X

NPTEL

reviewer1@nptel.iitm.ac.in ▾

Courses » **Chemistry - II**

Announcements **Course** Ask a Question Progress Mentor

Unit 4 - Week 3

Course outline

- How to access the portal
- Week 1
- Week 2
- Week 3
  - Lecture 10 : Diatomic Vibration Spectra Harmonic Model
  - Lecture 11 : Diatomic Vibration Morse Oscillator Model
  - Quiz : Assessment 5
- Week 4
- Week 5
- Week 6
- Week 7
- Week 8

Assessment 5

The due date for submitting this assignment has passed. **Due on 2016-03-18, 23:59 IST.**

Submitted assignment

Assume speed of light to be 3 x 10^8 m.s^{-1}; Planck's constant h = 6.626 x 10^{-34} J.s. Boltzmann constant k_B = 1.38 x 10^{-23} J.K^{-1}

1) The force constants of HI, HBr, HCl and HF are given as 314, 412, 516 and 966 Nm^{-1} respectively. The fundamental (or harmonic) vibrational frequencies are in the order *1 point*

- $\nu_{HF} > \nu_{HCl} > \nu_{HBr} > \nu_{HI}$
- $\nu_{HF} < \nu_{HCl} < \nu_{HBr} < \nu_{HI}$
- $\nu_{HCl} > \nu_{HF} > \nu_{HBr} > \nu_{HI}$
- $\nu_{HF} > \nu_{HCl} > \nu_{HI} > \nu_{HBr}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\nu_{HF} > \nu_{HCl} > \nu_{HBr} > \nu_{HI}$

2) The fundamental vibrational frequencies of HCl and DCl have the relation *1 point*

- $\nu_{HCl} = \nu_{DCl}$
- $\nu_{HCl} \approx 1.395\nu_{DCl}$
- $\nu_{HCl} \approx 0.717\nu_{DCl}$
- $\nu_{HCl} = 2\nu_{DCl}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\nu_{HCl} \approx 1.395\nu_{DCl}$

3) The reduced mass of CO is 1.138×10^{-26} kg and the force constant is 1902 Nm^{-1}. Light required to induce a transition from *n* = 2 to *n* = 3 has a wavenumber of *1 point*

- $6507\ cm^{-1}$
-

$4338\ cm^{-1}$

$2169\ cm^{-1}$

$1085\ cm^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2169\ cm^{-1}$

4) The energy required to excite a molecule from its ground state to the first excited state corresponds to a wavenumber of $1000\ cm^{-1}$. In thermal equilibrium, at a temperature of 100 K, the ratio of the number of molecules in the excited vibrational state to those in the ground vibrational state is ***1 point***

5.55×10^{-3}

5.55×10^{-5}

5.55×10^{-7}

5.55×10^{-9}

No, the answer is incorrect.
Score: 0

Accepted Answers:
5.55×10^{-7}

5) The Morse potential energy function for a diatomic molecule is given by the formula $D[1 - e^{-\alpha x}]^2$ where *x* is the vibrational amplitude. The interpretation of *D* is ***1 point***

- It is the force constant
- It is the frequency of fundamental vibration
- It is the energy required to excite the molecule from the ground state to the first excited state
- It is the dissociation energy of molecule

No, the answer is incorrect.
Score: 0

Accepted Answers:
It is the dissociation energy of molecule

6) The energy level expression for the Morse oscillator is (x_e is the anharmonicity constant and is << 1) ***1 point***

$E = h\nu_e(n + 1/2)$

$E = h\nu_e(n + 1/2)^2$

$E = h\nu_e(1 - x_e)(n + 1/2)$

$E = h\nu_e(n + 1/2) - h\nu_e x_e(n + 1/2)^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$E = h\nu_e(n + 1/2) - h\nu_e x_e(n + 1/2)^2$

7) The energy required to raise a Morse oscillator from an energy state with vibrational quantum number *n* = 3 to another state with *n* = 5 is given as ***1 point***

$2h\nu_e - 18h\nu_e x_e$

$2h\nu_e$

$2h\nu_e \; - \; 9h\nu_e x_e$

$2h\nu_e \; - \; 2h\nu_e x_e$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2h\nu_e \; - \; 18h\nu_e x_e$

8) The approximate formula for the anharmonicity coefficient x_e is (D is the dissociation energy; hint : problem 6) ***1 point***

$x_e \; \approx \; \sqrt{\frac{1}{D}}$

$x_e \; \approx \; \sqrt{\frac{\nu_e}{D}}$

$x_e \; \approx \; \sqrt{\frac{h\nu_e}{4D}}$

$x_e \; \approx \; \sqrt{\frac{D}{4h\nu_e}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$x_e \; \approx \; \sqrt{\frac{h\nu_e}{4D}}$

9) The selection rule for transitions in a Morse oscillator is ***1 point***

$\Delta n \; = \; \pm 1$

$\Delta n \; = \; \pm 1 \; or \; \pm \; 2$

$\Delta n \; = \; \pm 2 only$

Δn can be of any integer

No, the answer is incorrect.
Score: 0

Accepted Answers:
Δn can be of any integer

10)The parameter α in Morse oscillator is related to the harmonic oscillator frequency. The possible expression is ***1 point***

$\alpha \; \approx \; \nu_e$

$\alpha \; \approx \; \nu_e / c$

$\alpha \; \approx \; 1/\nu_e$

$\alpha \; \approx \; \nu_e x_e$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\alpha \approx \nu_e/c$

Previous Page

End