Science Olympiad Foundation Uganda

Uganda National Junior Science Olympiad 2020 - Paper 3

Exam ID: 117

Name: _____

Date: _____

Direction for Questions: 1 to 4

The human heart has four chambers — *the left atrium*, *the right atrium*, *the left ventricle* and *the right ventricle*. These four chambers and the various blood vessels connected to the heart are shown in the diagram below.

Major blood vessels to and from the heart	Heart Chambers
1. Pulmonary artery	RA) Right Atrium
2. Pulmonary vein	RV) Right Ventricle
3. Aorta	LA) Left Atrium
4. Superior Vena Cava	LV) Left Ventricle
5. Inferior Vena Cava	

Question: 1 of 27 QID: 346 Marks: 5

(a) Which of the above carry de-oxygenated blood? **(5 marks)**

Please write your answer below.

Question: 2 of 27 QID: 347 Marks: 3

(b) The table below shows the volume of blood in the left ventricle of an individual at different times during one cardiac cycle

t (s)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
v (cm^3)	80	89	75	60	48	47	70	80	89

What would be the individual's heart rate (in beats/minute) as calculated from the table? **(3 marks)**

Guidance to help you calculate the heart rate:
Your heart rate, or pulse, is the number of times your heart beats / contracts per minute.

Look at the table and note / record all instances of the highest recorded volume of blood and the time this volume of blood is recorded.

The time taken between the first highest recorded volume of blood and the second higest recorded volume of blood is the time taken to complete one cardiac cycle or one single heart beat.

Use this time taken to make one single heart beat to calculate how many heart beats this individual experiences in a single minute.

Please write your answer below.

Question: 3 of 27 QID: 348 Marks: 3

c) Blood flows from the heart into the aorta during a cardiac cycle. If the diameter of the aorta is approximately 2.4 cm, then, using the table in (b) calculate the average speed (in cm s^{-1}) of blood flowing into the aorta in one full cardiac cycle.

Use the formula Speed = Volume / (Cycle time * Area) **(3 MARKS)**

Please write your answer below.

Question: 4 of 27 QID: 349 Marks: 2

Blood flows from the aorta and its major arteries into arterioles and fine-walled capillaries. If all the major arteries in the body have a total cross-sectional area of about 7.0 cm^2, calculate the average speed (in cm s^{-1}) in the major arteries which have the same volume of blood as the aorta flowing through them. **(2 marks)**

Please write your answer below.

Direction for Questions: 5 to 13

Application of Sulphuric Acid in Industries

The consumption of sulphuric acid H_2SO_4 is usually an index of a country's industrial development, because of its extensive use in a large number of manufacturing operations. It is a highly corrosive, dense, oily liquid, with colourless to dark brown colour depending on its purity.

This is produced on a large scale by two commercial processes, **the Contact process** and the **Lead-Chamber process**.

In the Contact process, sulphur (IV) oxide is converted to sulphur (VI) oxide, in the presence of vanadium(V)oxide promoted by molybdenum oxide at 450^0C and 1-2 atmospheric pressure. The sulphur (IV) oxide is oxidised to sulphur (VI) oxide by vanadium(V)oxide. In the process, the vanadium (V) oxide is reduced to Vanadium (III) oxide then re-oxidised. This is a good example of the way a catalyst can be changed during the course of a reaction. In the absence of vanadium (V) oxide as a catalyst, the reaction is very slow. Sulphur (VI) oxide is converted to oleum ($H_2S_2O_7$ - sulphuric acid and sulphur (VI) oxide) by dissolution in sulphuric acid. The oxidation of sulphur (IV)oxide to sulphur (VI) oxide in the Contact Process is an exothermic reaction.

Concentrated sulphuric acid has a very strong affinity for water and is sometimes used as a dehydrating agent. It reacts with sucrose, leaving a brittle spongy black mass of carbon. The acid reacts similarly with skin tissue, cellulose, plant and animal matter.

Sulphuric acid is formed naturally in mines by the oxidation of sulfide minerals, such as iron (II) sulfide (FeS). The aqueous solution formed when such sulphide minerals dissolve is acidic and is capable of dissolving metal ores. The resultant solution is a brightly colored toxic stream.

During combustion, sulfide minerals in fossil fuels produce sulphur (IV) oxide which is given off to the Earth's atmosphere. The sulphur (IV) oxide can be converted to sulphur (VI) oxide by radiation from the sun and can be transformed into sulphuric acid during precipitation(rainfall).

The lead-chamber process depends upon the oxidation of sulfur (IV) oxide with nitric acid (HNO_3) in the presence of steam.

Question: 5 of 27 QID: 231 Marks: 2

Choose the **two** correct options from A-F, why it is not commercially suitable to dissolve SO_3 directly in water to give concentrated sulphuric acid?

Please mark (✓) for the correct answers.

- ☐ **A.** To reduce the hazards of spillage
- ☐ **B.** Because the density of the product is too high
- ☐ **C.** To minimise transport costs of large volumes
- ☐ **D.** Because the last step of the process is too expensive
- ☐ **E.** Because the last step of the process is too exothermic
- ☐ **F.** An aerosol of the sulphuric acid rapidly fills the container

Question: 6 of 27 QID: 232 Marks: 4

Match the role that sulphuric acid plays in manufacturing with each of the following industrial activities as shown below:

Please write the matching pair to the place provided [ ].

[ ]	**1.**	Electroplating of iron and steel	**A.** Manufacture of lead acid accumulators
[ ]	**2.**	Fertilizer industry	**B.** Functionalization of compounds with SO groups
[ ]	**3.**	Manufacture of detergents	**C.** Dissolution of phosphate rocks
[ ]	**4.**	Automotive industry	**D.** Cleaning of metal surfaces by dissolution of oxide layers

Question: 7 of 27 QID: 233 Marks: 4

Write balanced equations for the **four** major reactions in the Contact process. **(4 marks)**

Please write your answer below.

Question: 8 of 27 QID: 234 Marks: 1

Choose one option from A-C why vanadium (V) oxide is suitable for use as a catalyst in the Contact process

Please mark (✓) for the correct answer.

- ◯ **A.** Vanadium (V) oxide removes electron from SO_2 and is re-oxidised by oxygen
- ◯ **B.** Vanadium (V) oxide supplies electrons to SO_2 and is in turn reduced to vanadium (III) ions
- ◯ **C.** Vanadium (V) oxide reacts with oxygen to give a complex which is regeneratable

Question: 9 of 27 QID: 235 Marks: 4

If the Contact process is 80% efficient, calculate the weight of 98% sulfuric acid produced from 100 kg of pure sulphur. Assume 100% conversion of sulphur to sulphur (IV) oxide. (S = 32.0, H = 1.0, O = 16.0 and the density of 98% sulfuric acid is 1.98g/cm^3). **(4 marks)**

Please write your answer below.

Question: 10 of 27 QID: 236 Marks: 2

Write a balanced equation for the reaction of excess sodium chloride and concentrated sulfuric acid. **(2 marks)**

Please write your answer below.

Question: 11 of 27 QID: 237 Marks: 2

Write a balanced equation representing the dehydration of sucrose by concentrated sulphuric acid. The formula for sucrose is $C_{12}H_{22}O_{11}$ **(2 marks)**

Please write your answer below.

Question: 12 of 27 QID: 238 Marks: 2

What volume of 0.20mol.dm $^{-3}$ sulphuric acid is required to neutralise completely 25cm^3 of 16.0g of sodium hydroxide dissolved in 0.25 dm $^{-3}$ of water? (Na = 23.0, O =16.0, H = 1, S = 32.0) **(2 marks)**

Please write your answer below.

Question: 13 of 27 QID: 239 Marks: 3

From the list supplied below, select three (3) fuels that will give the most acid rain. **(3 marks)**

a) Firewood
b) petroleum
c) coal
d) biodiesel
e) bioethanol
f) natural gas

Please write your answer below.

Question: 14 of 27 QID: 350 Marks: 1

Which one is correctly matched?

Please mark (✓) for the correct answer.

- **A.** Acids – pH range above 7
- **B.** Acids – pH range below 7
- **C.** Acids – pH range 7 (neutral)
- **D.** Acids – pH range 8-9

Question: 15 of 27 QID: 351 Marks: 1

When hydrogen chloride gas is prepared on a humid day, the gas is usually passed through a guard tube containing calcium chloride. The role of calcium chloride taken in the guard tube is to

Please mark (✓) for the correct answer.

- **A.** absorb the evolved gas
- **B.** moisten the gas
- **C.** absorb moisture from the gas
- **D.** absorb Cl^- ions from the evolved gas

Question: 16 of 27 QID: 352 Marks: 1

What happens when a solution of an acid is mixed with a solution of a base in a test tube?

(i) Temperature of the solution decreases
(ii) Temperature of the solution increases
(iii) Temperature of the solution remains the same
(iv) Salt formation takes place

Please mark (✓) for the correct answer.

- **A.** (i) and (iv)
- **B.** (i) and (iii)
- **C.** (ii) only
- **D.** (ii) and (iv)

Question: 17 of 27 QID: 353 Marks: 1

What will be the product when HNO_3 reacts with NH_4OH?

Please mark (✓) for the correct answer.

- **A.** NH_4NO_3
- **B.** $2NH_4NO_3$
- **C.** $NH_4(NO_3)_2$
- **D.** NH_2NO_3

Question: 18 of 27 QID: 354 Marks: 1

The simplest organisation of matter that exhibits the properties of life is the

Please mark (✓) for the correct answer.

- **A.** cell
- **B.** tissue
- **C.** protein
- **D.** nucleic acid
- **E.** organism

Question: 19 of 27 QID: 355 Marks: 1

A cell that has membrane - bound units called organelles and a cytoskeleton is said to be

Please mark (✓) for the correct answer.

- ◯ **A.** prokaryotic
- ◯ **B.** organoid
- ◯ **C.** eukaryotic
- ◯ **D.** symbiotic
- ◯ **E.** endosymbiotic

Question: 20 of 27 QID: 356 Marks: 1

The organelle that packages and routes the synthesized products of a eukaryotic cell is the

Please mark (✓) for the correct answer.

- ◯ **A.** flagellum
- ◯ **B.** ribosome
- ◯ **C.** peroxisome
- ◯ **D.** nucleolus
- ◯ **E.** Golgi apparatus

Question: 21 of 27 QID: 357 Marks: 1

The surface to volume ratio of cells limits

Please mark (✓) for the correct answer.

- ◯ **A.** the type of organelles present
- ◯ **B.** the organelle / microtubule volume
- ◯ **C.** the number of organelles present
- ◯ **D.** the plasma membrane / DNA volume
- ◯ **E.** the size a cell may reach

Question: 22 of 27 QID: 358 Marks: 1

We humans get an entirely new skeleton every 12 years.

Please mark (✓) for the correct answer.

- ◯ **A.** True
- ◯ **B.** False

Question: 23 of 27 QID: 359 Marks: 1

Sweat is the main cause of body odor.

Please mark (✓) for the correct answer.

- ◯ **A.** True
- ◯ **B.** False

Question: 24 of 27 QID: 360 Marks: 1

What is the largest organ of the human body?

Please mark (✓) for the correct answer.

- ◯ **A.** The brain
- ◯ **B.** The liver
- ◯ **C.** The spine
- ◯ **D.** The skin

Question: 25 of 27 QID: 361 Marks: 1

What happens to the brain after a night of heavy drinking?

Please mark (✓) for the correct answer.

- ◯ **A.** The brain become dehydrated and shrinks away from the skull
- ◯ **B.** The brain swells, causing a splitting headache
- ◯ **C.** The nerve endings in the base of the brain become inflamed
- ◯ **D.** Brain activity increases and the surfeit of thoughts causes a headache

Question: 26 of 27 QID: 362 Marks: 1

In which parts of the body are cells not replaced when they die?

Please mark (✓) for the correct answer.

- ◯ **A.** Kidneys
- ◯ **B.** Muscles
- ◯ **C.** Skin
- ◯ **D.** Brain

Question: 27 of 27 QID: 363 Marks: 1

What colour are your eyes if you have comparatively little pigment in your iris?

Please mark (✓) for the correct answer.

- ◯ **A.** Blue
- ◯ **B.** Grey
- ◯ **C.** Black
- ◯ **D.** Brown
- ◯ **E.** Yellow

--- END OF QUESTION PAPER ---

Answer Key

No	Question Type	QID	Correct Answer
Question - 1	Essay (Evaluted by Admin)	346	Essay Type Question
Question - 2	Essay (Evaluted by Admin)	347	Essay Type Question
Question - 3	Essay (Evaluted by Admin)	348	Essay Type Question
Question - 4	Essay (Evaluted by Admin)	349	Essay Type Question
Question - 5	Multiple Correct	231	C., F
Question - 6	Matching	232	1 - D, 2 - C, 3 - B, 4 - A
Question - 7	Essay (Evaluted by Admin)	233	Essay Type Question
Question - 8	Multiple Choice (Radiobutton)	234	A
Question - 9	Essay (Evaluted by Admin)	235	Essay Type Question
Question - 10	Essay (Evaluted by Admin)	236	Essay Type Question
Question - 11	Essay (Evaluted by Admin)	237	Essay Type Question
Question - 12	Essay (Evaluted by Admin)	238	Essay Type Question
Question - 13	Essay (Evaluted by Admin)	239	Essay Type Question
Question - 14	Multiple Choice (Radiobutton)	350	B
Question - 15	Multiple Choice (Radiobutton)	351	C
Question - 16	Multiple Choice (Radiobutton)	352	D
Question - 17	Multiple Choice (Radiobutton)	353	A
Question - 18	Multiple Choice (Radiobutton)	354	A
Question - 19	Multiple Choice (Radiobutton)	355	C
Question - 20	Multiple Choice (Radiobutton)	356	E
Question - 21	Multiple Choice (Radiobutton)	357	E
Question - 22	True/False	358	A
Question - 23	True/False	359	B
Question - 24	Multiple Choice (Radiobutton)	360	D
Question - 25	Multiple Choice (Radiobutton)	361	A
Question - 26	Multiple Choice (Radiobutton)	362	A
Question - 27	Multiple Choice (Radiobutton)	363	A

--- END OF ANSWER KEY ---