

# Key Questions for Science

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# Biology

## Cell biology

1. What type of cells are plant and animal cells?

**Eukaryotic**

2. What type of cells are bacterial cells?

**Prokaryotic**

3. Name five sub cellular structures found in animal cells.

**Nucleus, cytoplasm, cell membrane, mitochondria, ribosomes**

4. Plant cells have all the sub-cellular structures that animal cells have, but they often have two additional structures as well. Name them.

**Chloroplasts and vacuole (also cell wall)**

5. What is the name of microscopes that have a higher magnification and resolving power than light microscopes?

**Electron microscopes**

6. What is the calculation for magnification?

**Magnification =  $\frac{\text{size of image}}{\text{size of real object}}$**

7. Why is cell division by mitosis important?

**Growth and repair in eukaryotes**

8. What is the name given to an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type?

**Stem cell**

9. State three places stem cells are found.

**Embryos, adult bone marrow & meristem tissue in plants**

10. Describe the spreading out of particles of any substance in solution or a gas by diffusion.

**There is a net movement of particles from an area of high concentration to an area of low concentration.**

11. Name three substances that either diffuse into or out of the blood.

**Oxygen, carbon dioxide and urea**

12. Describe the movement of water in osmosis.

**Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane**

13. What is the name given to the movement of a substance from a more dilute solution to a more concentrated solution which requires energy from respiration?

**Active transport**

## Biology - Organisation

14. What name is given to a group of cells with a similar structure and function?

**Tissue**

15. What name is given to an aggregation of tissues performing specific functions?

**Organ**

16. What feature of enzymes enables them to catalyse specific reactions in living organisms?

**The shape of their active site**

17. Where is amylase produced and what does it do?

**In saliva and the pancreas to break down starch**

18. Where are proteases produced and what do they do?

**In the stomach and pancreas to break down proteins into amino acids**

19. Where are lipases produced and what do they do?

**In the pancreas to break down lipids to glycerol and fatty acids**

20. What is made in the liver and stored in the gall bladder?

**Bile**

21. Where does the right ventricle pump blood to?

**The lungs**

22. Where does the left ventricle pump blood to?  
**The whole body**
23. Where are the aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries found?  
**Connected to the heart**
24. Name the three types of blood vessel.  
**Arteries, veins and capillaries**
25. What is the blood made up of?  
**Plasma, RBCs, WBCs and platelets**
26. What is the state of physical and mental well-being?  
**Health**
27. State four causes of ill health.  
**Diseases, diet, stress and life situations**
28. State a proven risk factor for type 2 diabetes.  
**Obesity**
29. State three risk factors for cardiovascular disease.  
**Diet, smoking and exercise**
30. What is the result of changes in cells that lead to uncontrolled growth and division?  
**Cancer**
31. State four factors that affect the rate of transpiration.  
**Temperature, humidity, air movement and light intensity**
32. Which cells are adapted for efficient uptake of water by osmosis, and mineral ions by active transport?  
**Root hair cells**

33. What does xylem tissue transport?

**Water**

34. What do stomata and guard cells control in leaves?

**Gas exchange and water loss**

35. What does phloem tissue transport?

**Dissolved sugars (food)**

36. What is the movement of food molecules through phloem tissue called?

**Translocation**

### **Biology – Infection and response**

37. What is a pathogen?

**A microorganism that causes infectious disease**

38. Which serious disease is spread by inhalation of droplets from sneezes and coughs and causes a fever and a red skin rash?

**Measles**

39. Which virus attacks the body's immune system meaning the body can no longer deal with other infections or cancers?

**HIV**

40. Which plant pathogen affects many species resulting in a lack of growth?

**Tobacco mosaic virus (TMV)**

41. What type of food poisoning is spread by bacteria ingested in food or on food prepared in unhygienic conditions?

**Salmonella**

42. Which STD causes a thick yellow/green discharge from the vagina or penis and pain in urinating?

**Gonorrhoea**

43. Which fungal disease causes purple or yellow spots to develop on leaves, affecting the rate of photosynthesis and growth?

**Rose black spot**

44. What type of pathogen is malaria caused by?

**Protist**

45. State three ways white blood cells help to defend against pathogens.

***Phagocytosis, antibody production, antitoxin production***

46. What is the name given to introducing small quantities of dead or inactive forms of a pathogen into the body to prevent infection?

***Vaccination***

47. Which type of pathogen do antibiotics kill?

***Bacteria***

48. What are drugs tested on during clinical trials?

***Healthy volunteers and patients***

### **Biology - Bioenergetics**

49. What is the word equation for photosynthesis?

***Carbon dioxide + water → glucose + oxygen***

50. Name an endothermic reaction in which energy is transferred from the environment to chloroplasts by light.

***Photosynthesis***

51. State four factors that affect the rate of photosynthesis.

***Temperature, light intensity, carbon dioxide concentration and the amount of chlorophyll***

52. How do plants produce proteins?

***Using glucose and nitrate ions in the soil***

53. What is the name for an exothermic reaction that is continuously occurring in living cells?

***Respiration***

54. Write the equation that represents aerobic respiration.

***Glucose + oxygen → carbon dioxide + water***

55. What is the chemical formula for glucose?

***C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>***

56. What is the equation for anaerobic respiration in muscles?

***Glucose → lactic acid***

57. What is the equation for anaerobic respiration in plant and yeast cells?

***Glucose → ethanol + carbon dioxide***

58. Anaerobic respiration in yeast is called fermentation. What is it used to manufacture?

***Bread and alcoholic drinks***

59. What increases during exercise to supply muscles with more oxygenated blood?

***Heart rate, breathing rate & breath volume***

# Chemistry

## Atomic Structure and the periodic table

1. What is the name given to the smallest part of an element that can exist?

**Atom**

2. About how many elements are there in the periodic table?

**100**

3. What name is given to two or more elements chemically combined in fixed proportions?

**Compound**

4. What name is given to two or more elements or compounds not chemically combined?

**Mixture**

5. What are filtration, crystallisation, simple distillation, fractional distillation and chromatography all used for?

**Separation of mixtures**

6. What name is given to an incorrect model of an atom that suggested atoms are a ball of positive charge with negative electrons embedded in them?

**Plum pudding model**

7. Who adapted the nuclear model of the atom by suggesting that electrons orbit the nucleus at specific distances?

**Niels Bohr**

8. What was James Chadwick able to provide evidence for the existence of?

**Neutrons in the nucleus**

9. Complete the table

Name of particle	Relative Charge
Proton	<b>+1</b>
Neutron	<b>0</b>
Electron	<b>-1</b>

10. What does the atomic number indicate about the atoms of an element?

**The number of protons**

11. What is the approximate radius of an atom?

**0.1nm ( $1 \times 10^{-10}m$ )**

12. Complete the table

Name of particle	Relative mass
Proton	<b>1</b>
Neutron	<b>1</b>
Electron	<b>Very small</b>

13. What is the mass number of an element the sum of?

**The protons and neutrons in an atom**

14. What is the name of atoms of the same element that have different numbers of neutrons?

**Isotopes**

15. What are elements in the periodic table arranged in order of?

**Atomic number**

16. What do elements in the same group of the periodic table have in common?

**The same number of electrons in the outer shell and similar properties**

17. How did Mendeleev overcome problems with ordering the elements?

**He left gaps for undiscovered elements**

18. What react to form positive ions?

**Metals**

19. The elements of which group of the periodic table are unreactive and do not easily form molecules?

**Group 0**

20. Which group of the periodic table is known as the alkali metals?

**Group 1**

21. Does reactivity increase or decrease going down group 1?

**Increase**

22. Which group of the periodic table is known as the halogens?

**Group 7**

### **Chemistry – Bonding, structure and the properties of matter**

23. What are the three types of chemical bond?

**Ionic metallic and covalent**

24. Which chemical bond forms when non-metals combined with metals?

**Ionic**

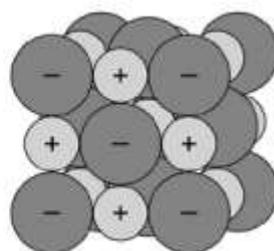
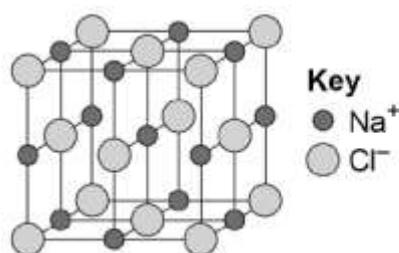
25. What charge do ions of group 2 elements have?

**+2**

26. What charge do ions of group 7 elements have?

**-1**

27. Which ionic structure can be represented in the following forms:

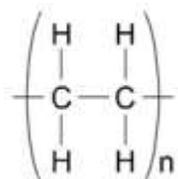


**Sodium Chloride**

28. What is a covalent bond?

29. **A shared pair of electrons between two atoms**

30. What type of structure is represented here:



**Polymer**

31. What does (aq) show in a chemical equation?

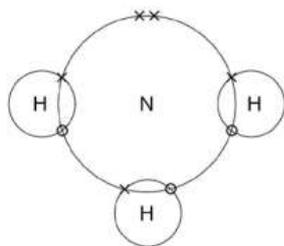
**Aqueous solution**

32. What state of matter are most polymers at room temperature?

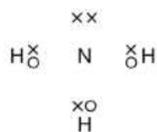
**Solid**

33. What type of chemical bonding is represented in these diagrams?

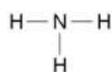
For ammonia (NH<sub>3</sub>)



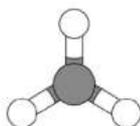
and/or



and/or

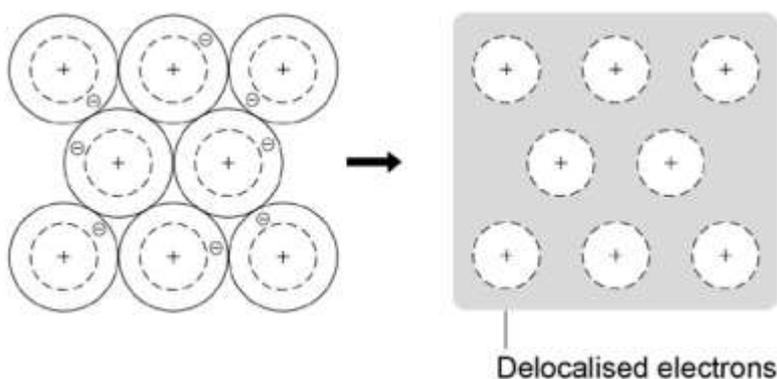


and/or



**Covalent**

34. Which type of chemical bonding can be represented in the following form:



**Metallic**

35. What determines the amount of energy needed to melt or boil a substance?

**The strength of the forces/bonds between the particles**

36. State key properties of ionic compounds.

**They have high melting and boiling points and they conduct electricity when molten or dissolved in water**

37. What forces acting between small molecules hold them together when liquid?

**Weak intermolecular forces**

38. Name three examples of giant covalent structures that you need to know.

**Diamond, graphite and silica**

39. How are atoms arranged in pure metals?

**Layers**

40. Which particles in metals allow them to conduct electricity and thermal energy?

**Delocalised electrons**

41. How many covalent bonds does each carbon atom in diamond have?

**4**

42. How many covalent bonds does each carbon atom in graphite have?

**3**

43. Which material is a single layer of graphite and has properties that make it useful in electronics and composites?

**Graphene**

44. What name is given to cylindrical fullerenes with very high length to diameter ratios?

**Carbon nanotubes**

**Chemistry – Quantitative Chemistry**

45. Which law states that no atoms are lost or made during a chemical reaction?

**(The law of) conservation of mass**

46. Why do some reactions appear to involve a change in mass?

***A reactant or product is a gas***

47. What name is given to the reactant that is completely used up in a chemical reaction?

***The limiting reactant***

### **Chemistry – Chemical changes**

48. What do metals react with oxygen to form in oxidation reactions?

***Metal oxides***

49. Which chemical reaction can be used to extract metals less reactive than carbon from their oxides?

***Reduction (using carbon)***

50. What do acids react with metal to form?

***A salt and hydrogen***

51. What word is used to describe the following reaction: acid + alkali → salt + water?

***Neutralisation***

52. What produce hydrogen ions (H<sup>+</sup>) in aqueous solutions?

***Acids***

53. What do aqueous solutions of alkalis contain?

***Hydroxide ions (OH<sup>-</sup>)***

54. Write the ionic equation for a neutralisation reaction.

***H<sup>+</sup>(aq) + OH<sup>-</sup>(aq) → H<sub>2</sub>O(l)***

55. What process can be used to split ionic compounds that are either molten or in aqueous solution by passing a current through them?

***Electrolysis***

56. What process is used to extract metals that are more reactive than carbon?

***Electrolysis***

57. Why is cryolite mixed with aluminium oxide in extraction of aluminium?

***To lower the melting point***

### **Chemistry – Energy Changes**

58. What name is given to a reaction that transfers energy to the surroundings, increasing the temperature of the surroundings?

***Exothermic***

59. What name is given to a reaction that transfers energy from the surroundings, decreasing the temperature of the surroundings?

***Endothermic***

60. What name is given to the minimum amount of energy that particles must have to react in a chemical reaction?

***Activation energy***

# Physics

## Energy

1. Write the equation used to calculate the kinetic energy of a moving object.

$$\text{Kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2 \text{ or } E_K = \frac{1}{2} m v^2$$

2. Write the equation used to calculate the amount of elastic potential energy stored in a stretched spring.

**Elastic potential energy =**

$$0.5 \times \text{spring constant} \times (\text{extension})^2 \text{ or}$$

$$E_e = \frac{1}{2} k e^2$$

3. What is the unit for kinetic energy, gravitational potential energy and elastic potential energy?

**Joules, J**

4. Write the equation used to calculate the amount of gravitational potential energy gained by an object raised above ground level.

**g.p.e. =**

$$\text{mass} \times \text{gravitational field strength} \times \text{height} \text{ or } E_p = m g h$$

5. What is the rate at which energy is transferred or work is done?

**Power**

6. Write two equations to calculate power.

$$\text{Power} = \frac{\text{energy transferred}}{\text{time}} \text{ or } P = \frac{E}{t}$$

And

$$\text{Power} = \frac{\text{Work done}}{\text{time}} \text{ or } P = \frac{W}{t}$$

7. What is the unit for Power?

**Watts**

8. What can be transferred usefully, stored or dissipated, but cannot be created or destroyed?

**Energy**

9. Write the equation for calculating the energy efficiency of any energy transfer.

$$\text{Efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

And

$$\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

10. What are the three main forms of fossil fuels used as energy resources?

**Coal, oil and (natural) gas**

11. State the three principle uses of energy resources.

**Transport, electricity generation and heating**

12. Name seven renewable energy resources available for use on Earth.

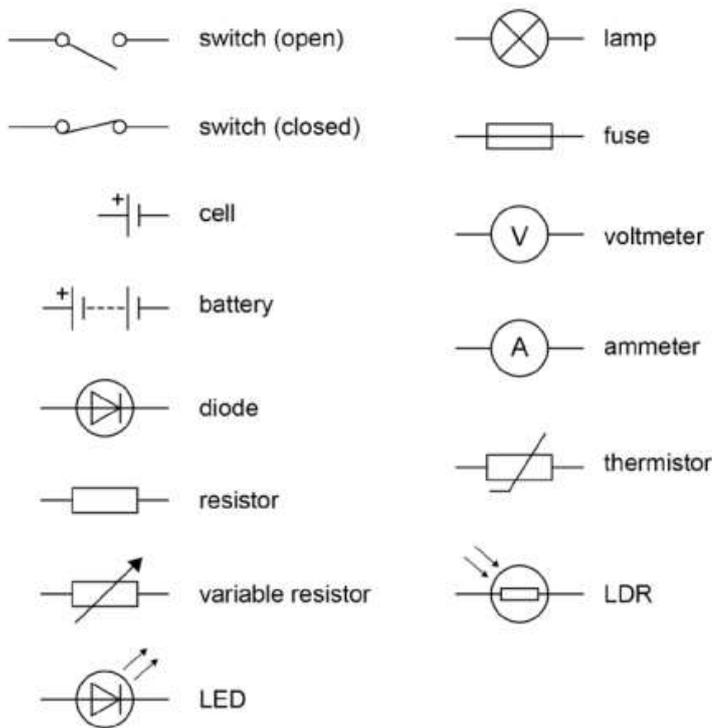
**Biofuel, wind, hydro-electricity, geothermal, the tides, the Sun, and water waves**

13. What is a renewable resource?

**One that can be replenished as it is used**

## Physics - Electricity

14. State what the following symbols show:



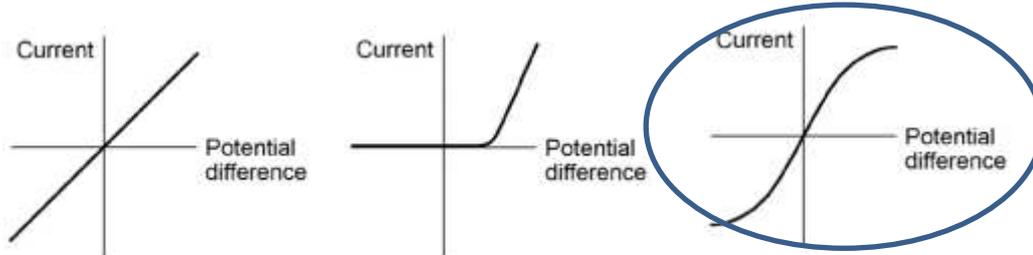
15. Write the equation used to calculate current, potential difference or resistance.

**Potential difference = current  $\times$  resistance or  $V = I R$**

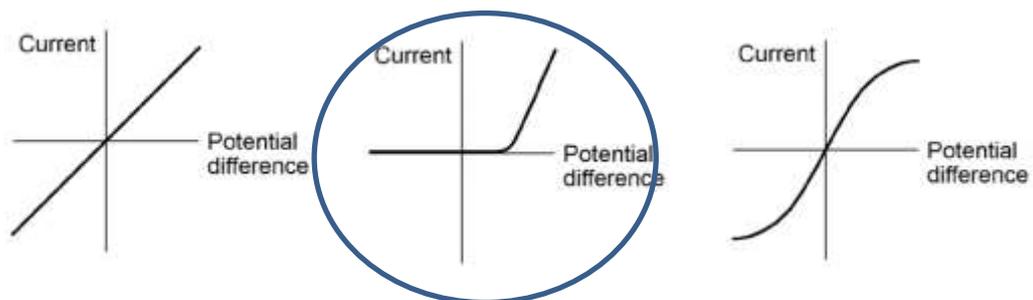
16. What is the unit for resistance?

**Ohms,  $\Omega$**

17. Which of the following graphs shows resistance in a filament lamp?



18. Which of the following graphs shows resistance in a diode?



19. What happens to the resistance of a thermistor as the temperature increases?

**It decreases**

20. What happens to the resistance of an LDR as the light intensity increases?

**It decreases**

21. Describe the current in a series circuit.

**It is the same through each component.**

22. Describe the potential difference in a series circuit.

**It is shared between components**

23. Describe resistance in a parallel circuit.

**It is less than the resistance of the smallest individual resistor**

24. Describe domestic mains electricity supply in the UK.

**It is ac (alternating current), has a frequency of 50 Hz and is about 230V**

25. What colour is the insulation on wires in a plug?

Live wire – **brown**

Neutral wire – **blue**

Earth wire – **green and yellow stripes**

26. Write two equations for calculating power transfer in an electric circuit.

**Power = potential difference × current**

$$P = VI$$

$$\text{Power} = (\text{current})^2 \times \text{resistance}$$

$$P = I^2 R$$

27. What does the amount of energy an appliance transfers depend on?

**How long the appliance is switched on for and the power of the appliance**

28. What are the two equations for calculating the amount of energy transferred by electrical work?

**Energy transferred = power × time**

$$E = Pt$$

**Energy transferred = charge flow × potential difference**

$$E = QV$$

29. How is electrical power transferred from power stations to consumers?

**The national grid**

**Physics - Particle model of matter**

30. What is the equation for calculating density?

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\rho = \frac{m}{V}$$

31. True or False: changes of state are physical changes?

**True**

32. What is the total kinetic and potential energy of all particles that make up a system known as?

**Internal energy**

33. Which three factors affect the increase in temperature of a substance?

**Its mass, the type of material and the energy input**

34. What is the amount of energy required to raise the temperature of a substance by 1°C known as?

**Specific heat capacity**

35. What is the energy needed for one Kg of a substance to change state without a change in temperature known as?

**Specific latent heat**

36. Describe the motion of molecules of a gas.

**Constant random motion**

37. What happens to the pressure exerted by a gas, held at constant volume, when the temperature is increased?

**It increases**

### **Physics – Atomic Structure**

38. What happens to an atom when it has an outer electron removed (e.g. by ionising radiation)

**It forms a positive ion**

39. What is the name given to the process when radiation is released as an unstable nucleus becomes more stable?

**Radioactive decay**

40. What is radioactivity measured in?

**Bequerels (Bq)**

41. What is an alpha particle?

**It consists of two neutrons and two protons – a helium nucleus**

42. What is a beta particle?

**A high speed electron**

43. What change takes place in a nucleus when a beta particle is emitted?

**A neutron turns into a proton**

44. What electromagnetic radiation can be released from the nucleus of a radioactive sample?

**Gamma rays**

45. How is an alpha particle represented in nuclear equations?



46. How is a beta particle represented in nuclear equations?



47. What is the time taken for the number of nuclei of an isotope in a sample to halve known as?

**Half life**

48. What is the presence of radioactive materials on or in other objects known as?

**Radioactive contamination**

49. What is the process of exposing an object to nuclear radiation without causing it to become radioactive known as?

**Irradiation**