60 Answers

1. 1, wave mechanical model refers to electron acting as waves of energy or tiny bits of negative charged matter, whirring around the nucleus in shells. The model is a statistical one of the likelihood of finding electrons in certain spaces around the nucleus. The closer electrons are to the nucleus, the lower energy they have. Neutrons are always in the nucleus, circular paths refer to the orbits that were described by Niels Bohr in his early model of the atom.

2. 3, all oxygen atoms are atomic number 8, which means they have a +8 nuclear charge. Any number of neutrons, for any isotope, have no additional charge. The atomic number is the net nuclear charge (positive) for any atom.

3. 3, at high temps the gas particles will have a harder time sticking together to form into a liquid, or solid. At low pressure they'll have a hard time finding each other, to collapse into a liquid.

4. 4, oxygen and ozone are made up only of oxygen atoms but in different bonding situations. Normal oxygen has a double nonpolar covalent bond with just 2 atoms and specific properties (like we can breathe it to stay alive, or it combusts with hydrocarbons). Ozone is a cool name, but with 3 atoms and funky bonding, it cannot be breathed, it does not support combustion, it does block harmful rays from the Sun. They both have different formulas, different molar masses, and different properties. They are ALLOTROPES. Other allotropes are carbon atoms, graphite carbon (sheets), and diamond carbon (dense 3D bonding). All carbons does not have the same bonding or properties even though it's all carbon.

5. 1, Mass defect means that in all nuclear fissions and fusions, that the mass of the products are less than the mass of the reactants. Mass becomes energy due to: $e=mc^2$.

6. 2, electrolytes are solutions with ions. Choice 2 has and acid (yes) and a base (yes again). Choice 1 has an acid (yes) and methanol which is an alcohol.
"Alcohols are molecular, the –OH does not ionize. Choice 3 has ribose (sugar) and methanol again. Choice 4 has ribose and a base (yes).

7. 2, neutralization of and acid plus a base into a salt and water requires acid or base. Choices in order are a salt, a base (yes), alcohol, and aldehyde.

8. 1, gold is number 79. All gold atoms have 79 protons and also 79 electrons since all atoms are neutral. This +3 gold cation has lost 3 electrons. So, 79—3 = 76 electrons.

9. 3, this is like methane, each bond is polar but since the molecule has radial symmetry it is a nonpolar molecule. Radial symmetry makes the negative charged F atoms "balanced" around the + carbon.

10. 4, metallic bonding is understood to have the atoms acting as packed cations awash in a sea of mobile electrons. Loose electrons allow for easy flow of
electricity (more loose electrons). Ions in solution have the same effect,
allowing electricity to flow.

11. 3, lowest electronegativity value means lowest tendency to gain electrons in a bonding situation. Survey says (see table S), nitrogen.

12. 2, oxidation is the loss of electrons (LEO). Aluminum loses 3 electrons when it becomes a cation.

13. 4, Sorry I couldn't remove this number. An acid plus an alcohol makes for esters.

14. 2, entropy is always increasing as the Universe breaks down. Energy is always spreading out (think about the Sun's energy going everywhere including Earth. One day the energy will all be spread out and the Earth will get cold. This energy will not return to the Sun.

15. 2, non polar is when there is no difference in electronegativity. Only the Br_2 molecule has this in this question.

16. 3, fusion is when two small atoms are forced into becoming one bigger one, often with the extra neutron(s) emitted. Choice one is a phase change, 2 is synthesis, 4 is artificial transmutation of a fission reaction.

17. 2, colligative properties of water state, the more particles in solution makes for a higher boiling point and/or a lower freezing point. These particles dissolved disrupt the water's freezing hydrogen bonding. On the hotter side, the water needs to break apart from itself (break the hydrogen bonds) to boil, with other particles dissolved, it needs to break apart from these particles as well.

18. 1, gases do this, they are not in a geometric pattern (solids), they don't have attraction (they'd become liquids), or have any loss of energy due to collisions.

19. 4, Allotropes again. Same atoms but different bonding which leads to different properties.

20. 1, look at table G, at ten degrees all solutions are saturated with 80 or less than 80 grams, except for KI, which 135 grams dissolves into 100 mL water.

21. 3, Leo the Lion is ALWAYS a RED-Cat. Reduction always happens at the cathode, therefore, oxidation always happens at the anode.

22. 1, Roman numeral means +2 charge here, so with oxygen it's a 1:1 ratio.

23. 4, to increase the rate of reaction you increase temperature and increase concentration of reactants. You could also add a catalyst, or increase surface area, but those choices are not part of this question.

24. 2, transmutation is when one kind of atom becomes a different kind.

25. 2, oxidation means loss of electrons (LEO). All other choices are wrong.

26. 1, chlorine can only become an anion, not a cation. Anions have the same number of electrons shells as the atoms they formed from, but have 1, 2, or 3 extra electrons. This will "stretch" the outermost shell slightly larger than the atom. Cations form when metal atoms lose electrons, and lose their entire valence shell.

27. 4, sulfur atoms have 16 electrons because they are atomic number 16.
The negative 2 ion has 16 + 2 = 18 electrons. Only argon has 18 electrons here.

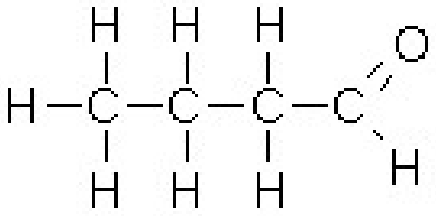
28. 1, energy is on the reactant side, it's added into the reaction. Since the solid becomes ions the particles are more disordered, more entropy.

29. 2, isotopes are chemically identical atoms with different masses because they have different numbers of neutrons.

30. 3. redox reactions have changing oxidation numbers. Double replacement reactions are not redox, so choices 1 and 2 are wrong. The fourth choice, acid base neutralization is a fancy kind of DR, it's also wrong. In DR or Acid base neutralization there is no change in oxidation numbers.

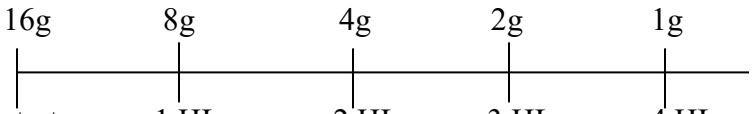
31. 1, at 60°C you can fit 125 grams NaNO3 into 100 mL of water. Upon cooling, it can only hold 80 grams. The difference, 45 grams, is the amount that falls out of solution as a precipitate. The closest answer is 46 grams.

32. 1, Draw this molecule, like this, which makes is butanal.



33. 3, the data suggests, loose ions in solution, an acid solution, and single replacement reaction with metal (redox), so the only choice is HBr, hydrobromic acid. In solution the H becomes the H^{+1} cation.

34. 2, draw your T chart timeline for a half life reaction problem.



4 HL = 237 sec.

1 HL = 59.3 seconds

35. 2, look at the table. Wave mechanical is the modern theory of the atom. Protons are always in the nucleus, electrons are in shells, or zones of likely location around the outside of the nucleus.

36. 3, acid base neutralization that forms calcium sulfate and HOH can be done in reverse. It would be calcium hydroxide and hydrogen sulfate (sulfuric acid).

37. 1, pick an atom from each group, bond it to oxygen, look at the atom to atom ratio to see what is possible. Only Na_2O works this way. (All atoms in group one make the same kind of +1 cation.

38. 2, using the titration formula, do the math. The answer can only be 20.0 mL (3 SF).

39. 3, this is fermentation, the products are ethanol + carbon dioxide. Find ethanol in the choices.

40. 4, allotropes again. Over the years allotropes, isotopes, and isomers knock around out students. These 3 words are important and easily mixed up.

41. 1, the carbon atoms are making a triple non polar covalent bond. To make a covalent bond each atom must put up an electron to share. One pair is two electrons. A double bond is when each atom puts up 2 electrons. Double bond is two pairs, four electrons. Triple bond is 3 electrons each, 6 atoms total.

42. 3, losing negatives is confusing. Cations form when metal atoms (neutral) lose electrons (become + charged).

43. 4, Isomers have the same chemical formula but different structures. Count the atoms in each pair to make sure they are the same. The only similarities that isomers have is same molar mass and same chemical formulas.

44. 2, Leo the Lion is AKWAYS a RED cat. Reduction happens on the cathode. Oxidation always happens at the anode!

45. 4, Electrolytes have ions in solution, only the base potassium hydroxide is okay here. Methanol, glucose and water have no ions to speak of.

46. 4, hydroxides are the only base anions. Hydronium or hydrogen ions are the only cations in acids (according to Arrhenius and he's our main man from Sweden on this topic).

47. 2, solutions are always mixtures, and unsaturated solutions are always mixed perfectly, homogeneous. If a solution were to become saturated, it might have some precipitation if the temperature changes even a little bit.

48. 1, batteries, or voltaic cells spontaneously convert chemical energy into electricity. The reverse are electrolytic cells, which use electricity to force a non-spontaneous redox reaction.

49. 4, fusion is when 2 small atoms are forced to become one bigger one, only the last choice here qualifies as even close to correct.

50. 2, Sr has a ground state configuration of Sr 2-8-18-8-2, choice 2 has the correct number of electrons and has one electron from the 4th shell that has jumped up to the fifth shell, which is excited state.

51. 1, at STP brittle means a nonmetal and not gas or liquid.
Sulfur is correct. K & Na are malleable metals, Ar is a gas.

52. 4, the higher the shell, the higher the energy of the electrons in the shell.

53. 3, check table S for Pb, or lead. 601 K is the melting/freezing point. But there is not a correct choice unless you convert to centigrade.

54. 3, the hardest question ever. The normal titration math gives an answer that does not show up on the test. Think hard now, sulfuric acid makes 2 hydrogen ions at once, and the molarity of the acid means the number of moles of hydrogen ions per liter. The answer here is 3, don't get mad.

55. 2, thyroid glands absorb iodine. Cobalt-60 is for treating some tumors and cancer. No other radioisotopes are used in medicine.

56. 3, carbon is number 6, it has six protons, and no matter the isotope, the neutrons are all neutral. The nucleus has a+6 charge.

57. 4, The O_2^{-2} ion is on table E, it's called peroxide ion.

58. 2, catalysts lower activation energy by offering an alternative or different path for the reaction to follow. It's not about the collision rate with catalysts.

59. 2, high vapor pressure means it evaporates easily. If it evaporates easily it must not be too "sticky" to itself, hence, weak intermolecular bonding.

60. 1, mass defect again. It's not hard, but mass becomes energy (not ever the reverse!).