Quiz E21.2
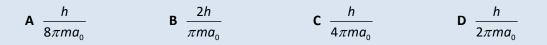
Atomic physics HL

(You may use the fact that the orbit radius of an electron in the nth state of the hydrogen atom is given by $a_0 n^2$ where a_0 is a constant.)

1. What is a common characteristic of the Bohr and the Rutherford models of the hydrogen atom?

    A Both predict the size of the hydrogen atom
    B The electron orbit radii are discrete
    C The electron radiates as it orbits the nucleus
    D The electron moves in circular orbits

2. The condition $mvr = n\dfrac{h}{2\pi}$ was used in the Bohr model. What is **not** a consequence of this condition?

    A The total electron energy is quantized.
    B The electron orbit radius is quantized.
    C The wavelengths in the emission spectrum of hydrogen are discrete.
    D The electron total energy is negative.

3. What was Bohr's main objection to the Rutherford model of the atom?

    A It did not take into account the strong nuclear force.
    B Given the orbital radius, the energy could not be predicted.
    C It could not be applied to multi-electron atoms.
    D The electron would radiate and plunge into the nucleus.

4. Which expression gives the speed of an electron in the $n = 4$ state of hydrogen?

    A $\dfrac{h}{8\pi m a_0}$
    B $\dfrac{2h}{\pi m a_0}$
    C $\dfrac{h}{4\pi m a_0}$
    D $\dfrac{h}{2\pi m a_0}$

5. What is the ratio of the kinetic energy of an electron in the $n = 3$ state of hydrogen to that in $n = 2$?

    A $\dfrac{2}{3}$
    B $\dfrac{4}{9}$
    C $\dfrac{3}{2}$
    D $\dfrac{9}{4}$

6. What is the total energy of an electron in the $n = 2$ state of hydrogen?

   A $-\dfrac{ke^2}{8a_0}$
   B $-\dfrac{ke^2}{4a_0}$
   C $-\dfrac{ke^2}{2a_0}$
   D $-\dfrac{ke^2}{a_0}$

7. What is the ratio of the period of revolution of an electron in the state $n = 2$ of hydrogen to that in the state $n = 1$?

   A 2
   B 4
   C 8
   D 16

8. What is the wavelength, in meters, emitted in a transition from the state $n = 4$ of hydrogen to the state $n = 2$?

   A $\dfrac{3}{16} \times \dfrac{1.24 \times 10^{-6}}{13.6}$

   B $\dfrac{16}{3} \times \dfrac{1.24 \times 10^{-6}}{13.6}$

   C $\dfrac{3}{4} \times \dfrac{1.24 \times 10^{-6}}{13.6}$

   D $\dfrac{4}{3} \times \dfrac{1.24 \times 10^{-6}}{13.6}$

9. What is an estimate of the minimum speed of an electron which upon collision with an electron in the $n = 1$ state of hydrogen will force the hydrogen electron to leave the atom?

   A 10^2 m s^{-1}
   B 10^4 m s^{-1}
   C 10^6 m s^{-1}
   D 10^8 m s^{-1}

10. Hydrogen gas is kept at a low temperature. What is an estimate of the temperature to which the gas must be raised to so that an appreciable number of electrons find themselves in the state $n = 2$?

    A 300 K
    B 10^3 K
    C 10^5 K
    D 10^7 K

Quiz E21.2 Answers	
1	D
2	D
3	D
4	A
5	B
6	A
7	C
8	B
9	C
10	C