WebAssign
CH08-HW02-SP12 (Homework)

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PHYS 172-SPRING 2012, Spring 2012
Instructor: Virendra Saxena

Current Score : 21 / 21 **Due :** Tuesday, March 6 2012 11:59 PM EST

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1. 2/2 points | Previous Answers MI3 8.3.X.019

The Franck-Hertz experiment involved shooting electrons into a low-density gas of mercury atoms and observing discrete amounts of kinetic energy loss by the electrons. Suppose instead a similar experiment is done with a very cold gas of atomic hydrogen, so that all of the hydrogen atoms are initially in the ground state. If the kinetic energy of an electron is 10.7 eV just before it collides with a hydrogen atom, how much kinetic energy will the electron have just after it collides with and excites the hydrogen atom?

K_{final} = 0.5 ✓ eV

- *Read the eBook*
- Section 8.3

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2. 3/3 points | Previous Answers MI3 8.4.X.009

Suppose a collection of quantum harmonic oscillators occupies the lowest 4 energy levels, and the spacing between levels is 0.04 eV. What is the complete emission spectrum for this system? That is, what photon energies will appear in the emissions? Include all energies, whether or not they fall in the visible region of the electromagnetic spectrum. Enter the photon energies in order of increasing energy.

Smallest photon energy = 0.04 ✓ eV
Next larger photon energy = 0.08 ✓ eV
Largest photon energy = 0.12 ✓ eV

- *Read the eBook*
- Section 8.4

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3. 3/3 points | Previous Answers MI3 8.2.X.005

Suppose you had a collection of a large number of hypothetical quantum objects, each of whose individual energy levels were -4.0 eV, -2.1 eV, -1.8 eV, and -0.7 eV. If nearly all of these identical objects were in the ground state, what would be the energies of dark spectral lines in an absorption spectrum if *visible white light* (1.8 to 3.1 eV) passes through the material? Enter the energies in order of increasing energy, followed by entering 0 in any later boxes for which there is no dark line within the visible spectrum. (That is, if your answers were 1, 2, and 3 eV, you would enter 1 in the first box, 2 in the second box, and 3 in the third box. If your answers were 1 and 2 eV, you would enter 1 in the first box, 2 in the second box, and 0 in the third box. If your answer is just 1 eV, you would enter 1 in the first box, 0 in the second box, and 0 in the third box.)

Smallest energy of a dark line: 1.9 ✓ eV
Next larger energy of a dark line (or 0): 2.2 ✓ eV

Next larger energy of a dark line (or 0): 0 eV

- *Read the eBook*
- Section 8.2

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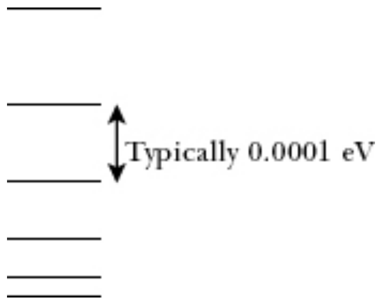
4. 5/5 points | Previous Answers MI3 8.7.X.033

Match the type of system or situation to the appropriate energy level diagram.

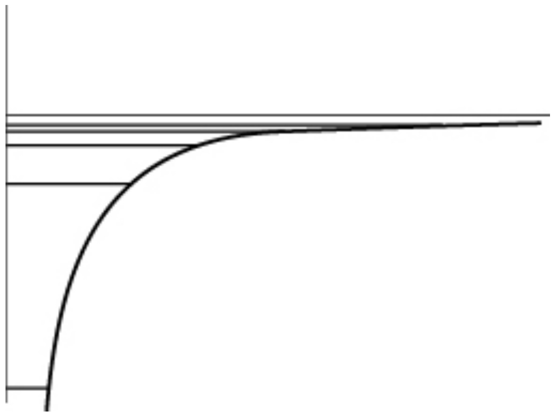
g — vibrational states of a diatomic molecule such as O_2

a.



d — idealized quantized spring-mass oscillator

b.



a — rotational states of a diatomic molecule such as O_2

c.

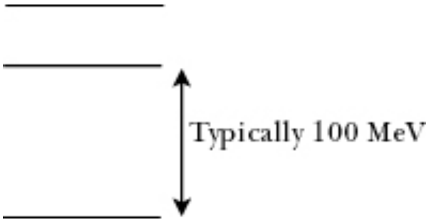
b — electronic states of a single atom such as hydrogen

d.

f

nuclear (such as the nucleus of a carbon atom)

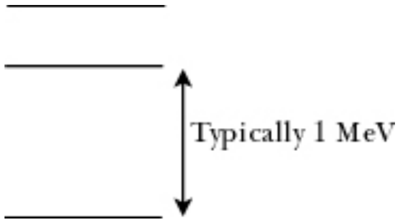
e.



c

electronic, vibrational, and rotational states of a diagonal molecule such as O_2

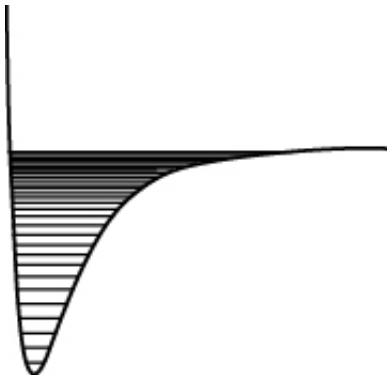
f.



e

hadronic (such as Δ^+)

g.



- *Read the eBook*
- Section 8.7

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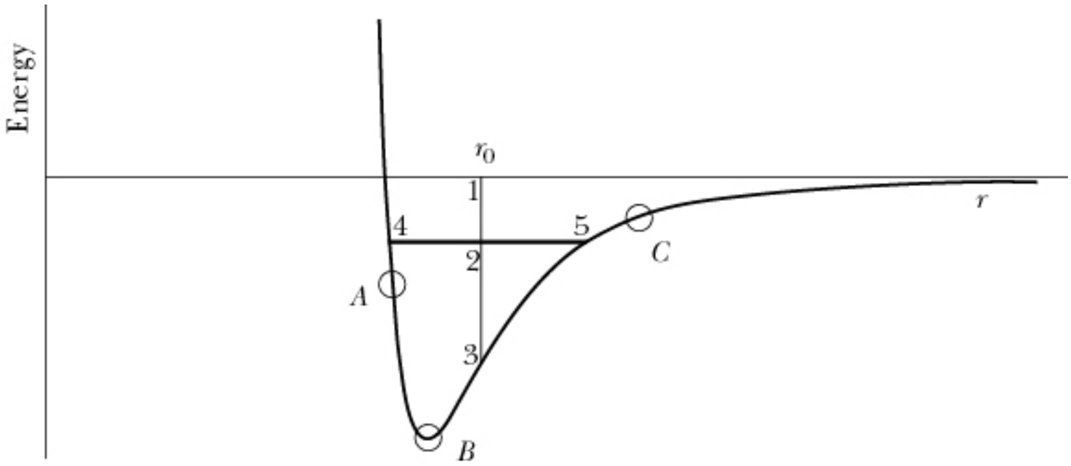
5. 8/8 points | Previous Answers MI3 8.3.P.027.alt01

(a) The diagram below is a graph of potential energy *vs.* interatomic separation for a particular diatomic molecule (that is, a molecule consisting of two atoms).

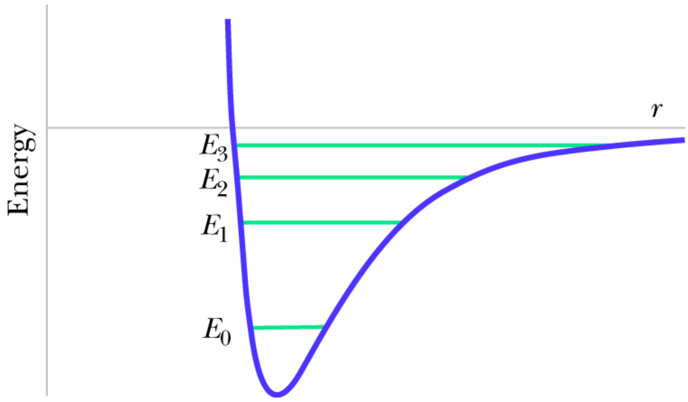


For the energy level shown on the graph, imagine drawing a line whose length represents the kinetic energy when the interatomic separation is r_0. This line runs from where to where?

- ○ from 1 to 3
- ○ from 4 to 5
- ○ from 4 to 2
- ○ from 1 to 2
- ◉ from 2 to 3
- ○ from 2 to 5

(b) The graph below shows all of the quantized energies (bound states) for one of these molecules. For this molecule, E_0 = -2.6 eV, E_1 = -1.22 eV, E_2 = -0.53 eV, and E_3 = -0.22 eV. What is the minimum amount of energy required to break a molecule apart, if it is initially in the ground state? (Note that the final state must be an unbound state; the unbound states are not quantized.)

2.6 eV



(c) If the temperature is high enough, in a collection of these molecules there will be at all times some molecules in each of these states, and light will be emitted. What photon energies could be detected in the emitted light? List the energies in ascending order, from smallest to largest.

0.31 eV, 0.69 eV, 1 eV, 1.38 eV, 2.07 eV, 2.38 eV

- *Read the eBook*
- Section 8.3