A level Biology A

H420/03 Unified biology

Question Set 2

1 Bread contains a mixture of polypeptides known as gluten.

Gluten consists of two types of polypeptide: gliadins and glutenins.

(a) (i) The table below contains statements about the structures of gluten polypeptides.

In the boxes next to each statement, write the level of protein structure (primary,secondary, tertiary, or quaternary) to which the statement refers.

Statement	Level of protein structure
Short α-helical sections are present in both polypeptides because of their high proline content	secondary
Intermolecular bonds form between glutenin and gliadin polypeptides	quaternary
Up to 45% of the amino acids in gliadins are glutamine	primary
Hydrophobic amino acids such as glutamine and proline are not found on the surface of gluten proteins	tertiary

[2]

(ii) Coeliac disease is caused by an immune reaction to gliadins in a person's digestive system. The immune system produces antibodies that bind to part of the gliadin polypeptides, which causes inflammation.

Some people who stop eating foods that contain gluten still occasionally experience thesymptoms of coeliac disease.

What can you conclude about:

- the structure of the antibody that causes coeliac disease; and
- what the antibody binds to when producing the symptoms of coeliac disease?

- other foods may contain the same antigen as gluten **[2]**
- antigen is a short sequence of amino acids
- variable region of antibody is not specific
- antibody binds to T lymphocyte / mast cell
- mast cell releases histamine causes inflammation

(b) Gluten helps to trap carbon dioxide within bread dough. This enables bread to rise when it isbaked.

The carbon dioxide is produced by baker's yeast, *Saccharomyces cerevisiae*. This species ofyeast is able to convert ethanol to acetyl CoA at low glucose concentrations.

Fig. 2 shows the oxygen consumption and carbon dioxide production of a population of
S. cerevisiae grown in batch culture. The population was provided with glucose as their onlyinitial source of carbon.

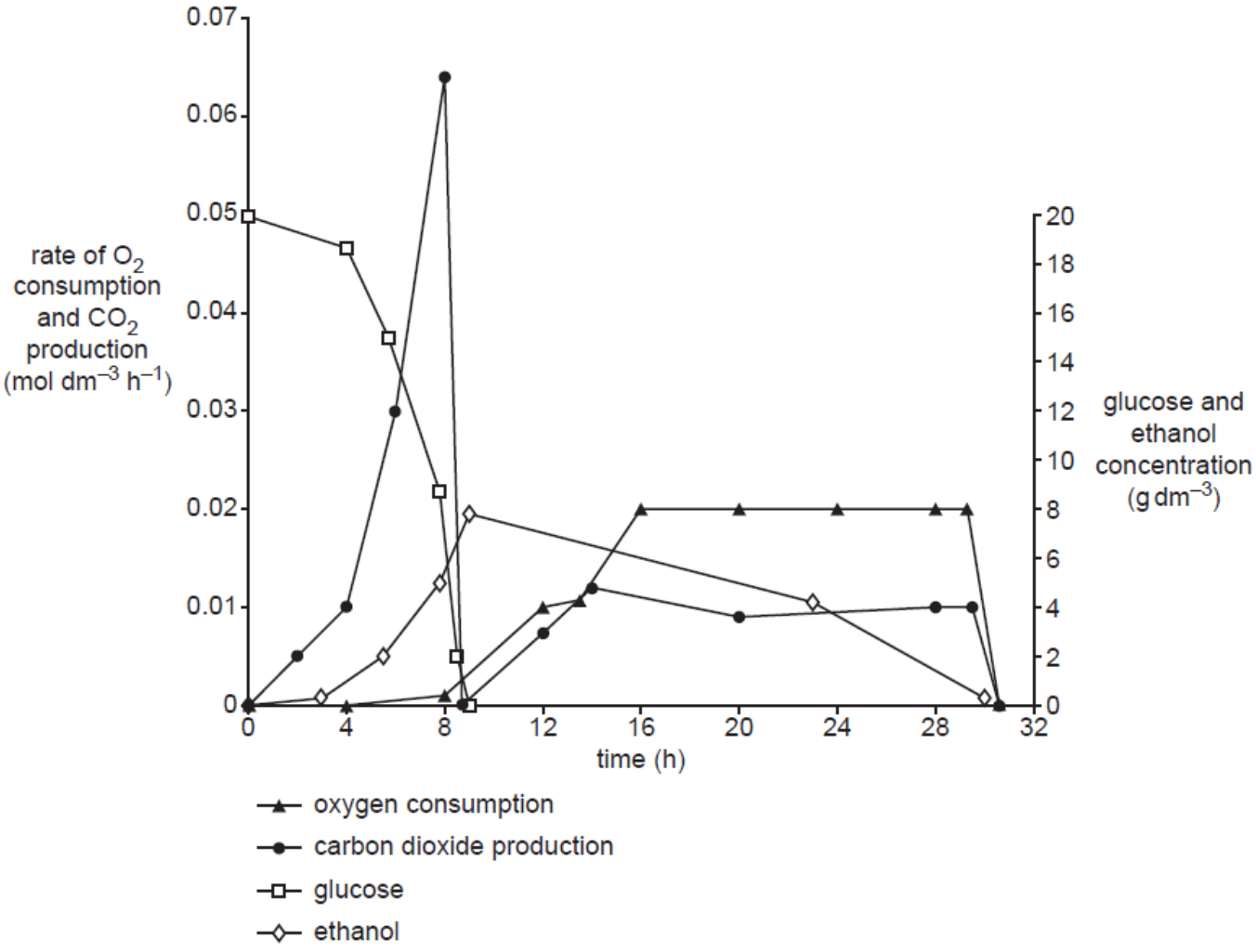

Fig. 2

(i) Suggest and explain what conclusions can be drawn from Fig. 2 about the factors that affected the rate and type of respiration carried out by S. cerevisiae in this batch culture. **[3]**

- at the start, anaerobic respiration where glucose converted into ethanol and ethanol used once glucose has been consumed via aerobic respiration
- respiration decreases rapidly and stops once glucose used up
- respiration stops when respiratory substrate has been used up

(ii) Describe **two** practical considerations to ensure the *S. cerevisiae* population growssuccessfully when the initial culture is established. **[2]**

- provide nutrients / respiratory substrates
- incubate at suitable optimum temperature

(iii) Scientists wanted to estimate the number of yeast cells in a 25 cm^3 solution of *S. cerevisiae*. They carried out the following two dilutions:

- 1 cm^3 of the original solution was mixed with 9 cm^3 of nutrient solution to makesolution 2.
- 1 cm^3 of solution 2 was mixed with 9 cm^3 of nutrient solution to make solution 3.

The scientists transferred 0.1 cm^3 of solution 3 onto an agar plate. 15 separate coloniesgrew on the plate.

Calculate the number of yeast cells in the original 25 cm^3 solution.

Express your answer in standard form to **three** significant figures. Show your working.

$15 \times 10 \times 10 \times 10 \times 25 = 375000$

Answer 3.75×10^5 **[2]**

(iv) A group of students were designing an experiment to investigate the effect of temperatureon the respiration rate of *S. cerevisiae*.

Their planned method included the following:

- *S. cerevisiae* yeast suspension will be divided into six equal volumes to formthe experimental groups.
- Six temperatures will be tested: 15 °C, 20 °C, 25 °C, 30 °C, 35 °C and 40 °C.
- Beakers of *S. cerevisiae* will be placed in water baths to control the temperature.
- Respiration rate will be measured by using a pH probe to monitor changes inthe pH of the suspensions.
- The experiment will be repeated four times.

Evaluate whether the students' method is likely to produce **valid** results. **[3]**

YES - range of temperatures chosen, volume controlled, temperature controlled, repeats to identify anomalies
NO - availability of nutrients not controlled, pH not controlled initially, no control sample

(v) The students used a Student's *t*-test to compare the results at 30 °C

and 35 °C.They calculated a *t* value of 2.200.

The critical value for $p = 0.05$ is 2.306.

Assuming their final method was valid, what can the students conclude from the result ofthe *t*-test? **[1]**

- difference between means is not significant
- so can be due to chance at $p = 0.05$

Total Mark for Questions Set 2: 15