

9.2.1 Valves, the heartbeat, monitoring the heart and coronary heart disease

Name: _____ Class: _____ Date: _____

Total: 34 marks

KEY WORDS coronary heart disease 冠心病 • septum 隔膜 • oxygenated 含氧 • heart rate 心率
• deoxygenated 缺氧

Objective

Sheet 9.2 named the chambers and the septum. This sheet is the rest of 9.2, and it is where the long questions live: the **valves** 瓣膜 and what each one does during a heartbeat, why the walls have the thicknesses they do, how the activity of the heart is **monitored** 监测, how to investigate the effect of exercise on **heart rate** 心率 and explain what you find, and **coronary heart disease** 冠心病 with its risk factors. This sheet covers syllabus 9.2.

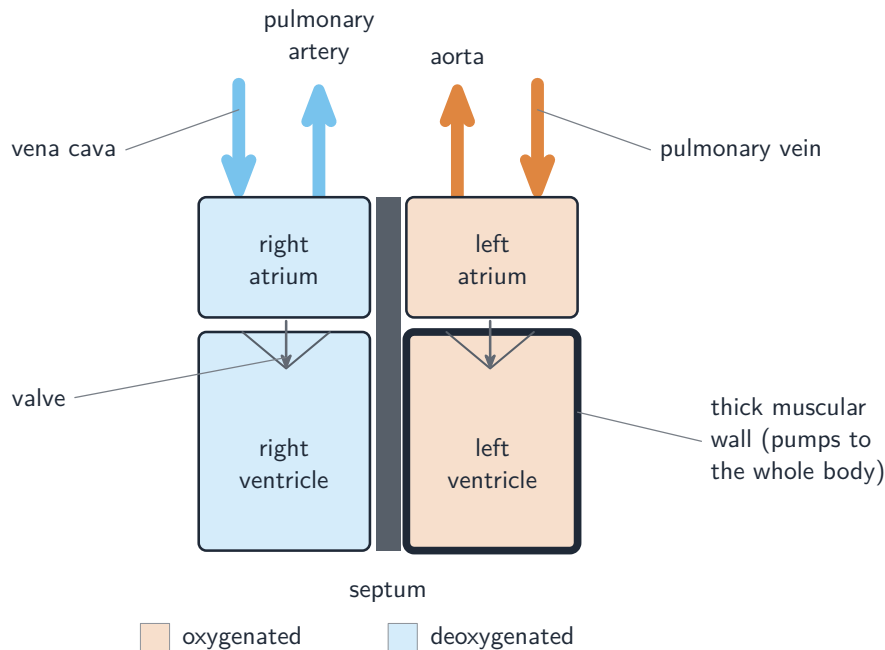
You must be able to:

- identify the muscular wall, **septum** 隔膜, left and right **ventricles** 心室, left and right **atria** 心房, the one-way valves and the **coronary arteries** 冠状动脉, including the **atrioventricular** 房室 and **semilunar** 半月 valves
- explain the relative thickness of the left and right ventricle walls, and of the atria compared with the ventricles
- explain the importance of the septum in separating **oxygenated** 含氧 and **deoxygenated** 缺氧 blood
- describe the functioning of the heart in terms of the contraction of the atria and ventricles and the action of the valves
- state that the activity of the heart may be monitored by **ECG** 心电图, pulse rate and listening to the sounds of the valves closing
- investigate, describe and explain the effect of physical activity on the heart rate
- describe coronary heart disease as a blockage of the coronary arteries, state its risk factors, and discuss the roles of diet and exercise in reducing the risk

1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

■ The parts, and the three “why is it thicker?” answers



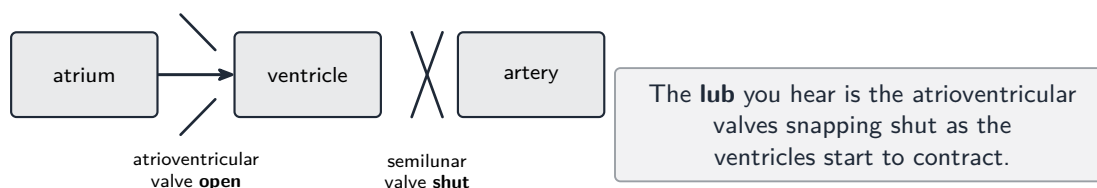
- Blood is pumped **away** from the heart in **arteries** and returns in **veins**.
- The **coronary arteries** run over the outside of the heart and supply the heart **muscle itself** with oxygen and glucose.

Three wall-thickness questions, three different answers:

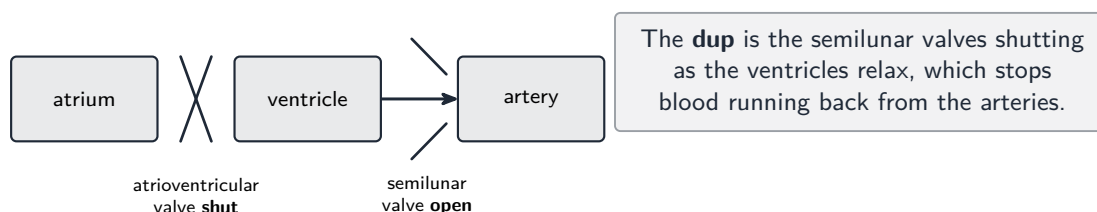
comparison	why
left ventricle wall thicker than right atria walls	the left ventricle pumps blood all round the body , the right only to the lungs , so the left needs a higher pressure and a stronger contraction
thinner than ventricle walls	the atria only push blood down into the ventricles , a short distance, so far less force is needed
septum	keeps oxygenated blood on the left completely separate from deoxygenated blood on the right, so the blood going to the body carries as much oxygen as possible

■ One heartbeat, valve by valve

1 the atria contract



2 the ventricles contract

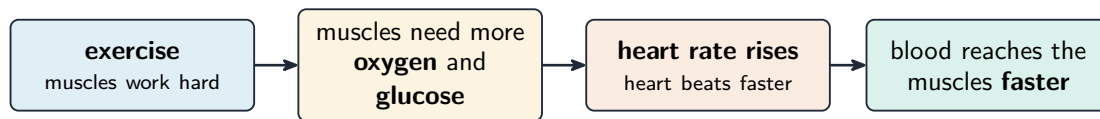


1. The **atria contract**. The **atrioventricular valves open**, so blood is pushed down into the ventricles. The **semilunar valves stay shut**.
 2. The **ventricles contract**. The **atrioventricular valves shut**, which stops blood going back into the atria, and the **semilunar valves open**, so blood is pushed out into the arteries.
 3. The ventricles **relax**. The **semilunar valves shut**, which stops blood running back from the arteries into the ventricles.
- The valves are **one-way**: they are pushed shut by blood trying to flow backwards.
 - The “**lub**” is the atrioventricular valves shutting; the “**dup**” is the semilunar valves shutting.

■ Three ways to monitor the heart

method	what it measures
pulse rate	the number of beats per minute, felt where an artery runs near the skin, such as the wrist or the neck
listening with a stethoscope	the sounds of the valves closing , so a faulty valve can be heard
ECG (electrocardiogram)	the electrical activity of the heart muscle, recorded as a trace

■ Exercise, and why the heart speeds up



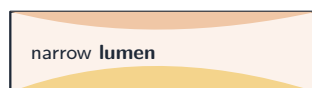
check the heart's activity by feeling the **pulse**, listening to the valves, or with an **ECG**

The chain, and every step is a marking point:

1. The muscles **respire faster** during exercise, so they need more **oxygen** and **glucose** and produce more **carbon dioxide**.
 2. So the heart **beats faster** (and more strongly).
 3. So blood is delivered to the muscles **more quickly**, supplying oxygen and glucose and carrying carbon dioxide away.
- Afterwards the rate falls back. **The fitter the person, the faster it returns to the resting rate** – that is what a “recovery time” question is testing.

Investigating it. Measure the resting pulse rate three times and take a mean; exercise for a set time at a set intensity; measure the pulse rate immediately afterwards and then every minute until it returns to resting. Keep the **type**, **intensity** and **duration** of the exercise the same for everyone you compare.

■ Coronary heart disease



coronary heart disease: fatty build-up narrows the coronary artery, so the heart muscle cannot get enough **oxygen**

risk factors

high-fat diet

smoking

lack of exercise

stress

family history

older age

a healthy diet

regular exercise

lower the risk

Coronary heart disease is the **blockage of a coronary artery** by a build-up of fatty material. The heart muscle beyond the blockage receives less oxygen and glucose, so it cannot respire enough and may be damaged.

- **Risk factors:** diet, lack of exercise, stress, smoking, genetic predisposition, age and sex.
- **Diet** reduces the risk when it is low in saturated fat and salt, so less fatty material builds up in the arteries.
- **Exercise** reduces the risk because it strengthens the heart muscle, lowers blood pressure, and helps keep body mass and blood fat levels down.

2 Practice

Now use the methods above.

2.1 Name the two kinds of valve in the heart, and state where each one is found. [2]

2.2 Explain why the walls of the atria are thinner than the walls of the ventricles. [2]

2.3 A baby is born with a hole in the septum. Explain why this baby becomes breathless easily. [3]

2.4 State **three** ways in which the activity of the heart can be monitored. [3]

2.5 Describe how you would investigate the effect of exercise on a person's pulse rate. [3]

3 Exam-style questions

3.1 Which row describes the heart while the **ventricles** are contracting? [1]

	atrioventricular valves	semilunar valves	blood moves
A	open	shut	from the atria into the ventricles
B	shut	open	from the ventricles into the arteries
C	open	open	from the atria into the arteries
D	shut	shut	nowhere

3.2 A doctor listens to a patient's heart with a stethoscope and hears two sounds in each heartbeat.

(a) Describe what happens in the heart when the atria contract. [3]

(b) Explain what causes the two sounds the doctor hears. [2]

(c) Name the valves that stop blood flowing back from the arteries into the ventricles. [1]

3.3 A student measured her pulse rate before exercise, immediately after five minutes of running, and then once a minute until it returned to normal.

time after the exercise stopped / minutes	pulse rate / beats per minute
before the exercise	72
0 (immediately after)	148
1	120
2	96
3	80
4	74

(a) State what is meant by the pulse rate, and name one other way of monitoring the activity of the heart. [2]

(b) Describe how her pulse rate changed after the exercise stopped. [2]

(c) Explain why her heart rate increased during the exercise. [4]

(d) A second student of the same age did the same exercise, and her pulse rate was back to its resting value after 2 minutes. Suggest what this shows about the second student. [2]

(e) State **two** risk factors for coronary heart disease other than a lack of exercise. [2]

(f) Explain how taking regular exercise reduces the risk of coronary heart disease. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

- **atrioventricular valves**, between each atrium and the ventricle below it
- **semilunar valves**, where the arteries leave the ventricles

2.2

- the atria only push blood a **short distance**, down into the ventricles
- so much **less force** is needed, and a thinner layer of muscle is enough

2.3

- the septum normally keeps **oxygenated** blood on the left completely separate from **deoxygenated** blood on the right
- a hole lets the two mix, so the blood pumped to the body carries **less oxygen**
- the body cells cannot respire fast enough, so the baby breathes faster to try to take in more oxygen and becomes breathless

2.4

- measuring the **pulse rate**
- **listening** to the sounds of the valves closing, with a stethoscope
- recording an **ECG**

2.5

- measure the resting pulse rate, repeating it and taking a **mean**
- exercise for a set **time** at a set **intensity**, then measure the pulse rate immediately afterwards
- keep measuring once a minute until it returns to the resting value; keep the type, intensity and duration of the exercise the **same** for everyone compared

3.1 B

- while the ventricles contract, the atrioventricular valves are pushed **shut** and the semilunar valves are pushed **open**, so blood leaves in the arteries
- **A** describes the atria contracting; **C** would let blood run straight through; **D** would move no blood at all

3.2

(a)

- the atria **contract**, raising the pressure inside them
- the **atrioventricular valves open**
- blood is pushed **down into the ventricles**, while the semilunar valves stay shut

(b)

- the first sound is the **atrioventricular valves shutting**, as the ventricles begin to contract
- the second is the **semilunar valves shutting**, as the ventricles relax

(c)

- the **semilunar valves**

3.3

(a)

- the pulse rate is the number of **heart beats per minute**, felt where an artery passes close to the skin
- also acceptable: an **ECG**, or listening to the valve sounds with a stethoscope

(b)

- it **fell**, from 148 beats per minute immediately after the exercise to 74 after 4 minutes
- the fall was **fastest at the start** and slowed as the rate approached the resting value of 72

(c)

- her muscles **respired faster** during the exercise, to release more energy
- so they needed more **oxygen** and **glucose**, and produced more **carbon dioxide**
- the heart beat **faster and more strongly**, so blood flowed through the muscles more quickly
- delivering oxygen and glucose faster and carrying carbon dioxide away faster

(d)

- her pulse rate **recovered more quickly**, in 2 minutes rather than 4
- which suggests she is **fitter**

(e)

- any **two** of: a diet high in **saturated fat** or salt; **smoking**; **stress**; **age**; **sex**; a **genetic** predisposition

(f)

- exercise **strengthens the heart muscle** and helps keep blood pressure and body mass down
- so less fatty material builds up in the **coronary arteries**, and they are less likely to become blocked