SCHOOL OF CLINICAL SCIENCES

DEPARTMENT OF PHYSIOTHERAPY

EXAMINATION INSTRUCTION SHEET

Paper Title: Human Structure and Function for Physiotherapy I
Paper Code: PHTY612
Year/Semester: Semester 2 2020

Written Examination
2 hours + 10 minutes reading time + 15 minutes upload time
Date: Friday 4th September 2020, 9 a.m.

Learning outcome 1
Discuss foundational anatomical knowledge of specific body systems relevant to physiotherapy practice.

Learning outcome 2
Discuss foundational physiological knowledge of specific body systems relevant to physiotherapy practice.

INSTRUCTIONS:

This is a time limited examination and consists of three (3) sections.

- Section A: Multi-choice questions (LO1 and LO2) (20 marks) – Question 1 (20 minutes)
- Section B: Short answer questions and table (LO1) (30 marks) - Questions 2-9 (60 minutes)
- Section C: Short answer questions (LO2) (20 marks)- Questions 10-12 (40 minutes)
- Download this document from Human Structure and Function for Physiotherapy I Blackboard site (Assessment folder)
- Save this document FIRST as: *lastname.firstinitial.HSFP*
- Answer the multiple-choice questions by selecting/unselecting the tick boxes to indicate your selected answer ***(there is only one correct answer).***
- Answer the short answer questions in the text box/es provided for each question.
- Do not communicate with other students during this exam.
- Ensure you answer the questions using your own words.
- When finished, upload the document into Turnitin as instructed
- **Upload deadline** time will be 11.25 am.
- If Blackboard or Turnitin are unavailable at the point of submission, take a screenshot of any error messages received and email (Kelly: kelly.van.der.zwan@aut.ac.nz) showing why you have been unable to submit your work on time.
- Read and tick the following and include your name and ID below declaring:

☒This assessment is written by me
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Name Sujita Adhikari Student ID 17995779

Section A **(20 marks total)**

Learning outcome 1 (LO1): Discuss foundational anatomical knowledge of specific body systems relevant to physiotherapy practice.

Learning outcome 2 (LO2): Discuss foundational physiological knowledge of specific body systems relevant to physiotherapy practice

Multiple choice questions :

Answer the multiple-choice questions by **selecting/unselecting the tick boxes** to indicate your selected answer ***(there is only one correct answer).***

Question 1.

1.1. The vertebrae are examples of what type of bone? (LO1)

☒a. Irregular
☐b. Flat
☐c. Long
☐d. Sesamoid
☐e. Short

(1 mark)

1.2. The perimysium is a non-contractile element of skeletal muscle. It covers the: (LO1)

☐a. outside of an entire skeletal muscle
☒b. fasciculi
☐c. muscle fibre
☐d. myofibrils
☐e. myofilaments

(1 mark)

1.3. An intervertebral joint, including the intervertebral disc, is classified as what type of joint?

(LO1)

☒a. Fibrocartilaginous (symphysis)
☐b. Fibrocartilaginous (synchondrosis)
☐c. Fibrocartilaginous (syndesmosis)
☐d. Synovial pivot joint
☐e. Synovial plane joint

(1 mark)

1.4. When assessing blood pressure using a sphygmomanometer, the cuff is typically applied around the arm to assess blood pressure through which blood vessel? (LO1)

☒a. Brachial artery
☐b. Brachial vein
☐c. Radial artery
☐d. Radial vein
☐e. Ulna artery

(1 mark)

1.5. Complete this sentence: In the pulmonary circulation… (LO1)

☐a. the pulmonary artery carries oxygenated blood from the right ventricle
☐b. the pulmonary veins carry oxygenated blood to the right ventricle
☐c. the pulmonary artery carries oxygenated blood from the left ventricle
☒d. the pulmonary veins carry deoxygenated blood from the right ventricle to the lungs
☐e. the pulmonary artery carries deoxygenated blood to the lungs

(1 mark)

1.6. What movements would place the rectus femoris muscle into its lengthened position? (LO1)

☐a. Hip extension and knee extension
☐b. Hip extension and knee flexion
☐c. Hip abduction and knee flexion
☐d. Hip abduction and knee extension
☒e. Hip flexion and knee extension

(1 mark)

1.7. Which of the following bony anatomical landmarks is NOT part of the femur? (LO1)

☐a. Adductor tubercle
☐b. Intercondylar eminence
☒c. Intercondylar fossa
☐d. Medial supracondylar ridge
☐e. Patella surface

(1 mark)

1.8. The diaphragm muscle originates from the lumbar vertebrae, ligaments of the posterior abdominal wall, costal cartilages and ribs 7-12, and which other bony landmark on the sternum?

(LO1)

☐a. Body of the sternum
☐b. Manubrium of the sternum
☐c. Manubriosternal joint (sternal angle)
☒d. Xiphoid process
☐e. Xiphisternal joint

(1 mark)

1.9. Which of the following statements is CORRECT regarding the lobes of the lung? (LO1)

☐a. The left lung has three lobes separated by an oblique and a horizontal fissure
☐b. The lobes can be further divided into a total of twenty (20) bronchopulmonary segments which are the smallest, functionally independent units of the lung
☐c. The oblique fissure is in line with the spinous process of the third thoracic vertebrae (T3) posteriorly and courses inferiorly to terminate at the level of the sixth ($6^{th)}$ rib at the mid-axillary line
☒d. The lobes of the lung are separated by parietal and visceral pleura
☐e. The bases of both the right and left lung are in line with the spinous process of the twelfth (12^{th}) (T12) posteriorly

(1 mark)

1.10. Which of the following are NOT being assessed, when assessing passive range of motion?

(LO1)

☐a. Joint capsule
☐b. Capsular ligaments
☐c. Muscle strength
☐d. Extra-articular ligaments
☒e. Hyaline cartilage

(1 mark)

1.11. What range, as a percentage (%), of oxygen saturation in the blood (SpO2) would indicate mild hypoxaemia?

(LO2)

☒a. 90-94%
☐b. 75-89%
☐c. 65-74%
☐d. 55-64%
☐e. 45-55%

(1 mark)

1.12. Which statement best describes the respiratory volume or capacity in someone with severe emphysema (chronic obstructive airways disease), when compared to someone with a normal healthy adult lung?

(LO2)

☐a. Increased vital capacity
☐b. Increased expiratory reserve volume
☒c. Decreased total lung capacity
☐d. Increased residual volume
☐e. Increased force vital capacity

(1 mark)

1.13. The arterial blood gas reading below is an example of:
$PaCO_2$ = 40 mmHg PH = 7.3 HCO_3- = 22 mmol/L

(LO2)

☒a. Metabolic acidosis
☐b. Hypoventilation
☐c. Metabolic alkalosis
☐d. Respiratory alkalosis
☐e. Respiratory acidosis

(1 mark)

1.14. End systolic volume is best described as:

(LO2)

☐a. the resistance against blood being ejected from the ventricle when contracting.
☐b. the amount of blood left in the ventricle after ventricular contraction.
☐c. the amount of blood ejected from the ventricle per beat.
☒d. the amount of blood in the ventricle at the end of filling.
☐e. the amount of blood pumped out of the ventricle every minute.

(1 mark)

1.15. Which statement best describes the events occurring during the relaxation phase of a single muscle twitch?

(LO2)

☐a. There is shortening of the sarcomere because of myosin cross bridge activity.
☐b. The sarcolemma and t-tubules repolarise, calcium is released, and cross bridges begin to cycle.
☐c. The sarcolemma and t-tubules depolarise, calcium is transported back to the terminal cisternae, and cross bridges begin to cycle.
☒d. Calcium is transported back to the terminal cisternae, cross bridge cycling slows and ends, muscle tension is reduced.
☐e. The sarcomere shortens because of calcium being transported back to the terminal cisternae.

(1 mark)

1.16. Complete this sentence: Slow twitch muscle fibres…

(LO2)

☐a. have a limited blood supply.
☐b. are white in colour.
☐c. have a high uptake and release of calcium.
☒d. are mainly used during high intensity exercise.
☐e. have a high myoglobin content.

(1 mark)

1.17. With respect to CO2 transport, which statement below is true?

(LO2)

☐a. Approximately 23% of CO_2 is transported in the form of bicarbonate, 70% in the form of carbamino-haemoglobin, and 7% dissolved in the blood plasma.
☒b. Approximately 70% of CO_2 is transported in the form of bicarbonate, 23% in the form of carbamino-haemoglobin, and 7% dissolved in the blood plasma.
☐c. Approximately 7% of CO_2 is transported in the form of bicarbonate, 70% in the form of carbamino-haemoglobin, and 23% dissolved in the blood plasma.
☐d. Approximately 7% of CO_2 is transported in the form of bicarbonate, 23% in the form of carbamino-haemoglobin, and 70% dissolved in the blood plasma.
☐e. All CO_2 is transported in the red blood cell.

(1 mark)

1.18. During continuous exercise, which statement below is true?

(LO2)

☐a. There is vasoconstriction of arterioles supplying the brain.
☐b. There is vasoconstriction of blood vessels supplying the heart.
☐c. There is vasodilation of arterioles supplying the gut.
☒d. There is no change in arteriole diameter of skeletal muscle.
☐e. There is vasoconstriction of arterioles supplying the gut.

(1 mark)

1.19. During aerobic metabolism of glucose, which of the statements below is NOT true?

(LO2)

☐a. H_2O is produced as a by-product.
☐b. Pyruvate is converted to Acetyl C-OA and enters the Krebs Cycle.
☒c. Pyruvic acid is converted to lactic acid.
☐d. Hydrogen is transported to the electron transport chain.
☐e. CO_2 is produced as a by-product.

(1 mark)

1.20. Which of the statements below is NOT correct about ventilation, in a healthy adult lung?

(LO2)

☐a. There are a greater number of alveoli in the bases of the lungs compared to the apices, therefore a greater capacity for respiration to occur.

☐b. Deep breathing increases the work of breathing against the elastic properties of the lungs, therefore more small airways can be opened.

☐c. Rapid breathing increases the work of breathing against airway resistance, which does not result in effective opening of the smaller airways.

☐d. The alveoli in the bases of the lungs are smaller and more compliant compared to the alveoli in the apices of the lungs.

☒e. Laminar flow through the conducting zone of the airways requires relatively high driving pressures to produce a certain flow rate, as it creates high airway resistance.

(1 mark)

PLEASE USE THIS TEXT BOX IF YOU HAVE NOT BEEN ABLE TO USE THE TICK BOXES ALLOCATED FOR A QUESTION OR QUESTIONS. WRITE THE QUESTION NUMBER AND YOUR CHOSEN RESPONSE i.e. a, b, c, d, or e.

Click or tap here to enter text.

End of section A.

Section B **(30 marks total)**

Learning outcome 1 (LO1): Discuss foundational anatomical knowledge of specific body systems relevant to physiotherapy practice.

Short answer questions and table.

Answer the short answer questions in the **text box/es** provided for each question.

Question 2. **(LO1)**

Outline two (2) key features of a synovial joint and **describe** the function of each feature

1. Articular Cartilage: It covers joint surfaces to provide smooth and lubricated surface for low friction.
2. Ligaments: It helps to keep joint surface together and prevents excessive & abnormal movement.

(3 marks)

Question 3. **(LO1)**

Describe the structure of a long bone. In your answer, include detail on the classification of a long bone, the type of bone present in a long bone, and the main components of bone.

Long bones has shaft and two ends. Example Femur. It has two parts and they are diaphysis and epiphysis. The main components of bone are:

Minerals : Hydroxyapitite-Calium-phosphate(65%)

Collagen: Prensent 31% and it provides tensile strength and flexibility

Remaining ECM: Present 3-4%.

(4 marks)

Question 4.

Describe how the articulating surfaces of the costotransverse joints contribute to changing the dimensions of the thorax during thoracic expansion (i.e. inspiration)

(LO1)

Click or tap here to enter text.

(3 marks)

Question 5.

Describe the function of the cells that are present in the conducting zone of the lower respiratory tract.

(LO1)

It creates low resistance pathway for air flow in order to ventilate properly.
It warms, moistens and filters the air .
It helps in voice production.

(3 marks)

Question 6.
Explain the difference in function between an end artery and an anastomosing artery

(LO1)

End Artery:
Arteries end in capillaries

-Central artery of the retina.
-A central artery of the brain.
-A coronary artery, some anatomoses but very limited.

Anastomosing artery:
Arteries do not always end as capillaries

-Arteries can unite with other arteries
- In limbs anastomoses are numerous around joints
- Can provide alternative channel of supply to a particular area.

(2 marks)

Question 7.
Compare and **contrast** the structure of the right and left sides of the heart

(LO1)

The right side of the heart pumps deoxygenated blood into the pulmonary artery.
The left side pumps oxygenated blood into the systemic circulation initially into the aorta.

(4 marks)

Question 8.
Compare and **contrast** the structure of the lateral and medial meniscus of the knee joint.

(LO1)

Lateral meniscus: No attachments to capsule or lateral collateral ligament.
Medial meniscus: It attached to capsule and medial collateral ligament.

(2 marks)

Question 9.

Joshua is a 19-year-old building apprentice. He recently sustained an injury to his right knee. His goals are to improve the strength and mobility of his right knee to climb a ladder at work.

9.1. Using the images below (fig. 1 and fig. 2), complete the following table (table 1), analysing the joint motion and muscle work required at the ***knee joint***, in order for Joshua to move from standing (phase 1 start position, fig. 1.) to placing his foot on the ladder (phase 1 finish position, fig.2.)

(LO1)

Figure 1.
Phase 1: Start position with right foot on the ground

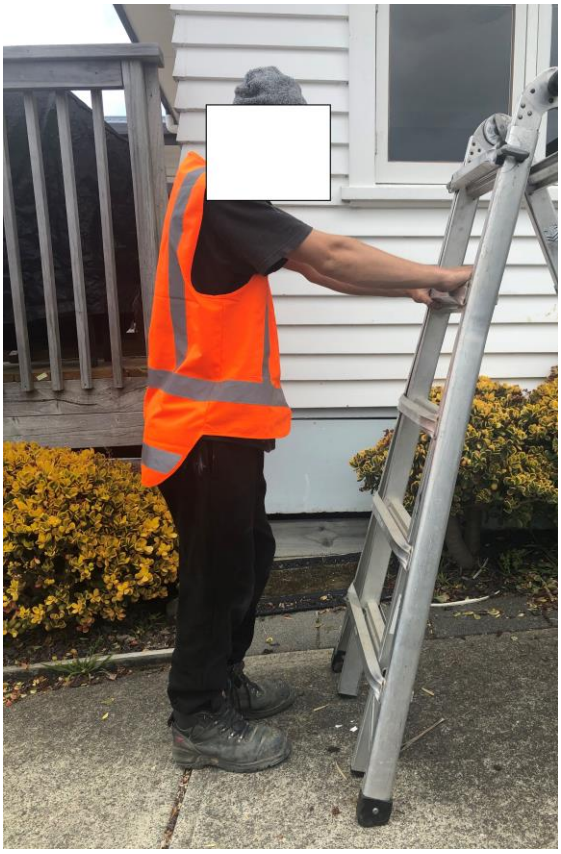

Figure 2.
Phase 1: Finish position with right foot on the first rung of the ladder

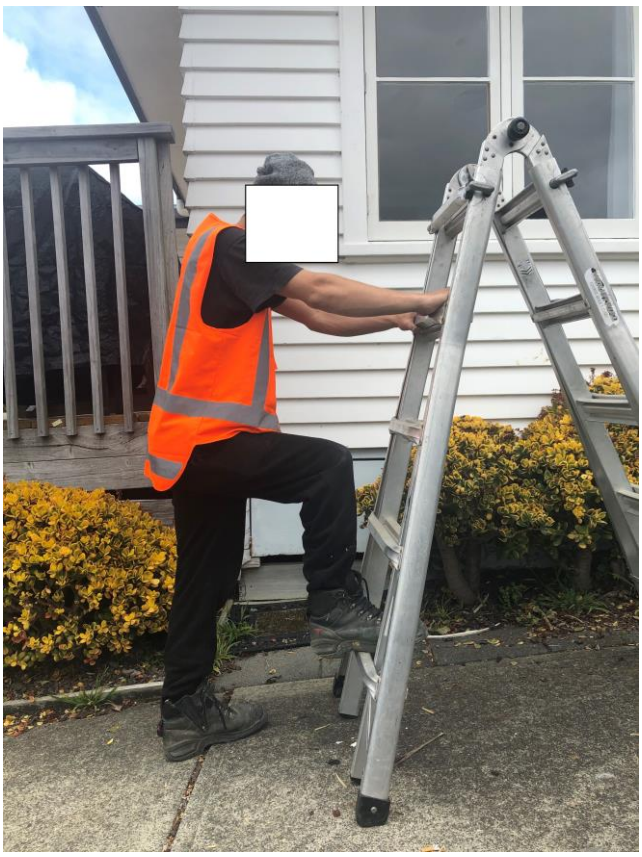

Table 1.

Analysis of knee joint motion and muscle work required for Joshua to place his right foot onto a ladder.

	Phase 1: Placing foot onto the rung of the ladder (figures 1 and 2) if start position was standing with right foot on the ground
Joint	**Knee joint**
Movement	**Knee flexion**
Plane	**Sagittal**
Axis	**frontal**
Muscle group acting on the knee as the prime movers (agonists) for this phase of the task.	**Knee flexors (posterior compartment of the thigh)**
Type of contraction	**Isometric**
Range of muscle work (i.e. inner, mid, outer)	**outer**

(2 marks)

Question 9.2. Describe the typical passive end feel for knee flexion**, outlining** the limiting structures at end of range knee flexion, assuming the start position was in supine lying.

(LO1)

Click or tap here to enter text.

(1 mark)

Question 9.3. Outline the normal range of motion for knee flexion, assuming the start position is in supine lying

(LO1)

Click or tap here to enter text.

(.5 mark)

9.4. Using the images below (fig. 3 and fig. 4), complete the following table (table 2), analysing the joint motion and muscle work required at the ***knee joint***. In this phase Joshua's start position is with his right foot on the rung of the ladder (fig. 3), and the finish position is when he accepts full weight through his right leg and is now standing up on the first rung of the ladder (fig.4)

(LO1)

Figure 3.
Phase 2: Start position with right foot on first rung of the ladder

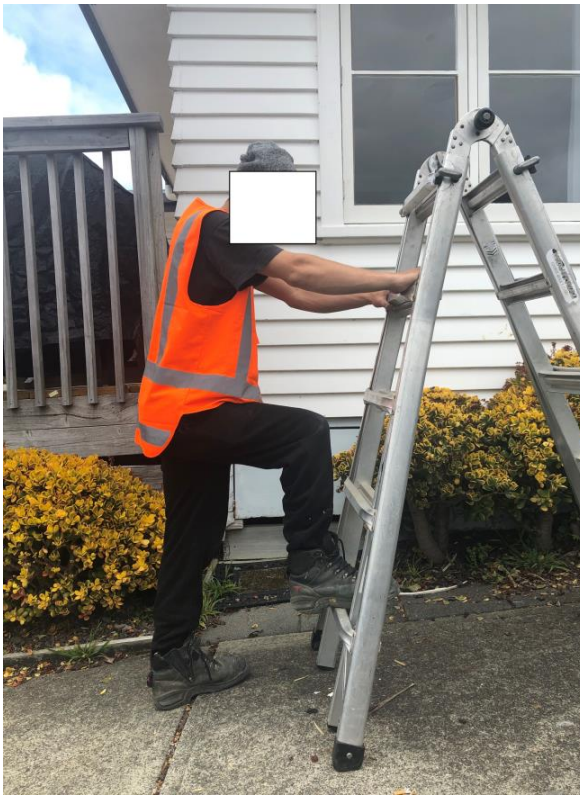

Figure 4.
Phase 2: Finish position having accepted full weight through his right leg and standing up on the ladder

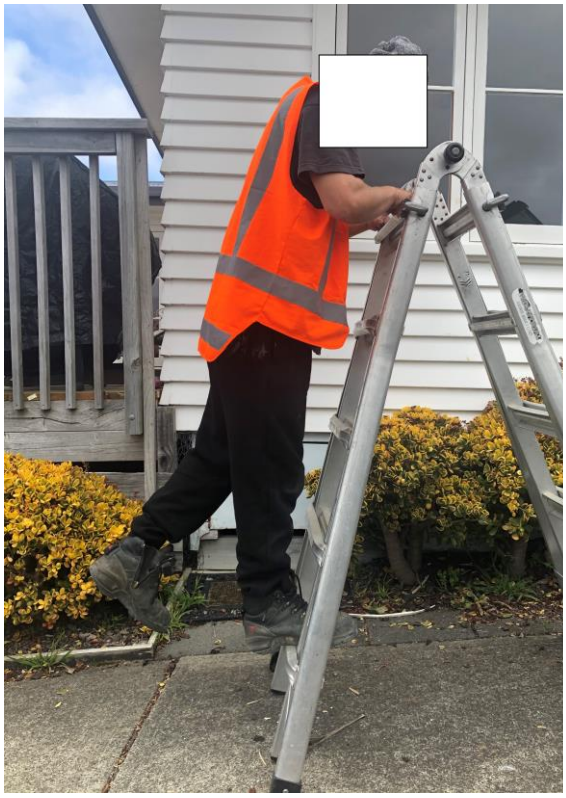

Table 2.

Analysis of knee joint motion and muscle work required for Joshua to stand up on the first rung of the ladder .

	Phase 2: Stepping up onto the ladder with his right leg (figures 3 and 4) if start position was standing with right foot on the ladder
Joint	***Knee joint***
Movement	**Knee extension**
Plane	Click or tap here to enter text.
Axis	Click or tap here to enter text.
Muscle group acting on the knee as the prime movers (agonists) for this phase of the task.	Click or tap here to enter text.
Type of contraction	Click or tap here to enter text.
Range of muscle work (i.e. inner, mid, outer)	Click or tap here to enter text.

(2.5 marks)

9.5. Describe the bony features at the knee joint that would contribute to the knee being stable in full extension.

(LO1)

Click or tap here to enter text.

(2 marks)

9.6. On assessment, you establish that Joshua has grade four (4) strength of his knee flexor muscles with isotonic manual muscle testing**. Explain** what the assessment finding of grade four (4) means on the Oxford Scale**.**

(LO1)

Click or tap here to enter text.

(1 mark)

END OF SECTION B

Section C **(20 marks total)**

Learning outcome 2 (LO2): Discuss foundational physiological knowledge of specific body systems relevant to physiotherapy practice

Short answer questions and table.

Answer the short answer questions in the **text box/es** provided for each question.

Question 10.

Dale has been referred to you for physiotherapy management, following a knee joint replacement three (3) months ago. Strength testing indicates that she has significant weakness in her quadriceps on her affected side.

10.1. List three (3) physiological changes in the muscle that would influence her strength**.**

(LO2)

Decrease cross sectional area of muscle
Decrease muscle firing rate
Decrease number of motor unit activated.

(1.5 marks)

You test her maximal strength on the leg press machine, which takes approximately 5-10 seconds.

10.2. Outline the main energy system used during this strength test and the fuel used to produce adenotriphosphate (ATP).

(LO2)

Aerobic respiration will be used

(1 mark)

You have prescribed her a daily walking programme at light to moderate intensity.

10.3. Describe the main energy system used in this type of activity. In your answer, include the types of fuels used in this energy system.

(LO2)

Phosphagen system: maximum turnover early in intense exercise.

Glycolysis contributes from the start of exercise.

Mitochondrial respiration reaches a maximum rate later and maintains a higher turnover.

(2 marks)

Dale also has type II diabetes and is taking a drug called Metformin to control her diabetes.

10.4. Outline three (3) ways Metformin can reduce blood glucose levels (decrease hyperglycaemia).

(LO2)

Metformin reduce blood glucose levels by improving the way body respond to the insulin, it helps by reducing amount of sugar that liver releases to the blood, and metformin improves insulin resistance, so the produced insulin works better.

(1.5 marks)

Question 11.

Burt has cystic fibrosis (chronic lung disease) and presents to the hospital following an acute flare up of his condition.

He has the following blood gas readings and performs lung volume tests.

$PaCO_2$: 50 mmHg

pH: 7.32

HCO_3-: 24 mmol/L

11.1. Name the condition that is reflected in his arterial blood gas results. Justify your answer**.**

(LO2)

It is respiratory acidic because :

PH is low
PaCO2 is high
Bicarbonate (HCO3) is normal.

(2 marks)

11.2. Describe vital capacity and **indicate** whether Burt would have a higher or lower vital capacity than a healthy person of a similar age.

(LO2)

Vital capacity is the maximal amount of air that can be expired after maximal inhalation.
It indicate that Burt would have a low vital capacity than a healthy person of a similar age.

(1 mark)

Burt is participating in an exercise class. With increasing exercise intensity, he gets a build-up of CO2 in his blood, which will increase his minute ventilation (breathing faster and harder).

11.3. Use the following bicarbonate buffer equation to **discuss** how a build-up of CO2 in the blood can stimulate the respiratory centres and the nerves supplying the muscles of respiration. In your answer, include the key nerves and muscles that will be stimulated.

$$\mathbf{CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-}$$

(LO2)

The phrenic and intercostal nerves stimulates contraction of the diaphragm and external intercostal muscles.

↑ CO_2 (hypercapnia), CO_2 diffuses from the blood into the cerebrospinal fluid (CSF) in the fourth ventricle

In the CSF $CO_2 + H_2O$ à carbonic acid à bicarbonate + H^+

↑ H^+ (↓ PH) stimulates the central chemoreceptors which send nerve impulses to the respiratory centers in the medulla

Respiratory centers send messages via – the phrenic and intercostal nerves stimulating contraction of the diaphragm and external intercostal muscles – increased depth and rate of breathing

(4 marks)

Question 12.

Annabelle is going for a forty (40) minute run on a warm, sunny day. She is running with a friend, at a pace where she finds it comfortable to talk.

12.1. Name two key local chemicals (substances) released by the working muscle. **Describe** how the release of these substances influence the diameter the blood vessels (arterioles) supplying the skeletal muscle and how this influences total peripheral resistance.

(LO2)

The two local chemicals released by working muscle are endorphins and epinephrine.
Skeletal muscle tends to dilate because of local metabolic factor dominate, decrease peripheral resistance and decrease blood pressure.

(2 marks)

12.2. Describe how the muscular pump action influences the amount of blood (venous return) returning to the heart during her run. Then use the Frank Starling law to **describe** how these changes in venous return will influence end diastolic volume and stroke volume (SV).

(LO2)

A major mechanism promoting venous return during normal locomotory activity (e.g., walking, running) is the muscle pump system. Peripheral veins, particularly in the legs and arms, have one-way valves that direct flow away from the limb and toward the heart. According to Frank Starling When venous return is increased, there is increased filling of the ventricle along its passive pressure curve leading to an increase in end-diastolic volume

(3 marks)

12.3. During exercise aldosterone will be released from the kidneys. **Briefly describe** how aldosterone influences sodium and water levels in the blood and what impact this has on blood volume.

(LO2)

Aldosterone release causes the sodium and water retention which causes increased

blood volume and this results increase in blood pressure which is sensed by baroreceptors.

(2 marks)

END OF SECTION C

END OF EXAMINATION PAPER