

phy202 List of Questions

Latex formatted questions may not properly render

Q1 Which of the following defines the decay constant λ of a radioactive nuclide?

- ☒ activity/number of undecayed nuclei
- ☐ $\frac{\text{half-life}}{0.693}$
- ☐ the number of nuclei that decay per unit time
- ☐ the time for the activity of the nuclide to reduce by a factor of 2

Q2 A source contains N_0 nuclei of a radioactive nuclide. How many of these nuclei have decayed after a time interval of three half-lives?

- ☒ $\frac{N_0}{16}$
- ☐ $\frac{N_0}{8}$
- ☐ $\frac{7N_0}{8}$
- ☐ $\frac{15N_0}{16}$

Q3 A newly prepared radioactive nuclide has a decay constant λ of 10^{-6} s. What is the approximate half-life of the nuclide?

- ☒ 1 week
- ☐ 1 day
- ☐ 1 hour
- ☐ 1 month

Q4 A radioactive material has a half-life of 3 minutes. If you begin with 512 000 radioactive atoms, approximately how many would you expect to have after 12 minutes?

- ☐ 256 000
- ☐ 128 000
- ☐ 64 000
- ☒ 32 000

Q5 A nucleus of ${}^{238}_{92}\text{U}$ captures a neutron to form an unstable nucleus that undergoes two successive beta minus decays. The resulting nucleus is

- ☐ ${}^{239}_{92}\text{U}$
- ☐ ${}^{239}_{93}\text{Np}$
- ☐ ${}^{238}_{94}\text{Pu}$
- ☒ ${}^{239}_{94}\text{Pu}$

Q6 A proton strikes a nucleus of ${}^{20}_{10}\text{Ne}$. Assuming the alpha particle comes out, what isotope is produced?

- ☐ ${}^{14}_6\text{C}$
- ☐ ${}^{15}_6\text{C}$
- ☒ ${}^{17}_9\text{F}$
- ☐ ${}^{16}_8\text{O}$

Q7 What type of decay process is involved in the reaction ${}^{228}_{92}\text{U} \rightarrow {}^{228}_{91}\text{Pa} + \text{?}$

- ☐ alpha
- ☒ beta plus
- ☐ beta minus

- ☐ electron capture

Q8 Which of the following is NOT correct about unstable nuclides?

- ☐ They continue to disintegrate until new stable nuclides is formed
- ☐ An unstable nuclide nuclear can undergo β^- decay so as to give an increase of proton number
- ☐ An unstable nuclide can undergo decay so that its proton number decreases and its neutron to proton ratio increases
- ☒ An unstable nuclide nuclear can undergo decay so as to give an increase of mass number

Q9 Which of the following is NOT correct about the stability of nuclides?

- ☐ The lightest nuclides have almost equal number of protons and neutrons
- ☐ The heaviest nuclides require more neutrons than protons
- ☐ Most nuclides have both an even number of protons and neutron
- ☒ The lightest nuclides have greater number of protons than neutrons

Q10 Find the energy released, if two ${}^2_1\text{H}$ nuclei can fuse together to form ${}^4_2\text{He}$. The binding energy per nucleon of ${}^2_1\text{H}$ and ${}^4_2\text{He}$ is 1.1 MeV and 7.0 MeV respectively

- ☐ 28.0 MeV
- ☐ 2.2 MeV
- ☒ 23.6 MeV
- ☐ 8.1 MeV

Q11 The stability of the atom depends on ----- in the atom

- ☐ both the number of protons and electrons
- ☒ both the number of protons and neutrons
- ☐ the number of electrons
- ☐ the number of protons

Q12 Which nuclei have the largest average binding energy per nucleon? The ones with nucleon number

- ☐ less than 20
- ☒ between 30 and 100
- ☐ more than 200
- ☐ They are all the same

Q13 Calculate the binding energy per nucleon for ${}^{98}_{42}\text{Mo}$

- ☐ 3.54 MeV
- ☒ 8.64 MeV
- ☐ 21.52 MeV
- ☐ 73.11 MeV

Q14 Which sketch best represents the variation of binding energy per nucleon with nucleon number?

- ☒ A
- ☐ B
- ☐ C
- ☐ D

Q15 Calculate the energy the electron in the n^{th} orbit of the hydrogen atom from the following data $e=1.6\times 10^{-19}\text{ C}$; $m=9.1\times 10^{-31}\text{ kg}$; $h=6.6\times 10^{-34}\text{ Js}$; $\epsilon_0=8.85\times 10^{-12}\text{ Farad/metre}$ and $c=3.0\times 10^8\text{ m/}$

- ☐ $\frac{-0.8}{n^2}$
- ☐ $\frac{-1.5}{n^2}$

- ☐ $\frac{-3.4}{n^2}$
- ☐ $\frac{-13.6}{n^2}$

Q16 What is the velocity of the electron in the first Bohr orbit of the hydrogen atom in term os the velocity of light \$\$\$?

- ☐ $\frac{1}{137}c$
- ☐ $\frac{1}{126}c$
- ☐ 2.71 C
- ☐ 3.11 c

Q17 The wave behaviour of tennis balls is not observed because

- ☐ their speed is too small
- ☐ their momenta are too small
- ☒ their wavelengths are too small
- ☐ wave properties only occur on the atomic scale

Q18 For the diagram shown, which quantity must be the same all ions arriving at the photographic plate on the screen?

- ☐ charge
- ☐ $\frac{\text{charge}}{\text{mass}}$
- ☐ mass
- ☐ momentum

Q19 The figure shown is -----

- ☐ electron gun
- ☐ cloud chamber
- ☐ Geiger counter
- ☒ mass spectrometer

Q20 Which nuclei would have the greater binding energies per nucleon, $^{56}_{26}\text{Fe}$ or $^{112}_{48}\text{Cd}$?

- ☐ $^{56}_{26}\text{Fe}$
- ☐ $^{112}_{48}\text{Cd}$
- ☐ They would have the same total binding energy
- ☐ there is not enough information to say

Q21 What is the binding energy of ^{12}C ?

- ☒ 92 MeV
- ☐ 931 MeV
- ☐ 124 MeV
- ☐ 13 MeV

Q22 What daughter is formed when $^{18}_7\text{N}$ decays by decay beta decay

- ☐ $^{18}_8\text{O}$
- ☐ $^{18}_6\text{C}$
- ☐ $^{19}_8\text{O}$
- ☐ $^{17}_6\text{C}$

Q23 How many neutrons are in the nucleus of $^{47}_{18}\text{Ar}$?

- ☐ 18

- ☐ 29
- ☐ 27
- ☐ 65

Q24 The chemical identity of an atom is determined by the number of ----- in its nucleus

- ☐ protons
- ☐ neutrons
- ☐ electrons
- ☐ nucleons

Q25 How many quantum states are there in $n = 3$?

- ☐ 6
- ☐ 8
- ☐ 12
- ☐ 18

Q26 The deBroglie waves can be regarded as ----- waves

- ☐ pressure
- ☐ probability
- ☐ electromagnetic
- ☐ gravitational

Q27 A bullet has a mass of 10 g and the muzzle velocity of 900 m/s. What is its de Broglie wavelength?

- ☐ $1.47 \times 10^{-39} \text{ m}$
- ☐ $2.21 \times 10^{-38} \text{ m}$
- ☐ $1.99 \times 10^{-29} \text{ m}$
- ☐ $2.98 \times 10^{-28} \text{ m}$

Q28 As the speed of a particle increases, the de Broglie wavelength of the particle

- ☐ increases
- ☐ decreases
- ☐ stays the same
- ☐ the wavelength is not defined

Q29 The wave behaviour of tennis balls is not observed because

- ☐ their speed is too small
- ☐ their momenta are too small
- ☐ their wavelengths are too small
- ☐ wave properties only occur on the atomic scale

Q30 Which of the following terms cannot be used to describe both an electron and an atom?

- ☐ wavelength
- ☐ mass
- ☐ energy
- ☐ momentum

Q31 Bohr's model predicts that the energies of an element's characteristic X rays

- ☐ increase with increase in atomic number
- ☐ decrease with increase in atomic number
- ☐ increase with increase in atomic mass

- ☐ decrease with increase in atomic mass

Q32 The spikes in the spectrum of X-rays are due to

- ☐ electrons slowing down in the material
- ☐ electrons knocked from the outer shell
- ☐ photons emitted by electrons dropping to fill the inner shell
- ☒ photons absorbed by electrons in the ground state

Q33 Sulphur is element number 16. how many electrons do you expect to find in each shell of the sulphur atom?

- ☐ 2,8,6
- ☐ 4,4,4,4
- ☐ 2,4,6,4
- ☒ 2,7,7

Q34 The statement that "no two electrons can have the same set of quantum numbers" is -----

- ☐ Hund's rule
- ☐ correspondence principle
- ☐ complementarity principle
- ☒ Paili's exclusion principle

Q35 Given the quantum number $n=1$ for a hydrogen atom, which of the following correctly represents the value of its magnetic moment?

- ☐ $\frac{e\hbar}{m}$
- ☒ $\frac{e\hbar}{2m}$
- ☐ $\frac{2m}{e\hbar}$
- ☐ $\frac{m}{e\hbar}$

Q36 In the hydrogen atom, if the quantum number $n=3$, what values can l take on?

- ☐ 0,1
- ☐ 0,1,2,3
- ☐ 1,2,3
- ☒ 0,1,2

Q37 The orbital quantum number determines the ----- of the atom

- ☐ total energy
- ☐ orientation of the angular momentum
- ☒ the angular
- ☐ spin magnetic moment

Q38 If the energy of the Bohr hydrogen atom is greater than zero, then the

- ☐ atom is in the excited state
- ☐ the atom is in the ground state
- ☒ the electron is no longer bound to the nucleus
- ☐ the atom emits a photon

Q39 Calculate the wavelength of electromagnetic radiation emitted by a hydrogen atom which undergoes a transition between energy levels of -1.36×10^{-19} J and -5.45×10^{-19} J. (Take Planck's constant $h = 6.6 \times 10^{-34}$ Js)

- ☒ 454 nm

- ☐ 732 nm
- ☐ 346 nm
- ☐ 220 nm

Q40 "An electron can circle an atomic nucleus indefinitely without radiating energy if its orbit an integral number of electron wavelengths in circumference" is a statement of -----

- ☒ Bohr's theory of the hydrogen atom
- ☐ Planck's quantisation condition
- ☐ Heisenberg's uncertainty principle
- ☐ de Broglie's postulate of wave particle duality

Q41 The plum pudding model of the atom was proposed by -----

- ☐ Ernerst Rutherford
- ☐ Neils Bohr
- ☒ J. J. Thomson
- ☐ Max Planck

Q42 Evaluate the ionization potential of hydrogen, E°_1 , in units of electron-volts (eV).

- ☐ 7.04
- ☒ 13.6
- ☐ 3.41
- ☐ 1.51

Q43 An electron revolves around a nucleus with positive charge Ze . Which of the following gives the correct relationship between the electron's velocity and the radius of its orbit

- ☐ $v^2 = \frac{ke^2}{mr}$
- ☐ $v = \frac{ke^2}{mr}$
- ☐ $v^3 = \frac{ke^{1/2}}{mr}$
- ☐ $v^{1/2} = \frac{ke^2}{mr}$

Q44 The angular momentum of the electron in the ground state of hydrogen is 1.06×10^{-34} J.s. What is the angular momentum of an electron in the $n = 4$ excited state of hydrogen?

- ☐ 1.06×10^{-34} J.s
- ☐ 2.12×10^{-34} J.s
- ☒ 4.24×10^{-34} J.s
- ☐ 17×10^{-34} J.s

Q45 An electron in the ground state of the Bohr atom has a radius of 0.053 nm. What is the radius of the first excited state?

- ☐ 0.053 nm
- ☐ 0.106 nm
- ☐ 0.159 nm
- ☒ 0.212 nm

Q46 Which of the following is quantised in the Bohr model?

- ☐ radius
- ☐ angular momentum
- ☐ energy
- ☒ All of these are quantised

Q47 Which of the following is NOT a feature of the Bohr model of the atom?

- ☐ an electron probability cloud
- ☐ electron in planetary-like orbit
- ☐ quantised energy levels
- ☐ accelerating electrons that do not radiate

Q48 The following isotopes of neon are found in nature: $^{20}_{10}\text{Ne}$, $^{21}_{10}\text{Ne}$, $^{22}_{10}\text{Ne}$ with percentages 90.9, 0.3 and 8.8 respectively. Calculate relative atomic mass of Ne

- ☐ 21.51
- ☐ 20.18
- ☐ 22.32
- ☐ 21.15

Q49 What daughter is formed when $^{239}_{94}\text{Pu}$ decays by alpha decay?

- ☐ $^{235}_{92}\text{Pu}$
- ☐ $^{235}_{92}\text{U}$
- ☐ $^{239}_{93}\text{Np}$
- ☐ $^{239}_{94}\text{Pu}$

Q50 How many neutrons are in the nucleus of $^{47}_{18}\text{Ar}$?

- ☐ 18
- ☐ 29
- ☐ 47
- ☐ 65

Q51 The three naturally occurring isotopes of neon are $^{20}_{10}\text{Ne}$, $^{21}_{10}\text{Ne}$, $^{22}_{10}\text{Ne}$. Given that the atomic mass of natural neon is 20.18 atomic mass units, Which of these three isotopes must be the most common

- ☐ $^{20}_{10}\text{Ne}$
- ☐ $^{21}_{10}\text{Ne}$
- ☐ $^{22}_{10}\text{Ne}$
- ☐ They are equally abundant

Q52 The chemical identity of an atom is determined by the the number of ----- in its nucleus

- ☐ protons
- ☐ neutrons
- ☐ electrons
- ☐ neucloens

Q53 Atoms whose nuclei contain the same number of protons but different numbers of neutrons are called

- ☐ radioactive
- ☐ daughters
- ☐ isotopes
- ☐ nucleons

Q54 Which of the following is NOT considered to be a success of Bohr's theory of the atom?

- ☐ Obtaining the numerical values for the spectral lines in hydrogen
- ☐ Explaining why there are more lines in emission spectra than the absorption spectra
- ☐ Explaining why electrons in fixed orbits do not radiate
- ☐ Providing the general features of the periodic table

Q55 Find the radius of the path of a charged particle whose velocity is 10^7 in a magnetic field of 0.02 T when the particle's path is perpendicular to the field. The mass and charge of the particle is 9.1×10^{-31} kg and 1.6×10^{-19} respectively

- ☐ 28 cm
- ☐ 34 cm
- ☐ 46 cm
- ☐ 17 cm

Q56 An electric field of 50 kV/m is perpendicular to a magnetic field of 0.25 T. What is the velocity of a charge q whose initial direction is perpendicular to both fields and which passes through the fields undeflected

- ☐ 2×10^5
- ☐ 2.5×10^6
- ☐ 2.0×10^4
- ☐ 2.5×10^4

Q57 The term charge quantization refers to the fact that

- ☐ any charge is an integral multiple of the electronic charge
- ☐ charge is conserved
- ☐ an atom which loses electrons is positively charged
- ☐ an atom is electrically neutral

Q58 The estimate of the atomic radius is of the order of -----

- ☐ 10^{-10} m
- ☐ 10^{-16} m
- ☐ 10^{-7} m
- ☐ 10^{-32} m

Q59 The interaction which is responsible for the existence of bulk matter is the -----

- ☐ gravitational interaction
- ☐ strong interaction
- ☐ electromagnetic interaction
- ☐ weak interaction

Q60 Which of the following is NOT true about the atom?

- ☐ The nucleus contains protons and neutrons
- ☐ The protons are chargeless
- ☐ The electrons are negatively charged
- ☐ Electrons occupy the shells

Q61 Calculate the wavelength associated with the motion of a 46 g golf ball at a speed of 36 m/s. Take $h = 6.63 \times 10^{-34}$ Js

- ☐ 5.0×10^{43} m
- ☐ 7.0×10^{-10} m
- ☐ 3.0×10^{-31} m
- ☐ 4.0×10^{-34} m

Q62 Which of the following experiments does NOT demonstrate the wave property of matter ?

- ☐ x-ray diffraction
- ☐ electron diffraction

- ☐ photoelectric effect
- ☐ polarization of electromagnetic radiation

Q63 Which of the following is NOT correct about x-ray spectra?

- ☐ They K-series x-rays are of shorter wavelengths than the L-series x-rays
- ☐ The K-series x-rays are less penetrating than the L-series x-rays
- ☐ They L-series x-rays are of shorter wavelengths than the M-series x-rays
- ☐ The K-series x-rays are harder than the M-series x-rays

Q64 Which of the following is correct about x-ray spectra?

- ☐ K_{α} x-ray have shorter wavelength than K_{β} x-ray
- ☐ K_{γ} x-ray have longer wavelength than K_{β} x-ray
- ☐ K_{α} x-ray have higher frequency than K_{β} x-ray
- ☐ K_{α} x-ray have lower frequency than K_{β} x-ray

Q65 Which of the following is the correct about X-rays

- ☐ They are produced when fast moving electrons are stopped by a metal target
- ☐ They ate fast moving alpha-particles
- ☐ They are produced when fast moving electrons are slowed down by very high stopping electric potential
- ☐ They can be defected by strong electri and magnetic fields

Q66 What is the value of the orbital angular momentum quantun number l for the ground state of the hydrogen atom?

- ☐ 1
- ☐ 0
- ☐ 2
- ☐ 3

Q67 What is the number of permitted orientations the orbital angular momentum for $l = 3$?

- ☐ 3
- ☐ 2
- ☐ 7
- ☐ 5

Q68 Which of the following is the correct electronic configuration of magnesium ($Z = 12$)

- ☐ $2s^2 2s^2 2p^8$
- ☐ $2s^2 2s^2 2p^6 2s^2$
- ☐ $2s^2 2s^1 2p^6 3s^2$
- ☐ $2s^2 2s^2 2p^6 3s^2$

Q69 The atomic number of sulfur is 16. How many electrons do you expect to find in each shell of a sulphur atom in its ground state?

- ☐ 2, 8, 6
- ☐ 4, 4, 4, 4
- ☐ 2, 4, 6, 4
- ☐ 2, 7, 7

Q70 A beam of electrons enters a uniform magnetic field of 1.2 T. Calculate the energy difference between electrons whose spins are parallel and antiparallel to the field .

- ☐ 1.39×10^{-4} eV

- ☐ 2.2×10^{-23} eV
- ☐ 1.72×10^{-3} eV
- ☐ 2.44×10^{-5} eV

Q71 An electron in $\text{He}^{\{+\}}$ is in an $n = 2$ orbit. According to Bohr's theory, what is its magnetic moment due to its orbital motion?

- ☐ 2.32×10^{-23} J/T
- ☒ 1.31×10^{-23} J/T
- ☐ 3.22×10^{-23} J/T
- ☐ 4.54×10^{-23} J/T

Q72 Calculate the wavelength in nanometers of photons having an energy of 1.80 eV

- ☒ 691 nm
- ☐ 342 nm
- ☐ 590 nm
- ☐ 342 nm

Q73 If electrons in hydrogen atoms are excited to the fourth Bohr orbit, how many different frequencies of light may be emitted?

- ☐ 1
- ☐ 3
- ☒ 6
- ☐ 8

Q74 Two hydrogen atoms have electrons in the $n = 3$ energy level. One of the electrons jumps to the $n = 2$ level, while the other jumps to the $n = 1$. Which property is larger for the first photon?

- ☐ velocity
- ☐ frequency
- ☒ wavelength
- ☐ energy

Q75 A gas can be identified by means of its spectral lines because each element

- ☐ can be recognized when greatly magnified
- ☐ occupies a unique position in the periodic table
- ☒ emits characteristic wavelengths when electrically excited
- ☐ has different atomic mass

Q76 Which of the following is NOT a feature of the Bohr model of the atom?

- ☒ an electron probability cloud
- ☐ electron in planetary-like orbit
- ☐ quantised energy levels
- ☐ accelerating electrons that do not radiate

Q77 A spectral line is emitted when an atom undergoes a transition between two levels with a difference of 2.4 eV. What is the wavelength of the line?

- ☐ 490 nm
- ☒ 518 nm
- ☐ 615 nm
- ☐ 249 nm

Q78 Electrons of energy 12.2 eV are fired at hydrogen atoms in a discharge tube. Determine the principal

quantum number which corresponds to the highest state to which the atoms can be excited

- ☐ 3
- ☐ 2
- ☐ 4
- ☐ 5

Q79 In a transition to a state of excitation energy 10.19 eV a hydrogen atom emits 4890 Å photon. Determine the binding energy of the initial state

- ☐ 0.37 eV
- ☒ 0.87 eV
- ☐ 0.43 eV
- ☐ 0.67 eV

Q80 The energy of a hydrogen atom when its electron that orbits in its smallest possible orbit is called -----

- ☐ excited state
- ☐ ionised state
- ☒ ground state
- ☐ stationary state