Chemisty sample question

1. Which atomic model is represented in the image?
a) Dalton model
b) Rutherford model
c) Bohr model ✅
d) Balmer model
✅ *Answer: c) Bohr model*
(*Note: The Bohr model shows electrons orbiting the nucleus in fixed energy levels.*)

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2. An increase in frequency represents a decrease in which of the following?
a) Wave number
b) Wavelength ✅
c) Energy
d) Quantum
✅ *Answer: b) Wavelength*

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3. Which one of the following expressions represents Planck's equation?
a) $E = mc^2$
b) $E = hv$ ✅
c) $F = ma$
d) $V = IR$
✅ *Answer: b) $E = hv$*

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4. Which one of the following expressions represents Heisenberg's Uncertainty Principle?
a) $E = hv$
b) $\Delta x \cdot \Delta p \geq \hbar/2$ ✅
c) $F = ma$
d) $E = mc^2$
✅ *Answer: b) $\Delta x \cdot \Delta p \geq \hbar/2$*

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5. Which one of the following sets of quantum numbers is possible?
a) n = 2, l = 2, ml = 0, ms = +½
b) n = 3, l = 1, ml = 0, ms = –½ ✅
c) n = 1, l = 1, ml = 0, ms = +½
d) n = 4, l = 3, ml = 4, ms = –½
✅ *Answer: b) n = 3, l = 1, ml = 0, ms = –½*
(*Explanation: l must be < n, and ml should be between –l to +l.*)

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6. The reaction: $MgCl_2 + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2AgCl$ is an example of which type of reaction?

a) Redox
b) Precipitation ✅
c) Neutralization
d) Acid-base

✅ *Answer: b) Precipitation*
(*Explanation: AgCl is an insoluble salt that precipitates out.*)

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7. According to bond order, a molecule is stable when the number of bonding electrons (N_s) is _____ the number of antibonding electrons (N_a).

a) Greater than ✅
b) Equal to
c) Less than
d) None

✅ *Answer: a) Greater than*

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8. A reducing agent is a species that loses electrons and _____ another species, but itself gets _____.

a) Oxidizes, oxidized
b) Reduces, oxidized ✅
c) Reduces, reduced
d) Oxidizes, reduced

✅ *Answer: b) Reduces, oxidized*

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9. According to Brønsted-Lowry concept, a base is any molecule that can:

a) Donate electrons
b) Donate proton
c) Accept proton ✅
d) Accept electron pair

✅ *Answer: c) Accept proton*

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10. Which one of the following elements is an example of a metalloid?

a) Oxygen
b) Silicon ✅
c) Fluorine
d) Chlorine

✅ *Answer: b) Silicon*

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11. The period number equals the _____ quantum number of the valence shell.
a) Principal ✅
b) Subsidiary
c) Magnetic
d) Spin
✅ *Answer: a) Principal*

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12. Mendeleev's statement of the law of periodicity depends on which physical constant?
a) Atomic number
b) Atomic weight ✅
c) Both
d) None
✅ *Answer: b) Atomic weight*
(*Explanation: Mendeleev arranged elements by increasing atomic weight.*)

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13. A coordination bond is formed by _____.
a) Exchange of electrons
b) Equal sharing of electrons
c) One-way sharing of electrons ✅
d) Equal electronegativity
✅ *Answer: c) One-way sharing of electrons*
(*Explanation: Also known as a dative bond—both electrons come from the same atom.*)

Essay Type: [Answer any three in your answer script]

2.
a. Discuss in your own words the contributions and limitations of the three atomic models.
b. Show the derivation of the Bohr's radius calculation for a hydrogen atom.
c. What is a spectrum? Calculate the wavelength of the line in the Balmer series that is associated with the drop of an electron from the fifth orbit. *(Rydberg constant = 109,677 cm^{-1})*

3.
a. What are quantum numbers? Explain the significance of the quantum numbers to clearly define the inner structure of the atom.
b. Prove by showing the mathematical derivation that the momentum of a particle in motion is inversely proportional to its wavelength.
c. Write the statement of Heisenberg's Uncertainty Principle. The uncertainty in the position

of a moving bullet of mass 0.35 kg is 1.25×10^{-8} cm. Calculate the uncertainty in its velocity. *(h = Planck's constant)*

4.

a. Describe the modern periodic table by highlighting the main features.

b. Write short notes on any two of the following (1.5 + 1.5):

i. Transition metals

ii. Halogens

iii. Noble gases

c. Explain Brønsted-Lowry concepts of acids and bases with the reasons for its superiority over the Arrhenius concept.

5.

a. What is an ionic bond? Illustrate with a suitable example the formation of an ionic bond by dot and cross diagrams.

b. Why is it important for engineers to understand the thermal and electrical conductivity of materials? Explain conductivity of matter using the electron sea model.

c. Show the construction of the N_2 molecule by molecular orbital diagrams and find the bond order, magnetic properties, and electronic configuration of N_2 molecules.