2021 ASSESSMENT RESOURCE

AS
BIOLOGY

Exchange of Substances / Genetics

Version 0.1

Total number of marks: 47

0 3 . 1 Describe the relationship between size and surface area to volume ratio of organisms.

[1 mark]

0 3 . 2 A scientist calculated the surface area of a large number of frog eggs. He found that the mean surface area was 9.73 mm^2. Frog eggs are spherical.

The surface area of a sphere is calculated using this equation

$$\text{Surface area} = 4\pi r^2$$

where r is the radius of a sphere

$$\pi = 3.14$$

Use this equation to calculate the mean diameter of a frog egg.

Show your working.

[2 marks]

Diameter = _____ mm

The scientist calculated the ratio of surface area to mass for eggs, tadpoles and frogs. He also determined the mean rate of oxygen uptake by tadpoles and frogs.

His results are shown in **Table 2**.

Table 2

Stage of frog development	Ratio of surface area to mass	Mean rate of oxygen uptake / μmol g^{-1} h^{-1}
Egg	2904 : 1	no information
Tadpole	336 : 1	5.7
Adult	166 : 1	1.3

0 3 . 3 The scientist used units of μmol g^{-1} h^{-1} for the rate of oxygen uptake.

Suggest why he used μmol in these units.

[1 mark]

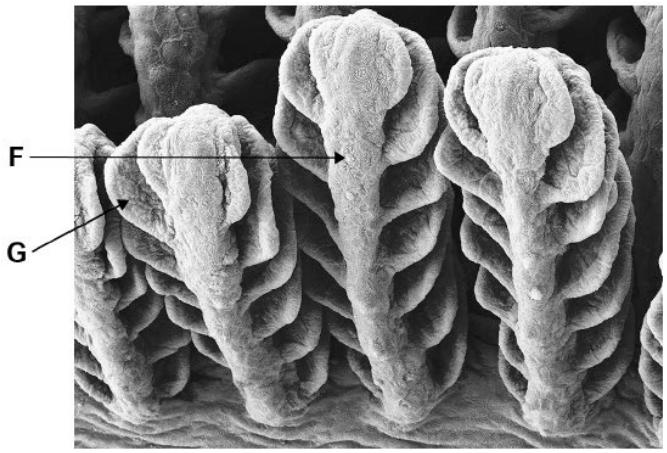
0 3 . 4 The scientist decided to use the ratio of surface area to mass, rather than the ratio of surface area to volume. He made this decision for practical reasons.

Suggest **one** practical advantage of measuring the masses of frog eggs, tadpoles and adults, compared with measuring their volumes.

[1 mark]

0 6 **Figure 4** is an image of a fish gill taken using a scanning electron microscope.

Figure 4



0 6 . 1 Identify structures labelled **F** and **G**.

[1 mark]

F _____

G _____

0 6 . 2 Describe and explain the advantage of the counter-current principle in gas exchange across a fish gill.

[3 marks]

0 5 . 1 Describe and explain the mechanism that causes lungs to fill with air.

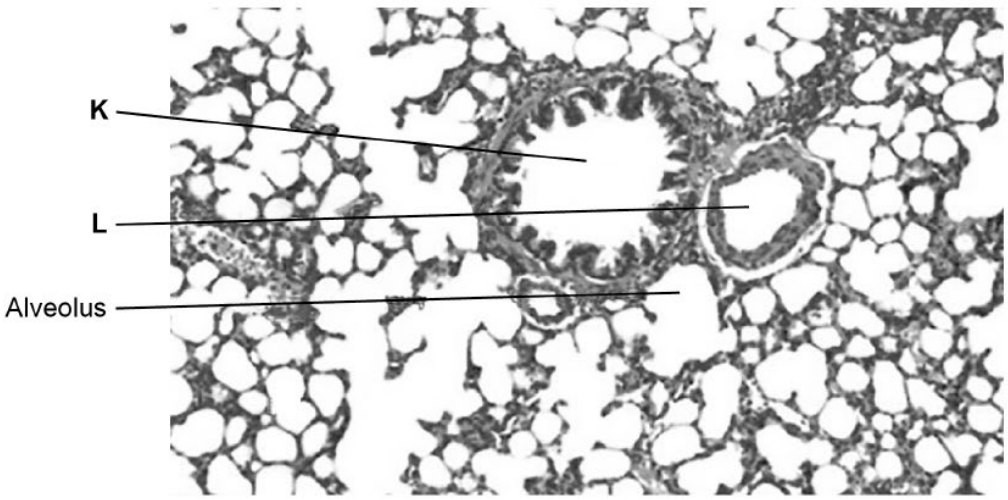
[3 marks]

A scientist observed sections of lung tissue using an optical microscope.

Figure 5 shows one of these sections.

K is an air-filled tube and **L** is a blood vessel.

Figure 5



0 5 . 2 Identify the structures labelled **K** and **L**.

[1 mark]

K _____

L _____

0 1 . 1 Describe the role of enzymes in the digestion of proteins in a mammal.

[4 marks]

Scientists investigated how the diet of rabbits affected their digestion and absorption of protein. The scientists fed rabbits an identical mass of food but varied the percentage of protein in the food.

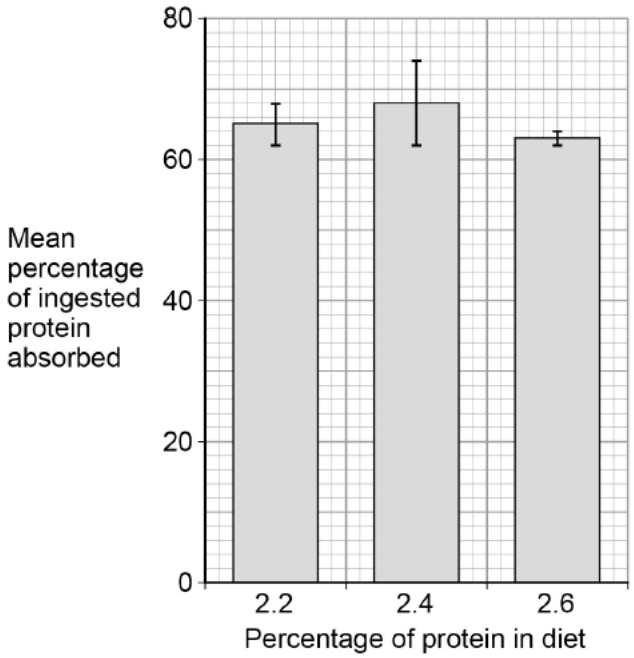
The scientists measured the mean mass of protein fed to the rabbits that was absorbed, which they then expressed as a percentage value.

The scientists' results are shown in **Figure 1**.

The error bars show ± 2 standard deviations.

± 2 standard deviations cover 95% of the data.

Figure 1



0 1 . 2 What can you conclude about the absorption of the products of protein digestion as the percentage of protein increased in the rabbits' food?

[3 marks]

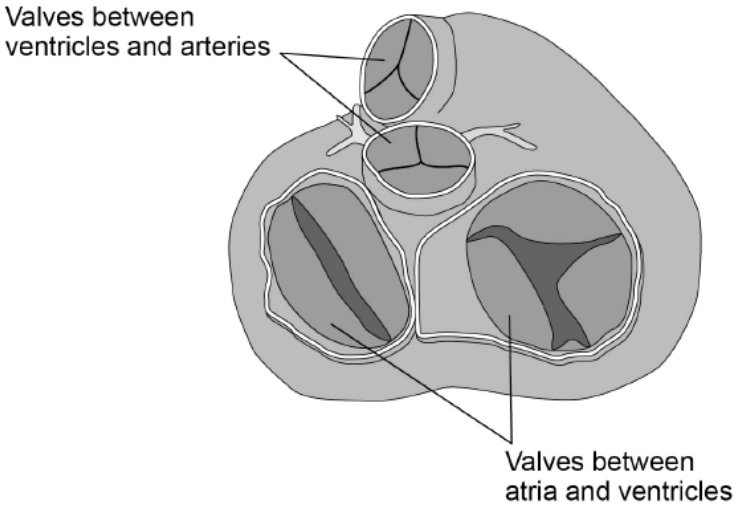
0 3 . 1 Explain how an arteriole can reduce the blood flow into capillaries.

[2 marks]

Figure 1 shows heart valves during one stage of a cardiac cycle.

Ventricles are visible through the open valves.

Figure 1



0 3 . 2 What can you conclude from the appearance of valves in **Figure 1** about heart muscle activity and blood movement between:

1. ventricles and arteries?

[2 marks]

2. atria and ventricles?

[2 marks]

0 3 . 3 Tick (✓) **one** box next to the blood vessel carrying blood at the lowest blood pressure.

[1 mark]

Capillary ☐

Pulmonary vein ☐

Renal vein ☐

Vena cava ☐

0 3 . 4 A scientist measured the heart rate and the volume of blood pumped in a single heart beat (stroke volume) of an athlete before exercise and calculated the cardiac output.

Cardiac output is calculated using this equation.

cardiac output = heart rate × stroke volume

Her results are shown in **Table 1**.

Table 1

Heart rate / beats minute^{-1}	Stroke volume / cm^3	Cardiac output / cm^3 minute^{-1}
62	80	4960

After exercise, the athlete's stroke volume increased by 30% and the cardiac output was 13 832 cm^3 minute^{-1}

Calculate the athlete's heart rate after exercise.

Give the answer to 2 significant figures. Show your working.

[2 marks]

0 8 . 1 A scientist measured the pressure in a phloem tube in a willow plant stem.
He repeated his measurements to obtain nine readings.

His results are shown in **Table 3**.

Table 3

Phloem pressure / arbitrary units								
7.4	8.0	7.0	8.6	8.2	9.3	7.4	9.1	8.8

The percentage error of the mean phloem pressure in this phloem tube is calculated using this equation.

$$\text{Percentage error} = \frac{\text{uncertainty in measurement}}{\text{mean}} \times 100$$

The uncertainty in measurement is half the range of the measured values.

Calculate the percentage error of the mean phloem pressure in this phloem tube.

Show your working.

[2 marks]

Percentage error _____ %

0 8 . 2 The mass flow hypothesis is used to explain the movement of substances through phloem.

Use your understanding of the mass flow hypothesis to explain how pressure is generated inside this phloem tube.

[3 marks]

0 6 . 1 Describe how mRNA is produced from an exposed template strand of DNA.

Do **not** include DNA helicase or splicing in your answer.

[3 marks]

0 6 . 2 Define the term exon.

[1 mark]

Table 3 shows **mRNA** codons for some amino acids.

Table 3

Serine	Proline	Glycine	Threonine	Alanine
UCU	CCU	GGA	ACU	GCA
UCC	CCA	GGG	ACC	GCG

0 6 . 3 **Figure 6** shows the DNA template nucleotide base sequence that determines the sequence of four amino acids.

Figure 6

AGG CGT CCT GGA

Use information from **Table 3** and **Figure 6** to give the amino acid sequence determined by this sequence of nucleotides.

[1 mark]

0 6 . 4 A mutation in the nucleotide sequence shown in **Figure 6** resulted in the following amino acid sequence.

Serine Glycine Glycine Proline

A student concluded that the mutation involved the addition of one nucleotide within the sequence shown in **Figure 6**. Does information in this question support the student's conclusion? Give reasons for your answer.

[2 marks]

0 8 A scientist investigated birth mass in a population of babies. She determined the birth mass (b) of babies and grouped this information into different ranges of birth mass.

Her results are shown in **Table 4**.

Table 4

Birth mass b / kg	**Range of mass / kg**	**Frequency density**
$0.0 < b \leqslant 2.0$	2.0	5 000
$2.0 < b \leqslant 2.5$	0.5	20 000
$2.5 < b \leqslant 3.0$	0.5	90 000
$3.0 < b \leqslant 3.5$	0.5	260 000
$3.5 < b \leqslant 4.5$	1.0	200 000
$4.5 < b \leqslant 5.5$	1.0	20 000

Frequency density is calculated using this equation

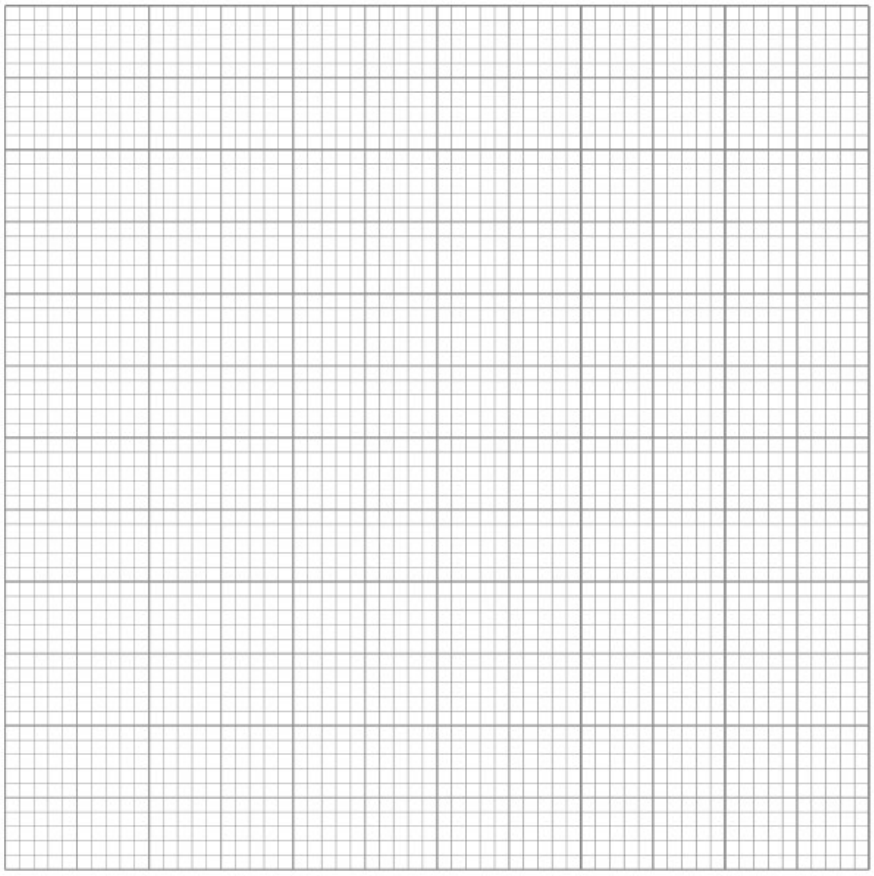
$$\text{Frequency density} = \frac{\text{number of babies}}{\text{range of mass}}$$

0 8 . 1 Draw, on **Figure 8**, a **suitable** chart to show the distribution of birth mass for this population of babies.

[4 marks]

Figure 8

Frequency density



Birth mass / kg

0 8 . 2 Babies with birth mass less than 2.5 kg are classified as low birth mass.

Use information in **Table 4** and the equation to calculate the number of babies born with low birth mass in this population.

Show your working.

[2 marks]

Answer _____