NUNAVUT PHYSICS 30 · UNIT D · 25 QUESTIONS

Atomic Physics — Practice Test

This practice test was made by AI and there may be mistakes. If a question or answer looks wrong, use the Flag a mistake button to let Brett know so he can fix it.

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

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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

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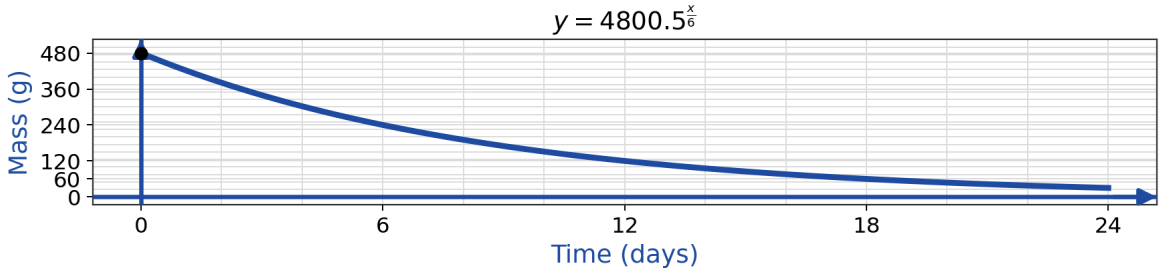
3 **The graph shows the mass of a radioactive sample against time. The mass of the sample remaining after 18 days, in grams, is**



ANSWER

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4 **Selected energy levels for a hydrogen atom are $E_1 = -13.6$ eV, $E_2 = -3.40$ eV, $E_3 = -1.51$ eV, and $E_4 = -0.85$ 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

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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

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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 $h = 6.63 \times 10^{-34}$ J · s, $c = 3.00 \times 10^{8}$ m/s, and 1 eV = 1.60×10^{-19} J. The wavelength of the emitted photon is**

A 2.00×10^{-7} m

B 5.00×10^{-7} m

C 2.00×10^{-9} m

D 1.24×10^{-6} m

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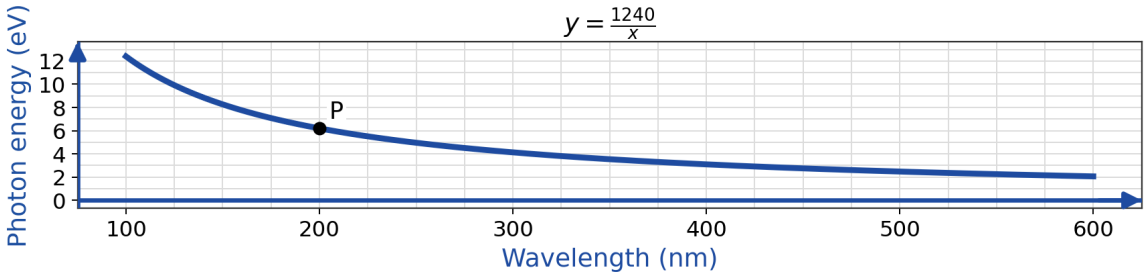
7 **An atom has a ground state energy of -8.50 eV and a first excited state energy of -2.30 eV. The graph shows photon energy against wavelength, with point P marked on the curve. An electron drops from the first excited state to the ground state. The wavelength of the emitted photon is**



A 2.00×10^{-7} m

B 5.00×10^{-7} m

C 2.00×10^{-9} m

D 1.24×10^{-6} m

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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

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

- **A** ${}^{1}_{0}\mathrm{n}$
- **B** ${}^{0}_{-1}\mathrm{e}$
- **C** ${}^{4}_{2}\mathrm{He}$
- **D** ${}^{0}_{+1}\mathrm{e}$

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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

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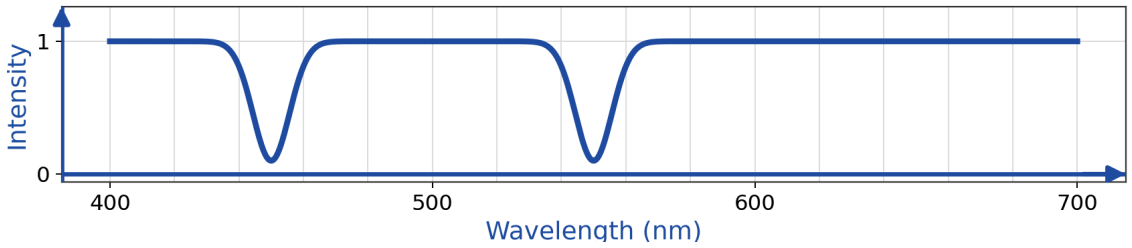
11 **The graph shows intensity against wavelength for light that passed through a cooler, low-density gas before reaching a spectroscope. The spectrum observed is**



- **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

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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

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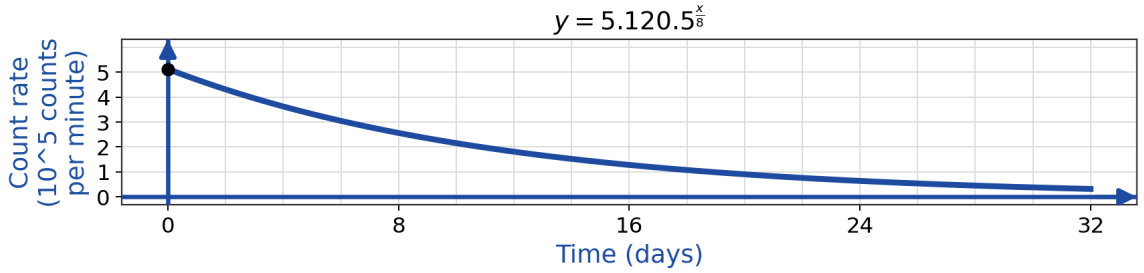
13 **The graph shows count rate against time for a radioactive sample. The half-life of the sample, in days, is**



ANSWER

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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

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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

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16 **The fission reaction $^{238}_{92}U + ^{1}_{0}n \rightarrow ^{99}_{38}Sr + ^{138}_{54}Xe + x\ ^{1}_{0}n$ is balanced when the value of x is**

ANSWER

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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, $2\,m_e\,c^2$. 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

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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

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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**

ANSWER _____

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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

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

- **A** $^{228}_{88}$Ra
- **B** $^{228}_{89}$Ac
- **C** $^{224}_{89}$Ac
- **D** $^{228}_{90}$Th

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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 eV = 1.60×10^{-19} J. The energy of the photon, to the nearest hundredth of an electron volt, is**

ANSWER

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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

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24

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

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

A two electrons

B two positrons

C two neutrons

D two protons

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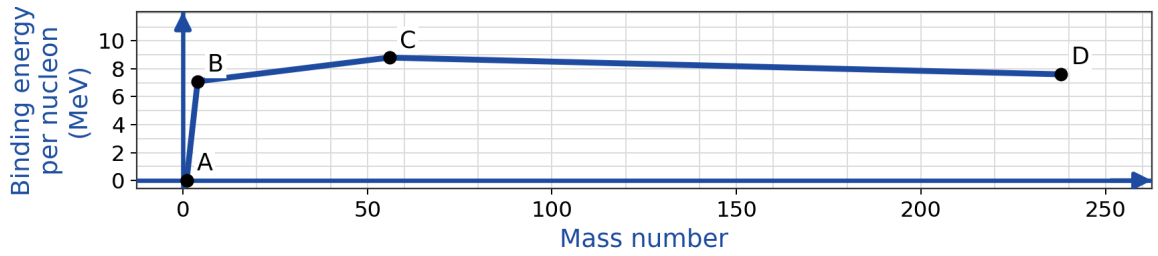
25 **The graph shows binding energy per nucleon against mass number. Points A, B, C, and D mark hydrogen-1, helium-4, iron-56, and uranium-238, in order. The binding energy per nucleon is greatest for a nucleus of**



A $^{1}_{1}H$

B $^{4}_{2}He$

C $^{56}_{26}Fe$

D $^{238}_{92}U$

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ANSWER KEY

1.	A	**10.**	D	**19.**	1.2
2.	A	**11.**	A	**20.**	A
3.	60	**12.**	C	**21.**	B
4.	C	**13.**	8	**22.**	2.86
5.	D	**14.**	B	**23.**	D
6.	A	**15.**	D	**24.**	B
7.	A	**16.**	2	**25.**	C
8.	B	**17.**	C		
9.	C	**18.**	D		

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