

Phys Sc 416/30
Pretest 1.2 Solutions

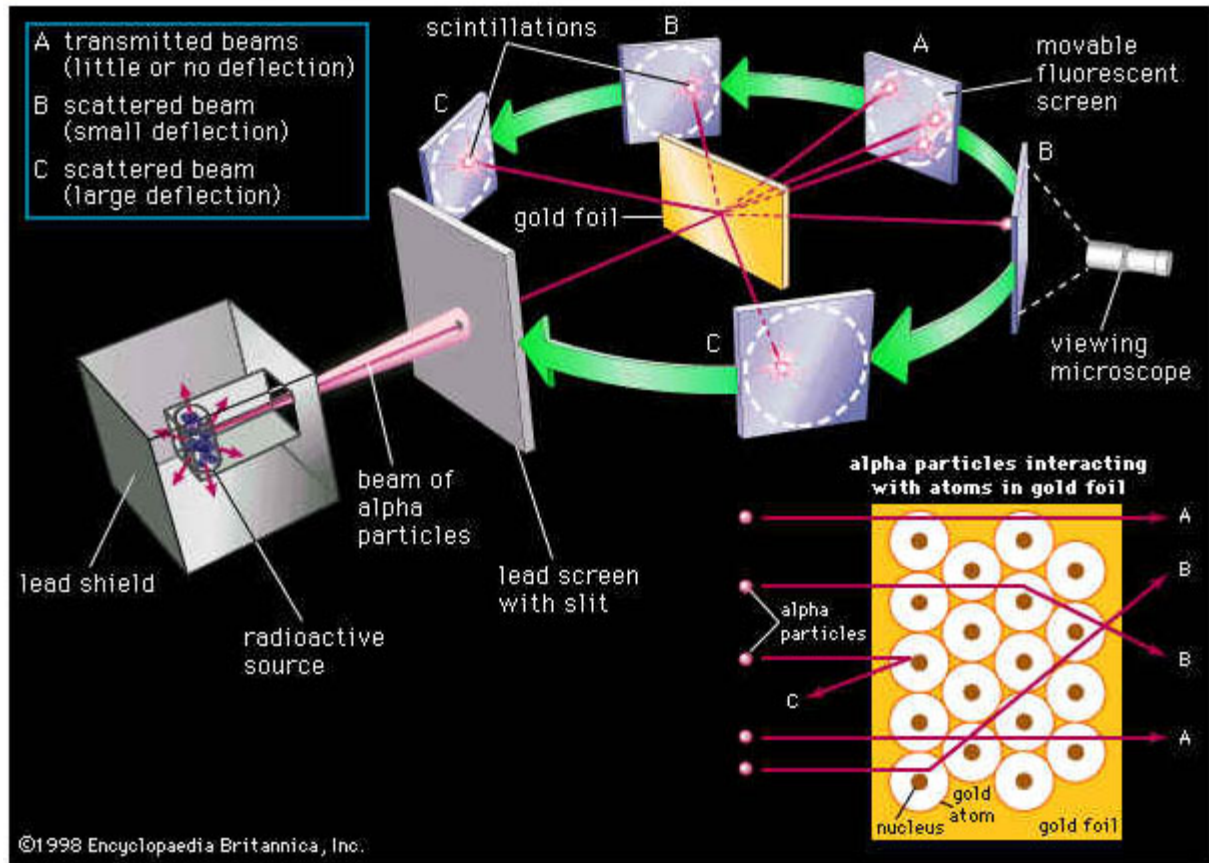
1. True? Or False?

- a. Democritus' model can be used to explain physical changes. TRUE
- b. Rutherford realized that the atom is mostly empty space. The mass of an atom is mostly concentrated in a tiny nucleus. TRUE
- c. Bohr's model has electrons moving in orbit-like paths TRUE
- d. Excited electrons sometimes emit light after returning to "orbits" that are closer to the nucleus. TRUE
- e. Electrons are heavier than neutrons. FALSE

1. Explain Rutherford's experiment. Use a diagram and distinguish between those alpha particles that come right back and those that are deflected at large angles.(430)

Rutherford and his team beamed alpha particles through gold foil and detected them as flashes of light or scintillations on a screen. The gold foil was only 0.00004 centimeter thick. Most of the alpha particles went straight through the foil, but some were deflected by the foil and hit a spot on a screen placed off to one side. Geiger and Marsden found that about

one in 20,000 alpha particles had been deflected 45° or more. **Rutherford** asked why so many alpha particles passed through the gold foil while a few were deflected so greatly. "It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper, and it came back to hit you," **Rutherford** said later. "On consideration, I realized that this scattering backwards must be the result of a single collision, and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive center carrying a charge."



3. How do electron "orbits" help explain hydrogen's spectrum?

Each time an electron gets excited to a higher energy level it emits a colour of a very specific wavelength because it can only fall back to one specific energy level. In all there are a very limited number of energy levels, so only a few coloured lines appear in an element's spectrum.

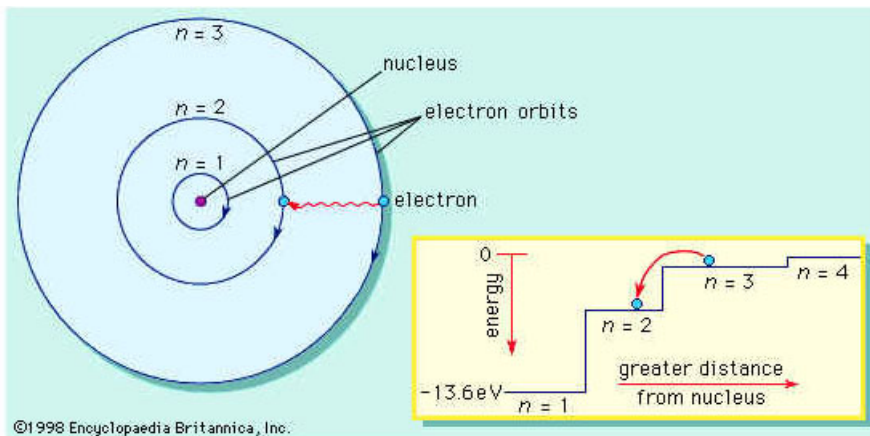


Figure 1: *The Bohr atom*. The electron travels in circular orbits around the nucleus. The orbits have quantized sizes and energies. Energy is emitted from the atom when the electron jumps from one orbit to another closer to the nucleus. Shown here is the first Balmer transition, in which an electron jumps from orbit $n = 3$ to orbit $n = 2$, producing a photon of red light with an energy of 1.89 eV and a wavelength of $656 \times 10^{-9} \text{ m}$.
Encyclopaedia Britannica, Inc.

4. List two differences between the Bohr model and the modern model.

Bohr	Modern
No neutrons	Neutrons exist in nucleus
Energy levels	Energy levels (shells) with specific number of electrons per shell

5. Complete the following table:

Name	Isotope Notation	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
neutral oxygen	^{16}O	8	16	8	$16 - 8 = 8$	$8 - 0 = 8$
sulfide (-2)	^{24}S	16	$16 + 8 = 24$	16	8	$16 - (-2) = 18$
Aluminum (+3)	^{27}Al	13	27	13	14	10
silver....(+1).....	$^{108}\text{Ag}^{+1}$	47	108	47	61	$47 - 1 = 46$
Chloride (-1)	$^{35}\text{Cl}^{-1}$	17	35	17	18	$17 - (-1) = 18$

6. Give the charge for each of the following subatomic particles:
- proton +1
 - electron -1
 - neutron 0
7. Arrange the following in order, from the lightest(1) to the heaviest(3).
 proton 2
 electron 1
 neutron 3 (slightly heavier than the neutron)
8. A certain atom has two more protons than electrons. Its charge is +2.
9. Will the chemical properties of helium change if it loses a(n) _____?
- electron Yes. Ions and neutral atoms have different chemical properties
 - neutron No. Isotopes have the same chemical properties.
 - proton Yes. You would be creating a different element.
10. If it was possible to remove 3 protons from a neutral aluminum:27 atom, what would you end up with? Show the full isotope notation of the newly created atom.

Before	After
^{27}Al 13 protons 13 electrons 14 neutrons	10 protons 13 electrons 14 neutrons $^{24}\text{Ne}^{-3}$ (no such thing exists in nature, by the way)

11. What are isotopes? Give an example.

Isotopes are different versions of the same elements. They have different mass numbers.

12. Show through example how an ion differs from its neutral counterpart.

Mg^{+2} does not burn; Mg does.

H^{+1} reacts with base; neutral hydrogen does not

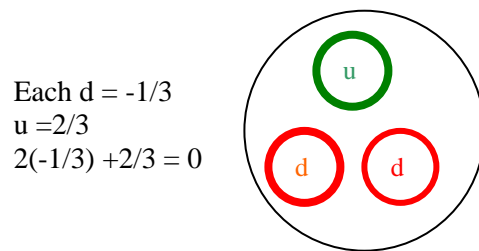
13. Draw a shell diagram for each of the following:



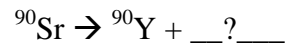


For (c) the **valence # (last shell electrons)** is 5.

14. Draw a neutron, including its quarks and show how they add up to the neutron's charge.



15. Which particle or form of energy will be emitted when the radioactive strontium-90 breaks down according to the following?



- A. alpha neutron B. beta C. gamma D.

$90 = 90 + x$
 $x = 0$ mass
 Find atomic numbers:
 $38 = 39 + y$
 $Y = -1$
 Answer beta = electron

16. Find the density of the following liquid:

3

A pure gray substance was placed in a open crucible and heated in the presence of air. The following observations were made.

	Before Heating	After Heating
State	Liquid	Solid
Colour	Gray	Red
Mass	12.0 g	13.2 g

Which of the following statements IS DEFINITELY FALSE?

- A) The substance before heating was an element.
- B) The substance before heating was a compound.
- C) The substance after heating is an element.
- D) The substance after heating is a compound.

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While identifying an unknown substance in the laboratory, you note that it has the following properties:

1. Its melting point is 0°C ;
2. It is colourless;
3. It does not change the colour of neutral litmus paper;
4. It does not conduct electricity.

Which of these properties most clearly indicates that the unknown substance is pure water?

- A) 1
- B) 2
- C) 3
- D) 4

Answers

1.C

2.D

3.C (It's possible for a compound to react with a gas and give a heavier compound, but it is not possible for an element to weigh more than the original substance.

4.A