Question 1 (10 marks)

Medical technologies have evolved to allow for better patient care and faster recovery times. Average life expectancy has increased due to improved medical care, and modern wound healing treatments.

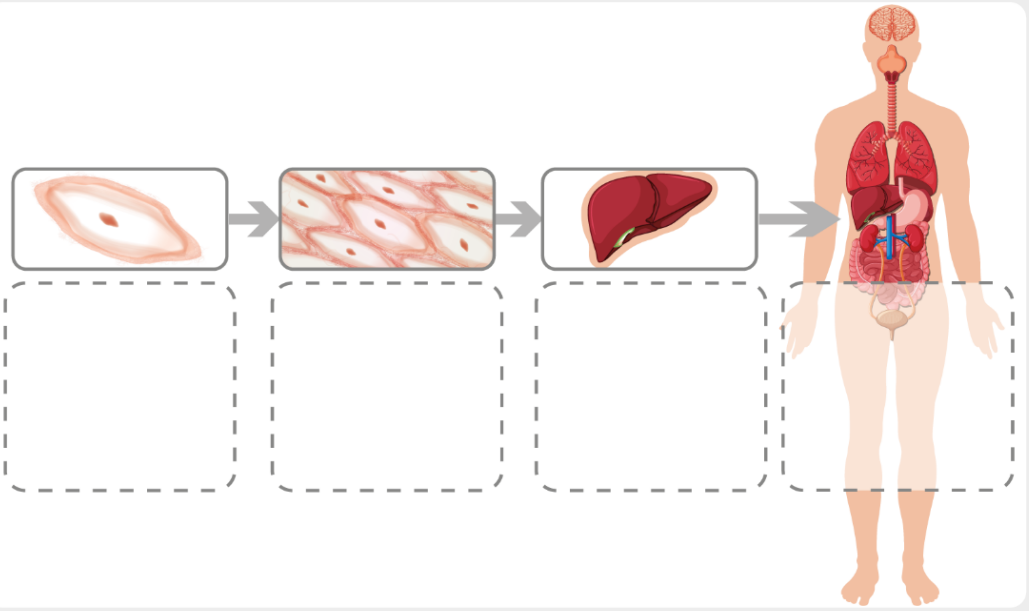
Question 1a (1 mark)

Wounds form after the skin barrier has been broken. The skin is the largest organ in the body. **Select** the appropriate description for each of the images below.

Select the appropriate description for each of the images below.

Draggable labels:

- Different types of cells working together to perform a similar function
- More than one of the same type of cell working together to perform a similar function
- Smallest unit of life
- A living organism formed of a collection of interdependent parts



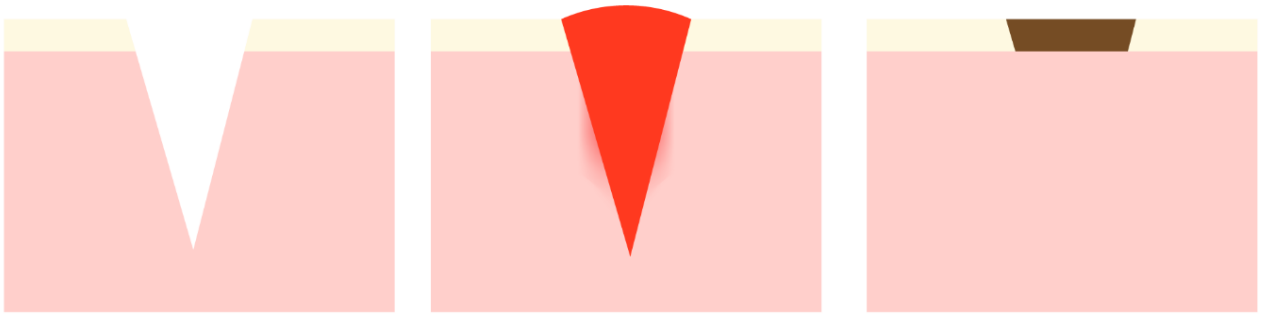
Question 1b (1 mark)

The figure below shows the stages of wound healing.

Stage 1:
The outer layers of the skin are broken.

Stage 2:
The area is filled with blood and immune system cells, which work to remove bacteria and begin the healing process.

Stage 3:
The skin is repaired and filled with scar tissue.



In stage 3, skin cells divide to form new cells to repair a wound. **State** the name of the process by which skin cells divide.

Styles

Words: 0

Question 1c (1 mark)

The first step in wound treatment is the use of antiseptic solution to clean the wound. These solutions usually contain hydrogen peroxide, H_2O_2.

Hydrogen peroxide is made of the elements hydrogen and oxygen. **Identify** one physical property that is the same for both elements.

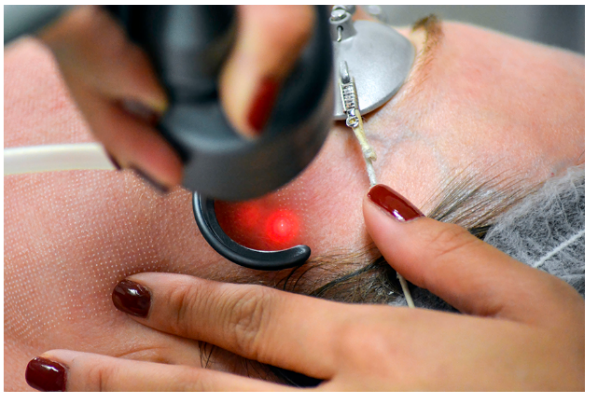
Question 1d (3 marks)

Explain how the atoms are bonded in hydrogen peroxide.

Styles

Words: 0

Question 1e (1 mark)



Other methods of wound treatment include the use of lasers to speed up healing. A laser emits waves in the visible light region of the electromagnetic spectrum.

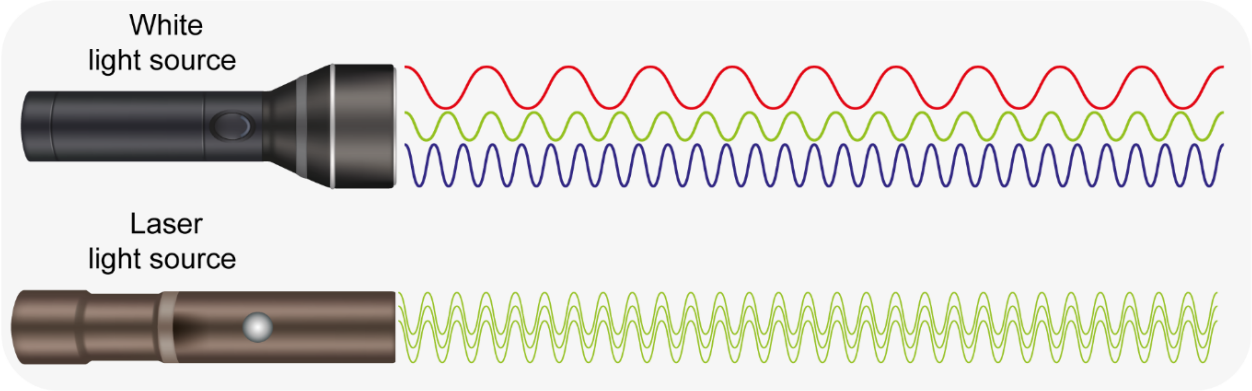
State one other type of wave found in the electromagnetic spectrum.

B I U x_2 x^2 Ω Styles

Words: 0

Question 1f (2 marks)

The light waves emitted by a flashlight and a laser are shown in the figure below.



Outline how the waves emitted by the laser are different to those emitted by the flashlight.

Question 1g (1 mark)

Suggest one safety precaution that medical professionals need to take to protect themselves when using lasers.

Styles

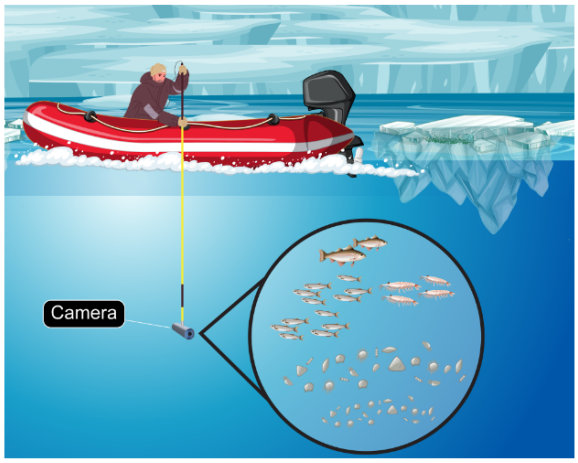
Bulleted List

Words: 0

Question 2 (13 marks)

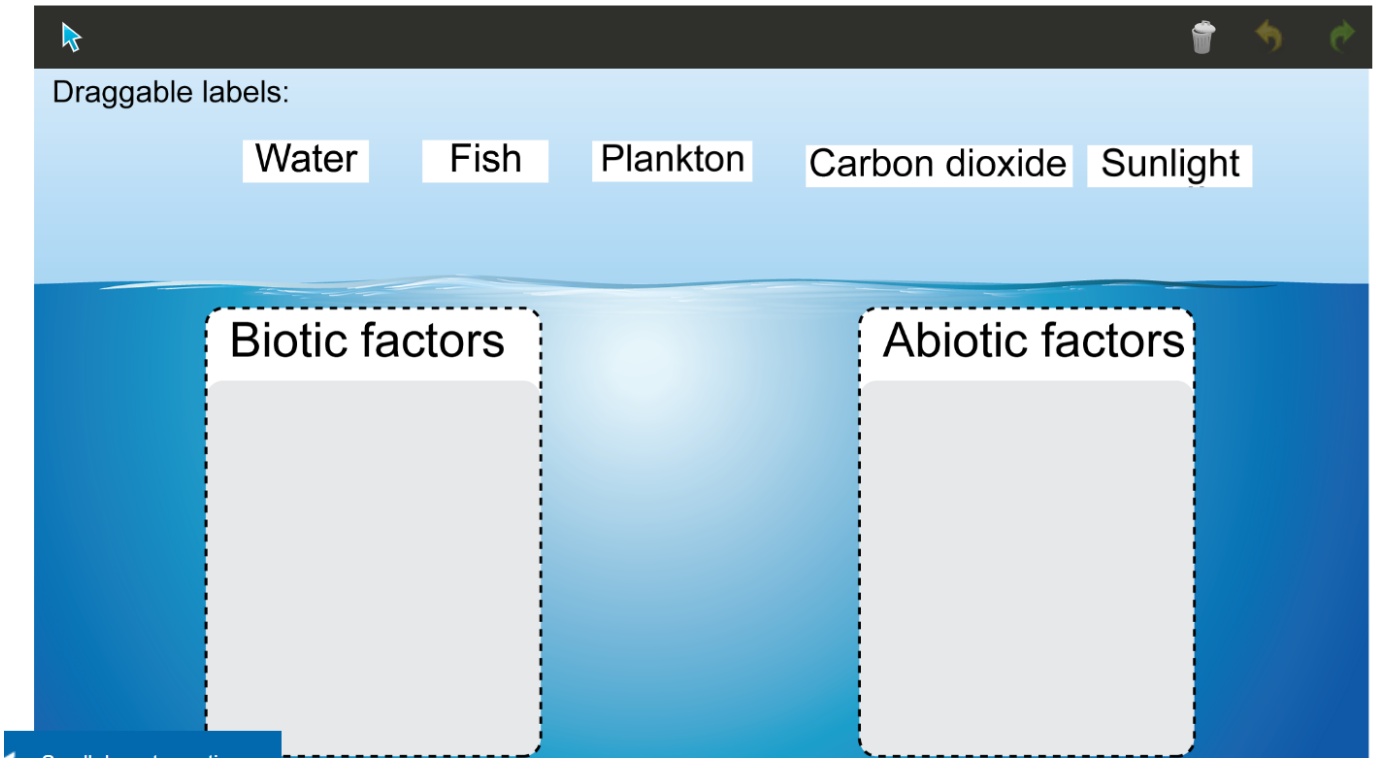
Scientists have been making scientific discoveries in extreme environments such as the Arctic and Antarctica since the development of technologies that allow them to live in and explore these territories.

Question 2a (1 mark)



By lowering cameras into a hole in the ice, scientists can study organisms found deep in the ocean. Recent discoveries have uncovered ecosystems with a range of species.

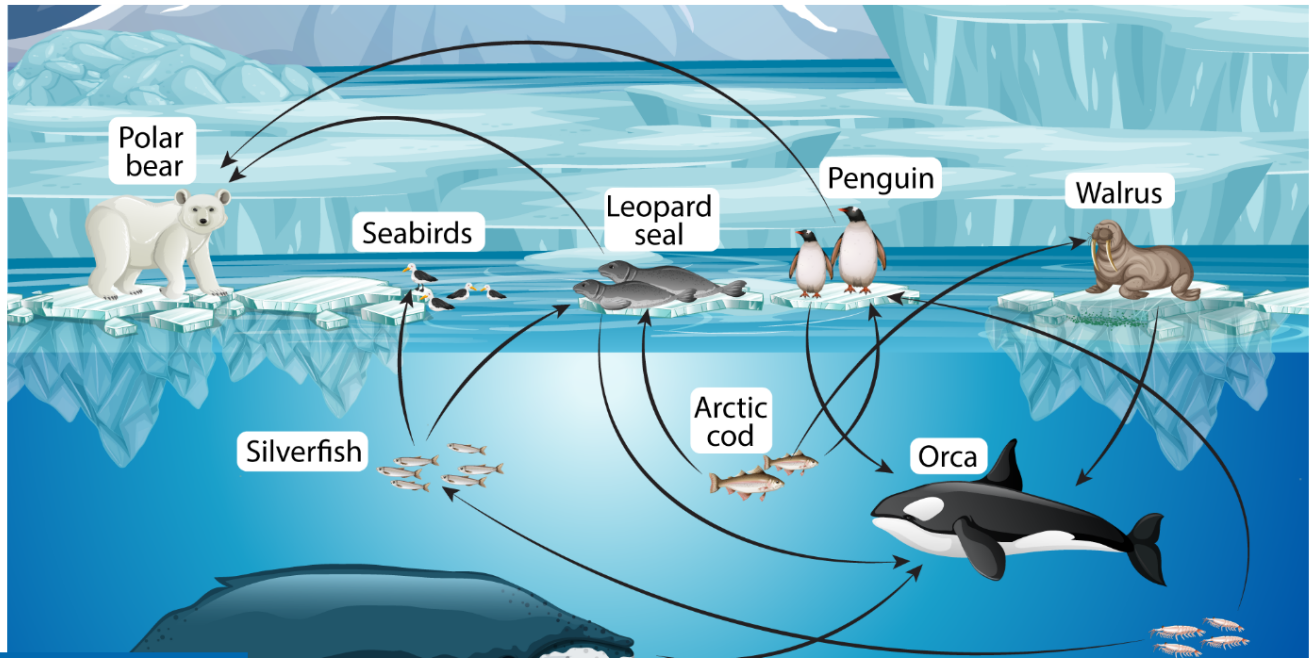
Biotic and abiotic factors are what make up ecosystems. Biotic factors are the living things in an ecosystem, abiotic factors are the non-living things. **Select** the location for each factor in the Arctic marine ecosystem.

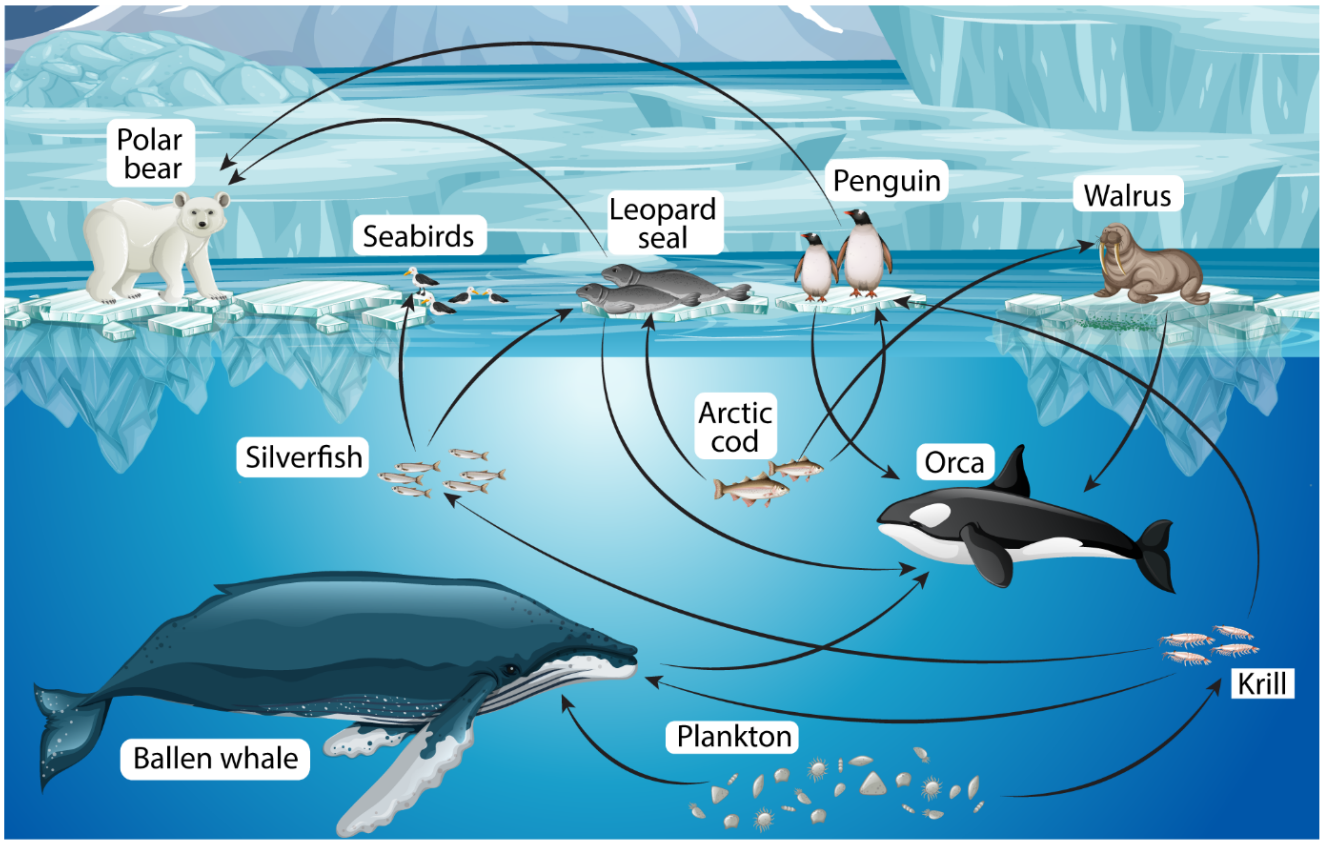


Question 2b (1 mark)

The food web for the Arctic marine ecosystem the scientists are studying is shown below.

Diagram not to scale




Polar bear
Seabirds
Leopard seal
Penguin
Walrus
Arctic cod
Silverfish
Orca
Krill
Plankton
Ballen whale

Identify the producer in this Arctic marine ecosystem.

Styles

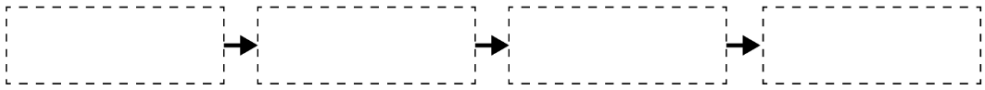
Words: 0

Question 2c (1 mark)

Identify one food chain of four organisms in the diagram in part (b).

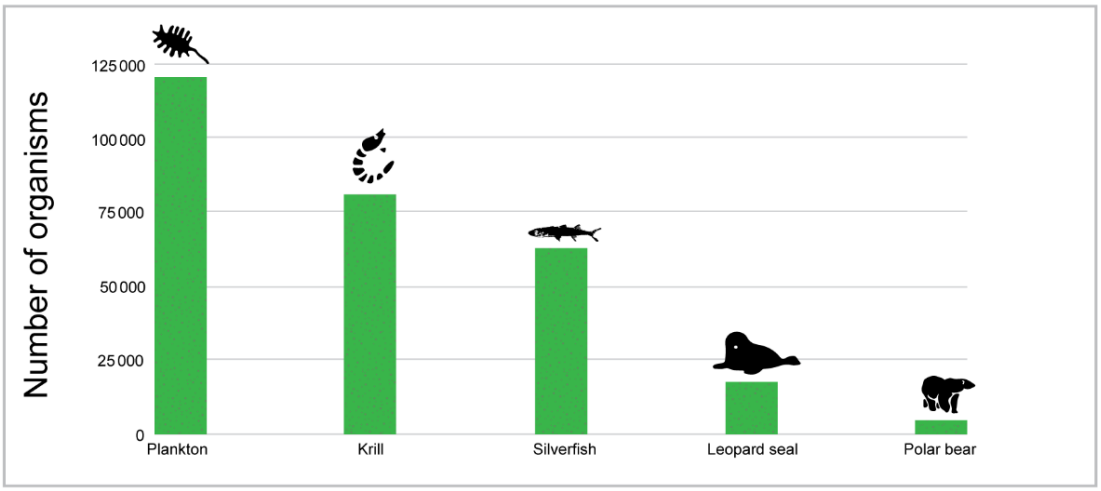
Draggable items:

Polar bear	Seabirds	Leopard seal	Penguin
Walrus	Arctic cod	Orca	Ballen whale
Plankton	Krill	Silverfish	



Question 2d (4 marks)

The scientists collected data on the number of organisms in the area they were studying. The data is shown in the graph below.



Use the food web in part (b) to **explain** the trends shown by the graph. You must use scientific terminology in your answer.

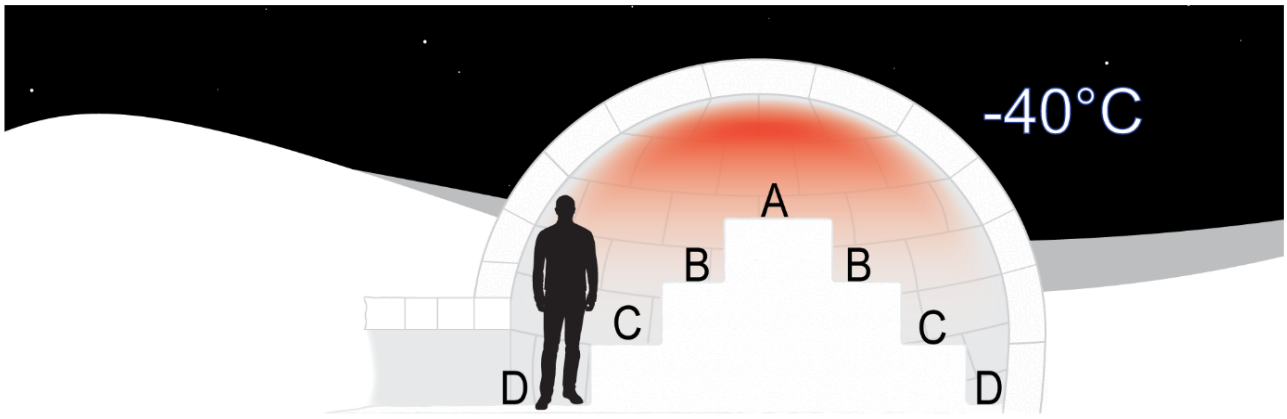
Use the food web in part (b) to **explain** the trends shown by the graph. You must use scientific terminology in your answer.

Styles

Words: 0

Question 2e (3 marks)

To survive the extreme cold temperatures in the Arctic, scientists build snow shelters. They pack snow loosely together to form the walls and the floors of the shelter. At night when the scientists are sleeping, the inside of the shelter is warmed by the heat from their bodies as shown in the diagram below.



Using scientific terminology, **describe** the process by which thermal energy is transferred from the scientist's body to warm the air inside the shelter.

Using scientific terminology, **describe** the process by which thermal energy is transferred from the scientist's body to warm the air inside the shelter.

Styles

Words: 0

Question 2f (1 mark)

Use your answer from part (e) to **select** the best location for the scientists to sleep.

Select
Select
A
B
C
D

Question 2g (1 mark)

Question 2g (1 mark)

Scientists who work in extreme cold conditions are often given hand warmers. These are small bags that heat up once they are unwrapped, allowing the oxygen in the air to react with iron in the hand warmer to form iron (II) oxide and release heat.

©

The chemical reaction happening inside the hand warmer is shown here. **Select** the correct coefficients to balance the equation.

? Fe + ? O_2 → ? Fe_2O_3

Question 2h (1 mark)

Identify the evidence that a chemical reaction is taking place when the oxygen in the air reacts with iron to form iron (II) oxide.

Styles

Words: 0

Question 3 (9 marks)

Some fish can adapt to live in different environments such as oceans, lakes or indoors in aquariums. When in aquariums, the fish must be provided with clean, oxygenated water and food needed for their species.

Question 3a (1 mark)

State two nutrients that a fish needs to maintain life.

Styles

Bulleted List

Words: 0

Question 3b (1 mark)

Fish nutrition has advanced dramatically in recent years with the development of new, balanced fish foods that promote optimal fish growth.

In an experiment to maximize fish growth, feed efficiency (FE) can be calculated using the formula:

$$\text{Feed efficiency (FE)} = \frac{\text{mass gained by the fish}}{\text{mass of food provided}} \times 100\%$$

Feed efficiency greater than 50 percent is considered acceptable.

One student measured the mass gained by the fish and calculated the feed efficiency of five different species of fish in a certain amount of time. 50 grams of food were provided for each species of fish over the course of the study. The results are shown in the table below.

Fish species	Mass gained in grams / g	Feed efficiency %
A	12	24
B	18	
C	14	28
D	30	60
E	35	70

Calculate the missing value in the table above.

Styles

Words: 0

Question 3c (1 mark)

Identify the fish species whose growth is not considered acceptable.

A ☐

B ☐

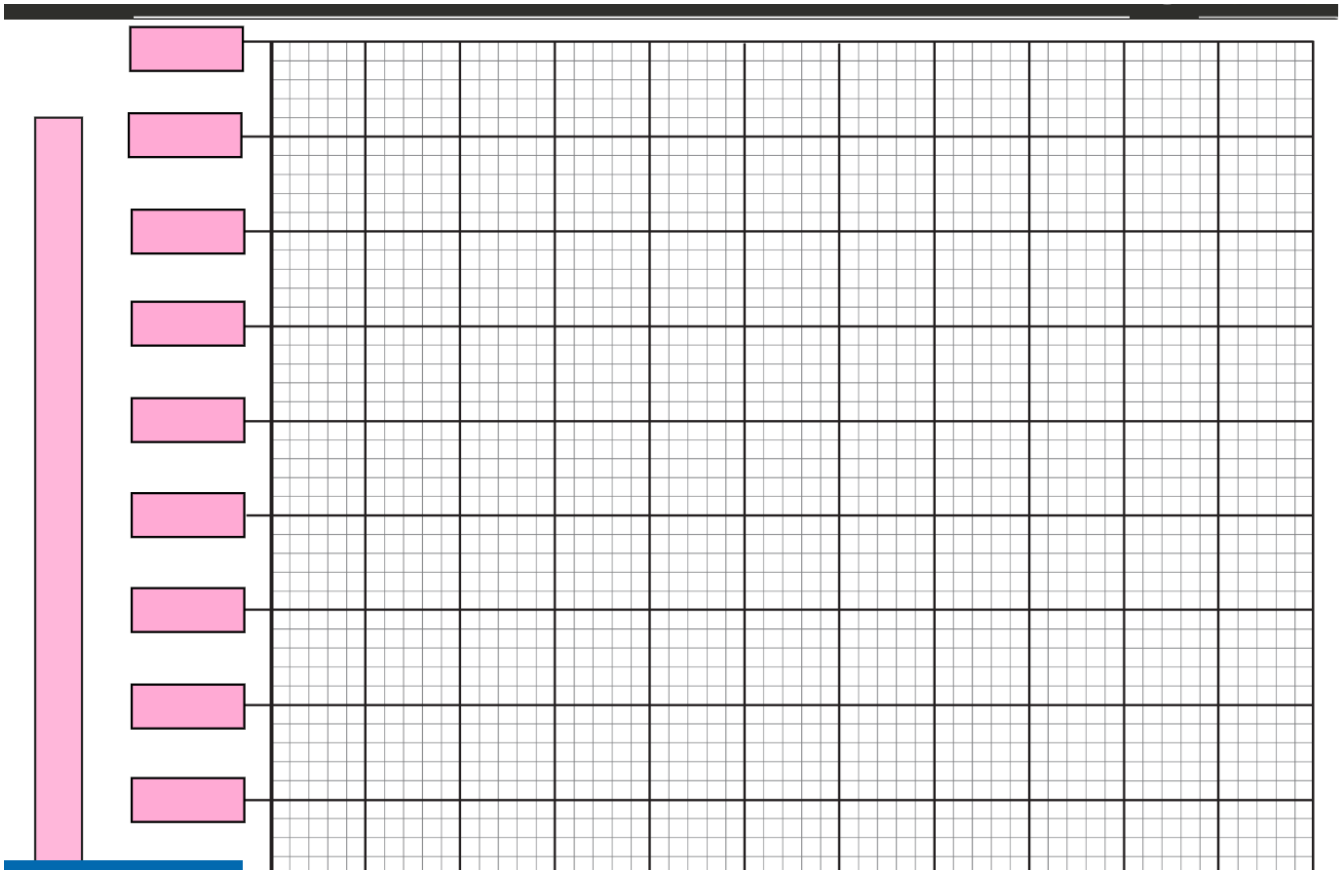
C ☐

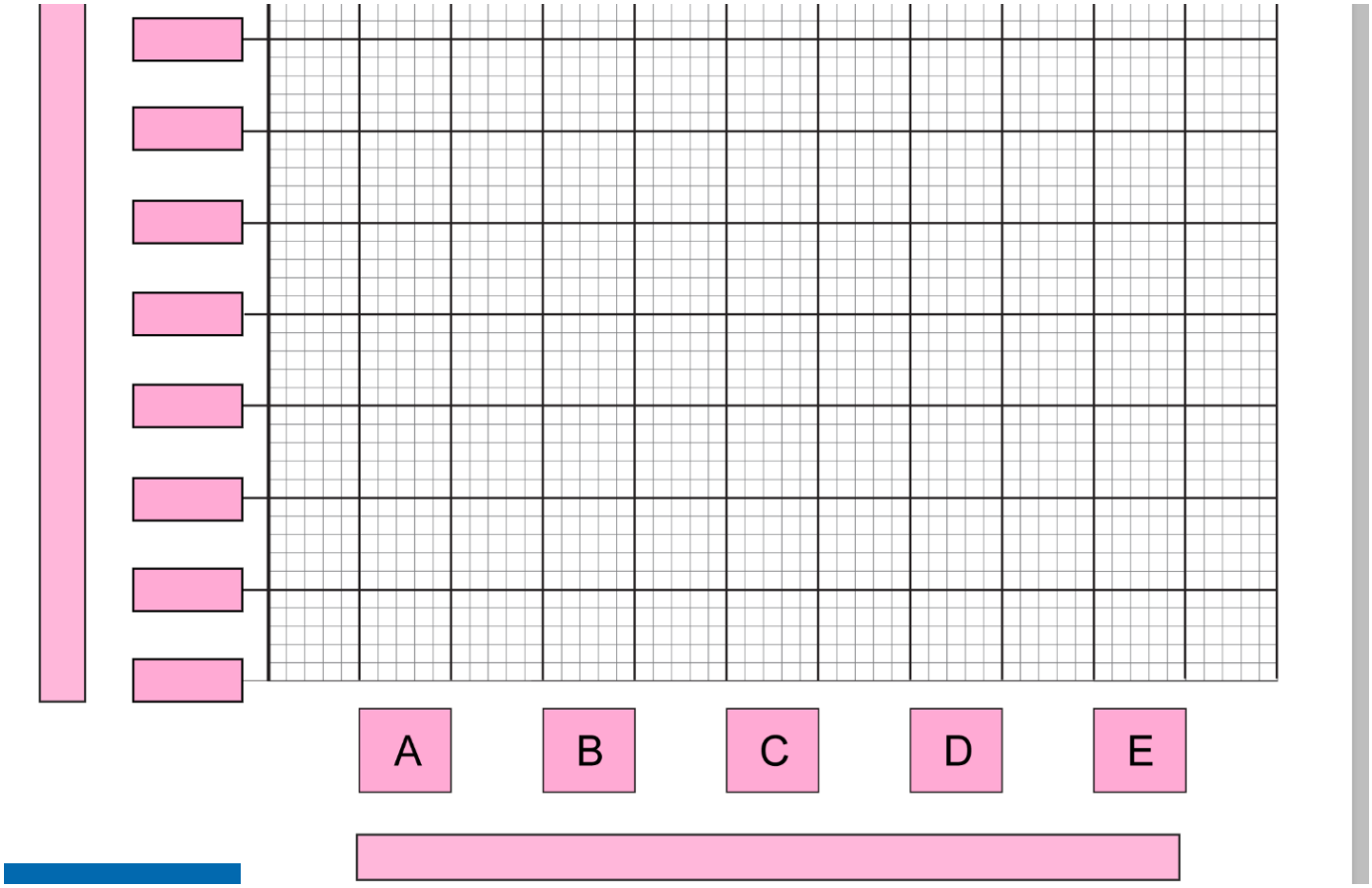
D ☐

E ☐

Question 3d (3 marks)

Plot a graph of the feed efficiency data in the table in part (b).




A
B
C
D
E

Question 3e (3 marks)

The hypothesis for the student's experiment was:

> *If the same mass of food is provided to different species of fish, then the feed efficiency would be similar for all species because fish have similar nutritional needs.*

Using the data from the graph, **comment** on the validity of the hypothesis provided by the students. **Justify** your answer.

○ Valid

○ Invalid

B I U x_2 x^2 Styles

Question 4 (20 marks)

Brine shrimp are a nutritious source of food for fish. The video shows some background information about brine shrimp.

Video | Transcript

While commercial dried fish food is a good base food for fish, it's essential to provide variety. Some fish benefit from occasional treats like brine shrimp, bloodworms, and even small pieces of vegetables.

Brine shrimp inhabit highly saline waters around the world, both inland and on the coast. Brine shrimp can grow up to approximately 1cm in length. Despite their small size, they are an important part of different saltwater ecosystems. Newly hatched brine shrimp are high in fats.

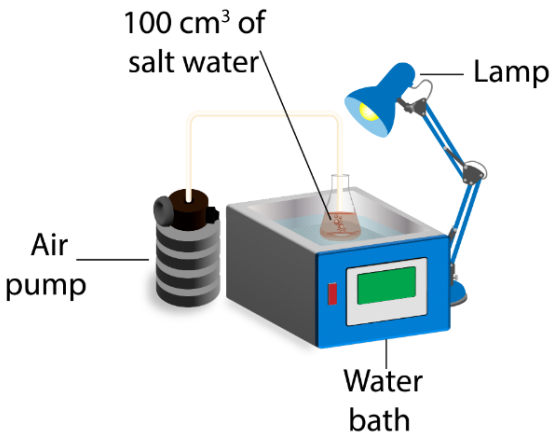
Brine shrimp produce eggs, known as cysts, which remain inactive until the environmental conditions are optimal for them to hatch. The cysts can be packaged and distributed to different fisheries around the world. The dried cysts can be stored for long periods and hatched in water on demand to provide a convenient form of feed for fish and other marine organisms. Each cyst is as small as a grain of fine sand. A teaspoonful contains many thousands of cysts.

For cysts to hatch, different variables need to be correct such as the temperature, salt concentration, pH, light and oxygen levels.

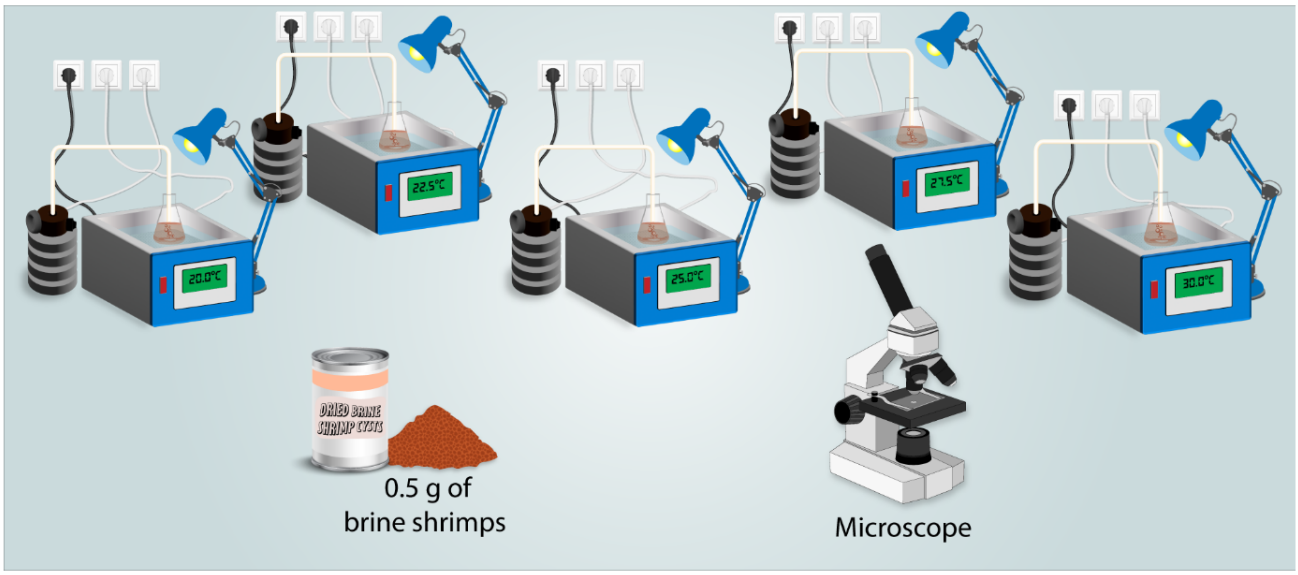
Question 4a (1 mark)

A student has built an aquarium in their school lab and wants to provide nutritious food to the fish. They have bought a can of dried brine shrimp cysts and want to hatch these small organisms in the lab.

The student wants to investigate the effect of changing the temperature of the water on the number of brine shrimp that hatch after 24 hours.



The student sets up the equipment as shown in the image below.



State a research question for this investigation.

Question 4b (2 marks)

Identify the independent and dependent variables in this investigation.

Independent variable

Styles

Words: 0

Dependent variable

Styles

Question 4c (2 marks)

State two variables that the student must control.

Control variable one

Styles

Words: 0

Control variable two

Styles

Words: 0

Question 4d (4 marks)

The information on the label of the can of cysts suggests that the temperature must be in the range of 22°C to 30°C.

Use scientific reasoning to **explain** what would happen if the student did not use the recommended temperature range.

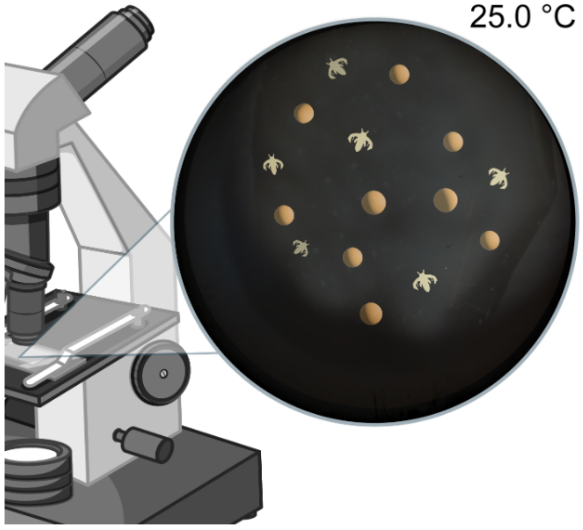
Styles

Words: 0

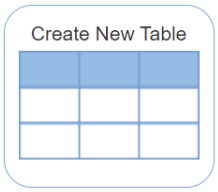
Question 4e (4 marks)

The student performed one trial. He added 0.5 g of brine shrimp cysts to 100 cm^3 of water at different temperatures. After 24 hours the student took one drop of water (0.05 cm^3) and observed it through the lens of the microscope. The student recorded their data on a page in their laboratory notebook.

Temperature	Number of cysts that hatched
30	6
22.5 °C	4
27.5	seven
20	3
25.0	



Present the student's data in a table and use the image above to **determine** the missing value.



Reset

Question 4f (2 marks)

The data in part (e) is for a sample of 0.05 cm^3. Use this data to **calculate** the total number of cysts that hatched in 100 cm^3 at 30°C.

B I ↩ ↪ U x_2 x^2 Styles

Words: 0

Question 4g (2 marks)

Suggest and **justify** one safety precaution which the student should take when performing this investigation.

Styles

Words: 0

Question 4h (2 marks)

State one weakness in the method and **suggest** one improvement to address this weakness.

Styles

Words: 0

Question 4i (1 mark)

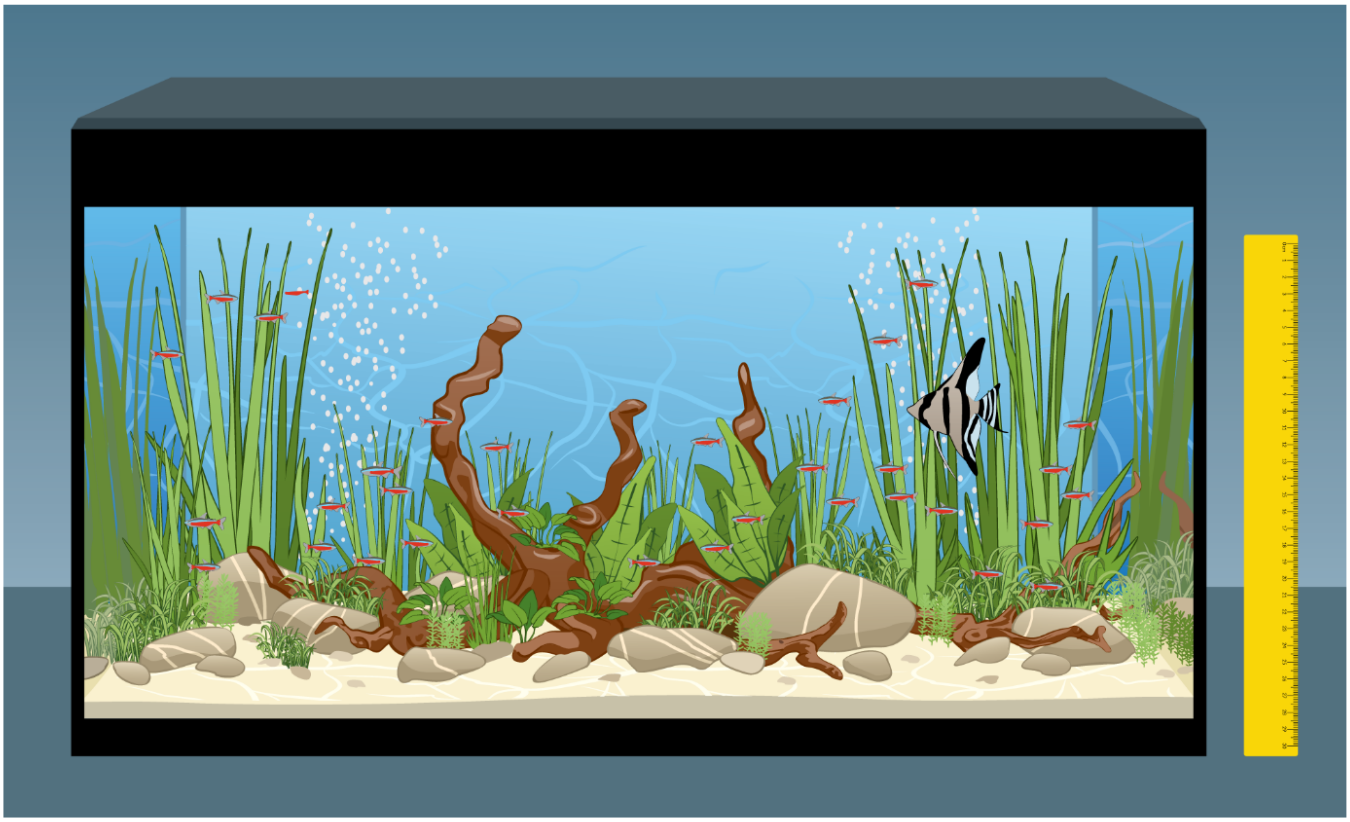
Suggest one ethical concern in this investigation.

Styles

Words: 0

Question 5 (16 marks)

The student wanted to study the relationship between fish growth and the mass of fish food. After feeding each fish with a different mass of food every day, they measured the length of each fish after one month. They used several fish tanks, some fish, and a large fish food container.



Design an investigation to study the effect of different masses of fish food on fish length after one month. In your answer, you must include:

- the independent variable, the dependent variable and two control variables
- a hypothesis
- a list of additional equipment needed
- how the variables will be manipulated to collect sufficient data
- a description of your method.

Question 6 (8 marks)

The student did some more research about factors affecting fish health in aquariums. They found some data linking breathing rate to water temperature. In fish, gills form the oxygen uptake system. The gills open each time a fish takes a breath. The researchers examined the gills to calculate the breathing rate of the fish at different temperatures.

20°C

00:21

20°C

03:20

Water flows in
through the mouth

Water flows out
through the gills

20°C

10:00

Water flows in
through the mouth

Water flows out
through the gills

Question 6a (2 marks)

Use the animation to **calculate** the breathing rate in breaths per minute at 20°C.

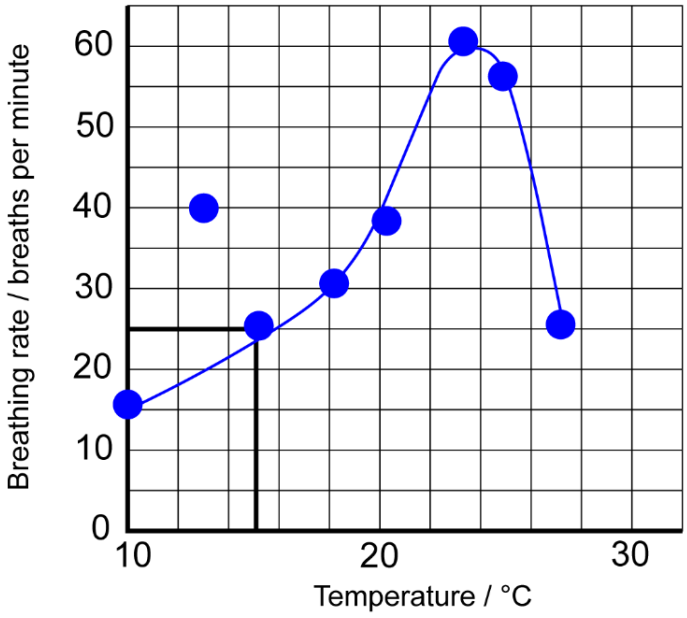
Special characters

Styles

Words: 0

Question 6b (1 mark)

The data that the student found is shown below.



Identify the outlier.

Styles

Words: 0

Question 6c (2 marks)

Outline the trend shown in the graph in part (b).

Styles

Words: 0

Question 6d (2 marks)

Using the graph in part (b), **predict** what might happen to the breathing rate at 0°C **and** the effect of this change on the fish.

Styles

Words: 0

Question 6e (1 mark)

The mass of oxygen dissolved in water changes with temperature as shown in the table below.

Water temperature / °C	Dissolved oxygen content of water / mg dm^{-3}
0	14.6
5	12.8
10	11.3
15	10.1
20	9.1
25	8.3
30	7.6

Use the graph in part (b) and the table to **estimate** the dissolved oxygen content of the water at the maximum breathing rate of the fish.

Question 7 (7 marks)

Question 7a (3 marks)

Approximately 1.3 million people die every year in road accidents worldwide. Human errors made by the driver are the leading cause of road accidents. One cause of human error in driving is use of a cell phone.

The image below shows a driver braking and stopping the car right before it hits the deer. Typically, the time it takes a human to react to a hazard on the road is 1.5 seconds.

Scroll down to continue

Describe how using a cell phone while driving affects the reaction time of the driver and the motion of the car.

Styles

Words: 0

Question 7b (4 marks)

Apart from human factors, other factors might affect driving and result in an accident. For each factor below, **identify** an example and **justify** how the risk of an accident is increased.

Environmental factor

Styles

Words: 0

Car-related factor

Styles

Words: 0

Environmental factor

Styles

Words: 0

Justification

Styles

Car-related factor

Styles

Words: 0

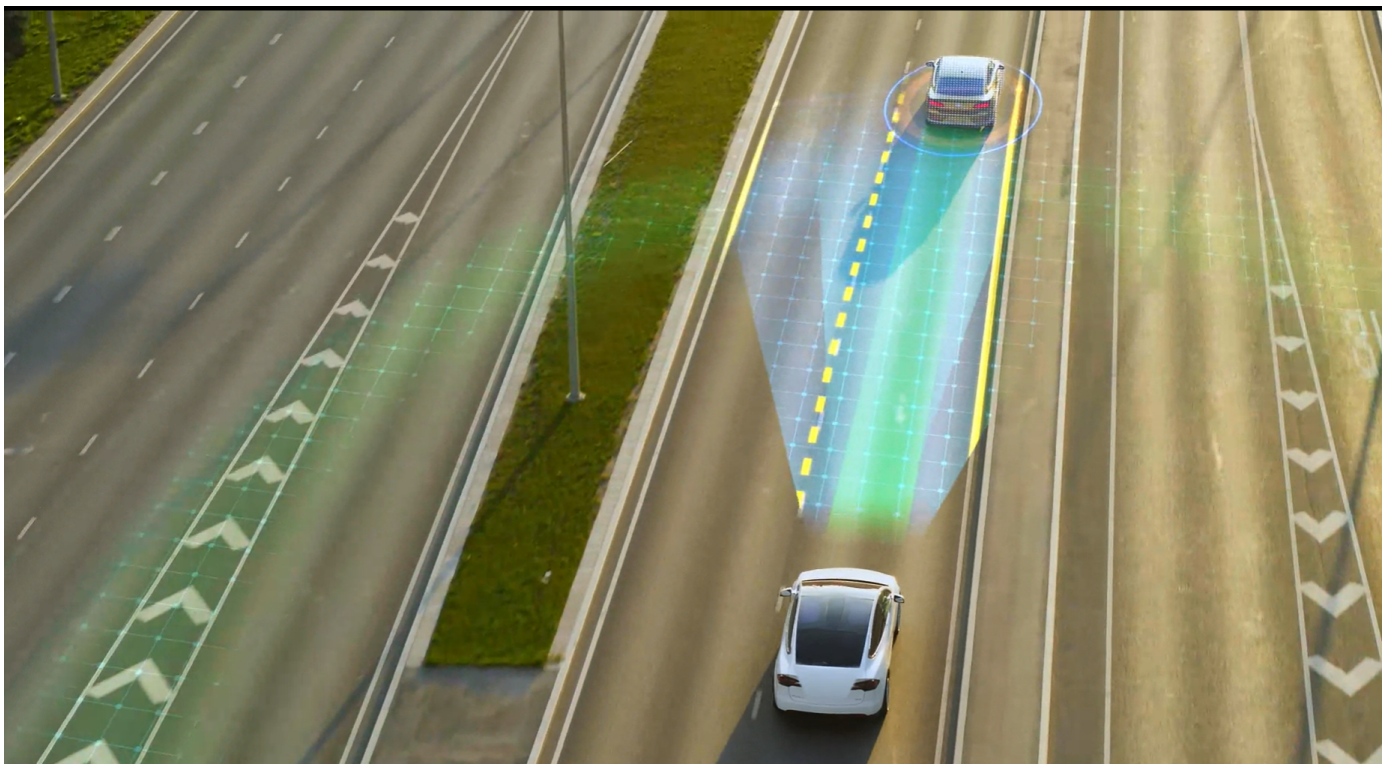
Justification

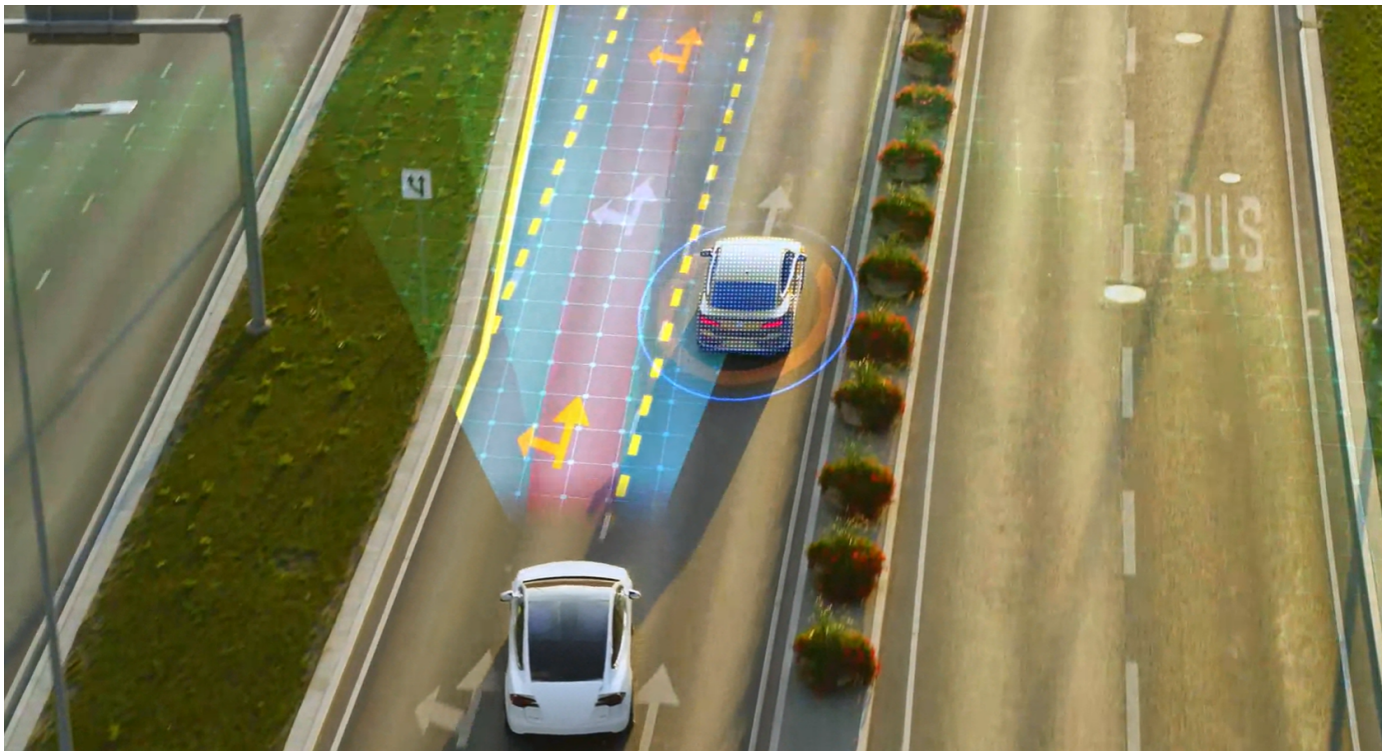
Styles

Question 8 (17 marks)

Road safety issues have been a concern in many countries. These countries have invested time, money, and human capacity to reduce the number of road accidents and the casualties caused by them. Investing in advanced car technologies and systems is one innovation countries are using to improve road safety.

A self-driving car is a vehicle that navigates its surroundings without the need for a driver. To sense its surroundings, make judgements, and control its motion on the road, a self-driving car uses a combination of cutting-edge technologies, including sensors, cameras, radar, LiDaR (light detection and ranging using laser), GNSS (Global Navigation Satellite System), and sophisticated software as shown in the video below.



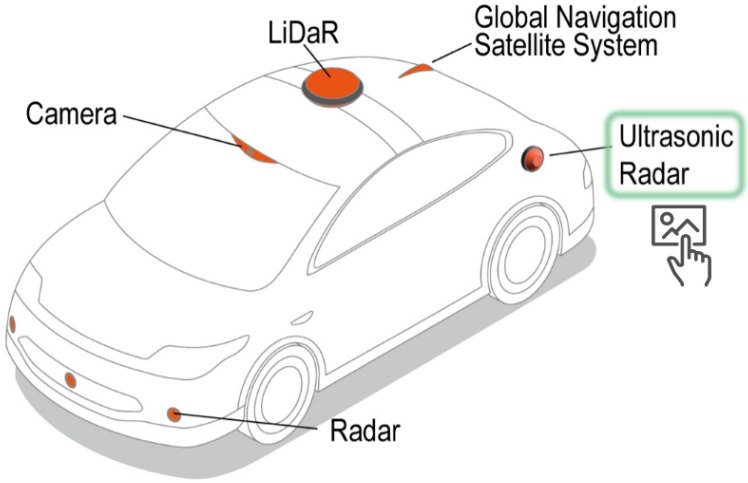

BUS

The infographic below will help you understand some of the technologies used in self-driving cars.

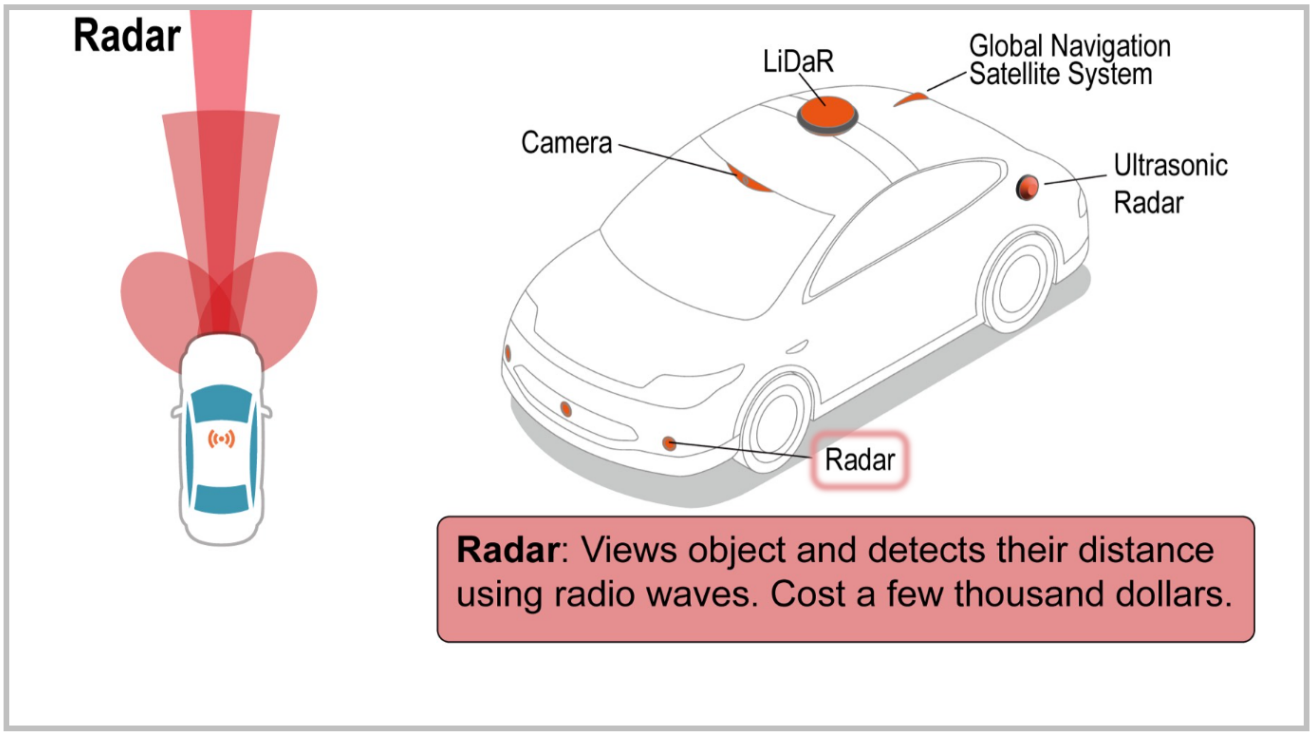
All of the different technologies work together in a self-driving car and some cost several thousand dollars each.

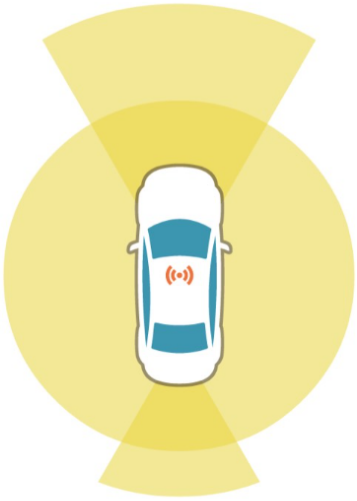
Click on the icons to show images.

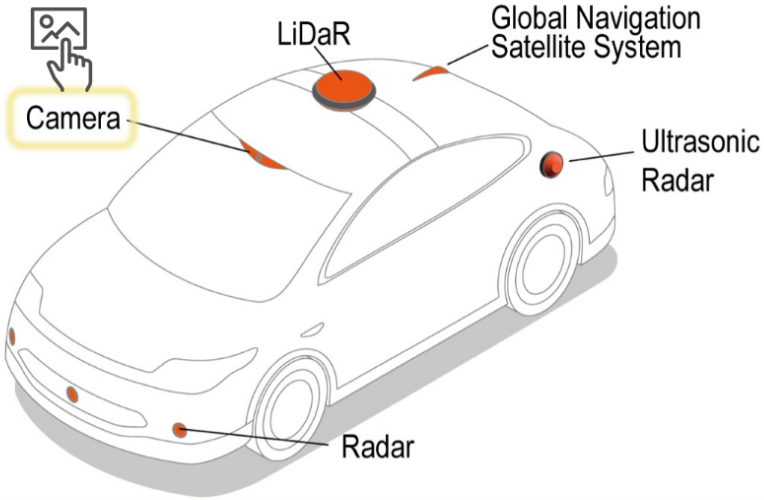
Ultrasonic Radar



Ultrasonic Radar: Detection of nearby cars or kerbs using sound waves to help in parking. Cost tens of dollars.

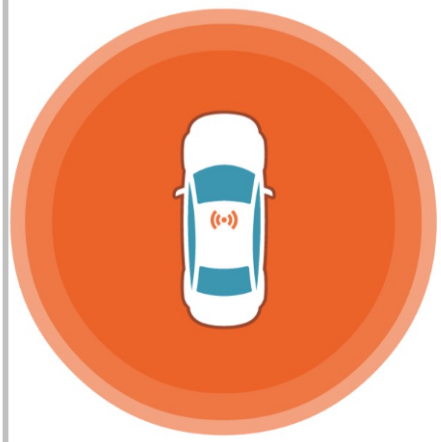

Radar
LiDaR
Global Navigation Satellite System
Camera
Ultrasonic Radar
Radar
Radar: Views object and detects their distance using radio waves. Cost a few thousand dollars.

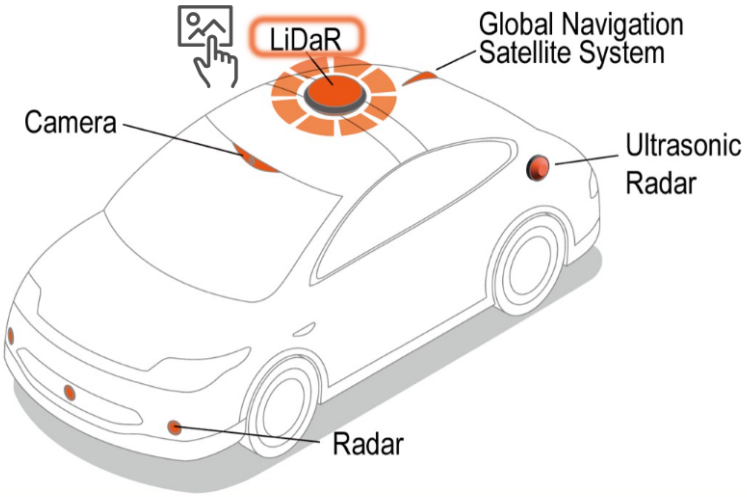




Camera: Views objects and traffic lights and identifies road signs with a 360 degree surrounding view. Cost several hundred dollars.

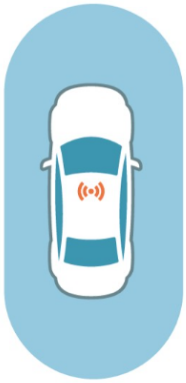
LiDaR

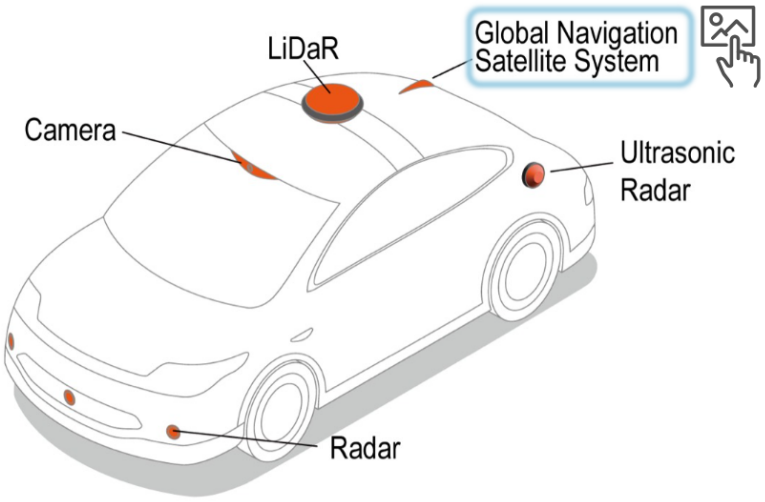




LiDaR: 3D mapping of the environment around the car. It detects objects and can tell the difference between an animal and another car. It can also identify road markings and the edge of the road. Cost a few thousand dollars.

Global Navigation Satellite System

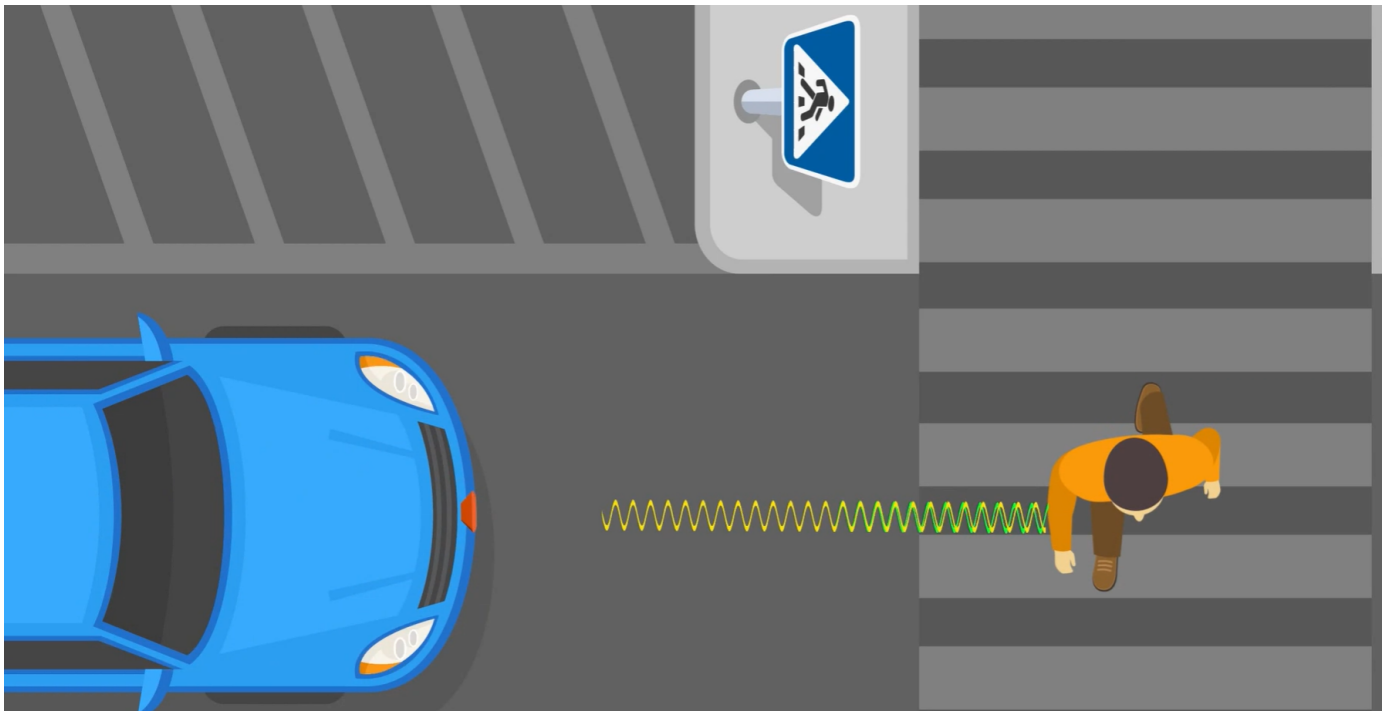




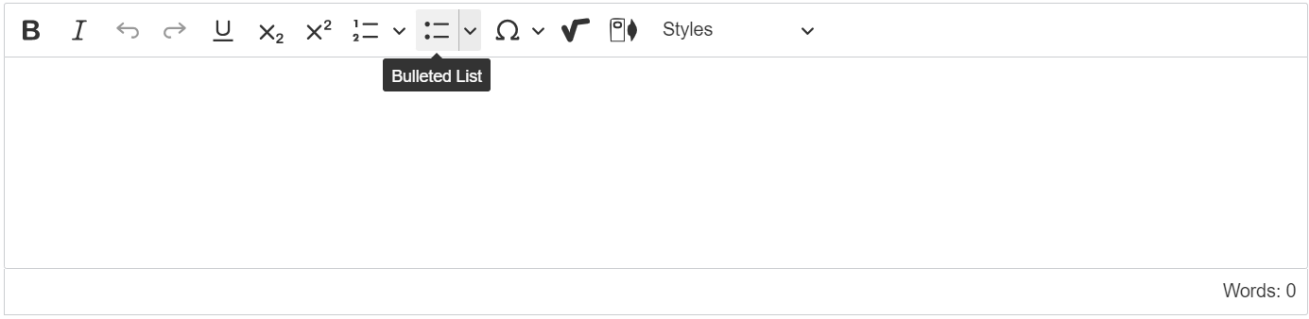
Global Navigation Satellite System: Communicates with other self-driving cars, registers other vehicles' location and speed. Cost a few thousand dollars.

Question 8a (3 marks)

A self-driving car's radar continuously sends waves to measure the distance to other objects. A wave takes 15 ns to travel to a pedestrian and back.



Using information from the formula sheet, **calculate** the distance between the pedestrian and the car. You should use the speed of light as 3×10^8 ms^{-1} and give your answer in m.



Question 8b (14 marks)

Approximately 1.3 million people die every year in road accidents worldwide. Self-driving cars have the potential to remove human errors by relying on advanced sensors and software to make split-second decisions. Despite the technology embedded in these self-driving cars, in 2022, the U.S. National Highway Traffic Safety Administration received reports of more than 400 crashes involving these self-driving cars.

Using all of the information provided and knowledge from your wider MYP studies, **discuss** and **evaluate** the use of self-driving cars. In your answer you must include:

- an explanation of how these systems and technologies work to replace humans in self-driving cars
- the ethical consequences of a self-driving car making decisions normally made by humans
- the positive and negative economic impacts of self-driving cars
- your opinion about whether self-driving cars should be used everywhere or not.