with **s**, **p**, **d** or **f**.



Question #: 25

2.0 grams of water is exposed to infrared radiation with a wavelength of 2.8×10^{-6} m. Assuming that all the radiation is absorbed and converted to heat, how many photons are required to raise the water temperature 2.0°C ? The specific heat of water is $4.18 \text{ J/g}\cdot^\circ\text{C}$

1 **photons**

Report your answer with **three** significant figures. Do **NOT** include units in your answer. Report your answer in scientific notation with the format 2.2E2 or 2.2E-2.

1. _____

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Periodic Table of the Elements

Period	1 IA																	18 VIIIA
1	H 1.008																	He 4.003
2	Li 6.941	Be 9.012											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18
3	Na 22.99	Mg 24.31											Al 28.98	Si 28.09	P 30.97	S 32.07	Cl 35.45	Ar 39.95
4	K 39.10	Ca 40.08	Sc 44.96	Ti 47.87	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.69	Cu 63.55	Zn 65.41	Ga 69.72	Ge 72.64	As 74.92	Se 78.96	Br 79.90	Kr 83.80
5	Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc 98	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.4	In 114.8	Sn 118.7	Sb 121.8	Te 127.6	I 126.9	Xe 131.3
6	Cs 132.9	Ba 137.3	La 175.0	Hf 178.5	Ta 180.9	W 183.8	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197.0	Hg 200.6	Tl 204.4	Pb 207.2	Bi 209.0	Po 209	At 210	Rn 222
7	Fr 223	Ra 226	Ac 227	Rf 261	Db 262	Sg 266	Bh 264	Hs 277	Mt 268	Ds 288	Rg 291	Cn 285	Uut 284	Fl 289	Uup 288	Lv 292	Uus 293	Uuo 294
lanthanides (see earth)		57 La 138.9	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 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0			
actinides		89 Ac 227	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237	94 Pu 239	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259			

Molar volume of ideal gas at STP = 22.4 L	Ideal gas constant:	Speed of light, $c = 3.00 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Faraday constant, $F = 9.6485 \times 10^4 \text{ C}\cdot\text{mol}^{-1}$	$R = 8.314 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	Rydberg constant, $R_H = 2.18 \times 10^{-18} \text{ J}$
Avogadro's number, $N = 6.022 \times 10^{23} \text{ mol}^{-1}$	$R = 1.987 \text{ cal}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	Electron charge, $e = 1.602 \times 10^{-19} \text{ C}$
Planck's constant, $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$	$R = 8.206 \times 10^{-2} \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	Atomic mass unit, $u = 1.6605 \times 10^{-24} \text{ g}$

attachment_for_pubExamUID_Inxp115005616882591799XX_203.jpg

Question #: 1

Which statement is a postulate of kinetic molecular theory?

- ✓A. The size of a gas particle is negligibly small compared to the distance between gas particles.
- B. The average kinetic energy of a gas particle is inversely proportional to the temperature in Kelvins.
- C. Gas particles do not collide with each other.
- D. All gas molecules are attracted to each other.

Question #: 2

Select the container which will have the fastest root-mean-square speed for the molecules.

- ✓A. A 1 L vessel of He(*g*) at 300 K.
- B. A 1 L vessel of Ne(*g*) at 300 K.
- C. A 2 L vessel of He(*g*) at 100 K.
- D. A 2 L vessel of Ne(*g*) at 100 K.

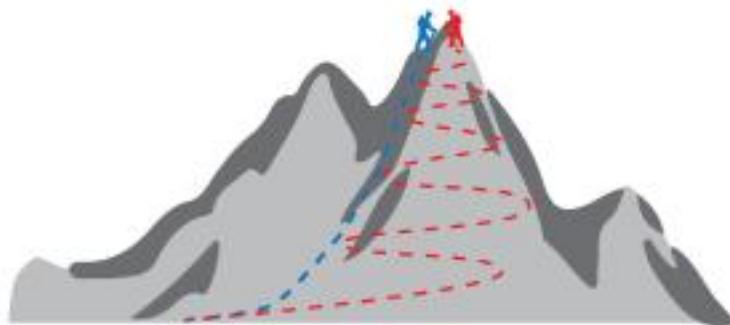
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Question #: 4

Consider the image below. Two hikers started and finished their hike at the same point. The "blue" hiker followed the blue path. The "red hiker" followed the red path up the mountain. Which property is a state function and why?



- ✓A. Altitude is a state function because the path taken does not affect the change in altitude.
 - B. The distance traveled is a state function because the path taken does not affect the distance traveled.
 - C. Work is a state function because work is path dependent.
 - D. Altitude, distance, and work are all three state functions because they do not depend upon the path taken.
-

Question #: 5

When the system is the reference, select the two correct statements below.

- A. When work is done by the system on the surroundings, the sign of work is positive (+).
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If a system absorbs 375 J of energy from the surroundings while it does 96.0 J of work, what is the change in internal energy of the system?

Report your answer with three significant figures. Do NOT include units in your answer.

1 J

1. 279|+279|

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How much work is done by the balloon? (1 L·atm = 101.3 J)

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Which sample of metal will require the most energy to raise the temperature by 5 °C?

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C_s (Fe) = 0.449 J/g·°C

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It was determined that a 50.0-gram sample of the alloy required 188 J of heat to raise the temperature of the alloy by 10.0 °C. What is the specific heat of the alloy?

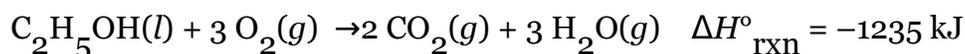
$$C_s = \underline{\quad 1 \quad} \text{ J/g}\cdot\text{°C}$$

Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. 0.376|.376|

Question #: 10

A 46.07 g sample of ethanol (C₂H₅OH, 46.07 g/mol) is burned in a bomb calorimeter, according to the following reaction equation. If the temperature of the calorimeter rises from 13.0 °C to 62.3 °C, what is the heat capacity of the calorimeter?



- A. 26.3 kJ/°C
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The enthalpy of formation, ΔH_f° , of sodium chloride (NaCl) = -411.2 kJ/mol. Which reaction is the formation reaction of NaCl and corresponds to this energy value?

- A. $2 \text{Na}(s) + \text{Cl}_2(g) \rightarrow 2 \text{NaCl}(s)$
- ✓B. $\text{Na}(s) + 1/2 \text{Cl}_2(g) \rightarrow \text{NaCl}(s)$
- C. $\text{NaCl}(s) \rightarrow \text{Na}(s) + 1/2 \text{Cl}_2(g)$
- D. $\text{Na}^+(g) + \text{Cl}^-(g) \rightarrow \text{NaCl}(s)$

Question #: 12

From the information provided, what is the standard enthalpy of formation, ΔH_f° , for $\text{IF}(g)$?

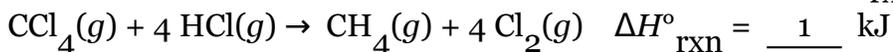


	H_f°
$\text{IF}_7(g)$	-941 kJ/mol
$\text{IF}_5(g)$	-840 kJ/mol

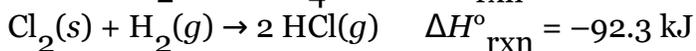
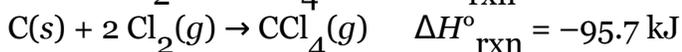
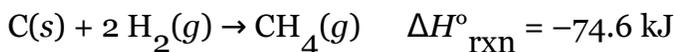
- A. 24 kJ/mol
- B. 101 kJ/mol
- ✓ C. -95 kJ/mol
- D. -146 kJ/mol
- E. -191 kJ/mol

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Use the standard reaction enthalpies below to determine $\Delta H_{\text{rxn}}^\circ$ for the reaction:



Given:

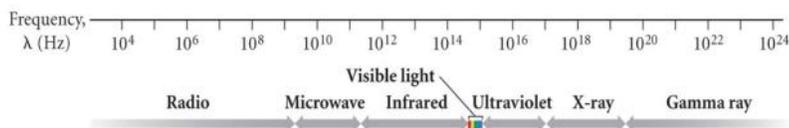


Report your answer with **three** significant figures. Do **NOT** include units in your answer.

1. 206|205|207|

Question #: 14

Compare **x-ray** and **gamma ray** radiation from the electromagnetic spectrum and answer the following questions:



- 1 have longer wavelength (Answer x-ray or gamma ray)
- 2 have more energy per photon. (Answer x-ray or gamma ray)

1. x-ray|xray|X-ray|
2. gamma|gamma ray|gamma rays|

Question #: 15

What is the energy of a photon of orange light ($\lambda = 623 \text{ nm}$)?

- A. $3.19 \times 10^{-19} \text{ J}$
- B. $4.82 \times 10^{-14} \text{ J}$
- C. 187 J
- D. $3.75 \times 10^{-26} \text{ J}$

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A laser used to weld detached retinas produces radiation with a frequency of $4.69 \times 10^{14} \text{ Hz}$. What is the wavelength of the radiation in nanometers?

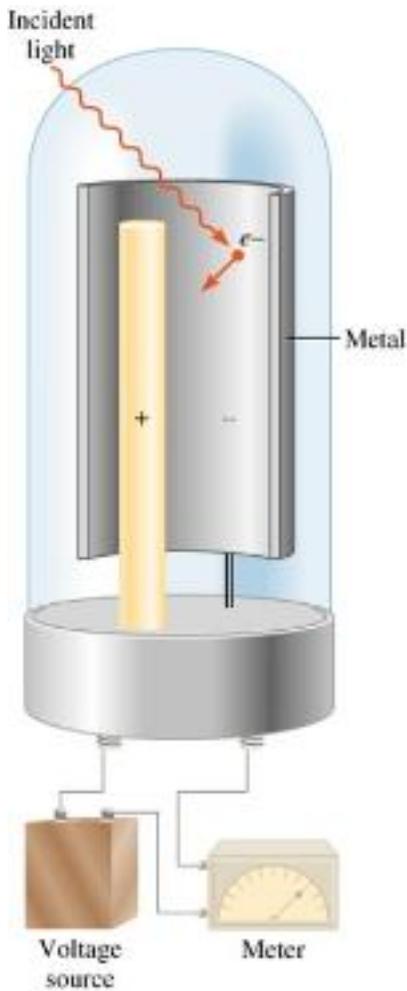
1 **nm**

Report your answer with **three** significant figures. Do **NOT** include units in your answer. Use the format 2.22E2 or 2.22E-2 for answers in scientific notation.

1. 640|6.40E2|6.40 E2|

Question #: 17

The image below illustrates the photoelectric effect. Match each sentence beginning, with the correct sentence conclusion by putting the **letter** in the blank.



ing
 minimum frequency (ν_0), called the
 frequency 1
 threshold frequency (ν_0), as the
 frequency 2
 threshold frequency (ν_0), as the
 frequency 3
 kinetic energy of the electron is 4
 was used to hypothesize the

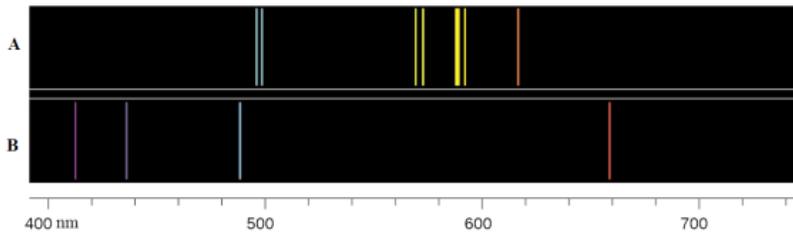
Sentence Conclusion

- A. the kinetic energy of the emitted electrons increases.
- B. no electrons can be emitted from the metal surface.
- C. photons.
- D. the number of electrons emitted increases.
- E. the minimum energy required to liberate an electron from the metal surface.
- F. wave nature of light.

1. B.|B|
2. A.|A|
3. D.|D|
4. E.|E|
5. C.|C|

Question #: 18

Which of the following statements is **true** about atomic spectra **A** and **B**?

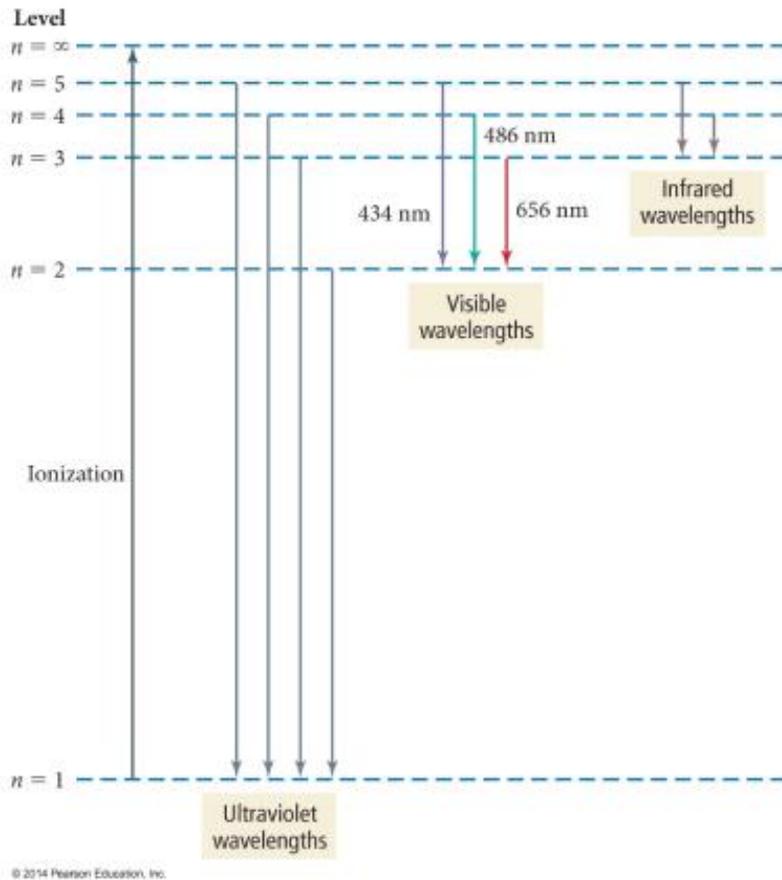


- A. Spectra **A** and **B** are emission spectra for the same element but at different wavelengths.
- ✓B. Spectra **A** and **B** are emission spectra for two different elements.
- C. Spectra **A** and **B** are absorption spectra for two different elements.
- D. **A** is an absorption spectrum and **B** is an emission spectrum for two different elements.

Question #: 19

A hydrogen atom releases the **least** energy when it undergoes which of the following electronic transitions?

Hydrogen Energy Transitions and Radiation



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- A. $n = 2$ to $n = 1$
- B. $n = 3$ to $n = 1$
- ✓C. $n = 3$ to $n = 2$
- D. $n = 4$ to $n = 2$

Question #: 20

How much energy must a hydrogen atom absorb to make the transition from the $n = 1$ ground state to the $n = 4$ excited state?

1 J

Report your answer with **two** significant figures. Do **NOT** include units in your answer. Use the format 2.2E2 or 2.2E-2 for answers in scientific notation.

1. 2.0E-18|2.0 E-18|

Question #: 21

What is the velocity of a marble (mass = 9.66 grams) with a de Broglie wavelength of 3.46×10^{-33} m?

- A. 11.3 m/s
- ✓B. 19.8 m/s
- C. 38.8 m/s
- D. 45.2 m/s
- E. 52.9 m/s

Question #: 22

An electron has quantum numbers $n = 3$, $l = 1$, and $m_l = -1$

Which orbital (sublevel or subshell) is this electron in? 1

(Your answer must consist of one number and one letter. For example 2s, 2p, 4f)

1. 3p|3 p|3P|3 P|

Question #: 23

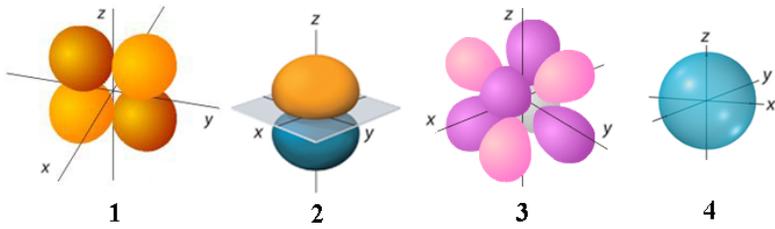
How many **orbitals** in an atom can have the quantum numbers $n = 4$ and $m_l = 0$?

 1

1. 4|four|

Question #: 24

Identify each of these atomic orbitals by filling in each numbered blank (1 , 2 , 3 , 4) with **s**, **p**, **d** or **f**.



1. d
2. p
3. f
4. s

Question #: 25

2.0 grams of water is exposed to infrared radiation with a wavelength of 2.8×10^{-6} m. Assuming that all the radiation is absorbed and converted to heat, how many photons are required to raise the water temperature 2.0 °C? The specific heat of water is 4.18 J/g·°C

1 **photons**

Report your answer with **three** significant figures. Do **NOT** include units in your answer.

Report your answer in scientific notation with the format **2.2E2** or **2.2E-2**.

1. 2.35e20|2.35E20|2.35 e20|2.35 E20|