

(a)

The chemical energy stored in **GLUCOSE** must be released by all cells through a series of enzyme-controlled reactions called **respiration**.

(b) The energy released from the breakdown of glucose is used to generate **ATP**.

The energy transferred by ATP can be used for cellular activities such as:

Muscle cell contraction

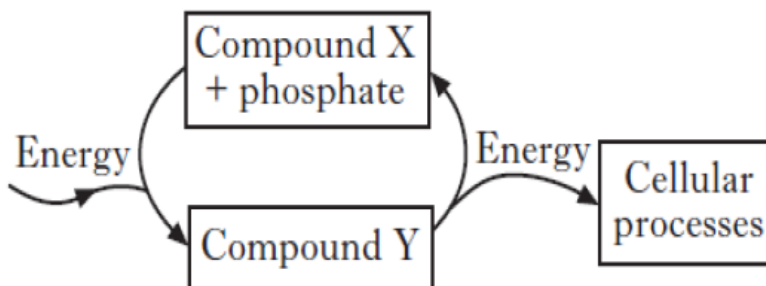
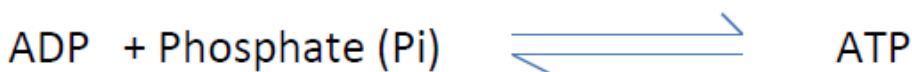
Cell division

Protein synthesis

Transmission of nerve impulses.

ATP is made from ADP by adding on a phosphate.

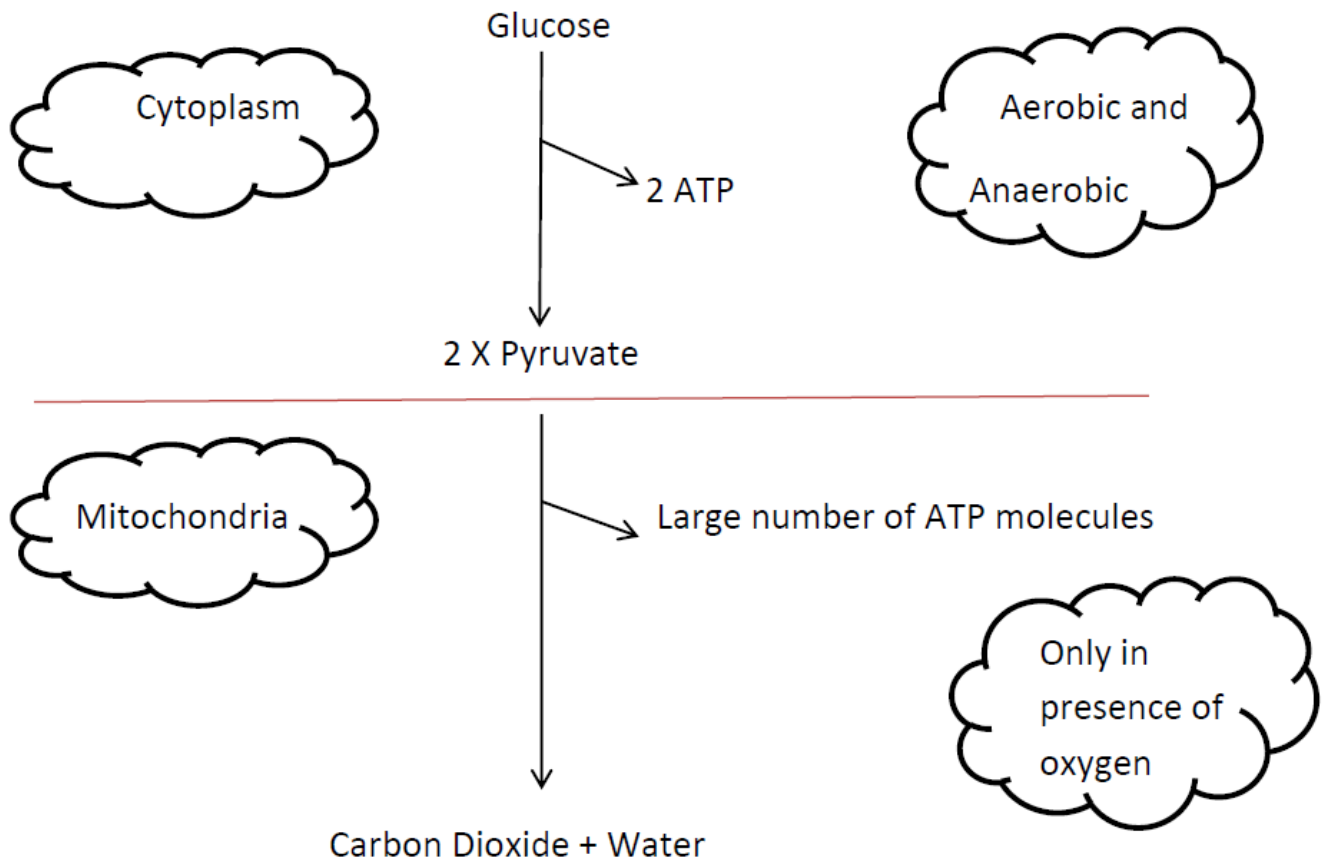
ATP can be broken down to ADP + phosphate. This releases energy for cellular processes.



In this diagram, Compound X is ADP and Compound Y is ATP. ATP is being used to provide energy for cellular process. During this process the ATP is broken down to ADP with the release of a phosphate.

(c) Aerobic Respiration

Glucose is broken down to **2 molecules of PYRUVATE**, releasing enough energy to yield **2 molecules of ATP**.



Further breakdown of the Pyruvate depends upon the presence/absence of oxygen.

If **oxygen is present**, **aerobic respiration** takes place and each pyruvate is broken down to **Carbon Dioxide and Water**. This releases enough energy to yield a **large number of ATP molecules** (36 more ATP, so 38 ATP in total).

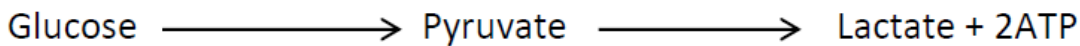
(For 2018 exam, the overall number of ATP molecules produced during aerobic respiration is not required but you may need to know this for past paper questions).

Fermentation

In the **absence of oxygen**, the fermentation pathway takes place.

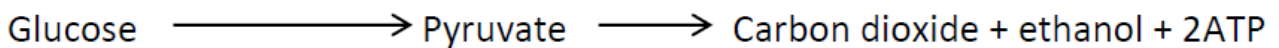
Animal and Bacterial Cells

In animal and bacterial cells, if **oxygen is not available**, the Pyruvate molecules are converted to **LACTATE** and only **2 molecules of ATP** are produced.



Plant and Fungal Cells

In plant and fungal cells, if oxygen is not available, the Pyruvate molecules are converted to **CARBON DIOXIDE** and **ETHANOL** and only **2 molecules of ATP** are produced.



(d) Respiration begins in the **Cytoplasm**. The process of **fermentation** is completed in the **cytoplasm** whereas **aerobic respiration** is completed in the **mitochondria**.