CH302 UNIT 7 EXAM FREE RESPONSE NAME:_____
Vanden Bout/LaBrake Spring 2013

EID:_____

(***You must keep your answers in the space provided.***)

Version #: _____

1. (**3 pts)** State three differences between chemical change and nuclear change.

- Energy released by a chemical change is much less than a nuclear change
- Macroscopically, you can see chemical changes, whereas nuclear changes require a Geiger counter, cannot be examined with the eye
- Chemical changes involve the rearrangement of atoms, maintaining their identity. Nuclear changes involve changes in the nucleus.
- Nuclear change "ignores" conservation of mass ($E=mc^2$)
- (Nuclear change has noticeable chases in mass)
- Nuclear change is all about the nucleus, chemical change is all about the electrons
- (Nuclear "ignores" electrons, chemical change doesn't)
- (Potential energy → chemical based off electrons nuclear based off nucleas)
- Nuclear change can be used to date things.

NOTE: Redundant items count as 1 (chemical change has a small amount of energy, nuclear changes produce a large amount of energy is ONE difference, not two)

1 point for each difference, Maximum 3 points

2. (**3 pts**) Write the balanced equation for the beta (-) decay of Am-242.

$^{242}_{95}Am \rightarrow ^{0}_{-1}\beta + ^{242}_{96}Cm$ or $^{242}_{95}Am \rightarrow ^{0}_{-1}e + ^{242}_{96}Cm$

3 pts: Perfect equation

2 pts: Something is off, but mostly right

- wrong type of decay, OR wrong element symbols, OR reversed equation

1 pt: Something was correct, partial credit given

- correct decay, wrong element and number, OR electron capture

3. (**4pts**) Determine the half-life in units of hours for the beta (-) decay of Am-242 given the following graph.

m=-k

$-\frac{3}{70}$=-k

k = 4.286 hrs^{-1}

$t_{1/2} = \frac{\ln(2)}{k}$

$t_{1/2}$ = 16.2 hrs

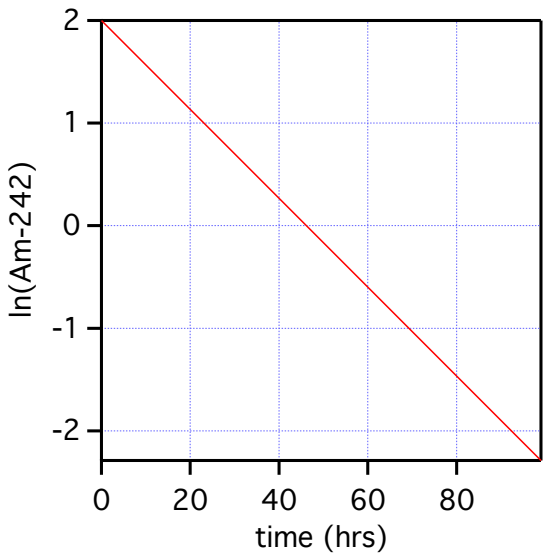
16 ± 2 accepted

Partial credit given for equations

+1 for m = -k, +1 for half life

+1 for finding k

-1 if $t_{1/2}$ is a negative number

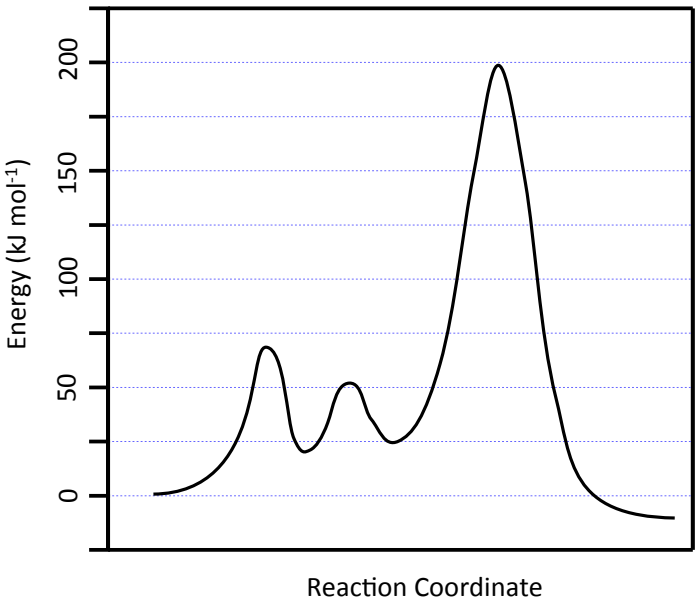


4. (**3 pts**) Based on the reaction coordinate diagram shown below circle the best, proposed mechanism for the reaction below:

Mechanism #1	**Mechanism #2**	**Mechanism #3**
$I_2 \leftrightarrow 2I$ (fast)	$H_2 \rightarrow 2H$ (fast)	$I_2 \leftrightarrow 2I$ (fast)
$H_2 + I \rightarrow H_2I$ (fast)	$I_2 \leftrightarrow 2I$ (slow)	$I + H_2 \leftrightarrow H_2I$ (fast)
$\frac{1}{2} I + \frac{1}{2} H_2I \rightarrow HI$ (fast)	$2H + 2I \rightarrow 2HI$ (fast)	$H_2I + I \rightarrow 2HI$ (slow)
$\frac{1}{2} I_2H + \frac{1}{2} H \rightarrow HI$ (slow)		

#3 is correct: 3 pts

5. (**3pts**) Briefly in the space below, state how you identified the best mechanism.



Mechanism #3
--has 3 "humps" (peaks) for 3 steps
--3rd step is the slow step, 3rd peak is the largest, has the largest activation energy
--has 2 intermediates, I and H_2I
Full credit given for 3 peaks, 3 steps and slow step has highest activation energy.
Multiple answers accepted

IF Mechanism #2
Total possible points: 2
3 steps, 3 peaks on graph

IF Mechanism #1
Total possible points: 2
Last step is the slow step, highest E_a

<u>FOR MECHANISM #3</u>

6. (**2 pts**) Write the overall balanced equation predicted by the correct mechanism.

$I_2 + H_2 \rightarrow 2HI$
2 pts for perfect equation, +1 if still contained some intermediates

7. (**4 pts**) Based on the mechanism you chose, write the rate law for the overall reaction and state the overall reaction order.

Rate = $k[I_2][H_2]$
3 pts: Perfect
2 pts: Substituted CORRECTLY for 1 intermediate, but not both
1 pts: Started with correct step, did not substitute for intermediates
Overall reaction order: 2nd order 1 pt, based on rate law AS WRITTEN

8. (3 pts) Based on the reaction coordinate diagram above, state the activation energy that limits the overall rate of the reaction.

175 kJ/mol 3 pts
IF 200 kJ/mol, then 1 pt

Conversion: 1 amu = 1.66×10^{-27} kg

FOR MECHANISM #2

6. (2 pts) Write the overall balanced equation predicted by the correct mechanism.

$I_2 + H_2 \rightarrow 2HI$
2 pts: perfect, +1 if didn't cross out intermediates

7. (4 pts) Based on the mechanism you chose, write the rate law for the overall reaction and state the overall reaction order.

Rate = $k[I_2][H_2]$ 3 pts
Overall reaction order: 2nd order 1 pt, BASED on the rate law written

8. (3 pts) Based on the reaction coordinate diagram above, state the activation energy that limits the overall rate of the reaction.

25 kJ/mol
IF 50 kJ/mol, then 1 pt
(Mechanism #2 has the slow step as the 2nd step, which would limit the overall rate of reaction, so the second peak is where the number comes from)

FOR MECHANISM #1

6. (2 pts) Write the overall balanced equation predicted by the correct mechanism.

$I_2 + H_2 + \frac{1}{2} I_2H + \frac{1}{2} H \rightarrow 2HI + \frac{1}{2} H_2I + \frac{1}{2} I$
2 pts: perfect, +1 if didn't cross out intermediates OR have $I_2 + H_2 \rightarrow 2HI$

7. (4 pts) Based on the mechanism you chose, write the rate law for the overall reaction and state the overall reaction order.

Rate = $k[I_2H]^{1/2}[H]^{1/2}$ 3 pts FULL Credit
1 pt: $k[I_2H][H]$
Overall reaction order: 1st order 1 pt, BASED on the rate law written

8. (3 pts) Based on the reaction coordinate diagram above, state the activation energy that limits the overall rate of the reaction.

175 kJ/mol 3 pts
IF 200 kJ/mol, then 1 pt