B2bD The Circulatory System and Heart: Exam Drill

AQA 8464 · Calculator allowed · about 95 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Name the blood vessels that carry blood away from the heart and name the blood vessels that return blood to the heart.

(a) Name the vessels that carry blood away from the heart. **(1)**

(b) Name the vessels that return blood to the heart. **(1)**

(Total for Question 1 is 2 marks)

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2 Describe two structural differences between arteries and veins and explain how each difference relates to their function.

(a) Give one structural difference and its functional reason. **(2)**

(b) Give a second structural difference and its functional reason. **(1)**

(Total for Question 2 is 3 marks)

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3 Complete the sentence: The chamber of the heart that pumps blood to the lungs is the ___.

(a) Fill the blank. **(1)**

(Total for Question 3 is 1 mark)

4 An investigation measures heart rate changes during three activities: resting, walking and climbing stairs. A student records heart rates (beats per minute) for one person: resting 64, walking 92, climbing stairs 128.

(a) Calculate the increase in heart rate from resting to walking. **(1)**

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(b) Calculate the percentage increase from resting to climbing stairs. Give your answer to one decimal place. **(2)**

.....

(Total for Question 4 is 3 marks)

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5 Blood transports dissolved substances. State two substances transported by blood plasma and give one function for each substance named.

(a) Name a substance transported in plasma and its function. **(1)**

(b) Name a second substance transported in plasma and its function. **(2)**

(Total for Question 5 is 3 marks)

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6 A student uses a light microscope to measure the diameter of a capillary in a prepared slide. The microscope eyepiece graticule reading for the capillary is 24 divisions. The calibration (stage micrometer) shows 10 divisions on the graticule = 50 micrometres. Calculate the diameter of the capillary in micrometres. Give your answer to the nearest micrometre.

(a) Calculate the calibration scale: micrometres per graticule division. **(1)**

.....

(b) Use the calibration to calculate the capillary diameter in micrometres to the nearest micrometre. **(2)**

.....

(Total for Question 6 is 3 marks)

7 A patient has a systolic blood pressure of 130 mmHg and a diastolic pressure of 82 mmHg. Calculate the pulse pressure and then the mean arterial pressure (MAP) approximated by: MAP = diastolic + 1/3 x pulse pressure. Give answers to one decimal place where appropriate.

(a) Calculate the pulse pressure. **(1)**

.....

(b) Calculate the mean arterial pressure (MAP) using MAP = diastolic + 1/3 x pulse pressure. Give your answer to one decimal place. **(2)**

.....

(Total for Question 7 is 3 marks)

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8 A researcher measures heart rate of volunteers before and after a 10-minute moderate exercise session. The table below shows mean results from two groups.

Group A (young adults): before 68 bpm, after 100 bpm.
Group B (older adults): before 76 bpm, after 92 bpm.

Use the data to answer the questions.

(a) Calculate the absolute increase in heart rate for each group. **(2)**

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(b) Suggest one physiological reason why the younger group shows a larger increase in heart rate after the same exercise. **(2)**

(Total for Question 8 is 4 marks)

9 Required practical style: A student investigates how activity affects pulse rate. They measure pulse at rest and immediately after climbing a short flight of stairs. The student times one minute and counts pulses by feeling the radial pulse. The results from five repeats are: rest counts 12, 11, 13, 12, 12; after stairs counts 22, 25, 24, 23, 26. Identify two possible sources of random error or human error in the method and give one practical improvement for each source to reduce the error.

(a) Identify one source of human error or random error in the measurements and give a practical improvement to reduce it. **(2)**

(b) Identify a second source of error and give a practical improvement to reduce it. **(3)**

(Total for Question 9 is 5 marks)

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10 Cardiac output is the volume of blood pumped by the heart per minute and is calculated as: cardiac output = stroke volume x heart rate. A middle-aged person has a stroke volume of 70 cm3 per beat and a resting heart rate of 72 bpm. Calculate their cardiac output in litres per minute. Give your answer to two decimal places.

(a) Substitute values and calculate cardiac output in cm3 per minute. **(1)**

.....

(b) Convert the cardiac output into litres per minute. Give your answer to two decimal places. **(2)**

.....

(Total for Question 10 is 3 marks)

11 Explain how the structure of the heart and valves ensures unidirectional flow of blood through the heart. You should include the roles of chambers, valves and muscle thickness in your answer.

(Total for Question 11 is 6 marks)

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12 Evaluate the statement: 'Reducing dietary saturated fat is the most important single change a person can make to reduce their risk of coronary heart disease.' In your answer consider other risk factors and give a justified conclusion.

(a) Give points that support the statement and points that argue against it, then give a justified conclusion. **(4)**

(Total for Question 12 is 4 marks)

Mark scheme · B2bD The Circulatory System and Heart: Exam Drill

Question 1

- (a) **B1** arteries cao
- **(a) Answer: Arteries**
- (b) **B1** veins cao
- **(b) Answer: Veins**

Question 2

- (a) **M1** states a structural difference between arteries and veins (eg thicker muscular or elastic wall in arteries or valves present in veins)
- (a) **A1** explains how that difference helps function (eg thick muscular and elastic walls in arteries allow them to withstand and even out high pressure; valves in veins prevent backflow at low pressure), oe
- **(a) Answer: Example: Arteries have thicker muscular and elastic walls than veins; this allows them to withstand and even out the high pressure from the heart. Veins have valves to prevent backflow because blood returns at lower pressure.**
- (b) **B1** a second linked structural and functional point (eg artery lumen relatively narrow so blood flows faster; vein lumen wider to act as a reservoir), oe
- **(b) Answer: Arteries have a narrower lumen so blood is forced to flow faster; veins have a wider lumen and can hold more blood, acting as a reservoir.**

Question 3

- (a) **B1** right ventricle cao
- **(a) Answer: right ventricle**

Question 4

- (a) **B1** 28 bpm (92 - 64)
- **(a) Answer: 28 bpm**
- (b) **M1** substitutes into percentage change = (change / original) x 100: (128 - 64) / 64 x 100
- (b) **A1** 100.0% cao
- **(b) Answer: 100.0%**

Question 5

- (a) **B1** glucose and a correct function (eg used in respiration) or amino acids and a function (eg used to make proteins) or hormones and a function
- **(a) Answer: Glucose transported for respiration.**
- (b) **M1** names a second substance and gives a linked function (eg platelets, antibodies, dissolved CO2 transported for excretion), oe
- (b) **A1** example: platelets to help blood clot cao
- **(b) Answer: Platelets transported to the site of bleeding to help blood clot.**

Question 6

- (a) **B1** states calibration: 50 micrometres / 10 divisions = 5 micrometres per division
- **(a) Answer: 5 micrometres per division**
- (b) **M1** multiplies graticule reading by calibration: 24 x 5
- (b) **A1** 120 micrometres cao
- **(b) Answer: 120 micrometres**

Question 7

- (a) **B1** pulse pressure = systolic - diastolic = 130 - 82 = 48 mmHg
- **(a) Answer: 48 mmHg**
- (b) **M1** substitutes: MAP = 82 + 1/3 x 48
- (b) **A1** 98.0 mmHg cao
- **(b) Answer: 98.0 mmHg**

Question 8

- (a) **M1** calculates increase for Group A: 100 - 68 and Group B: 92 - 76
- (a) **A1** gives both increases correctly: Group A 32 bpm, Group B 16 bpm cao
- **(a) Answer: Group A: 32 bpm increase; Group B: 16 bpm increase.**
- (b) **M1** suggests a physiological cause linked to age and cardiovascular response (eg younger adults have higher maximum cardiac output potential or a greater sympathetic response; older adults may have lower responsiveness or higher resting heart rate), oe
- (b) **A1** explains how this leads to a larger increase (eg greater sympathetic drive increases heart rate more in young adults), oe
- **(b) Answer: Younger adults may have a greater sympathetic response and higher cardiac output capacity, so their heart rate rises more for the same exercise intensity.**

Question 9

- (a) **M1** identifies an error (eg inconsistent timing, difficulty feeling the pulse, or variation in effort climbing stairs)
- (a) **A1** gives a linked improvement that would reduce that error (eg use a stopwatch started at the same time and have a second person check timing; use pulse sensor or heart rate monitor; standardise the climbing effort), oe
- **(a) Answer: Error: difficulty feeling the pulse consistently. Improvement: use a pulse oximeter or heart rate chest strap to record beats electronically to avoid missed beats.**
- (b) **M1** identifies a second error (eg inconsistent rest time before measurement, variable recovery time, small sample size causing random variation)
- (b) **M1** suggests a practical improvement that is specific and linked (eg ensure fixed rest period before measurement and fixed recovery time after exercise; increase number of repeats and use mean values)
- (b) **A1** explains how the improvement reduces error (eg standardising rest reduces variability due to different starting conditions; more repeats reduce effect of random variation), oe
- **(b) Answer: Error: variable recovery time between climbs leading to inconsistent post-exercise rates. Improvement: standardise procedure so subject rests for a fixed time before testing and measure immediately after a controlled climb; increase repeats and use the mean to reduce random variation.**

Question 10

- (a) **B1** calculates cardiac output in cm3: 70 x 72 = 5040 cm3 per minute
- **(a) Answer: 5040 cm3 per minute**
- (b) **M1** converts cm3 to litres by dividing by 1000: 5040 / 1000
- (b) **A1** 5.04 L per minute cao
- **(b) Answer: 5.04 L per minute**

Question 11

- **Level 3** (5-6): Detailed explanation. Candidate makes a clear description of how chambers, valves and muscle thickness interact to produce unidirectional flow; links anatomical features to function with clear causal explanation and uses correct examples (eg left ventricle thicker to pump to body; atrioventricular valves and semilunar valves close to prevent backflow).
- **Level 2** (3-4): Partial explanation. Candidate describes two or more relevant features and gives a basic link to function, but the causal chain is incomplete or lacks specific examples.
- **Level 1** (0-2): Simple statements about heart parts with limited or no explanation of how these produce unidirectional flow.
- **Indicative content:**
  - Chambers: atria receive blood, ventricles pump blood out; right ventricle pumps to lungs, left ventricle to body.
  - Valves: atrioventricular valves (tricuspid and mitral) between atria and ventricles prevent backflow when ventricles contract; semilunar valves (pulmonary and aortic) at exits prevent backflow when ventricles relax.
  - Muscle thickness: left ventricle has thicker muscular wall to generate higher pressure to pump blood around the body; right ventricle thinner as it only pumps to the lungs.
  - Sequence of contraction: atrial contraction followed by ventricular contraction and coordinated valve closure ensures blood moves forward; pressure differences open and close valves.
  - How these features interact: valves respond to pressure changes created by contraction; valve closure prevents backward flow so blood is forced in one direction.

Question 12

- (a) **M1** states a supporting point about saturated fat (eg high saturated fat raises LDL cholesterol which contributes to plaque formation)
- (a) **M1** states a contrasting point about other important risk factors (eg smoking, high blood pressure, genetics, diabetes, lack of exercise) that also strongly influence coronary heart disease risk
- (a) **M1** evaluates relative importance or interaction of factors (eg combined effect of multiple risk factors; reducing saturated fat helps but blood pressure control and smoking cessation may have bigger short-term effects)
- (a) **A1** gives a justified conclusion that weighs the evidence (eg reducing saturated fat is important but not necessarily the single most important change for everyone; combined lifestyle changes are preferable), oe
- **(a) Answer: Reducing saturated fat can lower LDL cholesterol and reduce risk, but smoking cessation and blood pressure control can have equal or greater effect; a combined strategy tailored to the individual is the best conclusion.**