OXFORD

INTERNATIONAL AQA EXAMINATIONS

Topic Test: OxfordAQA Combined Science 9204 Biology

Organisms interaction with the environment

Name: _____

Class: _____

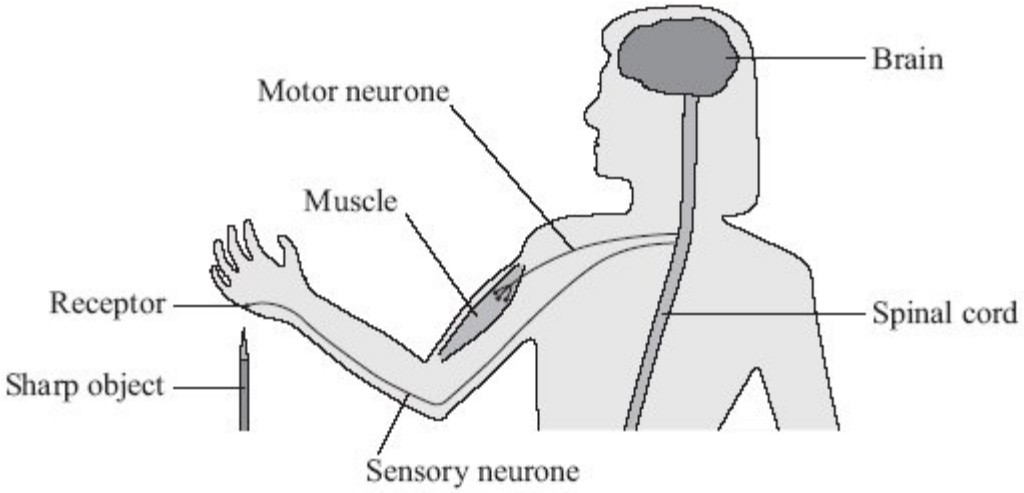
Date: _____

Time: **73 minutes**

Marks: **73 marks**

Comments:

1 A student accidentally touches a sharp object.
Her hand is immediately pulled away from the object.
The diagram shows the structures involved in this response.



(a) Use the correct word or phrase **from the diagram** to complete each sentence.

(i) The stimulus is detected by the _____

(1)

(ii) Impulses travel to the central nervous system along a

cell called a _____

(1)

(iii) Impulses travel from the central nervous system to the effector

along a cell called a _____

(1)

(iv) The hand is pulled away from the sharp object by the

_____

(1)

(b) Where in the body are there cells sensitive to:

(i) light _____

(1)

(ii) sound _____

(1)

(iii) changes in position? _____

(1)

(Total 7 marks)

2 Diabetes is a disease in which blood glucose (sugar) concentration may rise more than normal.

(a) Which organ in the body monitors this rise in blood sugar?

Draw a ring around your answer.

liver **pancreas** **stomach**

(1)

(b) One way of treating diabetes is by careful attention to diet.

Chart 1 shows the recommended diet for a person with diabetes.

Chart 2 shows a diet for a person without diabetes.

Chart 1 Person with diabetes

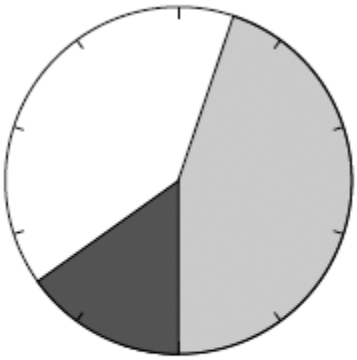
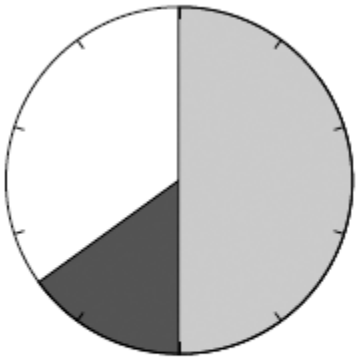
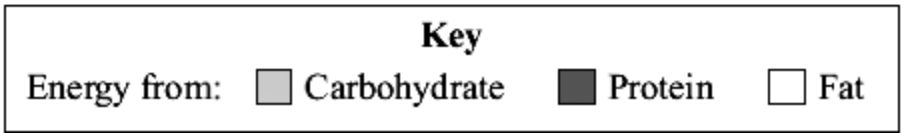


Chart 2 Person without diabetes





How is the recommended diet of a person with diabetes different from the diet of a person without diabetes?

Use information from the charts.

Tick (✓) **two** box.

The diabetic should get more energy from fat. ☐

The diabetic should get more energy from protein. ☐

The diabetic should get less energy from carbohydrate. ☐

The diabetic should get less energy from protein. ☐

(2)

(c) Other than diet, give **one** way in which diabetes may be treated.

_____

_____

(1)

(Total 4 marks)

3 A group of students is going on an outdoor expedition.
The students need to keep warm in windy conditions.

The table shows the effect of wind speed on how quickly someone gets frostbite at different air temperatures.

Wind speed in metres per second	Air temperature in °C				
	10	0	–10	–20	–30
0					
5					
10					
15					
20					

Key

Time taken to get frostbite:

- No frostbite
- 30 minutes
- 10 minutes
- 5 minutes

(a) (i) Describe the effect of changing air temperature on the time taken to get frostbite.

_____

_____

(1)

(ii) What is the longest time it is safe to stay outside when the air temperature is –20 °C and the wind speed is 10 metres per second?

_____ minutes

(1)

(b) When core body temperature begins to fall, changes may happen in the body.

Which **two** changes will happen when core body temperature begins to fall?

Tick (✓) **two** boxes.

More blood flows through skin capillaries	☐
Muscles 'shiver'	☐
Blood vessels supplying the skin capillaries constrict	☐
Sweat glands release more sweat	☐

(2)

(Total 4 marks)

4 (a) Below are some examples of animal behaviour.

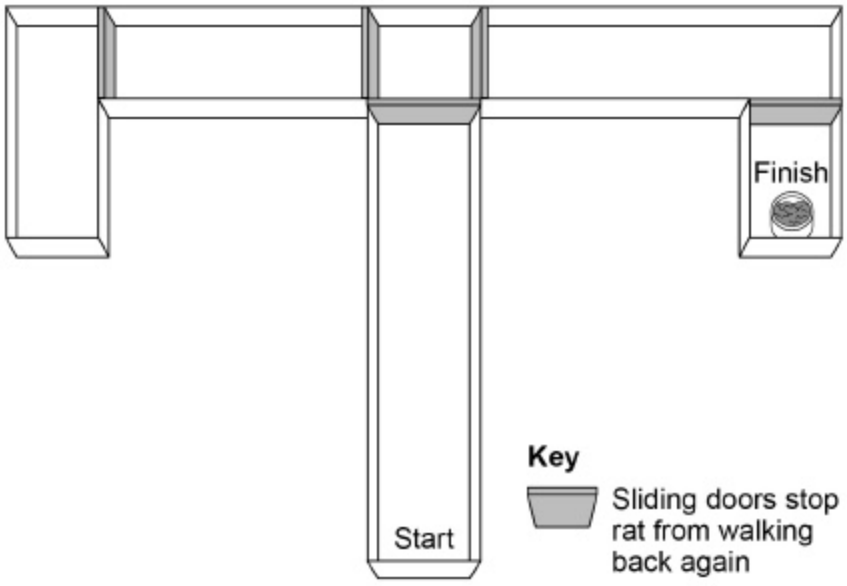
Draw **one** line from each example to the type of animal behaviour it demonstrates.

Example	Type of animal behaviour
A chick will follow the first moving object it sees as it hatches. After this it will only follow something that looks like the first object.	Classic conditioning
If a baby salamander is kept on its own away from water as it develops, when it is placed in water it will swim.	Habituation
Birds fly away when a farmer first fires a gun. If the farmer continues to fire the gun many times the birds will eventually ignore the noise.	Imprinting
	Innate
	Operant conditioning

(3)

(b) A scientist investigated if giving more food to rats encouraged them to learn at a faster rate. The scientist used a T-maze.

The diagram shows a T-maze.



The scientist found that:

After 1 day
- 58% of the rats chose the correct route no matter how much food they received at the finish.

After 5 days
- 70% of the rats which received one piece of food at the finish chose the correct route.
- 90% of the rats which received four pieces of food at the finish chose the correct route.

Describe a method using the T-maze that the scientist could use to get these results.

(4)

(c) Explain how the results demonstrate operant conditioning.

(3)

The table gives information about reproduction in three animals.

	Stickleback	**Turtle**	**Lion**
Type of animal	Fish	Reptile	Mammal
Number of young per breeding cycle	40	150	3
Parental behaviour	Adult keeps eggs and young in mouth	Eggs are buried in the sand and left to hatch	Young develop inside the mother's womb until birth
Aftercare of offspring	1 week	None	2.5 years
Offspring survival rate	30%	5%	50%

(d) Explain how the number of young in each breeding cycle and parental care relates to the offspring survival rate.

You should include advantages and disadvantages for each animal.

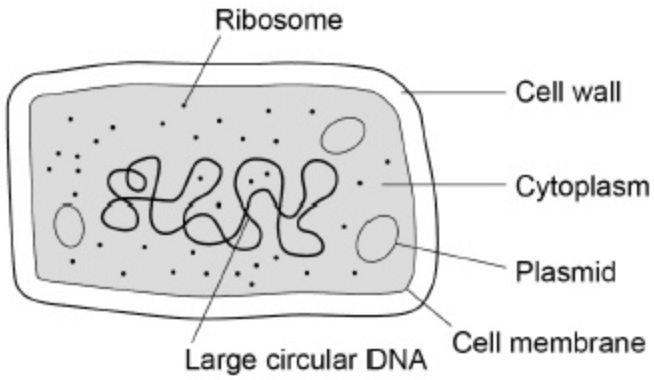
(6)

(Total 16 marks)

5 Bacterial cells and plant cells share many features.

Figure 1 shows a bacterial cell.

Figure 1



(a) Name **two** structures that are present in **both** a bacterial cell and a plant cell.

1. _____

2. _____

(2)

(b) Bacteria can cause gum disease.

Gum disease can be treated with antibiotics.

How do antibiotics work?

_____

_____

(1)

(c) A new antibiotic is used to treat gum disease.

Explain how a population of bacteria which are resistant to the antibiotic can develop.

_____

_____

_____

_____

_____

_____

(3)

Plant products such as blueberry juice and coconut oil can be used to treat gum disease.

A scientist investigated the antibacterial properties of these plant products.

This is the method used.

1. Heat a glass Petri dish containing agar at 120 °C for 30 minutes.
2. Allow the Petri dish to cool.
3. Spread bacteria over the agar surface in the Petri dish.
4. Soak three paper discs in either blueberry juice, coconut oil or antibiotic.
5. Place the paper discs on top of the agar.
6. Incubate the Petri dish at 37 °C for 48 hours.

(d) The glass Petri dish and agar were heated at 120 °C to kill any bacteria present.
Why is it important to kill any bacteria present?

_____

_____

(1)

(e) Why was the Petri dish incubated at 37 °C?

_____

_____

(1)

(f) There are health risks when doing investigations with bacteria.

Give **two** ways risks to health can be reduced.

1. _____

_____

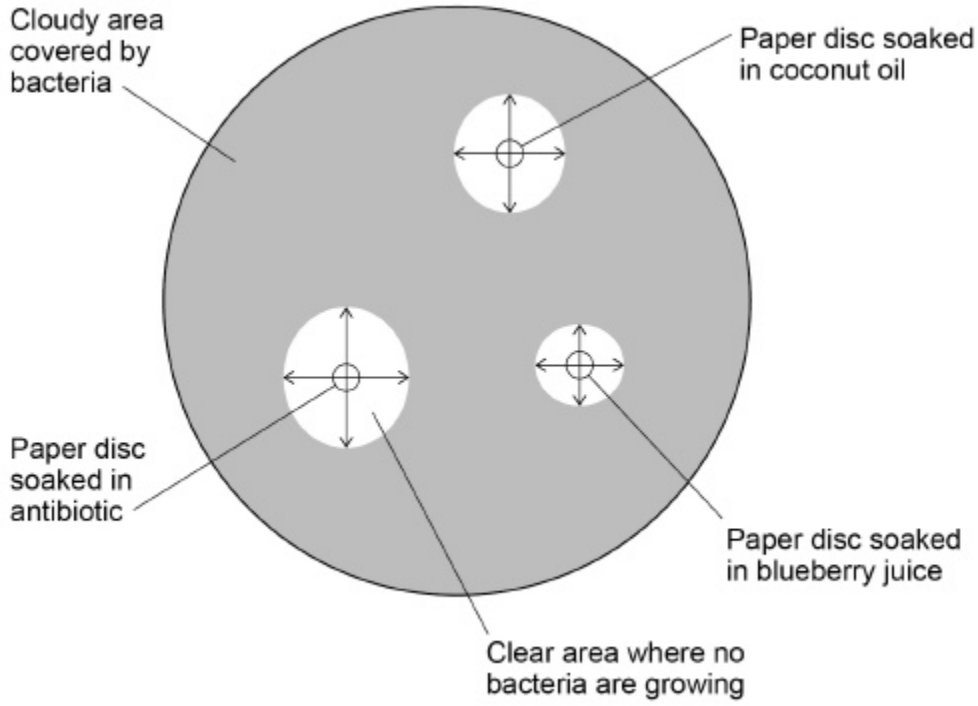
2. _____

_____

(2)

Figure 2 shows what the Petri dish looked like after 48 hours.

Figure 2



(g) The table shows some of the scientist's results.

Test solution	Diameter of clear area in mm		Mean diameter of clear area in mm
	First reading	Second reading	
Antibiotic	17	19	18.0
Blueberry juice	12	11	11.5
Coconut oil			

Complete the table for the coconut oil using **Figure 2**.

- Measure the diameter of the clear area at **two** points.
- Calculate the mean diameter of the clear area.

(2)

(h) The mean diameter of the clear area was used to assess antibacterial activity.

The larger the diameter, the greater the antibacterial activity.

- Clear diameters of > 13 mm had high antibacterial activity
- Clear diameters of 9 – 13 mm had medium antibacterial activity
- Clear diameters of < 9 mm had no antibacterial activity.

The scientist concluded that both blueberry juice and coconut oil could be used as effective antibacterial agents.

Do the results support the scientist's conclusion?

Give reasons for your answer.

Use data from the table.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(i) Another scientist repeated the same investigation a number of times.

The results were different from those shown in the table.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(Total 17 marks)

6 This question is about receptors.

(a) Name the organs where these receptors are found.

1. Light receptors _____

2. Sound receptors _____

(2)

(b) Receptors are involved in reflex actions.

Describe the nervous pathway taken during a pain withdrawal reflex.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

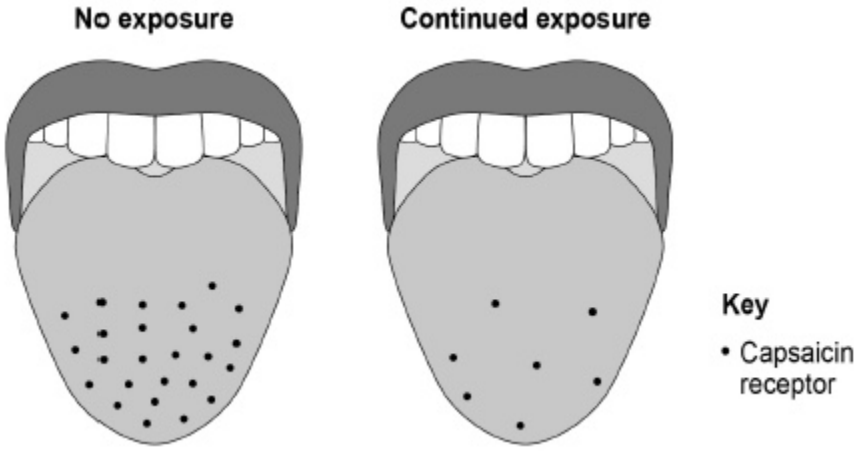
There are receptors in the tongue.

Capsaicin is a substance found in chilli peppers.

Capsaicin pain receptors on the tongue are stimulated when a person eats a chilli pepper.

Continued exposure to capsaicin causes a change to the receptors in the tongue as shown in **Figure 1**.

Figure 1



(c) Explain why people who have eaten chilli peppers for many years are less likely to feel pain when eating chilli peppers.

_____

_____

_____

_____

(2)

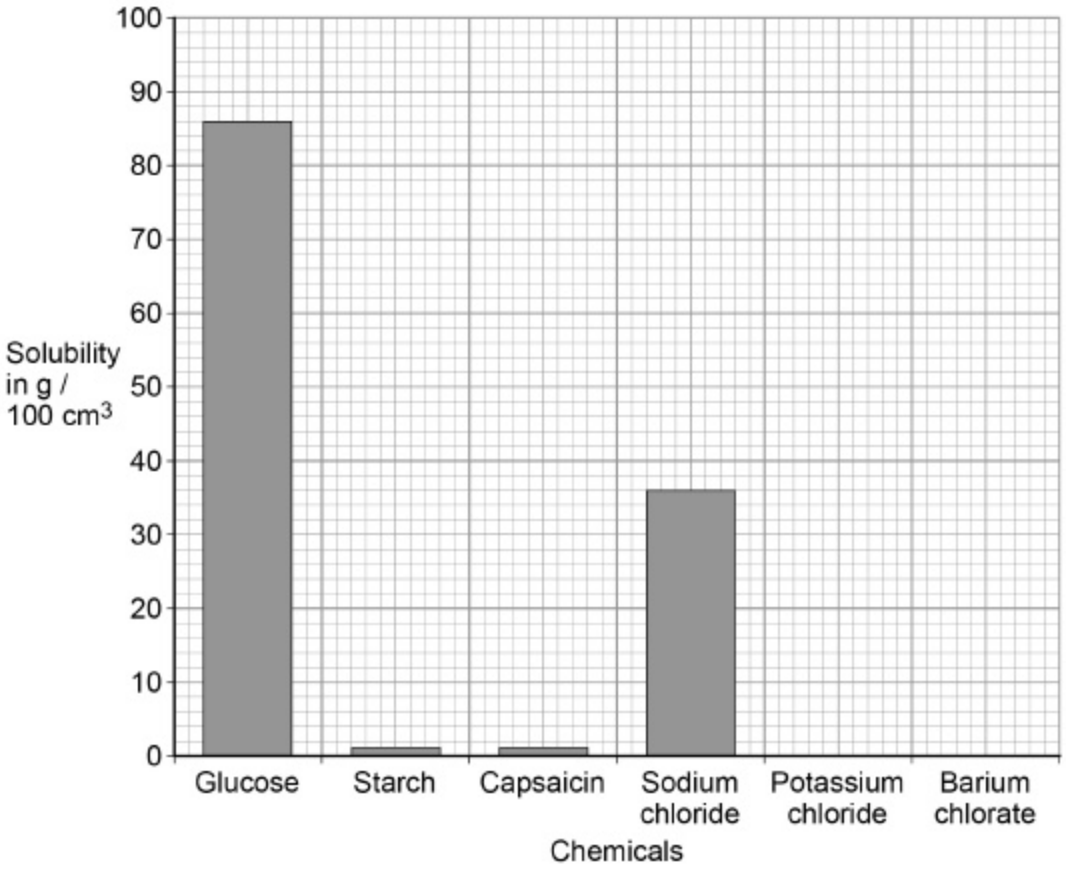
The table below shows the solubility in water of capsaicin and some other chemicals at 40 °C.

Chemicals	**Solubility in g / 100cm^3**
Glucose	86
Starch	1
Capsaicin	1
Sodium chloride	36
Potassium chloride	42
Barium chlorate	25

(d) Complete the bar chart in **Figure 2**.

Use the data in the table.

Figure 2



(1)

(e) Suggest why drinking water does **not** remove the pain immediately after eating chilli peppers.

_____

_____

_____

_____

(2)

(f) A plant leaf cell makes glucose in photosynthesis. Most of the glucose will be immediately converted to starch and stored within the cell.

Explain why storing starch rather than glucose stops plant cells from swelling with too much water.

Use **Figure 2** and your own knowledge.

_____

_____

_____

_____

_____

_____

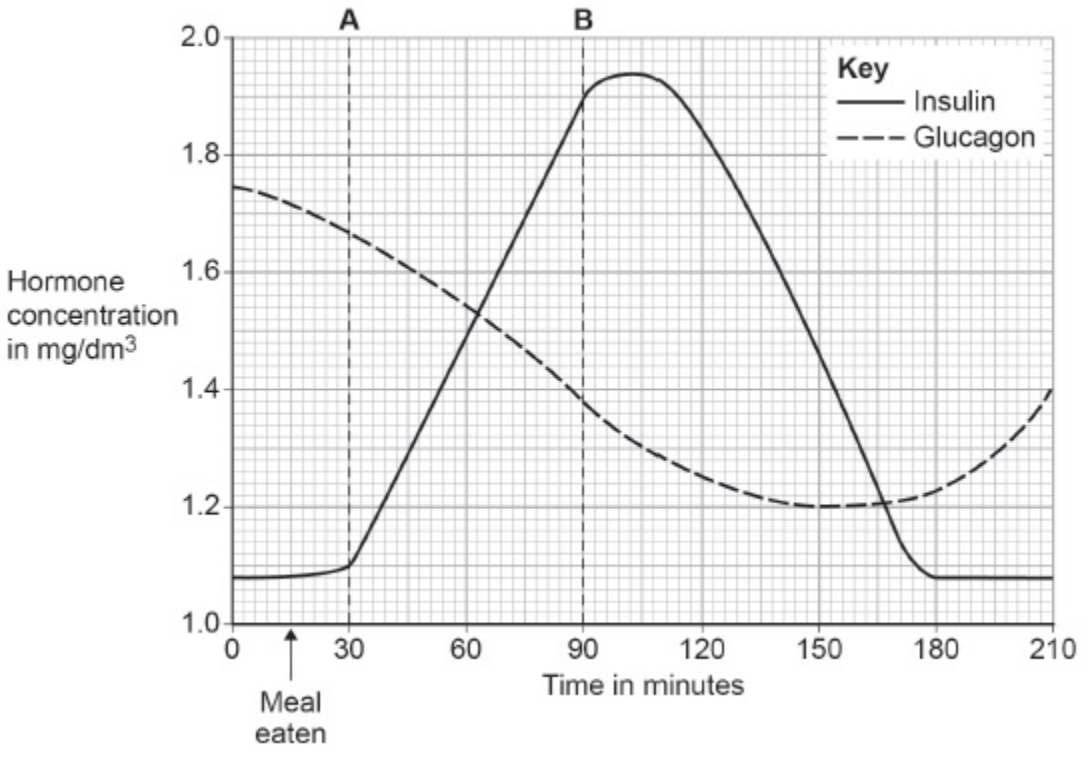
(3)

(Total 14 marks)

7 The human body needs to control blood glucose concentration within narrow limits.

Figure 1 shows how the concentrations of insulin and glucagon change after eating a meal.

Figure 1



(a) Name the organ that produces glucagon.

_____

(1)

(b) Describe how the release of insulin changes blood glucose levels.

_____

_____

_____

_____

(2)

(c) Calculate the rate of insulin release into the blood between points **A** and **B** on **Figure 1**.

You should include the units in your answer.

_____

_____

_____

_____

_____

_____

_____

Rate of insulin release = _____ Unit _____

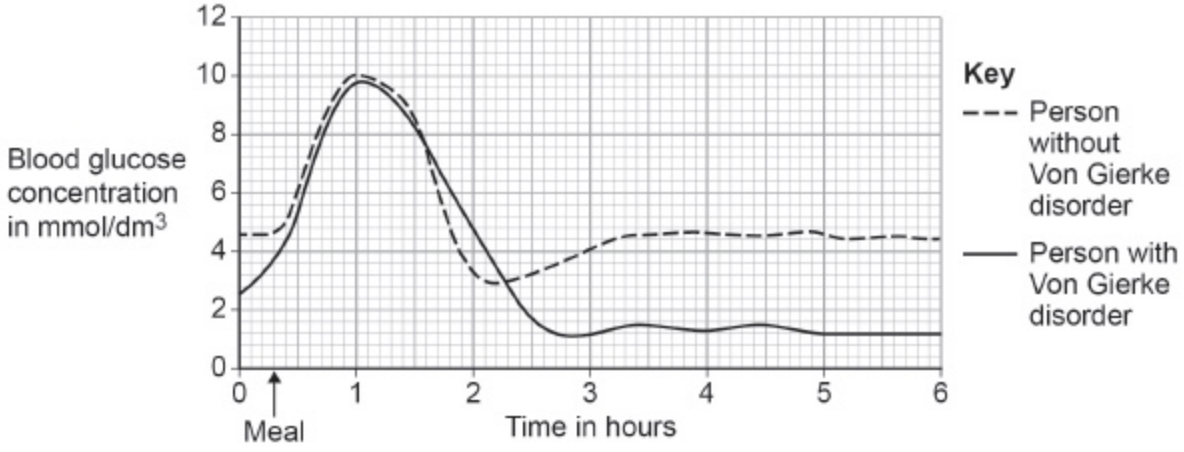
(3)

(d) Von Gierke disorder affects glycogen storage in the body.

One of the enzymes needed to break down glycogen does not work.

Figure 2 shows the blood glucose concentrations in two people after eating a meal.

Figure 2



Explain why people with Von Gierke disorder become very tired when they haven't eaten for some hours.

Use the data from **Figure 2** and your own knowledge.

(5)

(Total 11 marks)

1 (a) (i) receptor

1

(ii) sensory neurone

1

(iii) motor neurone

1

(iv) muscle

1

(b) (i) eye(s)

allow retina

ignore sight

1

(ii) ear(s)

ignore hearing

*do **not** allow ear drum*

1

(iii) ear(s)

ignore balance

1

[7]

2 (a) pancreas

1

(b) the diabetic should get more energy from fat

1

the diabetic should get less energy from carbohydrate

1

(c) (use) insulin

allow pancreas / stem cell transplant

*do **not** allow injection / transplant /stem cells / tablets alone*

ignore exercise

1

[4]

3 (a) (i) the lower the temperature the shorter the time

a trend is required

accept reverse

or

the lower the temperature the more chance of frostbite

accept the lower the temperature the faster you get frostbite

*accept positive correlation but **not** directly proportional*

ignore wind speed

1

(ii) any value from 5 to below 10

*do **not** accept 10*

*allow less than 10 **or** < 10*

1

(b) Muscles 'shiver'

*if more than two boxes ticked deduct **1** mark for each additional tick*

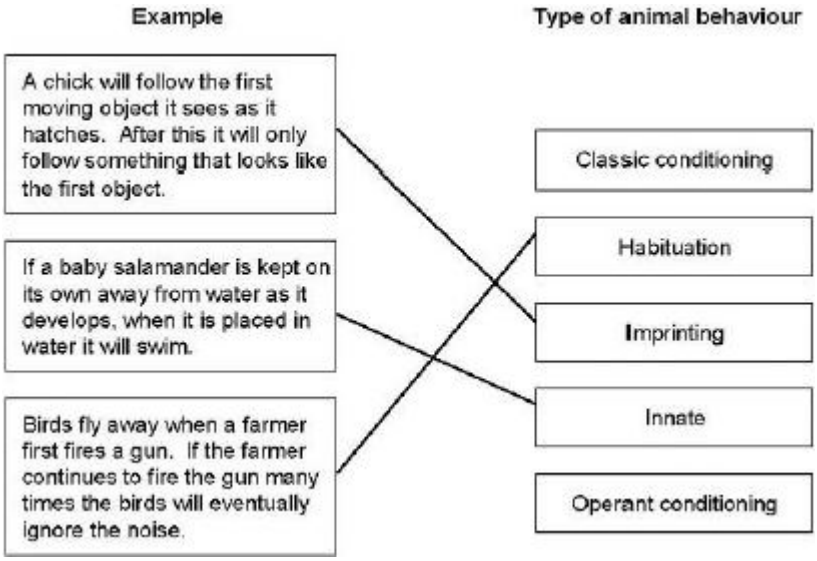
1

Blood vessels supplying the skin capillaries constrict

1

[4]

4 (a)



Extra information
one mark per correct response

more than one line from an example will cancel the mark

3

(b) any **four** from:

- use sample size of 20 or more rats
- (randomly) separate rats into 2 groups
- place 1 or 4 pieces of food at the finish according to the group
- put one rat at a time at the start (of T- maze)
- record if the rat reaches the food or not
- repeat every day for 5 days
- a relevant control variable

  example of a control variable:
  *same type/same size of food pieces **or** same diet prior to test/starved **or** same environmental noise **or** same age/type of rats*

- calculate percentage for each group (which took the correct route)

4 max

(c) rat learns to carry out activity/action

1

associated with reward/food

1

by trial and error

1

(d) **Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

stickleback example − mouth brooding **or** young kept in mouth for first week
Advantages:
- protection in early stages **or** first week increases survival rate (compared to turtle)
- resources required from parent **or** risk to parent are reduced

Disadvantages:
- only protected for first week
- low survival rate (compared to mammal)

Turtle example − egg laying **or** egg contains food for developing offspring
Advantages:
- no risk to parent **or** no further time **or** resources spent on offspring

Disadvantages:
- very low survival rate **or** lowest survival rate
- most die **or** get eaten
- parent has no way of increasing likelihood of offspring surviving
- relies upon innate behaviour **or** no learning from parent

Lion example − early development within mother (uterus)
Advantages:
- high level of parental care increases chances of offspring surviving **or** passing on genes to next generation **or** highest survival rate
- offspring have a reliable source of food **or** mother produces milk
- protection from predators
- taught how to avoid predators and where to find food etc.

Disadvantages
- mother at risk from starvation or disease **or** predators
- uses up a lot of mother's time and resources.

[16]

5 (a) any **two** from:

- ribosome(s)
- (cell) wall
- (cell) membrane
- cytoplasm

2 max

(b) prevents growth of

OR

kills bacteria

1

(c) (random) mutations occur (giving resistance)

1

the resistant bacteria (survives and) reproduces/replicates

1

population (of resistant strain) increases due to lack of competition or due to non-resistant killed by antibiotic

1

(d) to produce a plate with only one species

allow to prevent contamination from other bacteria or other species may affect results.

1

(e) optimum/best temperature to allow (these) bacteria to grow/replicate

1

(f) any **two** from:

- wash hands with (disinfectant) soap

  allow alcohol
  allow wear disposable gloves

- clean surfaces with disinfectant

  allow alcohol

- wear safety goggles

  allow eye protection

- keep Petri dish sealed

- dispose of waste in biohazard bag

  or

  by using pressure cooker/autoclave/heating to 120 °C

- incubate at 20−25 °C

  *allow do not eat **or** drink*

2 max

(g) diameter 15 **and** 16

1

(any order)

allow correct calculation for mean based upon student's own measurements.

mean diameter = 15.5

1

(h) In support:

both solutions (blueberry juice and coconut oil) produced a clear area or prevented growth of bacteria with at least medium antibacterial activity.

1

Qualified:

only coconut oil showed high antibacterial activity or blueberry juice (only) showed a medium level of activity.

1

Use of data:

(because) blueberry juice has a (medium antibacterial activity with a) diameter of 11.5 mm which is between 9 and 13 mm

or

(because) coconut oil has a (high antibacterial activity with a) diameter of 15.5 mm which is greater than 13 mm

or

antibiotic produced the greatest clear area by at least 2.5 mm **or** 16% **or** 6.5mm **or** 57% more than blueberry juice.

allow ecf from student's answer in (g)
allow any correct comparison using data

1

(i) any **two** from:

- first scientist did not repeat the test

  or

  anomalies unknown with only one Petri dish (for first scientist)

- (clear areas not symmetrical so) depends on where the diameter was measured
- concentration/volume of solutions may differ
- may have used a different type/strain of bacteria
- different sources/brands of plant extract
- paper discs may have been different sizes

*If not other marks gained allow used different equipment for **one** mark.*

2 max

[17]

6 (a) 1. Light receptors − eyes

1

2. Sound receptors − ears

1

(b) any **four** from:

- (receptor to) sensory neurone
- (ref to) CNS

or

spinal cord

or

relay neurone

- (ref to) motor neurone
- (ref to) muscles
- (ref to) synapse (at any suitable point)

Full marks can only be given if sequence is in the correct order

4

(c) fewer receptors

1

(so) fewer impulses sent along sensory neurones

or

(so) fewer impulses sent along sensory neurones

1

(d) both bars drawn to the correct height

1

(e) capsaicin is insoluble (so) will not be dissolved / removed by water

allow very low solubility
allow remains on tongue

1

impulse still sent (from receptors)

1

(f) starch is insoluble

allow converse points re glucose

1

(so) the concentration (of solution) inside the cell stays the same

1

(and therefore) water will not pass in by osmosis (and cause the cell to swell)

1

[14]

7 (a) pancreas

1

(b) any **two** from:

- lowers blood glucose levels
- by allowing glucose to move (from blood) into (liver) cells

  *must be clear that glucose moves **into** the cells and not out allow glucose moving into liver/muscles*
- to store as/convert into glycogen.

2

(c) $\frac{0.8}{60}$

1

$0.01\dot{3}$

1

$mg/dm^3/min$

allow mg dm^{-3} min^{-1}

1

OR

0.8 (1)

In 1 hour = 0.8 (1)

$mg/dm^3/hr$ (1)

an answer of $0.01\dot{3}$ scores 2 marks

(d) low/little glucose in blood after 2.5 − 3 hours

allow any correct ref to data

1

(low/little glucose) for respiration

1

to release energy

*do **not** allow to produce energy*

1

blood glucose levels cannot be brought back to normal

allow blood glucose levels stay low

1

because glycogen not converted into glucose

1

[11]