

2.1 Testing for biological molecules

Name: _____ Class: _____ Date: _____

Total: 17 marks

KEY WORDS reducing sugar 还原糖 • iodine 碘 • hydrochloric acid 盐酸 • protein 蛋白质 • starch 淀粉

Objective

Build the skills to answer exam questions on **testing for biological molecules** — carrying out and interpreting the food tests, the **semi-quantitative** 半定量 Benedict's test, and the test for **non-reducing sugars** 非还原糖.

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

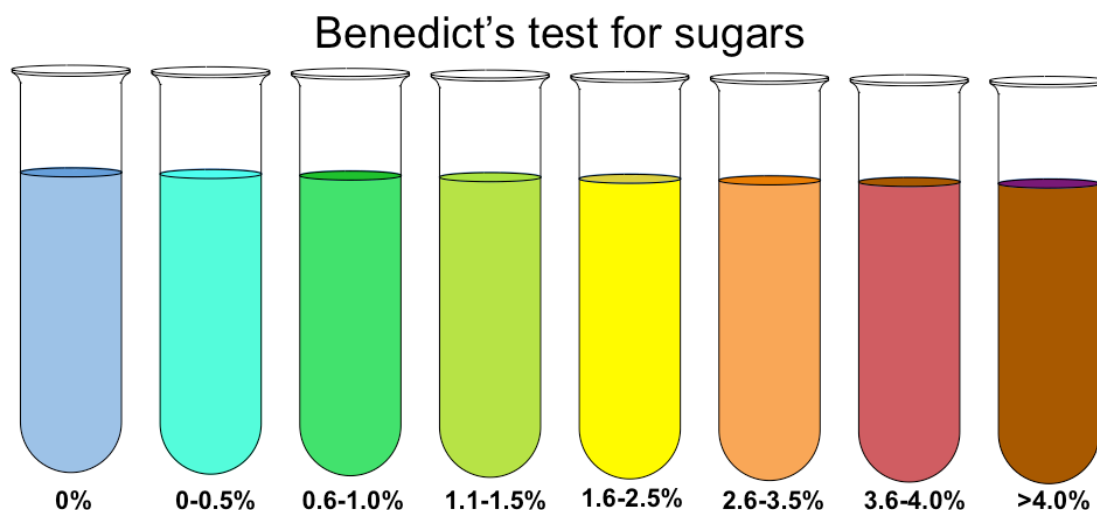
1 Worked examples

Study these first. Each one shows the **method** 方法 for a question type used later.

■ 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



Benedict's test: more reducing sugar gives a colour further along, from blue to brick-red

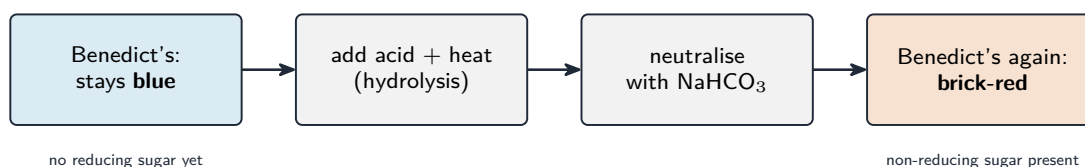
■ Making Benedict's semi-quantitative

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.

■ 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.



Hydrolyse the sugar with acid first, then the second Benedict's test turns red

2 Practice

2.1 State the reagent and the positive result for each test.

[4]

test	reagent	positive result
starch		
protein		

2.2 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.

[3]

3 Exam-style questions

3.1 Which test and result correctly identifies a protein?

[1]

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

3.2 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:

[1]

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

3.3 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.

[4]

(b) The student finds that X contains a non-reducing sugar but no reducing sugar. Describe how the student could have shown this. [3]

(c) State **one** variable the student should keep the same when comparing the colour from different samples. [1]

Solutions

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

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

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

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

3.3 (a) Benedict's solution + heat → brick-red shows reducing sugar; iodine solution → blue-black shows starch; biuret solution → purple shows protein.

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

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