

Cell Structures

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How is the **magnification** of a light microscope calculated?

1

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Total **magnification** is calculated by multiplying the magnification of the eyepiece lens by the magnification of the objective lens.

1

What Happens in Cells

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What term is used to describe the shape of a **DNA** molecule?

2

What Happens in Cells

A **DNA** molecule forms the shape of a **double helix**.

2

Respiration

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What is the word equation for **aerobic respiration**?

3

Respiration

glucose + oxygen → carbon dioxide + water (+ energy released)

3

Photosynthesis

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What are the products of **photosynthesis**?

4

Photosynthesis

The products of **photosynthesis** are glucose and oxygen.

4

Supplying the Cell

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What is the process by which water molecules move across a partially permeable membrane from a dilute solution to a more concentrated one?

5

Supplying the Cell

Osmosis is the movement of water molecules from a dilute to a more concentrated solution across a partially permeable membrane.

5

The Challenges of Size

Exchange surfaces allow efficient transport of materials. What are the three main features of an efficient exchange system?

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6

The Challenges of Size

An efficient exchange system should have: (1) a large surface-area-to-volume ratio; (2) thin membranes so the diffusion distance is short; (3) a good supply of transport medium (e.g. blood, air, etc.).

6

The Heart and Blood Cells

What are the three types of blood vessel?

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The Heart and Blood Cells

The three types of blood vessel are **arteries**, **capillaries** and **veins**.

7

Plants, Water and Minerals

What is **translocation**?

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8

Plants, Water and Minerals

Translocation is the movement of glucose from the leaf (where it is produced) to other parts of the plant (where it is needed) via the phloem.

8

Coordination and Control

The **nervous system** is composed of two parts. What are they?

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Coordination and Control

The nervous system is composed of the **central nervous system** (the brain and the spinal cord) and the **peripheral nervous system** (all the other nerve cells that connect to the central nervous system).

9

The Endocrine System

Hormones are chemical messengers produced by **glands**. How do they reach their target organ?

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10

The Endocrine System

Hormones are released directly into the blood, which transports them to their target organ.

10

Hormones and Their Uses

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What two hormones are combined in most contraceptive pills?

11

Hormones and Their Uses

Most contraceptive pills contain oestrogen and progesterone.

11

Maintaining Internal Environments

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What triggers the **pancreas** to produce **insulin**?

12

Maintaining Internal Environments

High blood sugar levels cause the **pancreas** to produce **insulin**.

12

Recycling

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Photosynthesis removes carbon dioxide from the atmosphere.
What two processes release carbon dioxide to the atmosphere?

13

Recycling

Respiration (animal, plant and microbial) and combustion release carbon dioxide to the atmosphere.

13

Interdependence

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What is the name of the relationship between two organisms where both depend on each other and both benefit?

14

Interdependence

Mutualism. In a mutualistic relationship, both organisms depend on each other and both benefit.

14

Genes

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The **allele** for brown eyes is **dominant** to the allele for blue eyes. What will be the **phenotype** of a person who is **heterozygous** for eye colour?

15

Genes

The person will have brown eyes.

15

What type of cell division produces **gametes**?

16

Meiosis produces **gametes**.

16

For evolution to occur, there must be genetic variation in a population. How might genetic variation arise?

17

Variation can arise through **mutations** in genes.

17

What piece of equipment is used to sample the number of plant species in a field?

18

A quadrat is used to sample the number of plant species in a field.

18

In an investigation, how would you make sure your measurements are **reliable** and identify any that might be **anomalous**?

19

All measurements should be repeated. If a single reading is very different to the others (**anomalous**), this might indicate that an error has been made in measuring.

19

How is **selective breeding** different from **genetic engineering**?

20

Selective breeding is the traditional, natural process of breeding plants and animals with certain, desirable genetic features. **Genetic engineering** is a modern, faster way of bringing about changes in organisms. It is the artificial process of transplanting genes for a desired characteristic into an organism.

20

What are the four main human defences to stop microorganisms entering the body?

21

Microorganisms are prevented from entering the body by the skin (a physical barrier), platelets that help the blood to clot and seal wounds, mucous in the lungs that traps microorganisms and acid in the stomach that destroys microorganisms.

21

Why wouldn't you use **antibiotics** to treat a cold caused by a virus?

22

Antibiotics are used for bacterial infections. They have no effect on viruses, which are found inside the cell.

22

What three options can be used to treat **cardiovascular disease**?

23

Cardiovascular disease can be treated with lifestyle changes (healthy eating and exercise, stopping smoking), surgery (heart transplants or **stents**) and medications (**statins** or aspirin).

23

The following **symbols** describe two different **substances**. Deduce all the information you can from these **symbols**.



24

The **substances** are **isotopes** of the same **element**, carbon. The **atomic number** of carbon is 6 and the **mass numbers** of the **isotopes** are 13 and 12. An **atom** of carbon-13 contains 6 **protons** and 7 **neutrons**. An **atom** of carbon-12 contains 6 **protons** and 6 **neutrons**.

24

Explain how the three different types of **chromatography** can be used to **separate** a **mixture**.

25

Chromatography separates **mixtures** using a **stationary phase** and a **mobile phase**. **Paper chromatography** is used to **separate mixtures** of coloured **dyes** in solution. **Thin layer chromatography** uses a thin layer of an **inert solid** as the **stationary phase**. **Gas chromatography** separates **mixtures** of gases by passing them through a solid **stationary phase**.

25

Describe the two main types of chemical **bond** that can form between two different **elements**.

26

An **ionic bond** is formed when one or more **electrons** are **donated** from an **atom** of one **element** to an **atom** of another **element**, so both **atoms** have full **outer electron shells**. The **atoms** form electrically charged **ions**.

A **covalent bond** is formed when two **atoms share electrons** to complete the **outer electron shells** of both **atoms**.

26

Explain the differences between **simple molecules**, **polymers** and **metals**, referring to how they are formed and the **bonding** that takes place.

27

Simple molecules are formed when two or more **atoms share electrons** and form **covalent bonds**.

Polymers are formed when **repeated units** of smaller **molecules bond covalently** to form a **long chain**.

Metal atoms have outermost **electrons** that can move freely from one **metal atom** to another. They are held together by strong **metallic bonds**.

27

Explain the difference between **intermolecular forces** and **intramolecular forces**.

28

Intermolecular forces are the forces between molecules.

Intramolecular forces are the forces between the **atoms** inside a **molecule**, such as **covalent bonds**.

28

Complete the table.

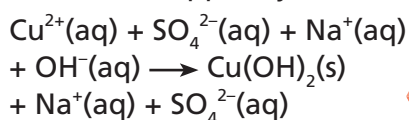
State of substance	State symbol
...	(s)
liquid	(...)
...	(g)
(...) dissolved in water	(...)

29

State of substance	State symbol
solid	(s)
liquid	(l)
gas	(g)
(aqueous) dissolved in water	(aq)

29

Simplify and balance the following **ionic equation**, which shows the reaction between copper sulfate and sodium hydroxide solutions to form solid copper hydroxide.



30

$\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \longrightarrow \text{Cu}(\text{OH})_2(\text{s})$
(The sodium and sulfate **ions** are **spectator ions** that do not change during the reaction, so they can be deleted from both sides.)

30

Which of the following sentences are true and which are false?

- A. Two **moles** of calcium **atoms** contain a total of just over 12×10^{23} **atoms**.
 B. Carbon has a lower **relative atomic mass** than calcium, so two **moles** of carbon atoms contain fewer than 12×10^{23} **atoms**.

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A is true: one **mole** is 6.022×10^{23} **atoms**, so $2 \times 6.022 \times 10^{23} = 12.044 \times 10^{23}$ atoms
 B is false: one **mole** of any **element** always contains 6.022×10^{23} **atoms**

31

What is the **activation energy** of a reaction and why is it not the same as the total **energy given out** or **taken in** during the reaction?

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32

For most chemical reactions, energy is needed to **break chemical bonds** so the reaction can start. This is the **activation energy**. Any new bonds that form will cause some energy to be **given out**, so the **total energy** of the reaction is not the same as the **activation energy**.

32

Use these words to complete the sentences that follow. (You do not need to use all the words.)

separately oxygen together reduction gains

In **oxidation** reactions, a substance often ... oxygen.

In ... reactions, a substance often loses ...

These two types of reaction always occur ...

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33

In **oxidation** reactions, a substance often **gains** oxygen.

In **reduction** reactions, a substance often loses **oxygen**.

These two types of reaction always occur **together**.

33

Explain the difference between a **strong acid** and a **weak acid**.

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34

A **strong acid** easily forms H^+ **ions**, so the acids **fully ionise**.

A **weak acid** forms an **equilibrium** mixture, so that some of the **ions** formed can **recombine** into the original acid.

34

Use these words to complete the sentences that follow.

positive negative anode dissociate electrolyte cathode

In **electrolysis**, the solution containing the **ionic compound** is called the ...

In solution, the **ions** in the compound ...

The negative electrode is the ... and attracts ... **ions**.

The positive electrode is the ... and attracts ... **ions**.

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35

In **electrolysis**, the solution containing the **ionic compound** is called the **electrolyte**.

In solution, the **ions** in the compound **dissociate**.

The negative electrode is the **cathode** and attracts **positive ions**.

The positive electrode is the **anode** and attracts **negative ions**.

35

Explain the differences in **electron shells** between atoms of Group 1, Group 7 and Group 0 **elements** and suggest what happens to these **elements** in chemical reactions.

36

Group 1 **elements** all have one **electron** in their **outer shell**. In a chemical reaction, they tend to **lose** this outer **electron** so that the 'new' **outer shell** is **complete**.

Group 7 **elements** all have seven **electrons** in their **outer shell**. They tend to **gain** one **electron** so the **outer shell** is **complete**.

Group 0 **elements** all have a **complete outer shell** of **electrons**. They are **unreactive**.

36

A sample of solid calcium carbonate is divided precisely into two equal masses. One half is a **single solid piece**, which is then reacted with an acid. The other half is **broken into small pieces** and reacted with a fresh sample of the same acid. Which half will **react faster**, and why?

37

The half that is broken into small pieces will **react** faster. This is because small pieces have a **large surface area** in relation to their **volume**. More **solid particles** are exposed to contact with **acid particles**, so there are more **collisions** and a faster **reaction**.

37

What is a **catalyst**?

38

A **catalyst** is a substance that **speeds up** the **rate** of a chemical reaction without being used up or changed in the reaction.

38

State **Le Chatelier's principle**.

39

Le Chatelier's principle: When the **conditions** of a system are **altered**, the **position** of the **equilibrium** changes to try and restore the **original conditions**.

39

How is carbon useful in the **extraction** of **metals**?

40

Most **metals** are found naturally as **minerals** (compounds). Carbon can **displace** less **reactive** metals from their mineral oxides. The carbon is heated with the metal oxide, and the pure metal is **extracted**.

40

According to a **life cycle assessment**, what are the four stages in the life of a product?

41

- 1 Obtaining **raw materials**.
- 2 **Manufacture** of the product.
- 3 **Use** of the product.
- 4 **Disposal** of the product when it is no longer useful.

41

Describe the **conditions** needed for the reaction called **cracking**, and explain why this reaction is useful.

42

Cracking requires a **catalyst**, **high temperature** and **high pressure**. **Cracking** breaks down some of the large molecules in **crude oil** to form smaller, more useful molecules.

42

Suggest **three** ways in which we could slow down **climate change**.

43

Any **three** from:
 Use less **fossil fuels**.
 Develop and use **alternative energy sources**.
 Improve **energy efficiency**/cut down on wasted energy.
 Plant new forests that can change carbon dioxide into oxygen.
 Reduce the amount of **waste** we produce, to cut down the amount of methane gas in the air.

43

Why have many governments passed laws restricting the amounts of **particulates** that can be emitted?

44

Particulates in the air can cause lung problems and **respiratory** diseases. They can coat buildings and trees. Laws to restrict their emissions aim to improve air quality.

44

What is a typical size of an **atom**? Choose from the following.

10^{-15} m 10^{-12} m 10^{-10} m

45

The size of an **atom** is of the order of 10^{-10} m.

45

What is the difference between the **specific heat capacity** and the **specific latent heat** of a material?

46

Specific heat capacity is the energy needed to raise the temperature of 1 kg of the material by 1 °C, with no change of state.

Specific latent heat is the energy needed to change the state of 1 kg of the material, with no change in temperature.

46

State the equation for calculating the **kinetic energy** of a moving object, and give the **unit** of each quantity.

47

Kinetic energy

$$= 0.5 \times \text{mass} \times (\text{speed})^2$$

Unit of kinetic energy: **joule** (J)

Unit of mass: **kilogram** (kg)

Unit of speed: **metres per second** (m/s)

47

Which equation is a statement of **Newton's second law**?

48

Force = mass × acceleration is a statement of **Newton's second law**.

48

What is meant by **work** in physics?

49

Work is done on an object when a **force** causes the object to move through a distance.

Work done = force × distance (along the line of action of the force)

The work done is equal to the **energy transferred**.

49

What is the difference between **elastic deformation** and **plastic deformation**?

50

Elastic deformation: forces make an object change shape, but it returns to its original shape when the forces are removed.

Plastic deformation: forces make an object change shape, and the object keeps its new shape when the forces are removed.

50

How does **friction** cause objects to become charged?

51

Friction transfers **electrons** between two objects that are rubbed together. This leaves one object with an excess of electrons (making it negatively charged) and the other object with a shortage of electrons (making it positively charged).

51

What is the relationship between the **potential difference** across, the **current** through and the **resistance** of a component in a circuit?

52

Potential difference
= **current** × **resistance**

52

State the equation for calculating the electrical **power** of a device in terms of its **resistance** and the **current** through it, and state the **unit** of power.

53

Power = (**current**)² × **resistance**
The **unit** of power is the **watt**, W (equivalent to J/s).

53

Describe the basic structure of an **electromagnet** and how it works.

54

An **electromagnet** is a coil of wire of many turns wound on an **iron core**. When **current** is passed through the coil, a strong **magnetic field** is set up through the core and around the coil.

54

What is a **wavelength** and what is its **unit**?

55

A **wavelength** is the **distance** from one point on a wave to the equivalent point on the next wave. Its **unit** is **metre** (m).

55

List the types of radiation in the **electromagnetic spectrum**, in order of **increasing frequency**.

56

In order of **increasing frequency**:
radio waves, **microwaves**, **infrared** radiation, visible light, **ultraviolet** (UV) radiation, **X-rays**, **gamma rays**.

56

Which type of **radioactive emission** is **least penetrating**, and why?
alpha **beta** **gamma**

57

Alpha radiation is **least penetrating** because it loses its energy in the shortest distance, by strongly **ionising** the atoms of a material.

57

Define the **half-life** of a **radioactive** material, and explain why radioactive **decay** can be considered **random**.

58

The **half-life** of a **radioactive** material is the time taken for the number of undecayed nuclei in a sample of the material to reduce by half. The decay of a particular nucleus is unpredictable, so the decay is described as **random**.

58

True or false?
If all of the electrical energy supplied to an efficient kettle is used to heat the water, this equation determines the change in temperature of the water.
potential difference × current × time
= mass of water × specific heat capacity of water × change in temperature

59

True.
The electrical energy supplied to the kettle is **potential difference × charge**
= potential difference × current × time.
The rise in temperature of the water depends on the mass and the **specific heat capacity** of the water. The thermal energy change of water is **mass × specific heat capacity × change in temperature**.

59

When a device **transfers energy**, some energy is wasted. How does the energy transfer obey the **law of conservation of energy**?

60

Energy is said to be wasted when the useful output energy of a device is less than the input (supplied) energy. This does not contravene the **law of conservation of energy** because the 'wasted' energy is **dissipated** to the surroundings, raising the temperature.

60

What is a typical **speed** for a cyclist on a clear flat road? Choose from:

1 m/s 10 m/s 100 m/s

61

A typical **speed** for a cyclist on a clear flat road is **10 m/s**.

A person walking slowly would have a speed of about 1 m/s.

A plane, or an extremely fast train, might have a speed of 100 m/s.

61

Give some types of **bio-fuel**, and explain whether bio-fuels are **renewable** or **non-renewable** energy resources.

62

Types of **bio-fuel** include: wood; oils and 'bio-diesels' from crops such as rape and palm; also 'bio-ethanol' from crops such as sugar cane.

Bio-fuels are **renewable** energy resources, because we can plant more trees and crops.

62

Why are **transformers** used in the **national grid**?

63

Transformers are used in the **national grid** to increase (**step up**) the generated voltage to a high value for transmission around the country, because there is then less energy loss from the cables. Transformers are then used to reduce (**step down**) the voltage to a safer and more convenient voltage for the user.

63