

Exercise walk-through

Testing for biological molecules ■ 2.1

eXercise

You must be able to

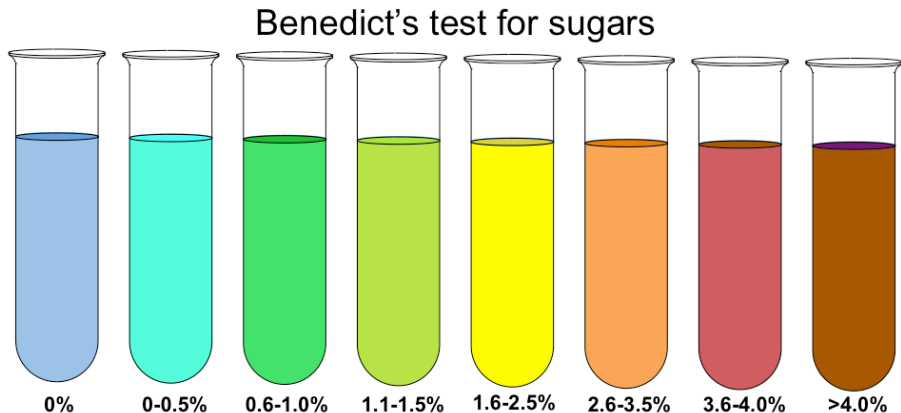
- name the reagent, method and positive result for the reducing-sugar, starch, lipid and protein tests
- make the Benedict's test semi-quantitative and use it to estimate a concentration
- describe the acid-hydrolysis test for a non-reducing sugar

Method — The four food tests

Learn the reagent and the colour change for each test.

test	finds	method	positive result
Benedict's	reducing sugar 还原糖	add Benedict's solution, heat in a water bath	blue → green → yellow → orange → brick-red precipitate 沉淀
iodine	starch 淀粉	add orange-brown iodine solution	turns blue-black
emulsion	lipid 脂质	mix with ethanol, then pour into water	white cloudy emulsion 乳浊液
biuret 双缩脲	protein 蛋白质	add biuret solution (no heating)	blue → purple

Method — The four food tests



A row of test tubes from blue through green and orange to brick-red

Method — Making Benedict's semi-quantitative

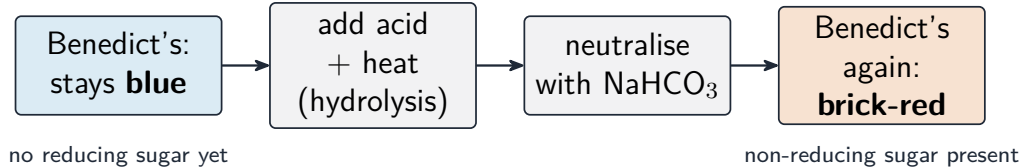
The normal test only says “yes/no”. To estimate **how much** sugar is present, first **standardise 标准化** the test on solutions of known **concentration 浓度**. Then estimate an unknown by either the **time to the first colour change** (more sugar → faster change) or by matching the final colour to your set of standards.

Method — Testing for a non-reducing sugar

Sucrose gives a *negative* Benedict's test. To detect it:

- 1 Do a normal Benedict's test — it stays blue (no reducing sugar).
- 2 With a fresh sample, add dilute hydrochloric acid and heat — this **hydrolyses** 水解 the sugar into reducing sugars.
- 3 **Neutralise** 中和 the acid with sodium hydrogencarbonate.
- 4 Repeat the Benedict's test — a brick-red colour now shows a non-reducing sugar was present.

Method — Testing for a non-reducing sugar



Practice 2.1 ■ 4 marks

State the reagent and the positive result for each test.

test	reagent	positive result
starch		
protein		

Solution 2.1

Method: The four food tests

Worked steps

starch — iodine (solution); turns blue-black **B1** **B1**. protein — biuret solution; turns purple/lilac **B1** **B1**.

Practice 2.2 ■ 3 marks

A student wants to compare the reducing-sugar concentration of three drinks. Describe how the Benedict's test can be made **semi-quantitative** to do this.

Solution 2.2

Method: Making Benedict's semi-quantitative

Worked steps

standardise the test using solutions of **known concentration** **M1**; record the time to first colour change *or* the final colour for each **M1**; estimate the unknown by comparing its time/colour to these standards **A1**.

Exam-style 3.1 ■ 1 mark

Which test and result correctly identifies a protein?

- A** biuret solution, stays blue
- B** biuret solution, turns purple
- C** Benedict's solution, turns brick-red
- D** iodine solution, turns blue-black

Solution 3.1

Method: The four food tests

A biuret solution, stays blue

B biuret solution, turns purple



C Benedict's solution, turns brick-red

D iodine solution, turns blue-black

Worked steps

B. Biuret turns from blue to purple with protein; no heating is needed.

Exam-style 3.2 ■ 1 mark

A solution gives a negative Benedict's test. After boiling it with hydrochloric acid, neutralising, and re-testing, it turns brick-red. The solution contained:

- A** a lipid
- B** a non-reducing sugar
- C** a protein
- D** starch

Solution 3.2

Method: Testing for a non-reducing sugar

A a lipid

B a non-reducing sugar



C a protein

D starch

Worked steps

B. A non-reducing sugar (e.g. sucrose) is negative until acid hydrolysis breaks it into reducing sugars.

Exam-style 3.3 ■ 4 marks

A student is given an unknown solution X and asked to find out whether it contains reducing sugar, starch and protein.

- (a) Describe the tests the student should carry out and the result that would show each substance is present.
- (b) The student finds that X contains a non-reducing sugar but no reducing sugar. Describe how the student could have shown this.
- (c) State **one** variable the student should keep the same when comparing the colour from different samples.

Solution 3.3

Method: The four food tests

Worked steps

(a) Benedict's solution + heat → brick-red shows reducing sugar; iodine solution → blue-black shows starch; biuret solution → purple shows protein **B1** *each, max 4 incl. correct pairing.*

(b) do a Benedict's test (stays blue) **B1**; then boil a fresh sample with hydrochloric acid and neutralise **B1**; Benedict's now gives brick-red → non-reducing sugar present **B1**.

(c) e.g. volume of sample / volume of Benedict's / temperature / time of heating **B1**.