3 **(a)** The lock-and-key hypothesis and the induced-fit hypothesis are used to describe the interaction of enzymes and their substrates.

Describe **one** similarity and **one** difference between the lock-and-key hypothesis and the induced-fit hypothesis.

similarity .....

.....

.....

difference .....

.....

.....

[2]

(b) Phosphorylase enzymes can catalyse the synthesis of starch **and** the breakdown of starch in some plant tissues. A reaction catalysed by starch phosphorylase is shown in Fig. 3.1.

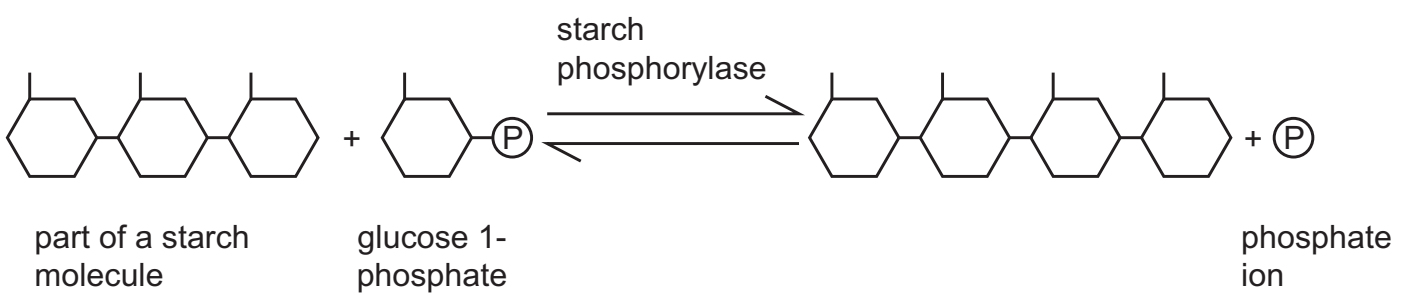

Fig. 3.1

A student carried out an experiment to study the synthesis of starch by phosphorylase found in potato tissue.

The student was provided with a solution, **E**, extracted from potato tissue. The extract was filtered to remove all the starch grains.

Extract **E** contained biological molecules from the potato tissue including phosphorylase but **no** starch.

(i) Iodine solution was used to confirm that starch was **not** present in extract **E**.

State the colour observed when iodine solution was added to a sample of extract **E**.

..... [1]

The student added a small drop of a dilute starch solution and a solution of glucose 1-phosphate to a test-tube containing extract **E**.

Samples of the reaction mixture in the test-tube were removed every minute and a drop of iodine solution was added to each.

The student used a colorimeter to measure the absorbance of the solution in each sample.

The results are shown in Fig. 3.2.

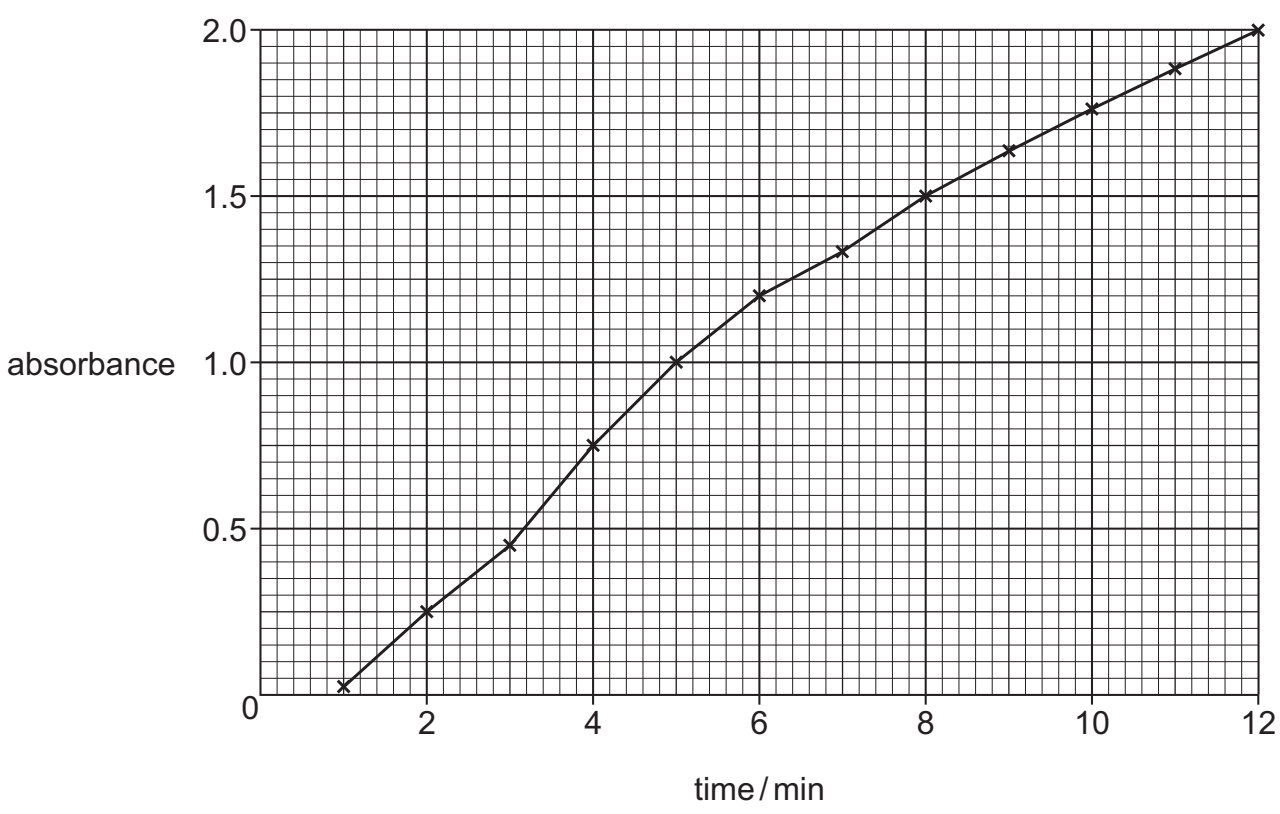

Fig. 3.2

(ii) Explain the results shown in Fig. 3.2.

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..... [3]

(iii) After 12 minutes, the student added a solution containing phosphate ions to the reaction mixture. The student continued taking samples every minute, adding iodine solution to each sample.

The absorbance of the solution in each of these samples was measured. The results showed that the absorbance decreased over time.

Suggest why the absorbance decreased.

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..... [1]

(c) Muscle cells contain glycogen phosphorylase.

Fig. 3.3 shows the effect of caffeine on the activity of glycogen phosphorylase at different concentrations of substrate.

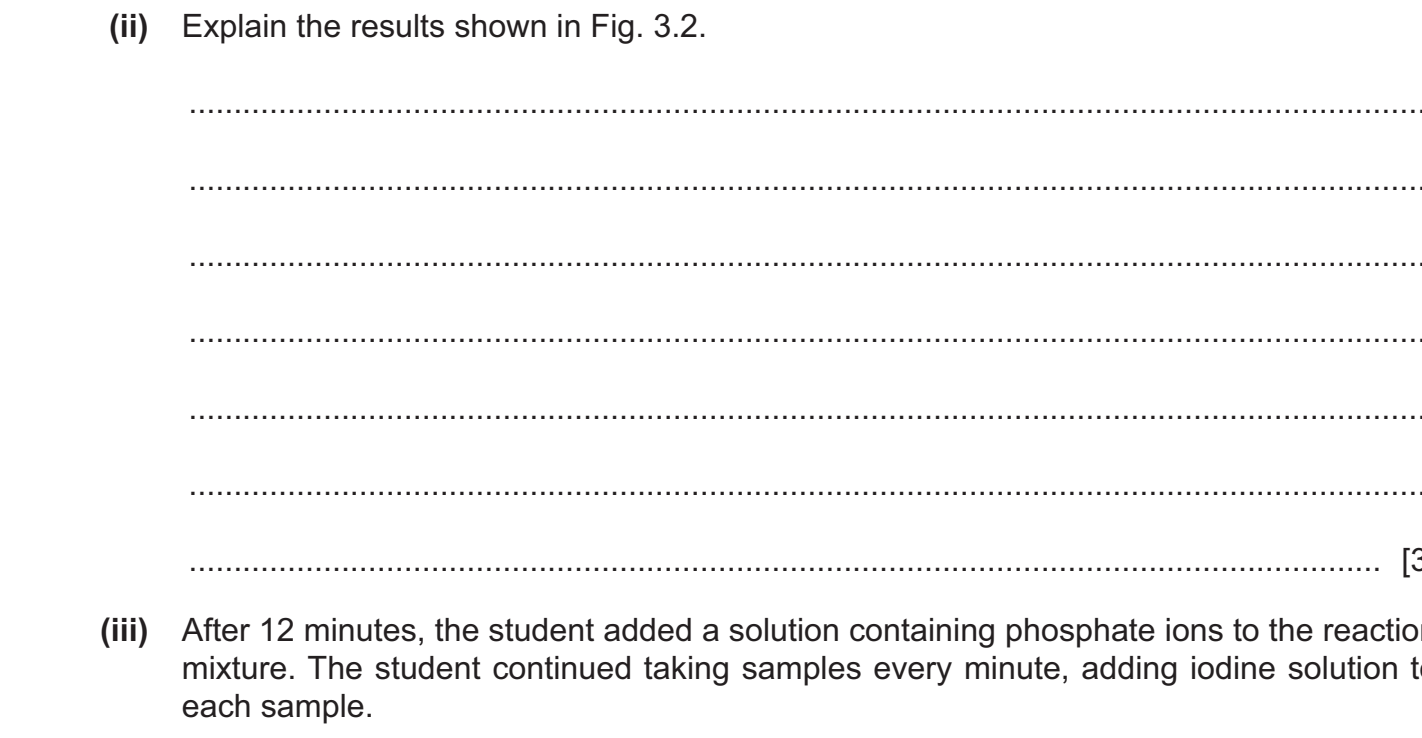

Fig. 3.3

A student concluded that caffeine acts as a non-competitive inhibitor of glycogen phosphorylase.

Explain how the results in Fig. 3.3 support this conclusion.

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..... [3]

[Total: 10]