Important note to candidates

The curriculum council for this course has determined the following:

- Special items: Non-programmable calculators
- Standard items: Pens, pencils, erasers, correction fluid, ruler, and highlighters

To be provided by the candidate:

- Multiple choice answer sheet
- This question/answer booklet

Materials required/recommended for this paper:

Working time for paper:

Reading time before commencing:

TIME ALLOWED FOR THIS EXAMINATION

Teacher:

Name: Answers

STAGE 2
WRITTEN PAPER
HUMAN BIOLOGICAL SCIENCE

QUESTION/ANSWER BOOKLET
SEMESTER ONE EXAMINATION, 2010
SETON CATHOLIC COLLEGE
<table>
<thead>
<tr>
<th>Questions</th>
<th>1</th>
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<td>B</td>
<td>C</td>
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</tbody>
</table>

Section One: Multiple Choice

This section has 30 questions. Answer all questions on the separate Multiple-Choice Answer Sheet provided. Only a blue or black pen should be used to shade the boxes. If you make a mistake, use only a eraser to correct it. If no marks are given, it means the answer will not be deduced for incorrect answers. No marks will be given if more than one answer is completed for any question.

Teacher: [signature]

Name: [signature]

Human Biological Science Stage 2 Semester One Exam 2010
**Instructions to candidates:**

- **Section One:** Answer all questions on the separate multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, please a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will be deducted for incorrect answers. No marks will be given for questions on which no answer is provided. Failure to answer a question will result in no marks being awarded. The number of working minutes suggested for each question may be used as a guide. Your time must be deducted from the number of minutes available.

<table>
<thead>
<tr>
<th>Mark Available</th>
<th>Maximum Marks</th>
<th>Suggested Number of Questions</th>
<th>Available Working Time (Minutes)</th>
<th>Percentage of Exam</th>
<th>Percentage of Working Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>20</td>
<td>50</td>
<td>2</td>
<td>4</td>
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<td></td>
<td>03</td>
<td>04</td>
<td>3</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Structure of this paper:**

Human Biological Science Stage 2 Semester One Exam 2010
3. Which of the following statements best describes the function of the nephron?

a. Carries blood at a higher pressure than veins
b. Contains valves to prevent backflow
c. Carries blood away from the heart
d. Have thicker walls than veins

2. Which of the following is NOT characteristic of arteries? Arteries

a. Pressure
b. Lumina

c. Thrombocytes

d. Epithelial cells

1. Blood cells which destroy invading bacteria are called

Suggested working time for this section is 40 minutes.

be given if more than one answer is completed for any question. Your new answer, whether correct or incorrect, will not be deducted. No marks will be awarded if only one of the boxes is shaded. If you make a mistake, cross through the previous answer. Do not erase or use correction fluid, and shade the cross again. This section has 30 questions. Answer all questions on the separate multiple-choice answer sheet. Provided. For each question shade the box to indicate your choice.
9. The chemical digestion of starch begins in the

- Mouth
- Stomach
- Duodenum
- Small Intestine

8. Which of the following processes requires ATP?

- Diffusion of oxygen
- Respiration
- Protein synthesis
- Osmosis

7. The function of the lymphatic system is to

- Remove fluid from the body
- Return excess fluid in the tissues into the blood
- Make problems

6. Which of the following foods would be chemically digested to the greatest extent in the stomach?

- A piece of lean meat
- A spoon of shefret
- A piece of cake
- A slice of bread

5. Which of the following is the first to prevent the entry of pathogens into humans?

- Inflammation response
- Phagocytes
- Antibodies
- Cilia
The diameter of the high power field of view will measure
respectively. If the low power field of view measures 1800 micrometers, the
objective and high power objectives lenses have magnifications of 10X and 30X.

1. The ocular of a light microscope has a magnification of 10X and the low power

   a. 400 μm
   b. 600 μm
   c. 1000 μm
   d. 300 μm

2. The temperature at point X is most likely to be between

   a. 10°C and 20°C
   b. 30°C and 40°C
   c. 40°C and 50°C
   d. 50°C and 60°C

3. Temperature °C

   X

   (arbitrary units)

   (arbitrary activity)

   enzyme

   and are shown in the following graph.

   10. The enzyme activity of micro-organisms found in the human body was

   a. measured
   b. observed
   c. assessed
   d. cited

   Human Biological Science Stage 2 Semester One Exam
   2010
1. The speech receptors in the nasal cavity allow speech.
2. The cilia in the nasal cavity filter the air.
3. The mucus in the nasal cavity moistens the air.
4. The blood capillaries in the nasal cavity warm the air.

14. The following statement is NOT true about the nasal cavity:

1. The diagram below shows three cells in the field of view of a microscope. The diameter of the field of view is 1.5 millimeters. What is the approximate diameter of each cell?

   a. 300 pm
   b. 450 pm
   c. 250 pm
   d. 500 pm

1. Active transport
2. Facilitated transport
3. Phagocytosis
4. Osmosis

12. What process is illustrated in the diagram above?

The following question refers to the diagram below:
17. What structures increase the surface area in the lungs?

a. The trachea
b. The bronchi
c. The alveoli
d. The pleural membrane

18. The function of the mitochondria is to produce

a. ATP and oxygen
b. Glucose and ATP
c. ADP and phosphate

19. Which of these substances is found in X but not in Y?

X

Y

Use the following diagram to answer the question below.
20. Which of the following causes a drop in the air pressure within the thoracic cavity?

- a. Pulmonary vein
- b. Inferior vena cava
- c. Superior vena cava
- d. Pulmonary artery

19. In which vessel is the concentration of oxyhaemoglobin the greatest?

- a. Produce bile
- b. Produce insulin
- c. Chemically digest fats
- d. Absorb lipids

18. A function of structure X is to

Use the following diagram to answer the question below.
23. A blood clot is formed when:

- The thrombin forms a meshwork trapping blood cells, platelets, and fibrin.
- Sufficient clotting factors are present to bind the blood cells together.
- The platelets of insoluble proteins contract.

22. Interphase needs to take place before cell division begins. Which of the following best describes what happens during interphase?

- C. The DNA duplicates
- D. The chromosomes line up at the equator
- B. The centrioles move to opposite poles
- A. Spindle fibers are formed

<table>
<thead>
<tr>
<th>D.</th>
<th>C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher</td>
<td>Higher</td>
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<tr>
<td>Lower</td>
<td>Lower</td>
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<tr>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Lower</td>
<td>Glucose in intercell</td>
</tr>
</tbody>
</table>
26. Anaerobic respiration involves the
   a. Small intestine
   b. Both the liver and kidneys
   c. Kidneys
   d. Liver

25. Deamination occurs in the
   a. Active site
   b. Substrate
   c. Enzyme
   d. Product

24. What is the structure labeled E?

Use the following diagram to answer the question below.
28. What process moves molecules from the beaker to the tube?

a. Osmosis
b. Filtration
c. Active transport
d. Radiation

27. In which of the above would the level of the solution in the tube rise the quickest when the tube is placed in a beaker of distilled water?

Use the following diagram to answer the next two questions.
END OF SECTION ONE

30. Which of the following shows the correct order of the phases of mitosis?

a. Prophase, Metaphase, Telophase, Anaphase
b. Prophase, Metaphase, Anaphase, Telophase
(c. Prophase, Metaphase, Anaphase, Telophase, Prophase
(d. Telophase, Anaphase, Metaphase, Prophase

31. Which of the following is the correct order of events in meiosis?

- Prophase I
- Prophase II
- Metaphase I
- Metaphase II
- Anaphase I
- Anaphase II
- Telophase I
- Telophase II

29. The following is a list of steps that occur in the process of meiosis:

- Prophase I
- Prophase II
- Metaphase I
- Metaphase II
- Anaphase I
- Anaphase II
- Telophase I
- Telophase II
Identify the parts listed below.

\[ A: \text{Veins} \quad B: \text{Blood} \quad C: \text{Blood} \quad D: \text{Blood} \quad E: \text{Blood} \quad F: \text{Blood} \quad G: \text{Blood} \quad H: \text{Blood} \quad I: \text{Blood} \quad J: \text{Blood} \quad K: \text{Blood} \quad L: \text{Blood} \quad M: \text{Blood} \quad N: \text{Blood} \quad O: \text{Blood} \quad P: \text{Blood} \quad Q: \text{Blood} \quad R: \text{Blood} \quad S: \text{Blood} \quad T: \text{Blood} \quad U: \text{Blood} \quad V: \text{Blood} \quad W: \text{Blood} \quad X: \text{Blood} \quad Y: \text{Blood} \quad Z: \text{Blood} \]

The diagrams below show some of the structures of the excretory system.

**Question 3**

Suggested working time for this section is 90 minutes.

Fill in the number of the question(s) that you are continuing to answer at the top of the page. The answer is continued, i.e., give the page number.

If you need to use the space to continue an answer, indicate in the original question.

If you continue an answer, please write your answer on the next page.

For planning your responses and additional space if required to complete all questions, write your answers in the space provided.

This section has nine (9) questions. Answer all questions. Write your answer.
Any 4 for 10 each

CREATININE

WATER, UREA, URIC ACID, IONS (K\(^+\), Na\(^+\), CHARGED)

(2 marks)

g) Name FOUR (4) components of urine.

TUBULAR SECRETION (1)

PHOSPHATE (1)

GLOMERULAR FILTRATION (1)

(3 marks)

(3) Name the THREE (3) processes that occur in the functional unit of the kidney.

REPTHROSON (1)

(1 mark)

(b) Name the functional unit of the kidney.

THE KIDNEY (1)

X: RENAL ARTERY - CARRIES BLOOD TOWARDS

(1 mark)

THE BLADDER (1)

D: URINARY EXCRETION FROM THE KIDNEYS TO

(2 marks)

II. STATE the function of the parts listed below. (2 marks)
This increases the blood pressure causing Z is larger in diameter to X.

How does it affect the function of Y?

Structures X and Z have one main difference, what is it and what is it for?

Y: Glomerular capsule / Bowman's capsule / filtrate

X: Effluent arteriole

Identify the parts listed below:

(p)

Use the following diagram to answer the question below.
(c) Explain how the structure of ATP relates to its function. (2 marks)

Mitochondria + chloroplast

(1 mark)

(a) Cell respiration takes place in all cells. In which organelle does this occur?

(b) Large molecules into small area + released energy

(c) Catabolic reactions involve the breakdown of large molecules into small ones + released energy

(d) Anabolic reactions involve the build up of

(2 marks)

Describe the difference between catabolic and anabolic reactions.

11 marks)

Question 32

Any 4 for 2 marks each.

Simple sugars, monomers, urine, etc.

Creatine, H2O, small amino acids, D, etc.

(2 marks)

Name FOUR (4) substances that enter Y.
Any 2 for 1 mark each

Concentration, presence of co-enzymes

pH levels, presence of co-factors, enzyme

Which affect enzyme activity.

Optimum level, Name TWO (2) factors other than temperature.

Enzymes require optimum temperature to work at all.

(0) Being used up itself (1 mark)

To speed up chemical reaction (1 mark)

What is the function of an enzyme?

1. Takes place in chloroplasts, only takes place in chloroplast

(a) Product A

(b) Product B

(c) Do not require oxygen

(d) Requires oxygen

(e) Glycolysis only

(f) Krebs cycle + glycolysis only

Table to show THREE (3) differences between the two. (0 marks)

(a) Cell respiration can be aerobic or anaerobic. Complete the following

Aerobic

Anaerobic

<table>
<thead>
<tr>
<th>Product A</th>
<th>Product B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Glycolysis only</td>
<td>Glycolysis only</td>
</tr>
</tbody>
</table>
Any 4 marks

(2) Damaged cells removed
(3) New cells are produced
(4) No longer attached to area + phagocytes are proteins signal finish + phagocytes are
(5) Tissue heals when inflammation + compartment
(6) Progenitor, which undergo dead cells
(7) Compartment protects tissue in un Mendicant
(8) Heparin prevents clotting in un Mendicant

(2) Skin is broken - brings about inflammatory response
(4 marks)

(ii) Explain the process by which Anna'singer will eventually heal.

Inflammation

What is the reaction to this injury called? (1 mark)

1. Swollen, red and tender

Anna cuts her finger while cooking. The injured area becomes

Question 33  6 marks

Human Biological Science Stage 2 Semester One Exam 2010
(a) Name this structure.

(b) Identify THREE (3) ways in which this can be done. (3 marks)

1. Through good hygiene, the spread of pathogens can be reduced.
2. Wear gloves when cleaning dirty areas. (3 marks)
3. Cover mouth when coughing + sneezing. (3 marks)
4. Never share personal articles. (3 marks)
5. Wipe down surfaces with detergent. (3 marks)
6. Use towels / pliers / tweezers when handling food or picking (1 mark).
(c) Complete the following table by describing how the following structures of the respiratory system are suited to their functioning.

<table>
<thead>
<tr>
<th>Structure</th>
<th>4 marks</th>
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<tbody>
<tr>
<td>Bronchial</td>
<td>( X )</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>( Y )</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Inspiration</td>
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</tbody>
</table>
(b) Name the dependent variable.

Any reasonable answer - read depth and width variable.

The percentage of bone present.

1 mark

(3) Why were 500 women followed for 4.5 years, then another 500 women, who were required to take a 400 mg calcium supplement daily to a total of 200 women where the researchers may have been

the calcium supplement, daily.

The researchers at Royal Perth Hospital have recently published the results

Question 35

Human Biological Science Stage 2 Semester One Exam 2010
(c) Name TWO (2) variables that were controlled in this study.

(d) What is the term given to the sugar tablet Group 3 were asked to take, and why is such a tablet necessary?
(2 marks)

(2 marks)

5. Are actually working - used as a control. 1

6. Name the group that contained 45 - 65 years of age, every 5 years. A span.

7. Informed of the results of the study, each answer for 1 mark.

8. Any 2 reasonable answers for 4 marks.
Average bone density (%) over a 20-year period (in women between the ages of 45 and 65)

(e) Graph this data on the graph paper below.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>GROUP 1 (calcium)</th>
<th>GROUP 2 (sugar label)</th>
<th>Average Bone Density (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>98</td>
<td>66</td>
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<tr>
<td>94</td>
<td>93</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

The average results for each group are shown below.
(6) Other than increasing the number of women in the investigation or

(7) Why reasonable expectation

(1) Bone density

(2) Increased Group 2 showed a large drop in average

(3) Group maintained a reasonable bone density

(2 marks)

(1) What do the results show?
(2 marks)

What are the two (2) components that make up structure A?

A: Phospholipid bilayer
B: Carrier protein

(2 marks)

Identify the parts labeled below.

(4 marks)

The diagram below shows a cross-section of part of the plasma membrane of a typical human cell. The substances labeled X and Y are transported across the membrane in the direction shown by the arrows. Substance Y is transported into the cell, while substance X is transported out of the cell.

Question 36

Human Biological Science Stage 2 Semester One Exam 2010
Phagocytosis involves taking in solid materials.

Exocytosis involves taking in liquids.

Explain the difference between phagocytosis and endocytosis.

Exocytosis - contents are pushed out of the cell, closing them.

Endocytosis - cell's face in material by engulfing.

Explain the difference between endocytosis and exocytosis.

Membrane is called active transport. Explain why this is so.

The type of transport that moves substance across the cell...
Which of the cells in the diagram above (A, B or C) would have the largest surface area to volume ratio? (1 mark)

(a) C

(b) B

(c) A

Which of the cells in the diagram above (A, B or C) would supply the organelles with the substances they require most efficiently?

(1 mark)
<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>Erythrocytes</td>
<td>( \text{function of blood cells.} )</td>
</tr>
<tr>
<td>Leucocytes</td>
<td>( \text{Complete the following table by comparing the structure and} )</td>
</tr>
<tr>
<td>Thrombocytes</td>
<td>( \text{Erythrocyte} )</td>
</tr>
</tbody>
</table>

1. Give the scientific name for the cell labeled \( A \). (1 mark)

\( {10\mu m} \)

Question 37

Human Biological Science Stage 2 Semester One Exam 2010
Use the following diagram to answer the questions below.
(g) Name TWO (2) features that contribute to cardiovascular disease:

- Hypertension
- Arteriosclerosis

(2 marks)

(h) Name TWO measures to improve cardiovascular health:

- Healthy diet
- Regular exercise

(2 marks)

(i) Match the parts of the circulatory system with their functions:

1. Heart - pumps blood
2. Arteries - carry oxygenated blood
3. Veins - carry deoxygenated blood
4. Capillaries - exchange oxygen and carbon dioxide
5. Pulmonary vein - lungs to heart
6. Intra-retinal capillaries - retina to the body

(6 marks)
The following diagram represents the human digestive system. (13 marks)

Question 38

Human Biological Science Stage 2 Semester One Exam 2010
3. Name TWO parts of the digestive system where protein is digested.

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Enzyme</th>
<th>Product</th>
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</thead>
<tbody>
<tr>
<td>Starch</td>
<td>Amylase</td>
<td>Maltose</td>
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<tr>
<td>Glycogen</td>
<td>Glucanase</td>
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<td>Lipids</td>
<td>Lipase</td>
<td>Fatty Acids</td>
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<td>Amino acids</td>
<td>3.4.9.5</td>
<td>3.4.10.1</td>
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<td>Protein</td>
<td>Trypsin</td>
<td>Peptide</td>
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<td>Substrate</td>
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<td></td>
</tr>
</tbody>
</table>

(3 marks) (5 marks)

Complete the following table in relation to chemical digestion.

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2. Metaphase
1. Prophase

(2 marks)

Identify the phases of mitosis that are taking place in the following:

5
2

nucleus

5 centrioles

4 chromosomes

3 spindle fibres

1 chromosomes

The following diagram shows the different stages of mitosis.

Question 39

Face more solid.

Back into the blood, making the

In the large intestine, water is resorbed.

(2 marks)

Generally a solid consistency. Explain what causes this to
happen.

The contents of the small intestine are liquid yet faces are

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END OF SECTION TWO

Spindle fibres/organize chromosomes

Chromosome is attached to visible or sister chromatid/spindle.

To oppose. Polyal chromosomes become breakdown or disappear/condensed migrate.

Nucleolus disappears/nucleus membrane

Any 2 for each mark

1 mark

(c) Explain TWO (2) processes that take place during prophase

(1) Contain?

(1 mark)

(d) How many chromosome does each daughter cell in mitosis?
Healthy Kidneys.

Describe FOUR (4) lifestyle choices that individuals can make to maintain renal vein as well as the urine composition in the ureter.

(16 marks)

The urine in your answer discuss the blood composition in the renal artery and theme from the body in the urine, compare the composition of the blood and remove function of the kidney is to filter wastes out of the blood and remove

(20 marks)

OR

Describe how the different nutrients are absorbed into the villi.

(10 marks)

Release the structure of the intestinal villi to their function. In your answer absorption of the final products.

(10 marks)

Mechanical and chemical digestive processes that occur as well as the different structures of the digestive system. Include in your answer the journey of a carbohydrate (starch) food source through the body.

(20 marks)

Answer either question 40 or 41.

Suggested working time for this section is 50 minutes.

With introductory notes, with linking sentences: clearly labeled tables and graphs; and annotated flow diagrams, responses can include clearly labeled diagrams with explanatory notes. Hints or points are continuing to answer at the top of the page. If the question is continued, write the page number. Fill in the number of the question(s) that you need to use the space to continue an answer. Indicate in the original answer space where you use the space provided. If you need an additional page required to continue an answer: Planning: If you need the space provided, choose question 40 or question 42 or question 43. Write your answers in the space provided.

This section contains FOUR (4) questions. Each question contains two (2) questions. You must answer TWO (2) questions. You can

Section Three: Extended answer

20% (40 marks)
END OF QUESTIONS

(8 marks)
(b) Explain the significance of milliseconds and explain how it is different to milliseconds.

(12 marks)
(a) Describe the process of simple diffusion, facilitated diffusion and active transport.
(c) Cells constantly exchange materials with their environment. Describe the cells' methods of exchanging materials. (20 marks)


OR

(4 marks)
(c) Name FOUR (4) factors that contribute to cardiovascular disease.

(8 marks)
(b) Explain the cardiac cycle. Include in your answer how the cardiac cycle is regulated, the process taking place in the heart and the length of each cycle.

(8 marks)
(a) Describe the journey of a red blood cell from the time it enters the heart, passes through all body cells, passes through the alveoli in the lungs and returns back to the heart. Give names of the blood vessels, and the processes that take place.
Any 10 marks

Carbohydrates are absorbed into blood capillaries.

Villii - absorptive tissue, place microvilli - segmentation

Intestinal epithelial cells - pancreatic amylase, trypsin, chymotrypsin, mechanical - peristalsis

Small intestine - duodenum - chyme

Stomach - mechanical - chewing

Movements - peristalsis

Pharynx - food enters throat

Esophagus - prevents food entering trachea.

Bolus - formed and swallowed

Salivary amylase - breaks down carbohydrates

Tongue - mechanical digestion - teeth.
- Long number of villi → small intestine
- Increased surface area
- Increased the absorption of nutrients
- Allow for exchange of nutrients
- Contain lacteal
- Castellated villi
- Exposed to food substances
- Exposed to mucus glands
- Mucus glands
- Contain microscopic projections
- Mucous lining
- Extend from the muscular layer
- Villi – structure: finger-like projections
- villi are moved along close proximity to mucus glands
- Exhanced from mucus glands, water, soluble vitamins
b) Healthy diet

- Avoid alcohol
- Maintain weight
- Drink water
- Do not smoke

Water
- Water
- Small amino acids
- Uric acid

Creatinine

Renal artery
- RBC's
- WBC's
- Platelets

Renal vein
- Glucose
- Amino acids
- Fatty acids
- Glycogen

Plasma proteins
- Sodium
- Potassium
- Chloride
- HCO₃⁻
- Max 2 x 4 for ions

Plasma protein
- Urea
- Some uric acid
- Creatinine
- Some creatinine

Kidney
- Urea
- Uric acid
- Creatinine
- Some amino acids

Toxins

- H₂O
SA node sends impulses across right atrium and ventricular septum, then to contract (chamber). The ventricles then open and close, forcing blood into pulmonary artery or aorta. The atria fill with blood. The atrioventricular valves open and force the remaining blood to enter the ventricles. Atrial systole occurs along with a ventricular contraction. The ventricles fill with blood. Ventricular diastole occurs in the atria. The atria fill with blood. The atrioventricular valves close, and the ventricular atrioventricular valves open. The heart continues to pump blood throughout the body. Pulmonary circulation regulates more in the brain, sending right atrium to the lungs.
heredity
physiological
environmental
counselling
smoking
environment
high blood cholesterol
high blood pressure
check
alcohol
not
42 c (2) any 4 including

Additional working space

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1. They are too long to move across the membrane. Small molecules that are larger than the transport protein cannot be moved across. Therefore, no limitation of rate.

2. Size of membrane proteins required to pass a substance to other cell. No carrier protein changes shape to move the substance. From high to low concentration.

3. Synthesis of solid or liquid.

4. Endocytosis, exocytosis.

5. Active transport or vesicular.
1. Any 1 for linear (a).) occurs in gamete cells instead of somatic cells.  
2. daughter cells are diploid.  
3. occurs in meiosis in meiosis only chromosome  
4. separate, meiosis in meiosis only chromosome  
5. the first division homologous pairs.  
6. crossing over takes place.  
7. produce  
8. homologous chromosome pair up in  
9. nucleus of chromosome instead of diploid  
10. each daughter cell contains a haploid (23)  
11. produced 4 daughter cells instead of 2  
12. involved in nuclear division unbuffered  
13.  
14. Sperm  
15. all set of chromosome  
16. the resulting gamete will have a  
17. sperm  
18.  
19.  
20. meiosis ensure that each gamete only  
21. by mitosis they would contain 24 chromosomes (23, sperms) were produced  

Additional working space