

**INSTRUCTIONS:**

1. Fill in your social security number carefully.
2. It will be to your advantage to answer all questions.
3. Only one answer per question is allowed. Select the *best answer* from choices given.
4. Use a #2 soft lead pencil.
5. Erasures must be complete.
6. Marks must blacken the entire space in the circle.
7. Answer sheets must not be torn or have holes.
8. This is a 100 point exam.
9. THIS EXAM HAS 30 QUESTIONS. PLEASE MAKE SURE YOUR EXAM IS COMPLETE.
10. Answer number 1 - 30 on your answer sheet.

**Useful information:**

$$PV = nRT$$

$$1 \text{ atm} = 101 \text{ kPa}$$

$$R = 0.0821 \text{ (L} \cdot \text{atm)/(mol} \cdot \text{K)}$$

$$q = ms\Delta t$$

$$c = \lambda\nu$$

$$E_n = -R_H \left( \frac{1}{n^2} \right)$$

$$R_H = 2.18 \times 10^{-18} \text{ J}$$

$$\Delta H_{\text{rxn}}^\circ = \sum n\Delta H_f^\circ(\text{products}) - \sum m\Delta H_f^\circ(\text{reactants})$$

$$1 \text{ mmHg} = 1 \text{ torr}$$

$$T(\text{K}) = T(^{\circ}\text{C}) + 273$$

$$P_A = X_A P_T$$

$$q = C\Delta t$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$\Delta E = R_H \left( \frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

$$h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$1 \text{ atm} = 760 \text{ torr}$$

$$\text{STP} = 1 \text{ atm}, 0^{\circ}\text{C}$$

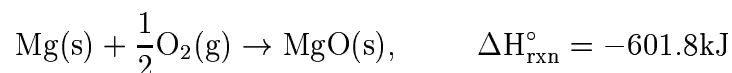
$$X_A = n_A/n_T$$

$$E = h\nu$$

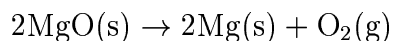
1. Which is the SI unit of pressure?
  - A. lbs/in<sup>2</sup>
  - B. atmospheres (atm)
  - C. Pascals (Pa)
  - D. torr
  
2. The instrument most likely to be used to measure gas pressure is the:
  - A. thermometer
  - B. calorimeter
  - C. spectrometer
  - D. barometer
  
3. 455 torr is equal to what pressure in kPa?
  - A. 60.5 kPa
  - B. 605 kPa
  - C. 59.3 kPa
  - D. 59.9 kPa
  - E. 593 kPa
  
4. A sample of gas occupies 4.3 L when the pressure is 1.9 atm. What volume does it occupy at 5.2 atm if the temperature remains constant?
  - A. 8.2 L
  - B. 1.6 L
  - C. 0.64 L
  - D. 2.7 L
  
5. Under constant pressure conditions, a sample of H<sub>2</sub> gas with an initial temperature of 350 K and an initial volume of 11.0 L is cooled until the final volume is 2.50 L. What is the final temperature?
  - A. 0.13 K
  - B. 80 K
  - C. 32 K
  - D. 140 K
  - E. 1540 K

6. A quantity of ideal gas weighing 14.2 g at 0.975 atm pressure and a temperature of 44 °C occupies a volume of 5.40 L. What is its molar mass (g/mol)?
- A. 14.2 g/mol
  - B. 28.4 g/mol
  - C. 35.1 g/mol
  - D. 70.2 g/mol
7. A mixture of gases contains 3.0 moles of N<sub>2</sub>(g), 3.0 moles of O<sub>2</sub>(g), and 2.0 moles of Cl<sub>2</sub>(g). If the total pressure of the system is 3.0 atm, what is the partial pressure of N<sub>2</sub>(g)?
- A. 3.0 atm
  - B. 1.25 atm
  - C. 1.13 atm
  - D. 0.75 atm
8. For which of the following reactions occurring at 25 °C and 1 atm is the enthalpy of reaction equal to the standard enthalpy of formation for AgNO<sub>3</sub>(s)?
- A.  $2\text{Ag}(\text{s}) + \text{N}_2(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{AgNO}_3(\text{s})$
  - B.  $\text{Ag}(\text{s}) + \frac{1}{2}\text{N}_2(\text{g}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{AgNO}_3(\text{s})$
  - C.  $\text{Ag}(\text{s}) + \text{N}(\text{g}) + 3\text{O}(\text{g}) \rightarrow \text{AgNO}_3(\text{s})$
  - D.  $\text{Ag}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{AgNO}_3(\text{s})$
  - E.  $\text{Ag}(\text{s}) + \text{NO}_3(\text{l}) \rightarrow \text{AgNO}_3(\text{s})$
  - F.  $\text{Ag}(\text{s}) + \text{N}(\text{g}) + \text{O}_3(\text{g}) \rightarrow \text{AgNO}_3(\text{s})$
9. The specific heat of ethanol (C<sub>2</sub>H<sub>5</sub>OH) is 2.46 J/g·°C. A sample of 2.5 kg ethanol is heated from 7.5 °C to 55.0 °C. The amount of heat absorbed by the ethanol is
- A.  $1.17 \times 10^2$  J
  - B.  $1.17 \times 10^5$  J
  - C.  $2.92 \times 10^2$  J
  - D.  $2.92 \times 10^5$  J
  - E.  $4.67 \times 10^1$  J
  - F.  $4.67 \times 10^{-2}$  J
10. An endothermic process:
- A. gives off heat to the surroundings
  - B. does not exchange energy with the surroundings
  - C. takes in matter from the surroundings
  - D. decreases the temperature of the surroundings
  - E. none of the above

11. Given the thermochemical equation:

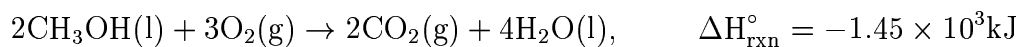


What is the enthalpy of reaction for the following reaction



- A. -601.8 kJ
- B. +601.8 kJ
- C. -300.9 kJ
- D. +300.9 kJ
- E. -1203.6 kJ
- F. +1203.6 kJ

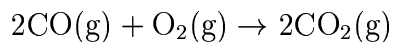
12. Given the following thermochemical equation:



How much heat is evolved when 640 g of  $\text{CH}_3\text{OH}$  is burned?

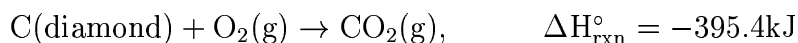
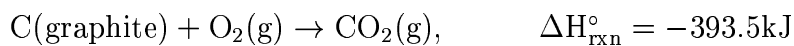
- A.  $1.45 \times 10^4$  kJ
- B.  $9.28 \times 10^5$  kJ
- C.  $4.64 \times 10^5$  kJ
- D.  $2.90 \times 10^4$  kJ

13. Based on the table of standard enthalpies of formation (see exam cover page), what is the standard enthalpy of reaction for the following reaction?



- A. -110.5 kJ
- B. -283.0 kJ
- C. -393.5 kJ
- D. -566.0 kJ
- E. -738.5 kJ

14. Use the following thermochemical equations to calculate the standard enthalpy of formation for C(diamond) from C(graphite).



- A. -395.4 kJ  
B. +395.4 kJ  
C. -788.9 kJ  
D. +788.9 kJ  
E. -1.9 kJ  
F. +1.9 kJ
15. What is the wavelength in nm of light with a frequency of  $5.10 \times 10^{14}$  Hz?
- A. 588 nm  
B. 593 nm  
C. 598 nm  
D. 603 nm  
E. 608 nm
16. What is the frequency of a photon emitted during a transition from the  $n = 6$  state to the  $n = 3$  state of the hydrogen atom?
- A.  $2.74 \times 10^{14}$  Hz  
B.  $-2.74 \times 10^{14}$  Hz  
C.  $3.65 \times 10^{14}$  Hz  
D.  $-3.65 \times 10^{14}$  Hz  
E.  $9.13 \times 10^{13}$  Hz  
F.  $-9.13 \times 10^{13}$  Hz
17. Which of the following sets of quantum numbers  $(n, l, m_l, m_s)$  is **not** allowed?
- A.  $1, 0, 0, \frac{1}{2}$   
B.  $4, 3, 2, -\frac{1}{2}$   
C.  $4, 1, 2, \frac{1}{2}$   
D.  $3, 0, 0, \frac{1}{2}$   
E.  $2, 1, -1, -\frac{1}{2}$

18. How many orbitals are there in the  $n = 3$  shell?
- A. 3
  - B. 5
  - C. 7
  - D. 9
  - E. 11
19. How many electrons can be placed in the 4f subshell?
- A. 2
  - B. 5
  - C. 7
  - D. 10
  - E. 14
  - F. As many as you like.
20. The quantum number  $l$  is called the
- A. principle quantum number
  - B. electron spin quantum number
  - C. angular momentum quantum number
  - D. magnetic quantum number
21. Substances that are attracted to a magnetic field due to the presence of unpaired electrons are called
- A. diamagnetic
  - B. supermagnetic
  - C. magnetites
  - D. chondrites
  - E. paramagnetic
22. The ground state electron configuration for  $\text{Pd}^{+4}$  ion is
- A.  $[\text{Kr}]5s^24d^8$
  - B.  $[\text{Kr}]5s^04d^{10}$
  - C.  $[\text{Kr}]5s^24d^4$
  - D.  $[\text{Kr}]5s^04d^6$
  - E.  $[\text{Kr}]5s^24d^{10}5p^2$

23. Which of the following elements has a  $[\text{Ar}]4s^23d^{10}4p^4$  ground state electron configuration?
- A. Se
  - B. As
  - C. Ge
  - D. S
  - E. P
  - F. Si
24. How many unpaired electrons are there in an oxygen atom in its ground state electron configuration?
- A. 0
  - B. 1
  - C. 2
  - D. 3
  - E. 4
  - F. 6
25. What category of element has atoms or ions with partially filled d subshells?
- A. Lathanide or rare earth elements
  - B. Transition metal elements
  - C. Noble gases
  - D. Halogens
26. Which of the following ions are isoelectronic with Ar?
- A.  $\text{S}^{2-}$
  - B.  $\text{Cl}^-$
  - C.  $\text{K}^+$
  - D.  $\text{Ca}^{2+}$
  - E.  $\text{Ti}^{4+}$
  - F. All of the above
27. Which of the following statements is true?
- A. Ar is larger than Kr
  - B. Cl is larger than Mg
  - C. K is larger than Mg
  - D. Cl is larger than Se

28. Which of the following ions is smaller than  $\text{Rb}^+$ ?
- A.  $\text{Sr}^{2+}$
  - B.  $\text{Br}^-$
  - C.  $\text{Cs}^+$
  - D. None of the above
29. The ionization energy of the elements usually increases as you move
- A. to the right and up the periodic table.
  - B. to the left and up the periodic table.
  - C. to the right and down the periodic table.
  - D. to the left and down the periodic table.
30. Which of the following elements has the largest electron affinity?
- A. H
  - B. F
  - C. K
  - D. He
  - E. Kr