IGCSE Cambridge (CIE)· Biology 16 mins 16 questions

Multiple Choice Questions

Biotechnology & Genetic Modification

Usefulness of Bacteria / Biotechnology / Genetic Modification

1 Which of these statements correctly describes genetic engineering?

A. Only breeding from crop plants that are resistant to pests.

B. Altering the DNA in crop plants so that they are resistant to herbicides.

C. Using yeast to produce ethanol.

D. Production of insulin in the pancreas.

(1 mark)

2 Which of the following is a reason yeast is used to make bread?

Yeast is used to make bread because…

A.....it produces ethanol.

B.....it produces lactic acid.

C ....it produces carbon dioxide.

D.....it produces oxygen.

(1 mark)

3 What is the name of the enzyme used to produce clear apple juice?

A. Lipase

B. Amylase

C. Protease

D. Pectinase

(1 mark)

4 What needs to be inserted into a bacterial cell to allow it to produce insulin to treat diabetes?

A. An enzyme.

B. A molecule of insulin.

C. A length of DNA from a human.

D. A length of DNA from a bacterium.

(1 mark)

5 Extended only

Why are bacteria used in biotechnology?

A. They can make complex molecules.

B. They are found inside the human body.

C. They reproduce slowly.

D. They can become resistant to antibiotics.

(1 mark)

Medium Questions

1 Extended only

Which of the following combinations of nutrients would be needed in a batch fermenter in the production of penicillin?

A. Amino acids and lipids

B. Lipids and glucose

C. Chlorine and amino acids

D. Glucose and amino acids

(1 mark)

2 Extended only

Which of the following statements would be an advantage of producing genetically modified crops?

A. To decrease the yield of the crop.

B. To prevent resistance to pests.

C. To increase the yield of the crop.

D. To prevent resistance to herbicides.

(1 mark)

3 Which of these is **not** a correct use of genetic modification?

A. Cloning

B. Resistance to pests

C. Increased crop yield

D. To modify crops to provide additional vitamins

(1 mark)

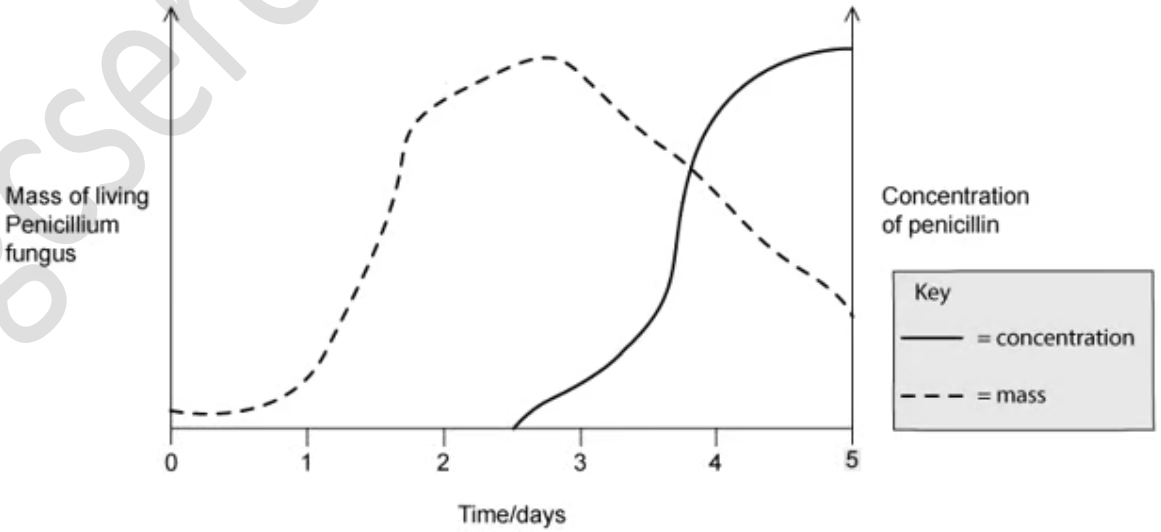
4 Which products of fermentation (anaerobic respiration in yeast) are important in the production of beer and bread?

	beer	bread
A	ethanol	simple sugars
B	lactic acid	ethanol
C	ethanol	carbon dioxide
D	simple sugars	lactic acid

(1 mark)

5 Penicillin is produced in a fermenter by growing the fungus *Penicillium*.

The graph below shows how the mass of living *Penicillium* fungus, and the concentration of penicillin, changed over time.



Which day would be the best to harvest the penicillin at?

A. 3 days

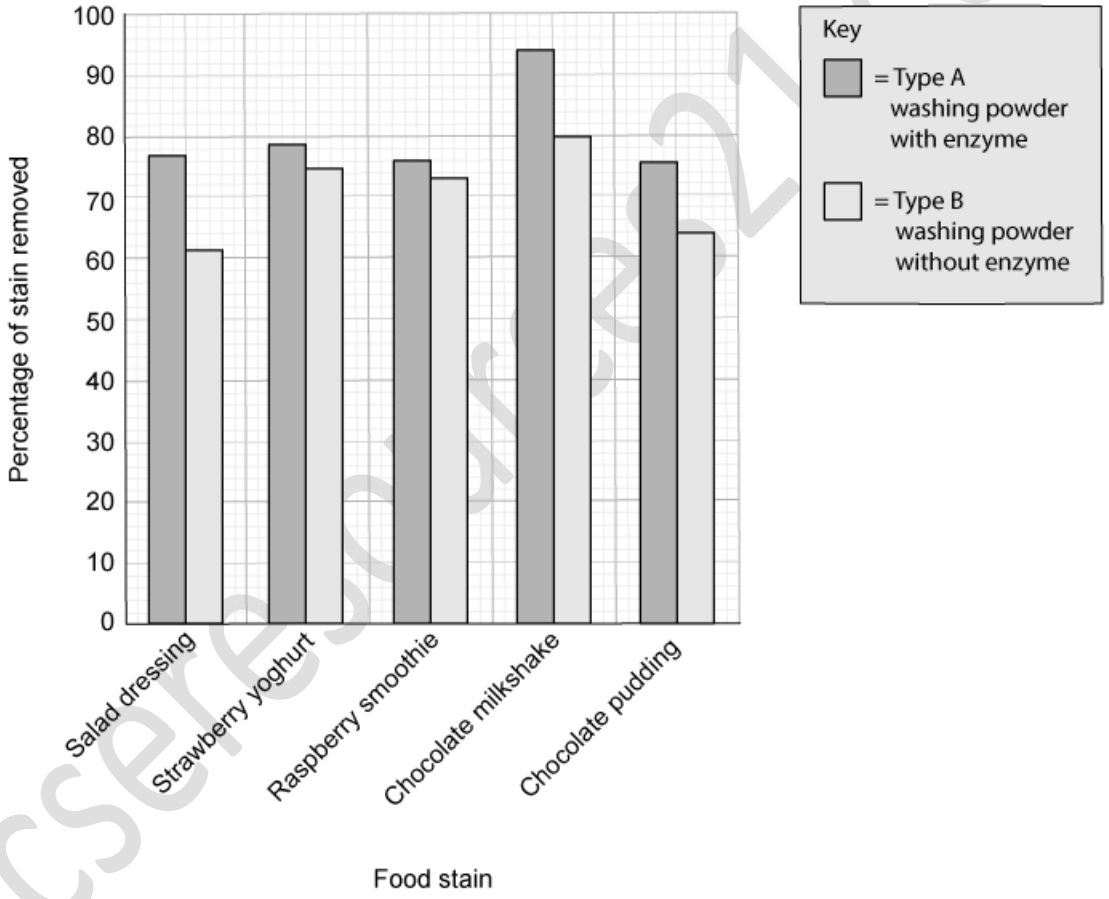
B. 1.5 days

C. 5 days

D. 3.5 days

(1 mark)

6 Which food shown in the graph below has the highest percentage stain removal with a biological washing powder?



A. Salad dressing

B. Chocolate pudding

C. Chocolate milkshake

D. Raspberry smoothie

(1 mark)

Hard Questions

1 Extended only

Genes are isolated from human DNA using ……**1**…… enzymes.

A bacterial plasmid is cut with the same enzyme creating ……**2**…… .

The human DNA is inserted into the bacterial plasmid using the enzyme ……**3**…… creating a ……**4**…… plasmid.

Which row correctly completes gaps **1**, **2**, **3** and **4**?

	1	2	3	4
A	restriction	sticky ends	ligase	recombinant
B	ligase	daughter plasmids	ligase	restriction
C	recombinant	new DNA	lipase	daughter
D	ligase	sticky ends	protease	diploid

(1 mark)

2 What is the role of ligase enzymes in genetic engineering?

A. To insert plasmids into bacteria.

B. To join human DNA with plasmid DNA.

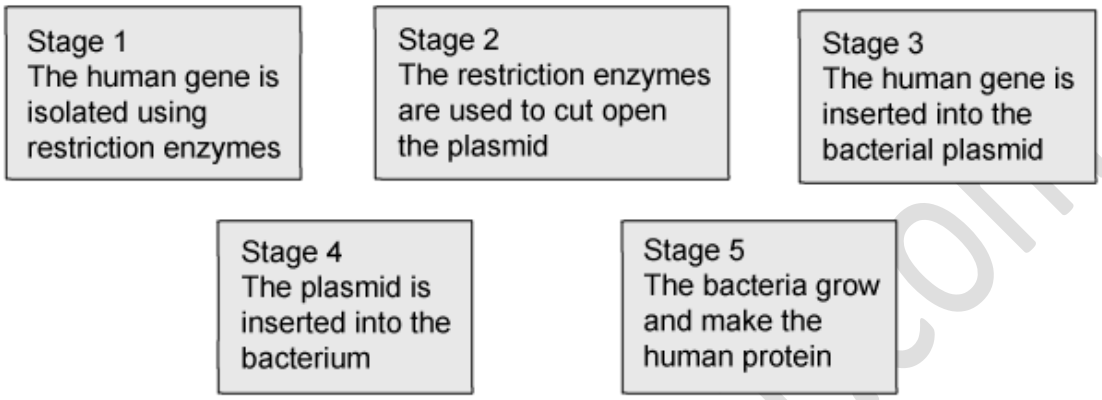
C. To isolate human genes.

D. To cut open plasmid DNA.

(1 mark)

3 Extended only

The stages of genetic engineering are shown in the diagram below.



Which stages involve the production of sticky ends?

A. 1, 2 and 3

B. 1 and 2 only

C. 1 and 3 only

D. 2 and 3 only

(1 mark)

4 The following statements describe biofuel.

1. Yeast respires to produce ethanol and carbon dioxide
2. It is a renewable energy source since it is made from living organisms instead of fossil fuels
3. Waste parts of crop plants can be used to produce biofuels
4. In some parts of the world, crops are grown specifically for use as biofuels

Which of these statements could be considered an advantage of biofuel?

A. 1, 2 and 4

B. 2 and 3 only

C. 2 only

D. 2 and 4 only

(1 mark)

5 Industrial fermenters are used to produce large quantities of microorganisms which can be used for many biotechnological processes.

Which of the following correctly matches the different conditions in the fermenters and the reason why it is important to control these conditions?

	aseptic conditions	optimum pH	agitation
A	creates an even distribution of substances throughout the fermenter	prevents enzymes from denaturing so that enzyme activity is at a maximum	ensures that only the desired species of microorganisms grow in the fermenter
B	ensures that only the desired species of microorganisms grow in the fermenter	creates an even distribution of substances throughout the fermenter	prevents enzymes from denaturing so that enzyme activity is at a maximum
C	prevents enzymes from denaturing so that enzyme activity is at a maximum	ensures that only the desired species of microorganisms grow in the fermenter	creates an even distribution of substances throughout the fermenter
D	ensures that only the desired species of microorganisms grow in the fermenter	prevents enzymes from denaturing so that enzyme activity is at a maximum	creates an even distribution of substances throughout the fermenter

(1 mark)

SOLUTIONS

1.

The correct answer is B (altering the DNA in crop plants so that they are resistant to herbicides) because:

Genetic engineering is the process of altering **DNA** to include new **genes** or sequences of **DNA.** This will give the modified organism new characteristics that may increase yield or increase resistance to chemicals.

A is incorrect because this process describes **selective breeding**. Selective breeding is the use of organisms with a particular characteristic in breeding so that the offspring have the trait that you desire.

C is incorrect because this process describes **fermentation**. This is a natural process that has been exploited for centuries to produce bread and beer.

D is incorrect because this is a natural process that occurs normally in healthy individuals.

2.

The correct answer is C (it produces carbon dioxide) because:

Yeast produces carbon dioxide and ethanol (alcohol) during fermentation, and it is bubbles of carbon dioxide gas that makes the bread rise as it gets trapped in the dough.

A is incorrect because while yeast fermentation does result in the production of **ethanol**, it is the production of the **carbon dioxide** that makes the bread rise.

B is incorrect because **lactic acid** is a product of **anaerobic** respiration in **animals** and some bacteria.

D is incorrect because fermentation is **anaerobic**, meaning that it doesn't require oxygen, and as a type of respiration does not produce oxygen. The process that produces oxygen is **photosynthesis** in plants and algae.

3.

The correct answer is D (pectinase) because:

Pectin is found in fruit juices. It is a **polysaccharide** that is responsible for holding cells together, but it makes fruit juice cloudy. **Pectinase** is the enzyme that breaks down **pectin** so that the juice is clear.

A is incorrect because **lipase** breaks down lipids into fatty acids and glycerol.

B is incorrect because **amylase** breaks down starch into **maltose**.

C is incorrect because **protease** breaks down proteins into **amino acids.**

4.

The correct answer is C (a length of DNA from a human) because:

To treat diabetes bacteria need to be **genetically modified** to produce human insulin, so that the insulin is not then rejected by the body when injected.

A is incorrect because it is a gene, not an enzyme, that needs to be inserted into bacterial cells. While enzymes are used in the process it is the DNA that codes for the insulin protein that must be inserted.

B is incorrect because this is the protein, not the **gene** for the protein. The bacterial cell can only produce the protein if it has the instruction (gene) to make it using its ribosomes.

D is incorrect because as bacteria do not naturally have a **gene** coding for **insulin**.

5.

The correct answer is A (they can make complex molecules) because:

- Bacteria are organisms that reproduce quickly (as much as once every 20 minutes for some species in optimum conditions)
- All cells contain ribosomes and therefore possess the ability to make **complex molecules**. This makes them ideal for biotechnology
  - Biotechnology is the use of microorganisms to make useful products for us
- **Bacteria** have relatively simple cellular systems that allow us to genetically modify them easily. We use them to produce **insulin** and other human hormones

B is incorrect because whilst humans host a whole ecosystem of bacteria in our body (prominently in the digestive tract) this has nothing to do with biotechnology.

C is incorrect because bacteria reproduce quickly. They show **exponential growth** - some species can double in number every 20 minutes.

D is incorrect because bacteria can evolve to become resistant to **antibiotics** and we often use this to select bacteria in genetic engineering. This is not a reason that **bacteria** are used in **biotechnology**.

MEDIUM QUESTIONS

1.

The correct answer is D (glucose and amino acids) because:

The two nutrients that would be needed are **glucose** for **respiration** and **amino acids** for **growth** and the production of **proteins**.

While the other nutrients may be used for respiration such as lipids, the main two nutrients together are glucose and amino acids.

2.

The correct answer is C (to increase the yield of the crop) because:

Genetic modification will enable the plant to have an increased yield. This is particularly important in growing crops more readily in conditions that the plant would normally not thrive in (such as drought).

A is incorrect because the purpose of **genetic modification** is to increase the yield of crops.

B is incorrect because some genetic modification will **provide,** not prevent, pest resistance.

D is incorrect because some genetic modification will **provide,** not prevent, resistance to herbicides.

3.

The correct answer is A (cloning) because:

Cloning is a process which aims to make an identical copy of the original organism being cloned. Within cloning there is no **genetic modification** of the organism.

B, **C** and **D** are incorrect because these are the uses and advantages of genetic modification of organisms.

4.

The correct answer is C because:

Anaerobic respiration in yeast breaks down glucose to produce ethanol (alcohol) and carbon dioxide. To make beer, ethanol (alcohol) needs to be produced, and for bread to rise carbon dioxide is required to make the dough rise.

All the other options are incorrect because anaerobic respiration in yeast does not produce lactic acid; this is produced by anaerobic respiration in animals and some bacteria. Simple sugars are used as a reactant in respiration, they are not formed in the process.

5.

The correct answer is C (5 days) because:

At 5 days this would give you the highest **yield** of penicillin. Penicillin is produced in a **batch culture** so you would want to harvest with the highest yield possible. This is also the point at which the mass of living organisms has reduced.

6.

The correct answer is C (chocolate milkshake) because:

This is the stain with the highest percentage stain removal which was achieved with the washing powder with enzyme (94% stain removal).

HARD QUESTIONS

1.

The correct answer is A because:

- **Restriction enzymes** are needed to cut a desired **gene** from human DNA (if the objective is to produce a human protein)
- The same enzymes are then used to cut open a **plasmid** leaving **sticky ends** that will have the same base sequence at the ends of the human DNA sequence
- **Ligase** can then be used to join the two strands together in the **plasmid**. This creates a **recombinant plasmid**. **Recombinant** means that the organism has had its **genetic sequence** changed

2.

The correct answer is B (to join human DNA with plasmid DNA) because:

- The **enzyme** that can join complementary **sticky ends** created by the activity of restriction enzymes on plasmid and human DNA is called **ligase**
- 'Sticky ends' can complement base-pair with each other, but ligase joins the sugar-phosphate backbones of adjacent DNA molecules together

A is incorrect because ligase enzyme is not used when plasmids are taken up by the bacteria.

C is incorrect because the human gene is isolated using **restriction enzymes** that cut the DNA at specific base sequences.

D is incorrect because **restriction enzymes** are used to cut the plasmid open to create **sticky ends.**

3.

The correct answer is B (1 and 2 only) because:

- **Restriction enzymes** are used to cut DNA at a certain sequence. This leaves short chains of single stranded DNA known as **sticky ends**
- The plasmid to which the isolated gene is to be inserted is cut with the same **restriction enzyme** so that it has **complementary sticky ends**
- **Sticky ends** are made in step 1 and 2

4.

The correct answer is B (2 and 3 only) because:

- Biofuel is considered to be a renewable energy source, since new crops can be planted to replace those that were harvested to produce biofuel. This is a major advantage since we are less likely to run out of biofuel in the future, unlike fossil fuels that are used up faster than it can be replaced (given that it takes millions of years to form)
- Using waste parts of crop plants can also be considered an advantage of biofuel, as these parts have no other commercial use in the food industry and would end up being thrown away. Being able to use these parts to produce something useful like biofuel means less waste will end up in landfills

A is incorrect because statement 1 only describes where the ethanol comes from that is used in biofuel, it is not a specific advantage. Statement 4 is considered to be a disadvantage of biofuel by some since using land to grow crops specifically for the production of these fuels will lead to less land available to grow crops used as a food source for people.

C is incorrect because statement 2 is not the only advantage listed in the options.

D is incorrect because statement 4 is considered a disadvantage of biofuel since this would lead to less land that is available to produce food crops.

5.

The correct answer is D because:

- **Aseptic conditions** will kill undesirable microorganisms and prevent chemical contamination so that only the species of microorganisms that are needed will grow in the fermenter
- The **optimum pH** must be maintained to ensure that the enzymes within the microorganisms function at their optimum rate. Remember that enzymes are proteins and they are very sensitive to changes in pH (and temperature) which will cause them to denature
- **Agitation** with the stirring paddles will ensure that the contents of the fermenter (microorganisms, nutrients, oxygen, pH and temperature) is evenly distributed so that the microorganisms can reproduce at their maximum rate