Unit 11 · Bioinorganic Chemistry

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 34

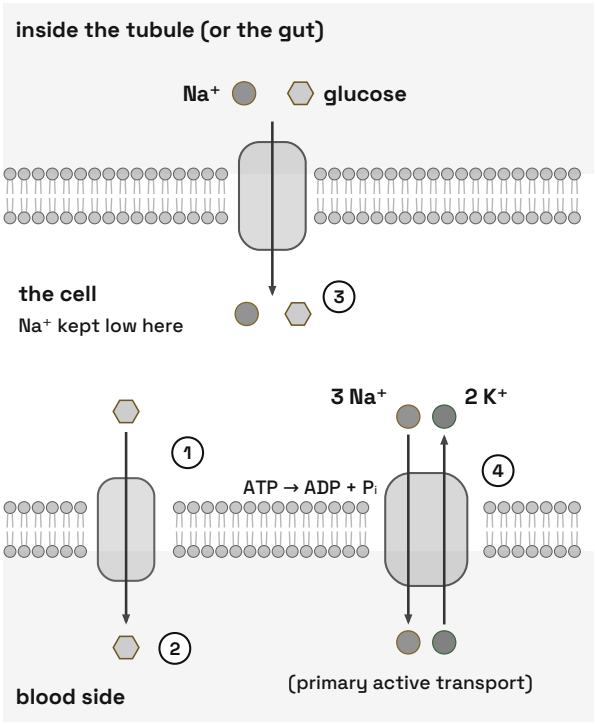
1 Match the columns [3]

Match each term in Column A with its meaning in Column B. One meaning in Column B is not needed. Each carries 0.5 mark.

Column A		Column B
1. bioinorganic molecule	☐	**a.** a protein that carries oxygen in muscles
2. metalloenzyme	☐	**b.** a poison building up more at each step of a food chain
3. cofactor	☐	**c.** a biological molecule with a metal ion as an essential part
4. active transport	☐	**d.** two substances carried across a membrane in the same direction
5. symport	☐	**e.** movement against a concentration gradient, using energy
6. biomagnification	☐	**f.** an enzyme with a metal bound tightly at its active site
		g. a metal ion or other small helper an enzyme needs to work

2 Label the diagram [2]

The diagram shows how a cell of the kidney tubule takes up glucose. Write the protein or process that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The metal ion at the center of vitamin B12 is: [1]

a. iron **b.** magnesium
c. cobalt **d.** zinc

ii. Which enzyme uses zinc to turn carbon dioxide into hydrogen carbonate in red blood cells? [1]

a. catalase **b.** urease
c. carbonic anhydrase **d.** tyrosinase

iii. The sodium–potassium pump leaves the inside of a cell negative because: [1]

a. it carries only negative ions into the cell
b. it carries three positive charges out for every two it brings in
c. it lets K^+ and Na^+ flow down their gradients
d. ATP is negatively charged

iv. Chronic arsenic poisoning from groundwater, seen in Nepal's Terai, is called: [1]

a. Minamata disease **b.** itai-itai
c. arsenicosis **d.** hemochromatosis

v. A child often swallows dust from old painted walls, is clumsy and slow to learn, and is anemic. The likeliest poison is: [1]

a. cadmium **b.** lead
c. arsenic **d.** mercury vapor

4 Short answers [9]

Write short answers to the following questions.

a. Write two differences between passive and active transport. [2]

b. Heme and chlorophyll have the same kind of ring. What is alike in how they hold their metal ion, and how do their metals and jobs differ? [2]

c. Write two jobs of calcium ions in the body. [2]

d. Give three ways in which toxic metals harm the body, with an example of each. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Explain how the sodium–glucose cotransporter (SGLT) takes glucose into a cell against its concentration gradient. Why is it called secondary active transport, and what part does the sodium–potassium pump play?

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take the energy from carbohydrate and protein as 17 kJ/g and from fat as 37 kJ/g, and the molar mass of glucose as 180 g/mol.

a. A lunch of rice, dal and vegetables with ghee has 70 g of carbohydrate, 25 g of protein and 20 g of fat. Find i. the total energy it gives, ii. the share of the energy from each, and iii. whether each share is within the recommended range (carbohydrate 45–65%, protein 10–35%, fat 20–35%). **[4]**

Answer:

b. The kidneys filter about 180 L of blood plasma a day, with a blood glucose of 5.5 mmol/L. i. Find the mass of glucose filtered in a day. ii. SGLT2 takes back 90% of it, carrying one Na^+ with each glucose. How many moles of Na^+ does it carry in with it? iii. In a person with uncontrolled diabetes the blood glucose is 14 mmol/L. Would you expect glucose in the urine? Why? **[4]**

Answer: _____

7 Think **[3]**

A healthy body carries small amounts of lead and cadmium, and also of iron and zinc. Explain why being found in the body does not show that a metal is essential, and why iron, though essential, can still poison.

8 Activity: Bubbles from a potato (not marked)

You need: 3% hydrogen peroxide (sold at pharmacies as an antiseptic), a raw potato, a boiled potato, two small glasses. **Safety:** use only the 3% solution; keep it off your eyes, and never drink it. Pour a little hydrogen peroxide into each glass, drop small pieces of raw potato into one and boiled potato into the other, and watch both for a minute.

	Raw potato	Boiled potato
What you see		
How fast (fast, slow, none)		

Which enzyme is at work, which metal does it contain, and why does boiling change the result?