

Brett Robbins Academic Consulting

Physics 30 Practice Test

Unit D: Atomic Physics

25 Questions

Original practice questions written to the Alberta curriculum, in the style of past diploma examinations. Work through each question, then check your answers with the key at the end.

This practice test was made by AI and there may be mistakes. If a question or answer looks wrong, contact Brett for clarification.

Question 1

In the gold foil experiment, most alpha particles passed straight through the foil, while a small number were deflected through large angles. This evidence led Rutherford to conclude that an atom

- A) is mostly empty space, with nearly all of its mass and positive charge concentrated in a tiny central nucleus
- B) consists of electrons embedded in a sphere of uniform positive charge
- C) has electrons travelling in fixed circular orbits of any radius
- D) is a solid, indivisible sphere

Question 2

When a nucleus undergoes beta negative decay, the change to the nucleus is

- A) the atomic number increases by 1 and the mass number is unchanged
- B) the atomic number decreases by 1 and the mass number is unchanged
- C) the atomic number decreases by 2 and the mass number decreases by 4
- D) the atomic number is unchanged and the mass number decreases by 1

Question 3

A radioactive sample has a mass of 480 g and a half – life of 6.0 days.

The mass of the original sample remaining after 18 days, in grams, is

Question 4

Selected energy levels for a hydrogen atom are $E_1 = -13.6 \text{ eV}$, $E_2 = -3.40 \text{ eV}$, $E_3 = -1.51 \text{ eV}$, and $E_4 = -0.85 \text{ eV}$. An electron drops from the $n = 3$ level to the $n = 1$ level. The energy of the emitted photon is

- | | |
|------------|------------|
| A) 10.2 eV | B) 1.89 eV |
| C) 12.1 eV | D) 15.1 eV |

Question 5

Gamma radiation is best described as

- | | |
|----------------------------|----------------------------|
| A) a helium nucleus | B) a high – speed electron |
| C) a high – speed positron | D) a high – energy photon |

Question 6

An atom has a ground state energy of -8.50 eV and a first excited state energy of -2.30 eV . An electron drops from the first excited state to the ground state.

Use $h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$, $c = 3.00 \times 10^8 \text{ m/s}$, and $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$.

The wavelength of the emitted photon is

- | | |
|------------------------------------|------------------------------------|
| A) $2.00 \times 10^{-7} \text{ m}$ | B) $5.00 \times 10^{-7} \text{ m}$ |
| C) $2.00 \times 10^{-9} \text{ m}$ | D) $1.24 \times 10^{-6} \text{ m}$ |

Question 7

An electron travels at a speed of $6.00 \times 10^6 \text{ m/s}$. Use $h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$ and $m_e = 9.11 \times 10^{-31} \text{ kg}$. The de Broglie wavelength of the electron, to the nearest picometre, is

Question 8

The measured mass of a nucleus is less than the total mass of its separated protons and neutrons by 1.62×10^{-28} kg. The binding energy of the nucleus is

- A) 4.86×10^{-20} J B) 1.46×10^{-11} J
C) 1.80×10^{-45} J D) 1.46×10^{-13} J

Question 9

The nuclear reaction ${}^{222}_{86}\text{Rn} \rightarrow {}^{218}_{84}\text{Po} + X$ is balanced when X is

- A) ${}^1_0\text{n}$
B) ${}^0_{-1}\text{e}$
C) ${}^4_2\text{He}$
D) ${}^0_{+1}\text{e}$

Question 10

In a nuclear fission reactor, the control rods are moved into the core in order to

- A) speed up the neutrons so that more fission occurs
- B) provide additional fuel for the chain reaction
- C) cool the reactor core
- D) absorb neutrons so that the rate of fission stays steady

Question 11

Light from a hot, dense source passes through a cooler, low – density gas before reaching a spectroscope. The spectrum observed is

- A) an absorption spectrum, with dark lines on a continuous background
- B) a continuous spectrum, with no lines
- C) an emission spectrum, with bright lines on a dark background
- D) no spectrum at all

Question 12

Cathode rays were found to be deflected by both electric and magnetic fields.

This led Thomson to conclude that cathode rays are

- A) a form of electromagnetic radiation
- B) streams of electrically neutral particles
- C) streams of negatively charged particles
- D) streams of protons

Question 13

A radioactive sample initially registers 5.12×10^5 counts per minute.

Its half – life is 8.0 days. After 32 days, the count rate, expressed in the form

$a.bc \times 10^4$ counts per minute, has a value of $a.bc$ equal to

Question 14

In one fission reaction, the total mass of the products is less than the mass of the original nucleus and neutron by 3.20×10^{-28} kg. The energy released by this one fission reaction is

- A) 9.60×10^{-20} J B) 2.88×10^{-11} J
C) 3.56×10^{-45} J D) 2.88×10^{-13} J

Question 15

An up quark has a charge of $+\frac{2}{3}e$ and a strange quark has a charge of $-\frac{1}{3}e$. A particle is made up of two up quarks and one strange quark. The charge of this particle is

- A) 0 B) $-1e$
C) $+2e$ D) $+1e$

Question 16

The fission reaction ${}_{92}^{238}\text{U} + {}_0^1\text{n} \rightarrow {}_{38}^{99}\text{Sr} + {}_{54}^{138}\text{Xe} + x {}_0^1\text{n}$ is balanced when the value of x is

Question 17

A photon can create an electron – positron pair only if its energy is at least equal to the combined rest energy of the pair, $2m_e c^2$. Use $m_e = 9.11 \times 10^{-31}$ kg, $c = 3.00 \times 10^8$ m/s, and $h = 6.63 \times 10^{-34}$ J · s. The minimum frequency of a photon that can produce an electron – positron pair is

- A) 1.24×10^{20} Hz
B) 4.95×10^{20} Hz
C) 2.47×10^{20} Hz
D) 6.18×10^{19} Hz

Question 18

Electrons passing through a double – slit apparatus build up an interference pattern on a screen. This observation provides evidence that electrons

- A) always follow definite, predictable paths
- B) travel at the speed of light
- C) are made up of smaller particles
- D) can exhibit wave – like behaviour

Question 19

An ultraviolet photon has a wavelength of 2.50×10^{-7} m. Use $c = 3.00 \times 10^8$ m/s. The frequency of the photon, expressed in the form $a.bc \times 10^{15}$ Hz, has a value of $a.bc$ equal to

Question 20

The Bohr model of the atom successfully explains

- A) the line spectrum of hydrogen
- B) the spectra of atoms with many electrons
- C) why orbiting electrons do not radiate energy
- D) the bonding of atoms into molecules

Question 21

A nucleus of ${}_{90}^{232}\text{Th}$ undergoes an alpha decay, and the daughter nucleus then undergoes a beta negative decay. The final nucleus is

- | | |
|-----------------------------|-----------------------------|
| A) ${}_{88}^{228}\text{Ra}$ | B) ${}_{89}^{228}\text{Ac}$ |
| C) ${}_{89}^{224}\text{Ac}$ | D) ${}_{90}^{228}\text{Th}$ |

Question 22

A photon has a wavelength of 434 nm (4.34×10^{-7} m).

Use $h = 6.63 \times 10^{-34}$ J · s, $c = 3.00 \times 10^8$ m/s, and $1 \text{ eV} = 1.60 \times 10^{-19}$ J.

The energy of the photon, to the nearest hundredth of an electron volt, is

Question 23

Radiation from a radioactive source is completely stopped by a single sheet of paper. The radiation is most likely

- | | |
|-------------------|--------------------|
| A) beta particles | B) gamma rays |
| C) X – rays | D) alpha particles |

Question 24

In the proton – proton chain in the Sun, four hydrogen nuclei fuse according to

$4\,{}_1^1\text{H} \rightarrow {}_2^4\text{He} + 2X + \text{energy}$. The particles represented by X are

A) two electrons

B) two positrons

C) two neutrons

D) two protons

Question 25

A proton travels at a speed of 2.50×10^7 m/s. Use $h = 6.63 \times 10^{-34}$ J · s

and $m_p = 1.67 \times 10^{-27}$ kg. The de Broglie wavelength of the proton, expressed

in the form $a.bc \times 10^{-14}$ m, has a value of $a.bc$ equal to

Answer Key

- | | | |
|--------|----------|----------|
| 1. A | 10. D | 19. 1.20 |
| 2. A | 11. A | 20. A |
| 3. 60 | 12. C | 21. B |
| 4. C | 13. 3.20 | 22. 2.86 |
| 5. D | 14. B | 23. D |
| 6. A | 15. D | 24. B |
| 7. 121 | 16. 2 | 25. 1.59 |
| 8. B | 17. C | |
| 9. C | 18. D | |

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