

Nature of matter, atomic structure and periodic table exam

Extra section (answers to be given without formula booklet).

1. Fill the periodic table (only the non-shaded squares). [0.2 per element]

[illegible]

2. Sketch the electromagnetic spectrum naming as many sections as you can [4]

3. Which colour carries more energy, blue or red? [1]

4. Explain why a fluorescent substance cannot absorb infrared and emit yellow light. [2]

Regular section

(a copy of the formula booklet and a calculator may be used) [76 marks not counting bonus]

1. Sketch a diagram of the states of matter, including the names of the changes of state. [4]

2. Of the following statements, which are true? [3]

i. A hot gas is difficult to compress because the particles are very close together

ii. In a liquid, most of the space is empty.

iii. In a solid, all particles have the same kinetic energy.

iv. If an object B is hotter than another object A, then the particles of B are moving faster than the particles of A.

a) Only i is true

e) i and ii are true

i) all are true except ii

b) Only ii is true

f) i and iii are true

j) none is true

c) Only iii is true

g) iii and iv are true

h) all are true

d) Only iv is true

h) all are true except i

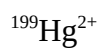
3. Explain, with drawings and words, the process of solvation.[4]

4. The particles of elements are atoms and the particles of compounds are molecules. Explain, with examples when this is true and when this is not [4]

5. What are the names of the components of a solution? [1]

6. Explain the difference between a homogeneous mixture and a chemical compound [3]

7. Write the number of protons, neutrons and electrons of the following: [5]



8. Draw the box diagrams showing the electronic configuration of the following: [3]



9. Write the electronic configurations of the following: [3]

Ne

I

Sc

10. Explain, in terms of atomic structure, why there are ten groups of transition metals. [2]

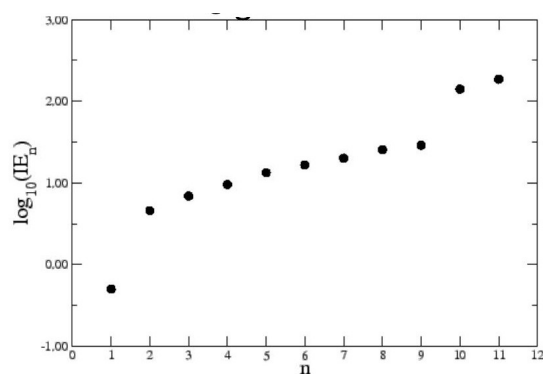
11. Which oxide will be more basic, strontium oxide or silver oxide? Explain why. [2]

12. Silver has mostly two isotopes, ^{107}Ag , which accounts for 51.8% of the silver, and ^{109}Ag , which accounts for the rest. Calculate the atomic weight of silver. (show your calculations) [2]

13. State and explain the vertical and horizontal trends of atomic radius in the periodic table [3]

14. State the definition of electronegativity [2] and compare it with the definition of electron affinity [2].

15 (HL only) The successive ionisation energies of an element of period 3 have been measured and the data is shown in this graph. Identify the element and explain how you identified it. [3]



16. HL only) A solution contains a metal M surrounded by four ligands L₁. Said solution is transparent. A different ligand L₂ is added to the solution so that the metal M is now surrounded by four L₂ ligands.

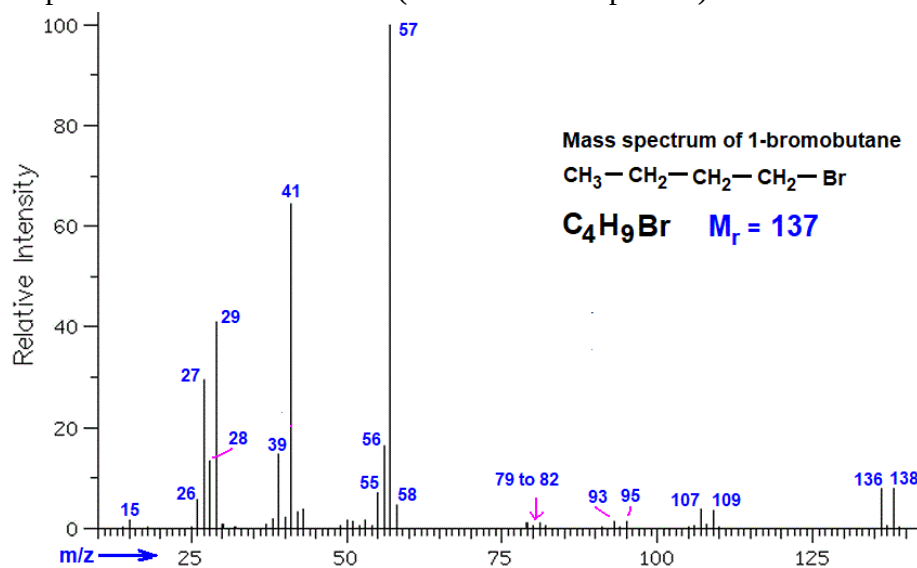
a) Explain how this can have the consequence of the solution turning blue. [4]

b) Can this also mean that the solution passed from being paramagnetic to being diamagnetic? if so, explain how. If not, explain how you can tell. [4]

17. (HL only) Name (or give the formula of) two bad ligands and two good ones [2]

18. HL only) This is the mass spectrum of 1-bromobutane (see structure in picture).

a) If the molecular mass is 137, how come there is no peak at 137? [2]



b) What are the peaks at 107 and 109 and what has happened to the molecule inside the device for these peaks to appear? [2]

c) What is the peak at 57 and what happened to the molecule for it to appear?[2]

d Bonus: The peak at 29 I understand, but where did the peak at 41 come from? [special award]

18. This sequence of reactions show how CO_2 is basic.

Explain, in terms of periodic properties why this could not possibly happen. [2]

33. Calculate the oxidation states of all elements in Fe_2O_3 , HClO_4 , $\text{Al}(\text{OH})_3$, H_2SO_4 , CaSiO_4 and LiAlH_4 [2 each]