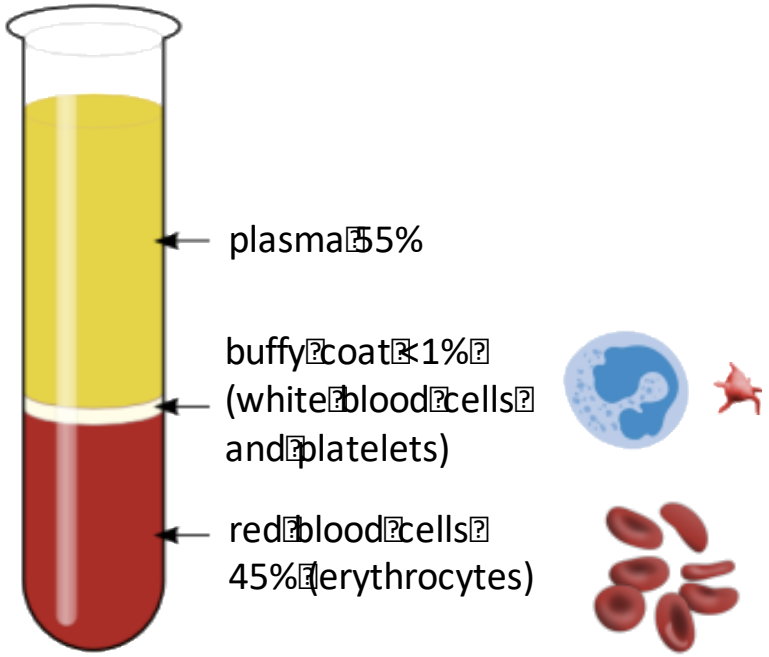
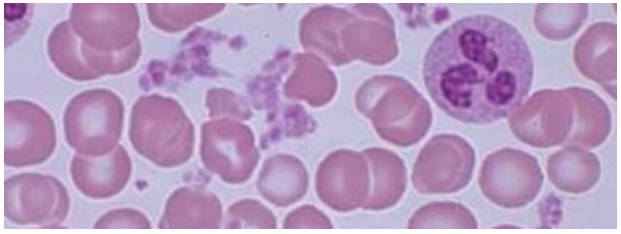
# Year 11 Triple Science

Subject specific revision session

# Animal tissues, organs and organ systems Part 2 - Blood

**Blood** is a **tissue** consisting of **plasma**, in which the **red blood cells**, **white blood cells** and **platelets** are suspended.



**Plasma** – Pale yellow fluid part of blood, transports cells, $CO_2$, hormones and waste.

**Red blood cells** (erythrocytes)
- have no nucleus (more room to carry $O_2$)
- contain the red pigment **haemoglobin** which carries $O_2$

**oxygen + haemoglobin → oxyhaemoglobin**

- they have a **large surface area to volume ratio** for faster diffusion of oxygen

**White blood cells** - An important part of the **immune** system, some produce **antibodies** (proteins that bind to microbes and destroy them) and others surround and **engulf** foreign cells, all have a nucleus.

**Platelets** - Tiny fragments of cells (no nuclei), clump together to help form clots, protect the body by stopping/reducing bleeding.

# Infection and Response part 1 – Human Defence Systems

Sometimes pathogens gain entry to the body.
The **immune system** takes over to destroy them.
The **white blood cells** are part of the immune system. **Pathogens** are identified by white blood cells because they have different surface proteins. We call these surface proteins **antigens.**

**White blood cells** act in **3** ways to **defend** the body:

1. White blood cells (called **phagocytes**) engulf the pathogens and digest them. This is called **phagocytosis**. Video phagocytes

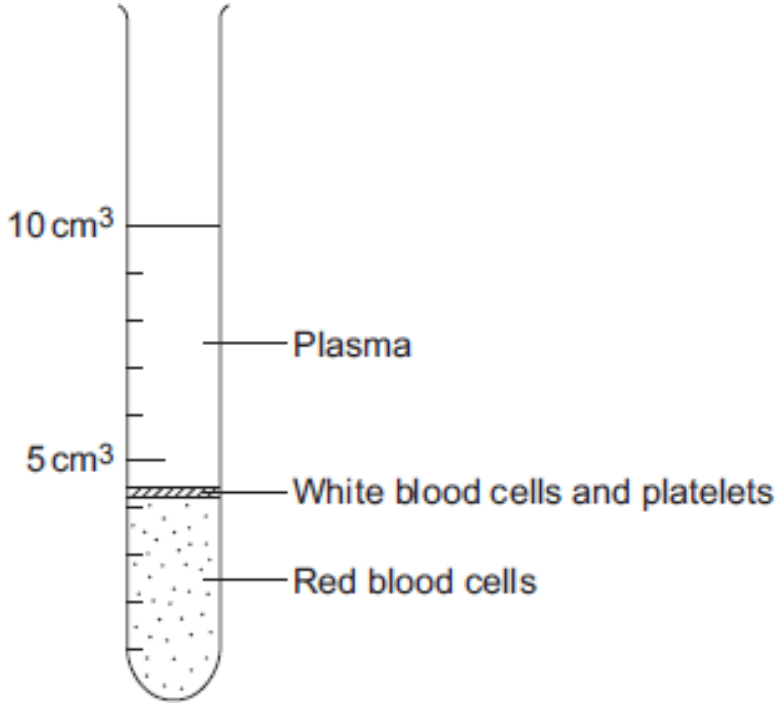
2. White blood cells (called **lymphocytes**) identify the **antigen** on the pathogen. They make **specific antibodies** to destroy the pathogens. This can take time and so an infection may occur. If a person is **infected again** by the same pathogen, the white blood cells make the **antibodies** much **faster.** Video lymphocytes

3. Bacteria may produce toxin (poison). White blood cells release specific **antitoxins** to **neutralise** the effect of the toxin.

**Q1.**

The parts of the blood can be separated from each other by spinning the blood in a centrifuge.

The image below shows the separated parts of a 10 $cm^3$ blood sample.




(a) Calculate the percentage of the blood that is made up of plasma.

_____

_____

Answer = _____ %

**(2)**

(b) Name **three** chemical substances transported by the plasma.

1. _____

2. _____

3. _____

**(3)**

# Describe

Students may be asked to recall some facts, events or process in an accurate way.

(c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

White blood cells are part of the immune system. White blood cells help the body to defend itself against pathogens.

Describe how pathogens cause infections **and** describe how the immune system defends the body against these pathogens.

_____

_____

_____

**(6)**

**(Total 11 marks)**

**Q1.**

(a) 55%

*__2__ marks for correct answer alone*

*accept 54 − 56*

*5.5 / 10 × 100 alone gains __1__ mark*

**2**

(b) any **three** from:

- amino acids
- antibodies
- antitoxins
- carbon dioxide
- cholesterol
- enzymes
- fatty acid
- glucose
- glycerol
- hormones / named hormones
- ions / named ions
- proteins
- urea
- vitamins
- water.

*ignore blood cells and platelets*

*ignore oxygen*

*max 1 named example of each for ions and hormones*

*allow minerals*

(c) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

**0 marks**
No relevant content.

**Level 1 (1 – 2 marks)**
There is a description of pathogens with errors or roles confused.
**or**
the immune response with errors or roles confused.

**Level 2 (3 – 4 marks)**
There is a description of pathogens **and** the immune response with some errors or confusion
**or**
a clear description of either pathogens **or** the immune response with few errors or little confusion.

**Level 3 (5 – 6 marks)**
There is a good description of pathogens **and** the immune response with very few errors or omissions.

**Examples of biology points made in the response:**

- bacteria and viruses are pathogens
  *credit any ref to bacteria and viruses*
- they reproduce rapidly inside the body
- bacteria may produce poisons / toxins (that make us feel ill)
- viruses live (and reproduce) inside cells (causing damage).

white blood cells help to defend against pathogens by:

- ingesting pathogens / bacteria / (cells containing) viruses
  *credit engulf / digest / phagocytosis*
- to destroy (particular) pathogen / bacteria / viruses
- producing antibodies
- to destroy particular / specific pathogens
- producing antitoxins
- to counteract toxins (released by pathogens)
  *credit memory cells / correct description*
- this leads to immunity from that pathogen.

6

**[11]**

# Bioenergetics part 1 – Photosynthetic reaction

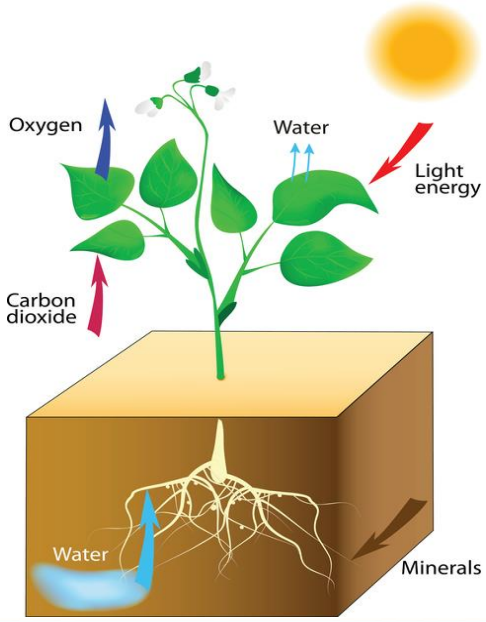
**Plants** make use of the **Sun's energy** to make **food** (glucose)

This process is called **photosynthesis**.

**photo** = light **synthesis** = to make

The plant manufactures **glucose** from carbon dioxide and water using **energy transferred** from the environment to the **chloroplasts** by light.

This is an **endothermic** reaction because photosynthesis needs an input of energy from the environment.



# Bioenergetics part 1 – Photosynthetic reaction

The **word equation** which represents photosynthesis is:

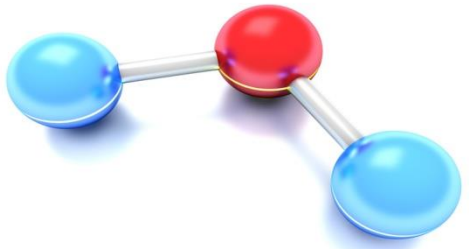
carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen

The balanced **symbol equation** which represents photosynthesis is:

$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$

| Molecule name | Chemical Symbol |
|---|---|
| **Carbon dioxide** | **$CO_2$** |
| **Water** | **$H_2O$** |
| **Oxygen** | **$O_2$** |
| **Glucose** | **$C_6H_{12}O_6$** |

**You need to be able to recognise the chemical symbols for these molecules.**

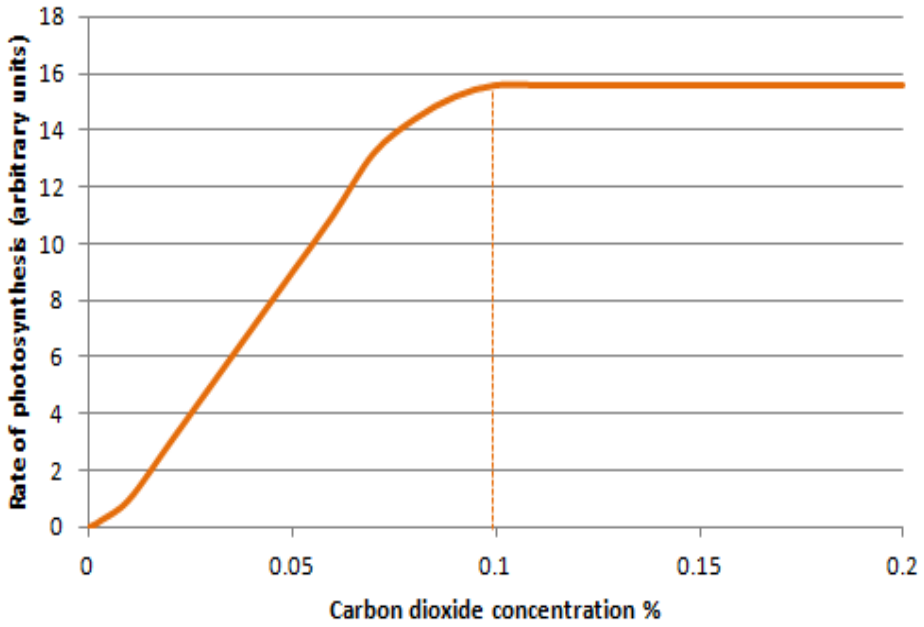


Video - Van Helmont's experiments

# Bioenergetics part 1 – Rate of photosynthesis

**Carbon dioxide** is one of the **reactants** needed for plants to make glucose. The **rate** of photosynthesis will **increase** when a plant is given **higher** concentrations of carbon dioxide **up** to a point.

$$\textit{Carbon dioxide} + \text{Water} \xrightarrow{\text{light}} \text{Oxygen} + \text{Glucose}$$




For this plant, the **maximum rate** of photosynthesis is achieved at a concentration of **0.1%** carbon dioxide.

Another factor is now preventing the rate of photosynthesis from increasing. This is called a **limiting factor**.

Possible limiting factors could be **light intensity**, **temperature** or amount of **chlorophyll**.

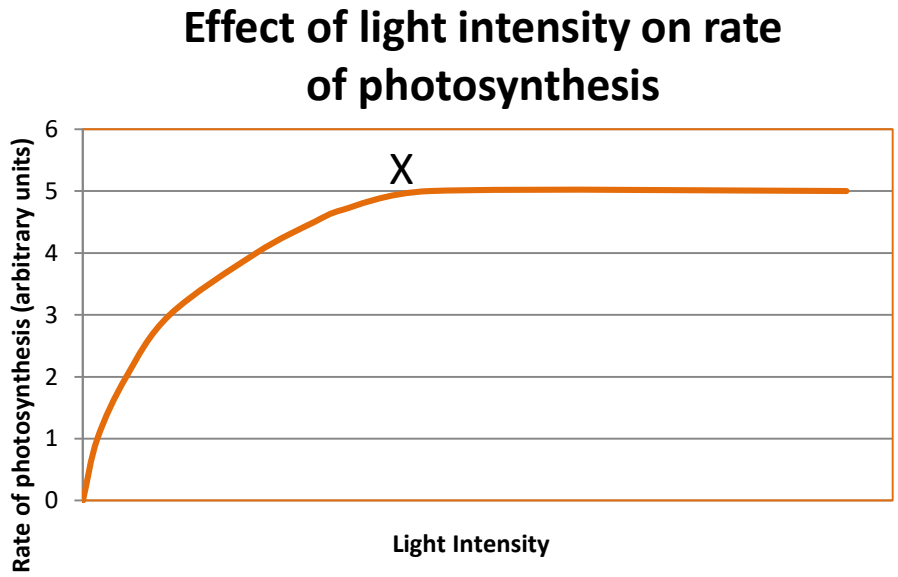
# Bioenergetics part 1 – Rate of photosynthesis

The **amount of light** a plant receives affects the rate of photosynthesis. Plants found in areas of lower light do not tend to grow as tall.

**Light intensity decreases as the distance between the plant and the light source increases.**

The graph shows that as **light intensity increases** so does the **rate** of photosynthesis up to a point. At **point X** another **factor** is **limiting** the rate of photosynthesis. This could be carbon dioxide concentration, temperature or amount of chlorophyll.

**Light intensity is a limiting factor.**



# Bioenergetics part 1 – Rate of photosynthesis

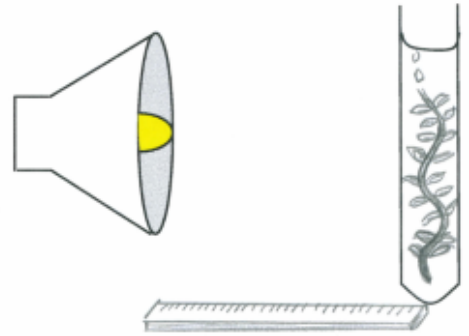
Water plants produce **bubbles of oxygen** when they photosynthesise. The bubbles can be **counted** over time and used to **calculate** the **rate** of photosynthesis. video

**Investigating the effect of light intensity on photosynthesis in pondweed.**

1. Fill a boiling tube with 0.2% **sodium hydrogen carbonate solution**.
2. Freshly cut a **10 cm piece of pondweed** and place it in the boiling tube with the cut end at the top.
3. Set up an **LED lamp** at a distance of **10 cm** to the boiling tube and leave to settle for 5 minutes.
4. **Start** the stopwatch and count the number of **bubbles** released in **one minute**.
5. Repeat twice and calculate the mean number of bubbles.
6. Repeat steps 1-6, altering distance of the lamp so it is 30 cm, 40 cm and 50cm away from the boiling tube.

**Why do we use sodium hydrogen carbonate solution?**

This provides excess dissolved carbon dioxide for the plant to use in photosynthesis so it is not a limiting factor.

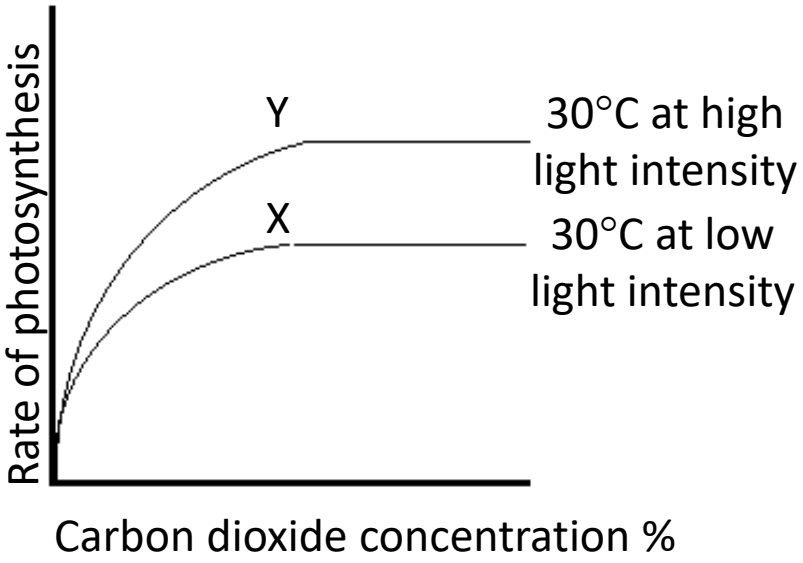


**Why is an LED lamp used?**

LED lamps produce less heat and this reduces the effect of temperature on the experiment.

# Bioenergetics part 1 – Rate of photosynthesis HT only

In **laboratory** investigations, plants experience variation in only **one** environmental factor.
Normally in **nature**, **more than one** environmental factor will vary and the rate of photosynthesis is due to the **interaction** of these factors.
Any one of the environmental factors may **limit** the rate of photosynthesis.

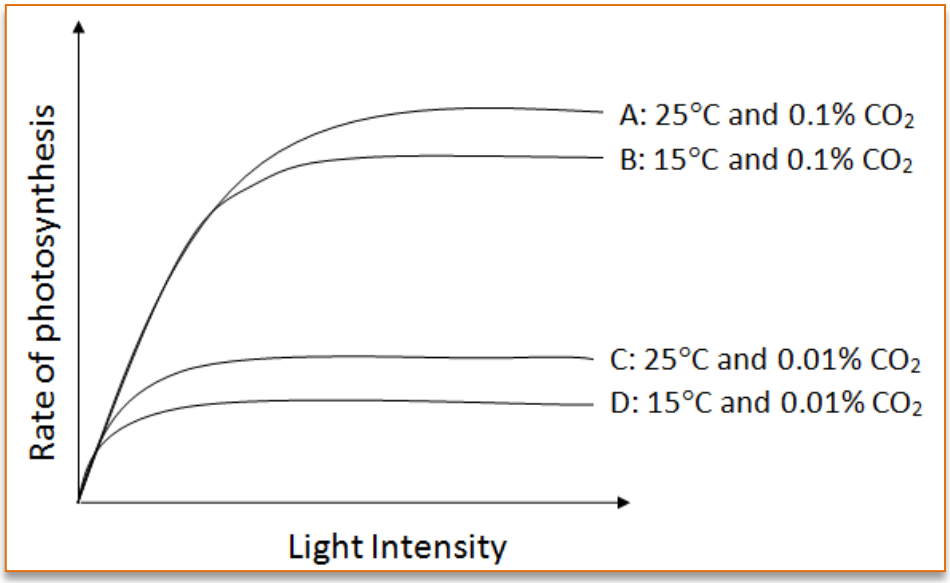



**Carbon dioxide is <u>not</u> the limiting factor**

In this experiment **temperature** is controlled.
At **low light intensity** the photosynthetic reaction becomes limited at point X.
If the light intensity is increased the reaction rate also increases.
**Light intensity** is therefore the limiting factor at point X.
A different factor is now limiting the rate of photosynthesis at Y.
This could be environmental **temperature** or the amount of **chlorophyll.**

# Bioenergetics part 1 – Rate of photosynthesis HT only

**Graph line A:** Rate could be limited by temperature and/or amount of chlorophyll. Plant tissue can be damaged when carbon dioxide concentrations exceed 0.1%




**Light intensity is <u>not</u> a limiting factor**

**Graph lines A and D:** If carbon dioxide concentration **and** temperature are increased the rate of photosynthesis increases significantly up to a point.

**Graph Lines A and B:** If carbon dioxide concentration is increased from 0.01% to 0.1%, then a large increase in rate occurs up to a point.

**Graph lines C and D:** If temperature is increased by 10°C then a slight increase in rate of photosynthesis occurs.

# Bioenergetics part 1 – Rate of photosynthesis HT only

Farmers apply their understanding of limiting factors to **improve** crop **yields**.
They can control conditions inside greenhouses more easily than in the fields.

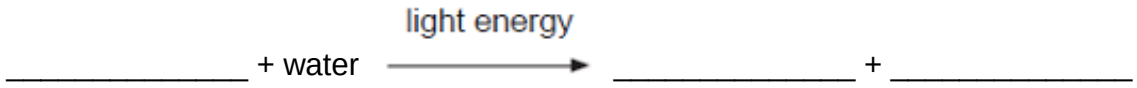
- **Heating** can be used to provide optimum temperatures for maximum plant growth.
- **Artificial lighting** enhances the natural sunlight especially overnight and on cloudy days.
- **Extra carbon dioxide** gas can be pumped into the air inside the greenhouses.

In commercial greenhouses the environmental factors are often controlled by computerised systems to minimise cost. The farmer must balance the **economics** of **additional costs** of heating, lighting and computer systems to achieve maximum photosynthesis whilst still making a **profit.**

Video - Improving crop yields

**Q2.**

(a) Complete the equation for photosynthesis.




**(3)**

(b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

_____

_____

_____

_____

_____

**(5)**

**(Total 8 marks)**

_____

**Q2.**

(a) LHS – carbon dioxide / $CO_2$

*allow CO2*

*ignore $CO^2$*

**1**

RHS

*in either order*

glucose / carbohydrate / sugar

*allow starch*

*allow $C_6H_{12}O_6$ / C6H12O6*

*ignore $C^6H^{12}O^6$*

**1**

oxygen

*allow $O_2$ / O2*

*ignore $O^2$ / O*

**1**

(b) any **five** from:

- factor 1: $CO^2$ (concentration)
- effect - as $CO_2$ increases so does rate and then it levels off or shown in a graph
- explanation:
  (graph increases) because $CO_2$ is the raw material or <u>used</u> in photosynthesis / converted to organic substance / named eg
  **or**
  (graph levels off) when another factor limits the rate.

  *accept points made via an annotated / labelled graph*
- factor 2: temperature

  *allow warmth / heat*
- effect – as temperature increases, so does the rate and then it decreases or shown in a graph

  *allow 'it peaks' for description of both phases*
- explanation:
  (rise in temp) increases rate of chemical reactions / more kinetic energy

  *allow molecules move faster / more collisions*

  **or**
  (decreases) because the enzyme is denatured.

  *context must be clear = high temperature*

  *allow other factor plus effect plus explanation:*

  *eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves*

  *2nd or 3rd mark can be gained from correct description and explanation*

5

**[8]**

# Explain

Students should make something clear, or state the reasons for something happening.

**Q3.**

(a) Complete the equation for photosynthesis.

_____ + _____ $\xrightarrow{\text{light energy}}$ _____ + oxygen

**(2)**

(b) Scientists investigated how temperature affects the rate of photosynthesis.
The scientists grew some orange trees in a greenhouse.
They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

(i) The leaf discs did not produce any oxygen in the dark.

Why?

_____

_____

**(1)**

(ii) The leaf discs took in oxygen in the dark.

Explain why.

_____

_____

_____

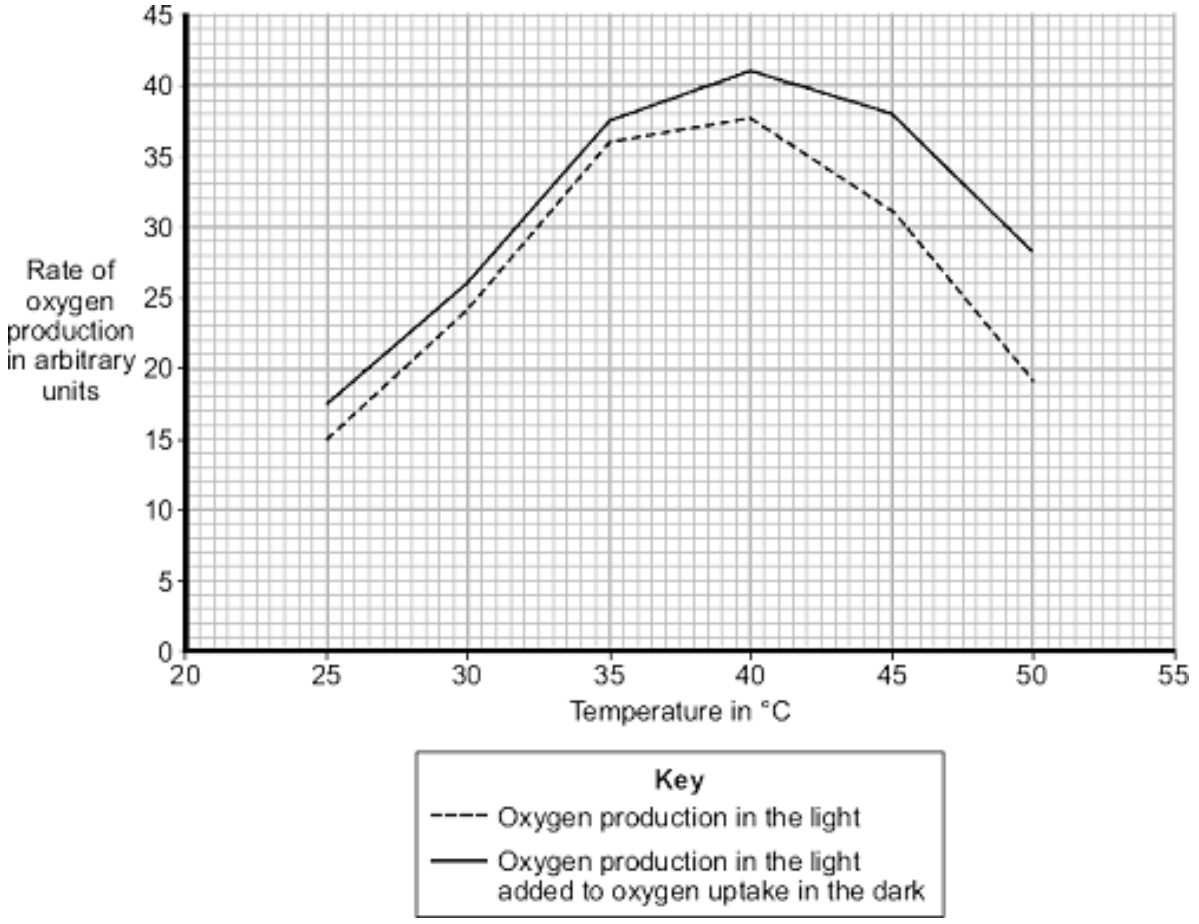
_____

**(2)**

(c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.




Use the information from the graph to answer each of the following questions.

(i) Describe the effect of temperature on oxygen production in the light.

_____

_____

_____

_____

**(2)**

(ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

_____

_____

_____

from 40 °C to 50 °C.

_____

_____

_____

**(2)**

(d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

**(3)**

**(Total 12 marks)**

**Q3.**

(a) LHS: carbon dioxide **AND** water

*in either order*

*accept $CO_2$ **and** $H_2O$*
*allow CO2 and H2O*
*if names given ignore symbols*

*do **not** accept $CO^2$ / $H^2O$ / Co / CO*
*ignore balancing*

**1**

RHS: sugar(s) / glucose / starch / carbohydrate(s)

*accept $C_6H_{12}O_6$*
*allow C6H12O6*
*do **not** accept $C^6H^{12}O^6$*

**1**

(b) (i) light is needed for photosynthesis

**or**

no photosynthesis occurred (so no oxygen produced)

**1**

(ii) oxygen is needed / used for (aerobic) respiration

*full statement*

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

**2**

(c) (i) (with increasing temperature) rise then fall in rate

**1**

use of figures, ie

max. production at 40 °C
**or** maximum rate of 37.5 to 38

**1**

(ii) 25 – 35 °C

**either** faster movement of particles / molecules / more collisions
**or** particles have more energy / enzymes have more energy

**1**

**or** temperature is a limiting factor over this range

40 – 50 °C

denaturation of proteins / enzymes

*ignore denaturation of cells*
*ignore stomata*

**1**

(d) above 35 °C (to 40 °C) – little increase in rate
**or** > 40 °C – causes decrease in rate

**1**

so waste of money **or** less profit / expensive

**1**

because respiration rate is higher at > 35 °C
**or**
respiration reduces the effect of photosynthesis

**1**

**[12]**