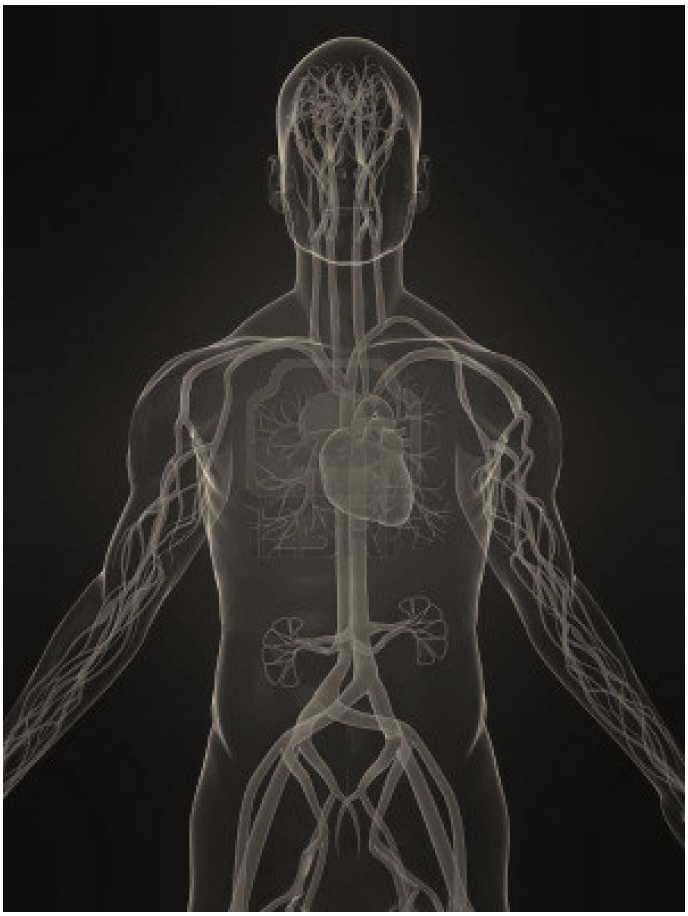
AS OCR

PHYSICAL EDUCATION

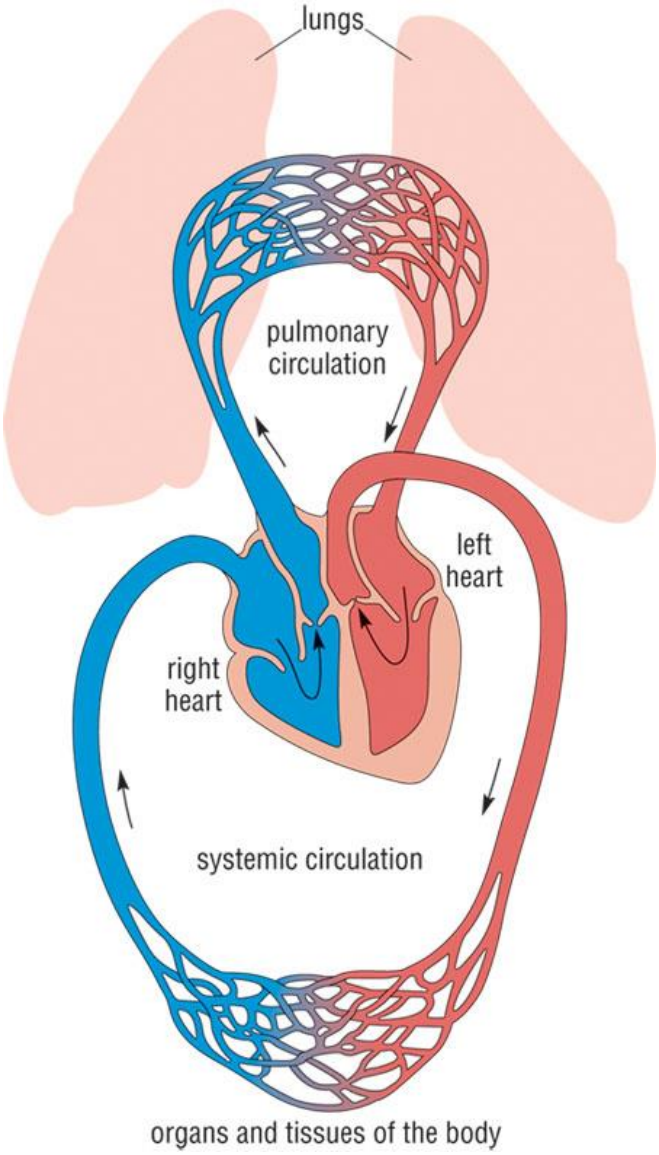
The Vascular System



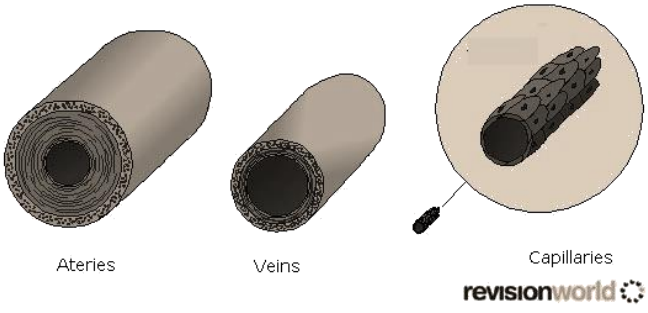
Learning Objectives:

- Distribution of Cardiac output at rest and during exercise
- Role of the Vasomotor centre, arterioles and pre-capillary sphincters
- Oxygen and Carbon Dioxide transport and the effect of smoking
- Blood pressure
- Blood pressure in exercise and hypertension
- Maintenance of Venous return - mechanisms
- Effects of warm up and cool downs on cardiovascular system
- Coronary Heart Disease, arteriosclerosis, atherosclerosis, angina and heart attack

Circulatory system



Describe the structures →



Arteries
Veins
Arterioles
Venules
Capillaries

Venous Return (VR)

Describe VR

.....

.....

.....

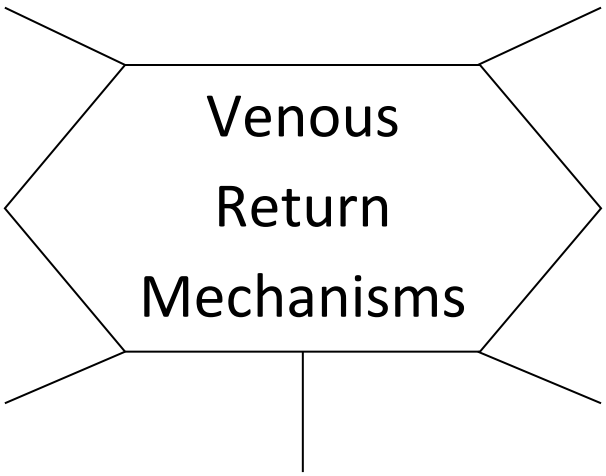
How is VR linked to Stroke Volume? (Hint: STARLING'S LAW)

.....

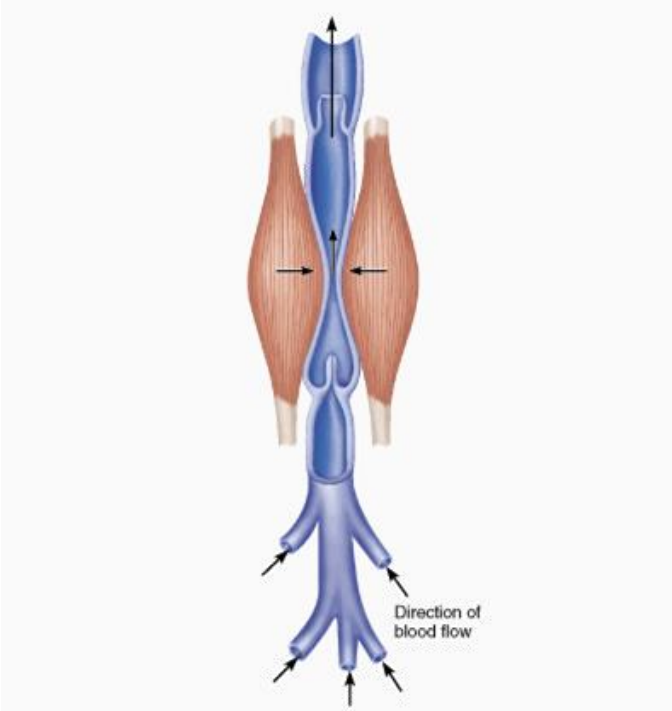
.....

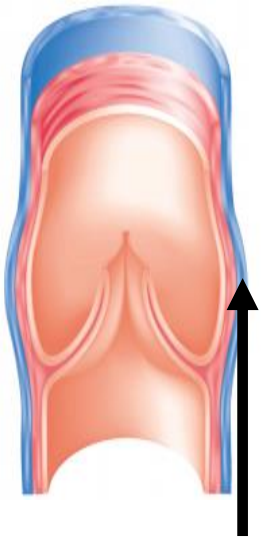
.....

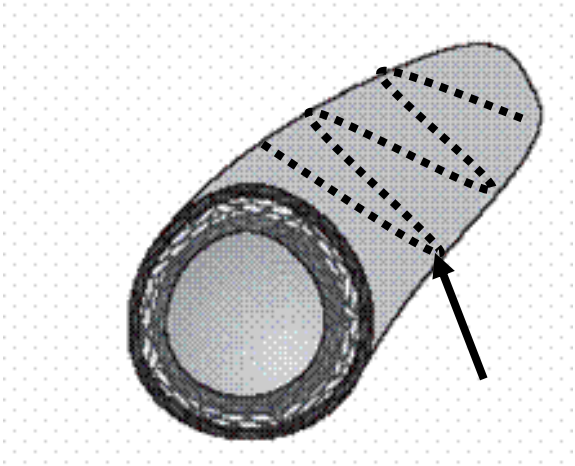
State and describe the mechanisms that maintain VR.

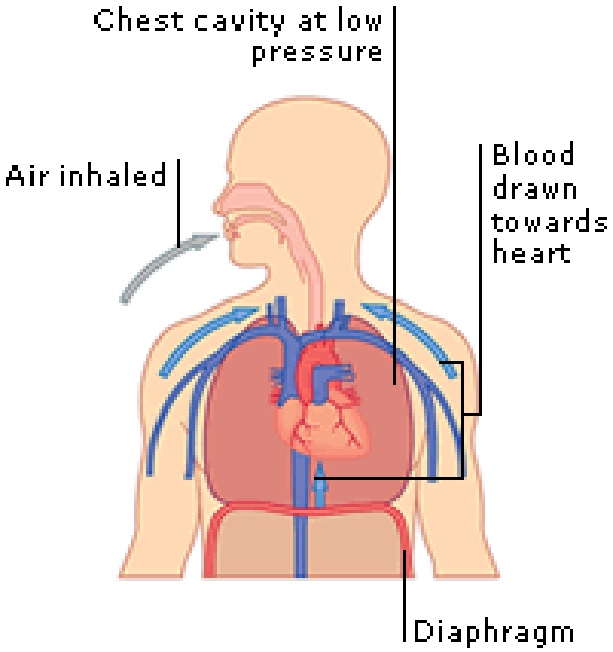


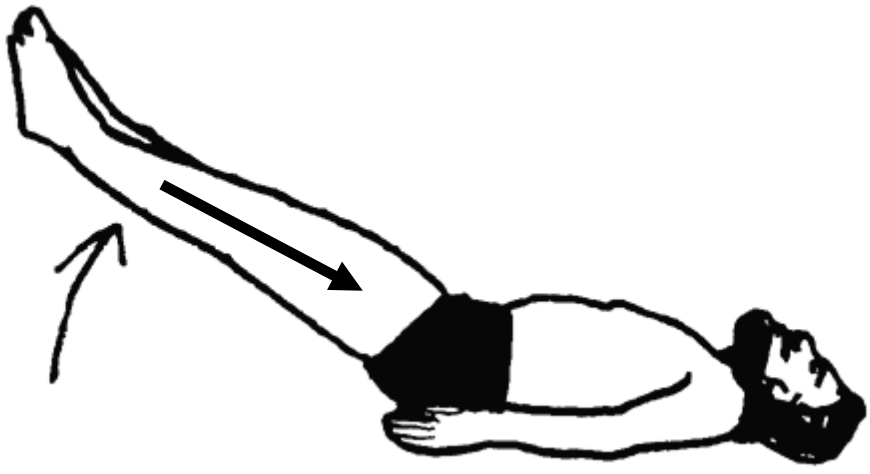
Name the Venous return mechanisms











The Impact of Venous Return on Performance

(Fill in the gaps, or delete as appropriate)

…….’s Law states that when venous return increases, stroke volume …… .

As Cardiac output = SV x HR, the increased blood returning to the heart means that **more / less** blood will be pumped out each beat.

If VR decreases, CO will ……, which means that **more / less** oxygen will be delivered to the …… .

A good VR will obviously help aerobic athletes to supply oxygen to their working muscles, but how does it help anaerobic athletes?

……

……

……

Describe how a good venous return would benefit the performance of a midfielder in football/hockey/netball?

……

……

……

What is blood pooling and how is it prevented?

……

……

……

Redistribution of Cardiac Output

Why do we faint? .....

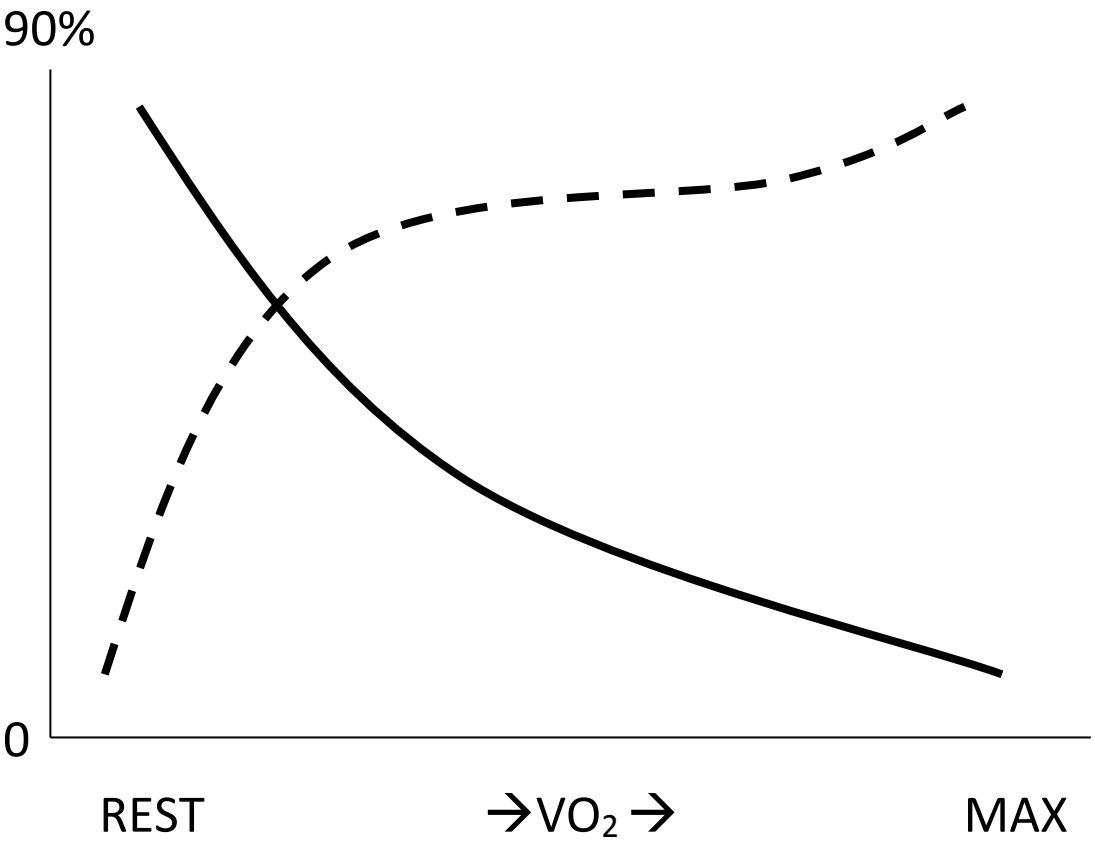
.....

.....

Cardiac output at rest = _____Litres/min

Cardiac output during exercise = _____Litres/min

Which is <u>muscle bloodflow</u> and which is <u>organ bloodflow</u>?



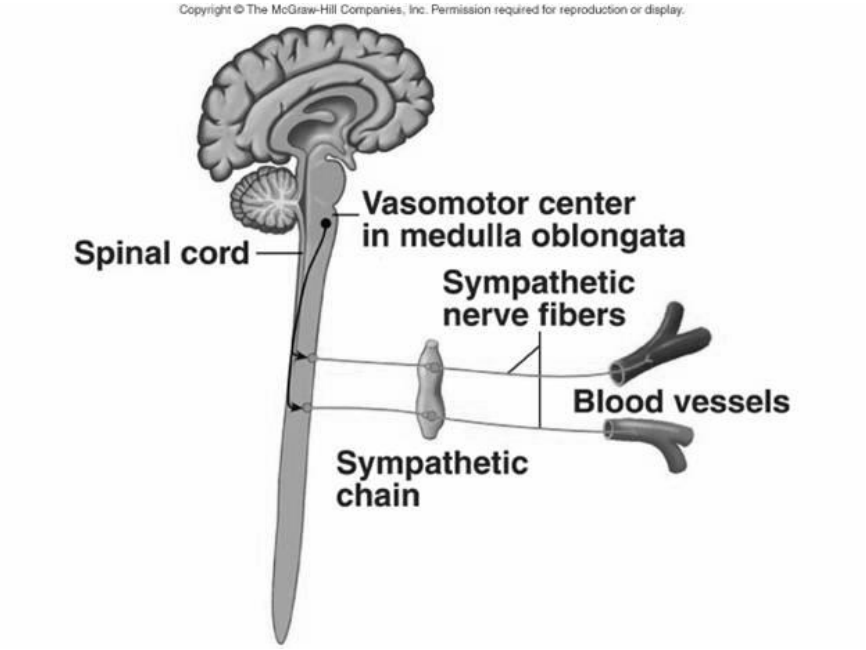
<u>At rest</u> .....% of Cardiac output goes to ..... and .....% goes to ..... .

<u>During exercise</u> the majority (.....%) of Cardiac output goes to ....., and .....% goes to the ..... . Blood supply to the ..... is maintained, in order to keep up vital functions.

Vasomotor Control & Vascular Shunting

Vasodilation, Vasoconstriction & Pre-capillary Sphincters

Exam questions that ask about the redistribution of blood are most likely looking for you to talk about **vascular shunting.**



The vascular shunt mechanism is controlled by the **Vasomotor control centre (VCC)** in the Medulla Oblongata.

The VCC receives information from ***Chemoreceptors*** and ***Baroreceptors*** about chemical and pressure changes.

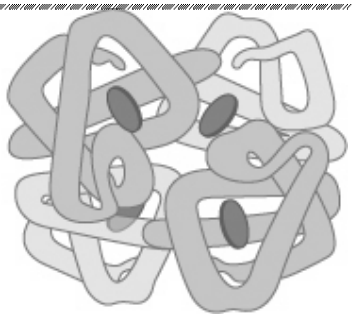
The VCC uses the Sympathetic Nervous System (SNS) to either vasodilate or vasoconstrict ***arterioles*** and ***pre-capillary sphincters,*** meaning blood is *shunted* from one location to where it is required (from organs to working muscles).

During exercise:

1. The VCC *increases* sympathetic stimulation of *arterioles* and *pre-capillary sphincters* leading to **organs**. = VASOCONSTRICTION
2. The VCC *decreases* sympathetic stimulation of *arterioles* and *pre-capillary sphincters* leading to **muscles**. = VASODILATION

(Examiners will give **two marks** for vasodilation, and **two marks** for vasoconstriction)

Oxygen and Carbon Dioxide Transport



Haemoglobin is the protein molecule found in Red blood cells, which carries Oxygen.

Oxygen transport	Carbon dioxide transport
➢ -	- - -

How does an efficient oxygen/carbon dioxide transport affect performance?

……

……

……

……

How does smoking reduce the capacity to transport oxygen?

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……

……

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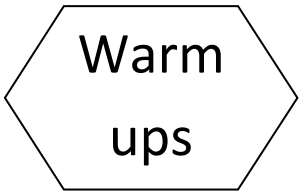
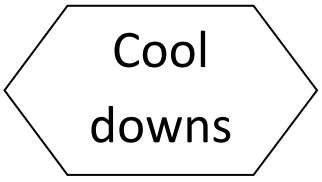
……

Effects of a Warm up on the Vascular System

The overall effect of performing a warm-up on the vascular system is to gradually **increase cardiac output** and **muscle bloodflow**. This is achieved as follows (spider diagram):



Effects of a Cool down on the Vascular System



Blood pressure

"The force of the blood exerted against the walls of the arteries"

SYSTOLIC	Average value = _____
DIASTOLIC	UNIT = ...

Systolic blood pressure

- The highest number
- The pressure created during the ***contraction phase***

Diastolic blood pressure

- The lowest number
- The pressure created during the ***relaxation phase***

Blood pressure can also be expressed in the following way:

Blood pressure = Blood flow (Q) x resistance

In this case ***resistance*** refers to the frictional force of the blood caused by its thickness. This is also known as ***viscosity***.

Questions

What would happen to blood pressure if ***"blood viscosity"*** increased?

.....

What happens to blood pressure when cardiac output decreases?

.....

Blood pressure measurement

The blood pressure cuff is also known as a .....

Changes to Blood Pressure

There are many fluctuations In blood pressure during the day.

↑ During stress

As we age

In warm temperatures

↓ When we sleep

The smaller we are

In cold temperatures

Measuring Blood pressure

Traditional method

1. Wrap cuff around upper arm and inflate to 180mmHg (higher than Systolic BP, preventing blood to flow past the cuff)
2. Place a stethoscope over the brachial artery (below the cuff). Release the pressure on the cuff.
3. Listen for the first audible noise (blood flow) after releasing the pressure, and take a reading. This is the **systolic pressure**.
4. Continue to release the pressure until the sound disappears. Note this point – this is **diastolic pressure**.

Modern method

Use an electrical blood pressure monitor and it does it all for you!

We need to know what happens during exercise:

Give some values as well as just saying "It increases/It decreases"

	Endurance exercise	Isometric/resistance exercise
Systolic		
Diastolic		

Exercise can be used to great advantage for people with High blood pressure:

- Systolic blood pressure decreases for up to 12 hrs post-exercise
- Diastolic blood pressure also decreases for hours after exercise

What is Hypertension?

.....

.....

.....

Typical value - ..... mmHg

True or False

1. Hypertension is only present if blood pressure is measured as high over a prolonged period. **TRUE / FALSE**
2. "Real Hypertension" is 140/90 mmHg. **TRUE / FALSE**
3. Hypertension increases the workload of the heart. **TRUE/FALSE**
4. Developing Hypertension slows down development of atherosclerosis. **TRUE / FALSE**
5. Hypertension increases the risk of stroke and heart failure. **TRUE/FALSE**
6. Obesity is a common cause of Hypertension. **TRUE / FALSE**
7. Regular exercise can reduce Hypertension. **TRUE / FALSE**
8. A well-trained athlete will have a lower exercising blood pressure than a sedentary individual. **TRUE / FALSE**

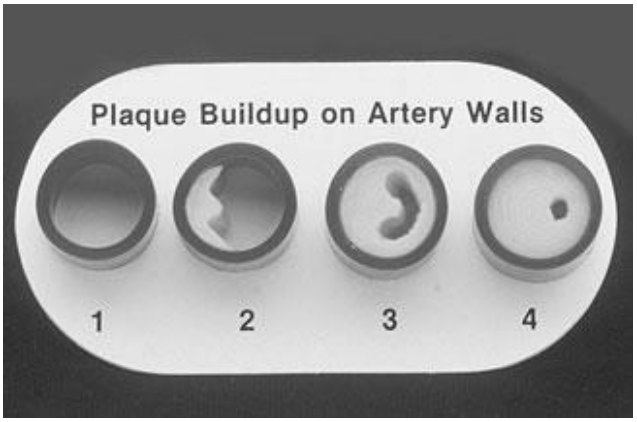
Impact of Physical activity on Cardiovascular System

The ***FOUR*** key cardiovascular diseases are:

[GET THEM RIGHT!!!] – The book also refers to them as CHD.

Arteriosclerosis	
Atherosclerosis	
Angina	
Heart Attack	

Which Cardiovascular disease are these? ***BE CAREFUL!!***



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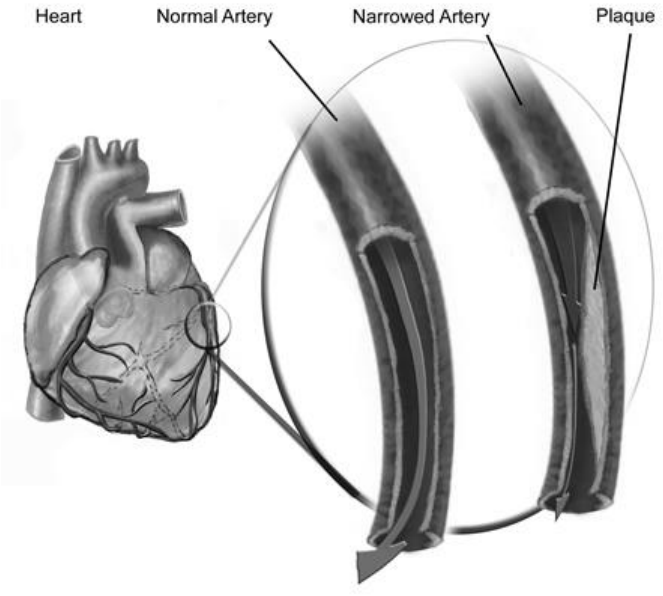

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Current Recommendations for Exercise

There are two key organisations who set the guidelines for exercise:

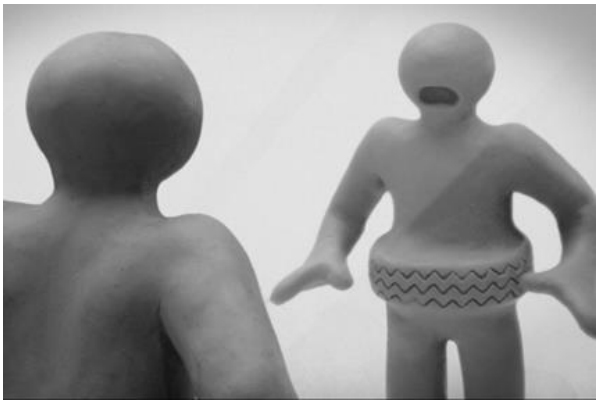
World Health Organisation (WHO)

- Sedentary individuals are 2-3 times more likely of developing CV diseases than active individuals.
- Young people should take part in *60* minutes of *moderate intensity* exercise every day.
- Adults should accumulate *30* minutes of *moderate intensity* exercise every day.
- Exercise should include activities that improve strength, flexibility and bone density.

American College of Sports Medicine (ACSM)

- Adults should perform 30 minutes of moderate intensity cardio five times a week.
- Alternatively, they should perform 3 sets of 20 minute cardio sessions, and two 2 sets of strength training sessions per week.

The intentions of the above guidelines are to manage weight in order to reduce the development of risk factors that will increase the occurrence of cardiovascular diseases.



[*This is a likely 20 marker topic]*

Risk factors for CVD:

1. **Low physical activity**
2. **High blood pressure**
3. **Smoking**
4. **Blood lipid (fat/cholesterol) content**
5. **Obesity**

Developing <u>one</u> of these risk factors **<u>doubles</u>** the risk of CVD.

Developing <u>three</u> of these risk factors increases the risk of CVD **<u>fivefold.</u>**

A balanced, active and healthy lifestyle (BAHL) will:

- ✓ <u>Improve cardiac hypertrophy</u> – better pumping capacity
- ✓ <u>Increased vascularisation</u> of the coronary circulation
- ✓ <u>Improved blood flow</u> – decreased clotting and viscosity
- ✓ <u>Decrease blood lipid content</u> – less chance of fatty deposits
- ✓ <u>Decrease Low Density Lipoprotein</u> (LDL) – lowered lipid and cholesterol depositing
- ✓ <u>Increase High Density Lipoprotein</u> (HDL) – remove cholesterol from artery walls
- ✓ <u>Lower Blood Pressure</u> and hypertension development
- ✓ <u>Improve weight management</u> – lower BP and diabetes
- ✓ <u>Relieve stress</u> – less hypertension

Overall message – regular exercise will reduce the risk of cardiovascular diseases, and outweigh any increased risk of Heart attack during exercise!

Other factors in a BAHL:

- **Stop smoking** – reduces development of arteriosclerosis
- **Proper nutrition** – better weight management

You should now be able to explain:

- Distribution of Cardiac output at rest and during exercise
- Role of the Vasomotor centre, arterioles and pre-capillary sphincters
- Oxygen and Carbon Dioxide transport and the effect of smoking
- Blood pressure and typical values
- Blood pressure in exercise and hypertension
- Maintenance of Venous return - mechanisms
- Effects of warm up and cool downs on cardiovascular system
- Coronary Heart Disease, arteriosclerosis, atherosclerosis, angina and heart attack

Past Exam questions on the Vascular system:

Year	Question	Description
Spec	**1c (5)**	Venous return mechanisms
Jan09	**1b (5)**	Blood pressure
May09	**1d (5)** **1e (10)**	Oxygen transport and smoking Critically evaluate BAHL and CV system
Jan10	**1c (6)**	Venous return mechanisms and Q
May10	**1e (10)**	Coronary Heart Diseases and BAHL
Jun11	**1b (5)** **1c (6)**	Blood pressure and Cool downs Vascular shunt mechanism
Jan12	**1di (2)** **1e (10)**	Carbon dioxide transport Warm up and Cool downs
Jun12	**1a (5)** **1d (5)** **1e (10)**	Coronary Heart Diseases Venous return and performance Effects of smoking on performance

Try to answer the past paper questions, then look at the mark schemes for the model answer.