This print-out should have 20 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001　10.0 points
Which of the following is not true about the catalyst responsible for the hole in the ozone layer?

1. Sunlight facilitates the formation of the catalyst.

2. The catalyst's source is often a chlorofluorocarbon.

3. It is a heterogeneous catalyst.

4. It is a free radical.

5. Ozone is converted to O_2 in the catalyzed reaction.

002　10.0 points
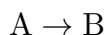Which of the following can increase the rate of reaction by increasing the rate constant k?
　I.　raising the temperature
　II.　decreasing the volume
　III.　adding a catalyst
　IV.　increasing the concentration

1. II only

2. I only

3. I, II, and III only

4. III and IV only

5. I and III only

003　10.0 points
If $k = 2.7 \times 10^{-6} \text{ M}^{-1}\text{s}^{-1}$ for the reaction

$$A \to B$$

which of the following is the correct rate law?

1. rate $= k\,[A]^0\,[B]^{-1}$

2. rate $= k\,[A]^0$

3. rate $= k\,[A]^2$

4. rate $= k\,[A]^2\,[B]^{-1}$

5. rate $= k\,[A]^1$

004　10.0 points
Calculate the density of camphor $(C_{10}H_{16}O)$ at $80°C$ and 12 Torr.

1. $0.083 \text{ g} \cdot \text{L}^{-1}$

2. $6.8 \times 10^{-3} \text{ g} \cdot \text{L}^{-1}$

3. $0.37 \text{ g} \cdot \text{L}^{-1}$

4. $0.62 \text{ g} \cdot \text{L}^{-1}$

5. $8.2 \times 10^{-4} \text{ g} \cdot \text{L}^{-1}$

005　10.0 points
Lithium metal reacts with nitrogen gas to produce lithium nitride. What volume of nitrogen gas at 2 atm and $175°C$ is required to produce 75.0 g of lithium nitride?

1. 39.6 L

2. 79.2 L

3. 19.8 L

4. 119 L

5. 7.73 L

006　10.0 points
Calculate the ratio of the rate of effusion of CO_2 to that of He (at the same temperatures).

1. $1 : 11$

2. $1 : 11^2$

3. $\sqrt{11} : 1$

4. $11^2 : 1$

5. 1 : 1

6. 11 : 1

7. 1 : $\sqrt{11}$

007　10.0 points

Rank the gases H_2, CH_3F, N_2, CF_4, HF from left to right in terms of the increased non-ideality that results from a reduction in the effective pressure of the gas due to intermolecular forces.

1. H_2, N_2, CF_4, CH_3F, HF

2. CF_4, CH_3F, N_2, HF, H_2

3. H_2, N_2, HF, CH_3F, CF_4

4. H_2, CH_3F, N_2, CF_4, HF

5. H_2, HF, N_2, CH_3F, CF_4

6. HF, CH_3F, CF_4, N_2, H_2

008　10.0 points

The molar volume of a gas at STP is

1. 22.4 liters.

2. 12.4 gallons.

3. 12.4 liters.

4. 6.02×10^{23} liters.

009　10.0 points

All of the following statements, except one, are important postulates of the kinetic-molecular theory of ideal gases. Which one is not a part of this kinetic molecular theory?

1. The average kinetic energy of the molecules is inversely proportional to the absolute temperature.

2. The time during which a collision between two molecules occurs is negligibly short compared to the time between collisions.

3. There are no attractive nor repulsive forces between the individual molecules.

4. The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.

5. Gases consist of large numbers of particles in rapid random motion.

010　10.0 points

Which of the following statements is true about the speeds of molecules in a gas sample?

1. As the temperature is raised the fraction of molecules with high speeds decreases.

2. As the temperature is raised the fraction of molecules with high speeds increases.

3. The fraction of molecules having very low speeds is high.

4. As the temperature is raised the fraction of molecules with low speeds increases.

5. As the temperature is raised the fraction of molecules with a given speed remains unchanged.

011　10.0 points

In an improved version of the gas law, V is replaced by $(V - n\,b)$. Which of the following would you predict has the largest b?

1. He

2. Ar

3. Kr

4. Xe

5. Ne

012　10.0 points

If we increase the volume of a gaseous system

by a factor of 3 and raise the temperature by a factor of 6, then the pressure of the system will (increase/decrease) by a factor of (2/18):

1. increase, 2

2. increase, 18

3. decrease, 2

4. decrease, 18

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013   10.0 points

Which of the following statements is/are true?
   I) At a given temperature, larger molecules have greater average kinetic energy than smaller molecules.
  II) As the temperature of a gaseous system rises, the gas molecules' average speed increases.
 III) Gas molecules have an average rate of diffusion that is lower than their average velocity.

1. I, II

2. I only

3. II, III

4. I, II, III

5. II only

6. I, III

7. III only

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014   10.0 points

Consider the data below:

	[NO] M	[CO$_2$] M	initial rate M$\cdot$s^{-1}
Exp 1	0.4	1.2	2.178×10^{-1}
Exp 2	0.8	2.4	8.572×10^{-1}
Exp 3	0.4	0.6	2.178×10^{-1}

Which of the following is a correct rate law for the reaction?

1. $k \cdot [CO_2]^2[NO]^{-1}$

2. $k \cdot [CO_2]^2$

3. $k \cdot [NO]^2$

4. $k \cdot [NO]$

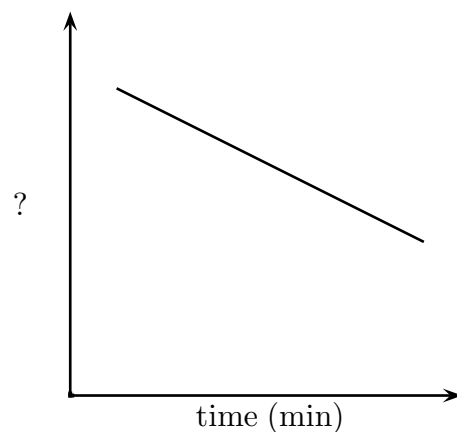**5.** $k \cdot [NO] \cdot [CO_2]$

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015   10.0 points

A non-steroidal anti-inflammatory drug is metabolized with a first-order rate constant of 3.25 day^{-1}. What is the half-life for the metabolism reaction?

1. 1.63 day

2. 2.25 day

3. 0.213 day

4. 0.308 day

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016   10.0 points

If the plot below were for a 1st order reaction, what units belong on the y-axis?

1. Not enough information

2. [A] (M)

3. ln [A]

4. $\dfrac{1}{[A]}$ (M^{-1})

017　10.0 points

In collision theory, temperature most impacts which of the following terms?

1. collision frequency

2. steric requirements

3. Collision theory has nothing to do with temperature.

4. activation energy

018　10.0 points

Consider the reaction mechanism below:

Step	Reaction
1	$C_2H_4 + BrF \longrightarrow C_2H_4F + Br$
2	$C_2H_4F + BrF \longrightarrow C_2H_4F_2 + Br$
3	$Br + Br \longrightarrow Br_2$
overall	$C_2H_4 + 2\,BrF \longrightarrow C_2H_4F_2 + Br_2$

What is the rate law if step 2 is the rate-determining step?

1. rate $= k \cdot [C_2H_4] \cdot [BrF]^2$

2. rate $= k \cdot [C_2H_4] \cdot [BrF]^2 \cdot [C_2H_4F_2]^{-1}$

3. rate $= k \cdot [C_2H_4] \cdot [BrF]$

4. rate $= k \cdot [C_2H_4] \cdot [BrF]^2 \cdot [Br]^{-1}$

5. rate $= k \cdot [C_2H_4] \cdot [BrF] \cdot [Br]^{-1}$

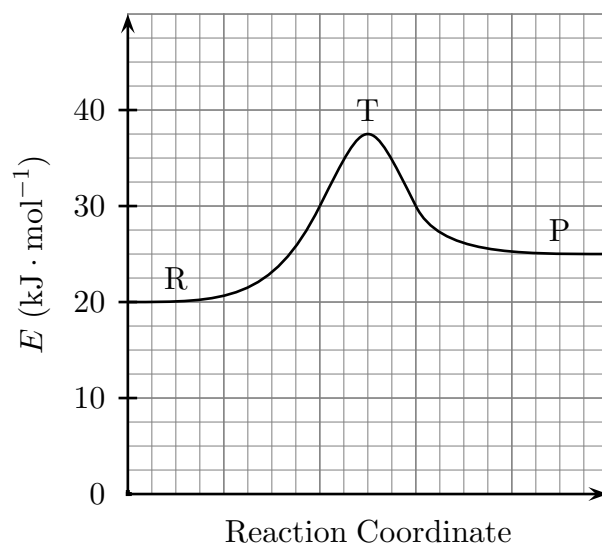### 019　10.0 points

Consider the reaction mechanism below:

Step	Reaction
1	$Cl_2 + Pt \longrightarrow 2\,Cl + Pt$
2	$Cl + CO + Pt \longrightarrow ClCO + Pt$
3	$Cl + ClCO \longrightarrow Cl_2CO$
overall	$Cl_2 + CO \longrightarrow Cl_2CO$

Which species is/are intermediates?

1. Pt

2. Cl, ClCO

3. Pt, ClCO

4. Cl

5. Pt, Cl

6. ClCO

020　10.0 points

What is the activation energy for the forward reaction in the diagram below?

1. $17.5 \text{ kJ} \cdot \text{mol}^{-1}$

2. $5.0 \text{ kJ} \cdot \text{mol}^{-1}$

3. $20.0 \text{ kJ} \cdot \text{mol}^{-1}$

4. $12.5 \text{ kJ} \cdot \text{mol}^{-1}$

5. $25.0 \text{ kJ} \cdot \text{mol}^{-1}$

6. $37.5 \text{ kJ} \cdot \text{mol}^{-1}$