

20 Selected regents exam questions covering fall chemistry topics (the old stuff)

- 1 According to the wave-mechanical model of the atom, an orbital is a region of the most probable location of
(1) an alpha particle (2) a gamma ray (3) an electron (4) a proton
- 2 Which particles have approximately the same mass?
(1) an electron and an alpha particle (2) an electron and a proton
(3) a neutron and an alpha particle (4) a neutron and a proton
- 3 During a flame test, a lithium salt produces a characteristic red flame. This red color is produced when electrons in excited lithium atoms
(1) are lost by the atoms (2) move to higher energy states within the atoms
(3) return to lower energy states within the atoms (4) are gained by the atoms
- 4 Compared to the energy and charge of the electrons in the first shell of a Be atom, the electrons in the second shell of this atom have
(1) less energy and the same charge (2) less energy and a different charge
(3) more energy and the same charge (4) more energy and a different charge
- 5 Which quantity can vary among atoms of the same element?
(1) mass number (2) atomic number (3) number of protons (4) number of electrons
- 6 An atom that has 13 protons and 15 neutrons is an isotope of the element
(1) nickel (2) silicon (3) aluminum (4) phosphorus
- 7 Which elements have the most similar chemical properties?
(1) Si, As, and Te (2) N₂, O₂, and F₂ (3) Mg, Sr, and Ba (4) Ca, Cs, and Cu
- 8 A sample of CO_{2(s)} and a sample of CO_{2(g)} differ in their
(1) chemical compositions (2) empirical formulas (3) molecular structures (4) physical properties
- 9 Which equation represents sublimation?
(1) Hg_(L) → Hg_(S) (2) H₂O_(s) → H₂O_(g)
(3) NH_{3(g)} → NH_{3(L)} (4) CH_{4(L)} → CH_{4(g)}
- 10 Two grams of potassium chloride are completely dissolved in a sample of water in a beaker. This solution is classified as (an/a)
(1) element (2) compound (3) homogeneous mixture (4) heterogeneous mixture

- 11 Which compound is an electrolyte?
(1) CCl_4 (2) CH_3OH (3) $\text{C}_6\text{H}_{12}\text{O}_6$ (4) $\text{Ca}(\text{OH})_2$
- 12 What is the overall charge of an ion that has 12 protons, 10 electrons, and 14 neutrons?
(1) -2 (2) +2 (3) -4 (4) +4
- 14 Which electron configuration represents the electrons of a sulfur atom in an excited state?
(1) 2-6-6 (2) 2-7-7 (3) 2-8-4 (4) 2-8-6
- 15 Given the word equation: sodium chlorate \rightarrow sodium chloride + oxygen
Which type of chemical reaction is represented by this equation?
(1) double replacement (2) single replacement (3) decomposition (4) synthesis
- 16 Which compound has the highest percent composition by mass of strontium?
(1) SrCl_2 (2) SrI_2 (3) SrO (4) SrS
- 17 Which formulas represent one ionic compound and one molecular compound?
(1) N_2 and SO_2 (2) Cl_2 and H_2S (3) BaCl_2 and N_2O_4 (4) NaOH and BaSO_4
- 18 Which Kelvin temperature is equal to $200.^\circ\text{C}$?
(1) 73 K (2) 73 K (3) 200. K (4) 473 K
- 19 Which statement describes the location of protons and neutrons in an atom of helium?
(1) Protons and neutrons are in the nucleus.
(2) Protons and neutrons are outside the nucleus.
(3) Protons are outside the nucleus, and neutrons are in the nucleus.
(4) Protons are in the nucleus, and neutrons are outside the nucleus.
- 20 Given a list of atomic model descriptions:
A: electron shells outside a central nucleus B: hard, indivisible sphere C: mostly empty space
Which list of atomic model descriptions represents the order of historical development from the earliest to most recent?
(1) A, B, C (2) B, C, A (3) A, C, B (4) B, A, C

ANSWERS to the June 2013 Regents Exam, MID YEAR review

1. In the wave-mechanical model of the atom, an orbital (shell is a better word, shells contain sub-orbitals) is a region of the most probable location of (3) an electron
It's the ZONE of statistical likelihood that the electron is present.
It's NOT like an orbit, with a set radius, like planets around the Sun.
2. Which particles have approximately the same mass? (4) a neutron and a proton
Both have 1 amu exactly in high school. Electrons have no mass in High School. The other particles listed YOU DID NOT YET MEET. Now you know that they have mass on table O.
3. During a flame test, a lithium salt produces a characteristic red flame. This red color is produced when electrons in excited lithium atoms (3) return to lower energy states within the atoms. Energy is absorbed which allows electrons to energize and move to higher energy levels or shells, but when this unstable time ends, the electrons can return to the ground state only when they emit this previously gained energy, as the spectra we can see.
4. Compared to the energy and charge of the electrons in the first shell of a Be atom, the electrons in the second shell of this atom have (3) more energy and the same charge
All electrons have the same -1 charge, but electrons in orbitals closer to the nucleus have a lower energy associated with them, while the electrons further away are more energized.
5. Which quantity can vary among atoms of the same element? (1) mass number
That's because of isotopes. All atoms of one type have the same number of protons, same number of electrons, but can have different numbers of neutrons (meaning) different mass.
6. An atom that has 13 protons and 15 neutrons is an isotope of the element (3) aluminum
13 protons means aluminum, no other choices in the Universe. Also 13 electrons.
7. Which elements have the most similar chemical properties? (3) Mg, Sr, and Ba
All of these are in group 2 together. Groups are like families, they have many similar chemical properties. Elements in the same period only share the SAME NUMBER of electron shells
8. A sample of $\text{CO}_{2(s)}$ and a sample of $\text{CO}_{2(g)}$ differ in their (4) physical properties
These are the same stuff, different phase.
9. Which equation represents sublimation? (2) $\text{H}_2\text{O}_{(s)} \rightarrow \text{H}_2\text{O}_{(g)}$
Sublimation means the phase change from SOLID to GAS without becoming liquid. Iodine was sublimated in our class. $\text{I}_{2(s)} \rightarrow \text{I}_{2(g)}$
10. Two grams of potassium chloride are completely dissolved in a sample of water in a beaker.
This solution is classified as a (3) homogeneous mixture
If it completely dissolves into solution, solutions are homogeneous (same throughout) and they are a type of mixture, not chemically combined. It's not a chemical reaction, it's a phase change, $S \rightarrow \text{AQ}$

- 11 Which compound is an electrolyte? (4) $\text{Ca}(\text{OH})_2$ Electrolytes must be IONIC and AQUEOUS. Molecular compounds that are polar dissolve into (polar) water (like dissolves like) but have no loose mobile ions.
- 12 What is the overall charge of an ion that has 12 protons, 10 electrons, and 14 neutrons? (2) +2
This is an isotope of Mg, with 12 protons it HAS to be Mg, and it's the Mg^{+2} cation, since it LOST 2 electrons. The extra neutrons are there to disrupt your thoughts, but just mean that this isotope has mass of 26 instead of the more common Mg-24.
- 14 Which electron configuration represents the electrons of a sulfur atom in an excited state? (2) 2-7-7
To be sulfur, there are 16 electrons, and they are usually in the ground state (2-8-6) configuration.
- 15 Given the word equation: sodium chlorate \rightarrow sodium chloride + oxygen
Which type of chemical reaction is represented by this equation? (3) decomposition
One bigger reactant breaks down into 2 (or more) products.
- 16 Which compound has the highest percent composition by mass of strontium?
(this requires you to do all the math to get the right answer.)
- (1) SrCl_2 molar mass = 158 g/mole, % comp is $88/158 \times 100\% = 55.7\%$ Sr
(2) SrI_2 molar mass = 332 g/mole, % comp is $88/332 \times 100\% = 26.5\%$ Sr
(3) SrO molar mass = 104 g/mole, % comp is $88/104 \times 100\% = 84.6\%$ Sr
(4) SrS molar mass = 120 g/mole, % comp is $88/120 \times 100\% = 73.3\%$ Sr
- 17 Which formulas represent one ionic compound and one molecular compound? (3) BaCl_2 and N_2O_4
Choices 1+2 are both molecular (no metals), 4 are both ionic.
- 18 Which Kelvin temperature is equal to $200.^\circ\text{C}$? $\text{K} = \text{C} + 273$ (write the formula!) (4) 473 K
- 19 Answer is (1) protons and neutrons are in the nucleus, electrons are flying around outside of the nucleus.
- 20 Answer is (2) BCA. Dalton said atoms are small hard spheres, Rutherford (Gold foil) discovered that the electrons fly around a dense positive nucleus, and then Bohr put the electrons into "orbits" which were also energy levels. We know now that the "orbit" part was incorrect, the electrons are not like planets following neat little loops around the nucleus. The electrons are in energy levels but the zones are fuzzy shapes not loops.