XPERTSTEM Chemistry Sample Test Division 4 for Grade 9 & 10

1. Dalton's atomic theory was revolutionary but incomplete. Which limitation of Dalton's theory was most directly challenged by the discovery of isotopes?

A Atoms cannot be divided.
B All atoms of an element have identical mass.
C Atoms combine in fixed ratios.
D Atoms are solid spheres.

2. In Rutherford's gold foil experiment, why did most alpha particles pass through the foil undeflected, while a small fraction were deflected at large angles?

A Most of the atom is empty space with a dense, positively charged nucleus that repels alpha particles on close approach.
B The gold atoms were uniformly charged throughout, causing random deflections.
C The alpha particles were weakly charged, so passed easily.
D The electrons inside the atom caused scattering of alpha particles.

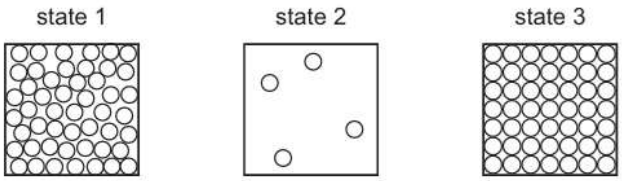
3. Bohr's model introduced quantized electron orbits. According to Bohr, an electron in a higher energy orbit can move to a lower orbit by:

A Absorbing energy and emitting a photon.
B Losing energy and emitting a photon.
C Emitting energy spontaneously without photon emission.
D Gaining energy and emitting a photon.

4. Which process happens when water vapour changes to rain?

A boiling
B condensing
C evaporating
D freezing

5. The diagrams show the arrangement of particles in three different states of matter.



Which row describes the change in energy of the particles and in particle motion for the given change in state?

	change in state	energy of particles	particle motion
A	1 → 2	decreases	decreases
B	2 → 1	decreases	increases
C	3 → 1	increases	increases
D	1 → 3	increases	decreases

6. Which of these samples of gas contains the same number of atoms as 1 g of hydrogen gas?

A 22 g of carbon dioxide (M_r: CO_2, 44)
B 8 g of methane (M_r: CH_4, 16)
C 20 g of neon (M_r: Ne, 20)
D 8 g of ozone (M_r: O_3, 48)

7. When a small piece of a Group I metal is placed into a large beaker of cold water, a reaction occurs. Four statements about this reaction are listed.

(1)The metal melts.
(2) Hydrogen is produced.
(3) Steam is produced.
(4) The pH of the solution increases.

Which statements about this reaction describe a physical change?

A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

8. The equation for the decomposition of hydrogen peroxide is shown.

$2H_2O_2 \rightarrow 2H_2O + O_2$

The reaction is exothermic. When a small amount of a catalyst is added, the oxygen is produced more quickly. Which statement about the catalyst is correct?

A The catalyst makes the reaction more exothermic.
B The mass of catalyst is the same before and after the reaction.
C The catalyst increases the final volume of oxygen produced.
D All of the catalyst is used up in the reaction.

9. Which row identifies the number of electrons, neutrons and protons in a particle which is an isotope of B -11?

	electrons	neutrons	protons
A	5	5	5
B	5	6	5
C	6	5	6
D	6	6	6

10. Which statement about the properties associated with the different types of bonding involved is correct?

A Any covalent compound that contains both oxygen and hydrogen in its molecule forms hydrogen bonds.
B Ionic bonds and covalent bonds cannot both occur in the same compound.
C Ionic compounds differ from metals in that ionic compounds do not conduct electricity in the solid state.
D The only covalent compounds with high melting points are those in which hydrogen bonds occur.

11. What type of intermolecular forces are present in CH_3OCH_3 (dimethyl ether)?

A London dispersion forces only
B London dispersion and dipole-dipole forces
C London dispersion, dipole-dipole, and hydrogen bonding
D Ionic bonding

12. Why does ICl have a higher boiling point than Br_2?

A because of the difference in the bond energies of the covalent bonds within ICl and Br_2
B because of the difference in the polar nature of ICl and Br_2
C because of the difference in the number of electrons contained within ICl and Br_2
D because of the difference in the relative molecular mass of ICl and Br_2

13. Which factor causes helium to have a higher first ionisation energy than hydrogen?

A In the 1s orbital in helium, electrons are paired.
B The lowest energy level in helium is filled.
C The nuclear charge in helium is higher than in hydrogen.
D There is less shielding of the outer shell in helium.

14. X and Y are elements in Period 3 of the Periodic Table. Y has a greater atomic number than X. The stable ion formed by Y has a greater radius than the stable ion formed by X. The stable ion formed by Y has 18 electrons.
Which row is correct?

	number of electrons in the stable ion of X	element with the greater atomic radius
A	10	X
B	10	Y
C	18	X
D	18	Y

15. The equation shows the thermal decomposition of magnesium carbonate.

$\mathbf{MgCO_3 \rightarrow MgO + CO_2}$ [M_r: $MgCO_3$, 84]

Which mass of magnesium oxide is formed when 21.0 g of magnesium carbonate is completely decomposed?

A 1.9 g
B 4.0 g
C 10.0 g
D 40.0 g

16. A hydrogen–oxygen fuel cell uses 630 dm^3 of oxygen. The oxygen for the reaction is extracted from clean, dry air. What is the minimum volume of clean, dry air needed to provide this volume of oxygen?

A 788 dm^3
B 808 dm^3
C 3000 dm^3
D 3316 dm^3

17. A 0.216 g sample of aluminium carbide reacts with an excess of water to produce methane gas. This is the only carbon-containing product formed in the reaction. This methane gas burns completely in O_2 to form H_2O and CO_2 only. The volume of CO_2 produced at room temperature and pressure is 108 cm^3.

What is the formula of aluminium carbide?

A Al_2C_3
B Al_3C_2
C Al_3C_4
D Al_4C_3

18. Copper reacts with nitric acid under certain conditions. The products are copper(II) nitrate, water and an oxide of nitrogen. 3 mol of copper reacts with exactly 8 mol of nitric acid. What is the oxidation state of nitrogen in the oxide produced?

A +1
B +2
C +3
D +4

19. Equations for some reactions of hydrogen peroxide are given.

1 $2Fe^{2+} + H_2O_2 + 2H^+ \rightarrow 2Fe^{3+} + 2H_2O$

2 $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

3 $2Fe^{3+} + H_2O_2 + 2OH^- \rightarrow 2Fe^{2+} + O_2 + 2H_2O$

In which reactions is hydrogen peroxide acting as a reducing agent?

A 1 and 3
B 1 only
C 2 and 3
D 2 only

20. Which statements about potassium iodide are correct?

1 It is formed from potassium anions and iodide cations.
2 It is a good electrical conductor when molten or in aqueous solution.
3 Potassium atoms share electrons with iodine atoms

A 1 and 3
B 1 only
C 2 and 3
D 2 only 7

21. Which substances contain one or more shared pairs of electrons?

A argon
B methane
C iron(III) oxide
D chlorine

22. Which one of the following is the correct formula of tin(IV) chlorate?

A $Ti_4C\ell O_3$
B $Ti(C\ell O_3)_2$
C $Sn(C\ell O_3)_2$
D $Sn(C\ell O_3)_4$

23. Why does the rate of a gaseous reaction increase when the pressure is increased at a constant temperature?

A More particles have energy that exceeds the activation energy.
B The particles have more space in which to move.
C The particles move faster.
D There are more frequent collisions between particles.

24. Ocean acidification is primarily caused by:

A Increased evaporation rates

B Increased absorption of atmospheric CO_2 by the oceans

C Oil spills and marine pollution

D Decreased ocean temperatures

25. River water in an agricultural area contains NH_4+, CO_3^{2-}, HCO_3^-, Cl^- and NO_3^- ions. This water is treated by adding a calculated quantity of calcium hydroxide. What is precipitated from the river water when calcium hydroxide is added?

A $CaCl_2$

B $CaCO_3$

C $Ca(NO_3)_2$

D NH_4OH

26. Four atmospheric pollutants are listed.

1 nitrogen oxides

2 carbon monoxide

3 unburnt hydrocarbons

4 sulfur dioxide

Which pair of pollutants react to form peroxyacetyl nitrate, PAN?

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

27. An aqueous solution of hydrogen peroxide is placed in a flask and decomposes, as shown. $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$ The total volume of oxygen gas evolved is 180 cm^3 after 90 seconds, measured under room conditions. The rate of the reaction is calculated using the equation shown.

$$\text{rate} = \frac{\text{change in moles of } H_2O_2}{\text{time}}$$

What is the average rate of the reaction, measured in mol. min^{-1}, over the duration of the experiment?

A 8.33×10^{-5}

B 1.67×10^{-4}

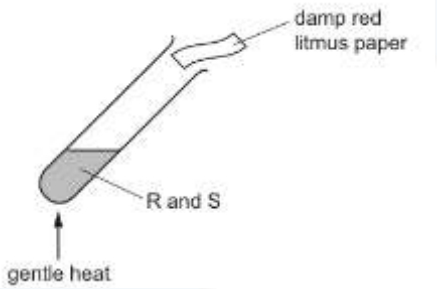
C 0.0050

D 0.010

28. Which row gives the colours observed when thymolphthalein and methyl orange are added separately to the named solution

	solution	colour with thymolphthalein	colour with methyl orange
A	dilute HCl	colourless	yellow
B	dilute HCl	blue	red
C	aqueous NaOH	colourless	red
D	aqueous NaOH	blue	yellow

29. A mixture of two substances, R and S, is heated gently. The damp red litmus paper turns blue. gentle heat



What are R and S?

	R	S
A	a basic oxide	ammonium chloride
B	a basic oxide	sodium nitrate
C	an acidic oxide	ammonium chloride
D	an acidic oxide	sodium nitrate

30. Which reactants are used to make the salt copper(II) sulfate?

A dilute acid + alkali

B dilute acid + metal carbonate

C dilute acid + metal

D dilute acid + non-metal oxide