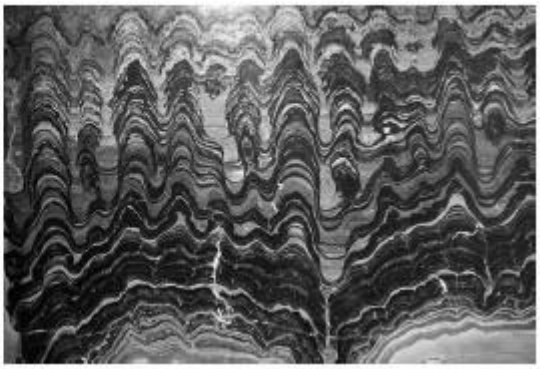
1 **Figure 1** shows photographs of fossils of extinct organisms.

Figure 1

Fossil A

Fossil B



(a) What is a fossil?

_____

_____

_____

_____

(2)

(b) What does extinct mean?

_____

_____

(1)

(c) **Fossil A** is a trilobite which had a shell, eyes and limbs.

Fossil B is a stromatolite formed by layers of microorganisms.

Which **two** statements suggest that the microorganisms lived at an earlier time than the trilobites?

Tick **two** boxes.

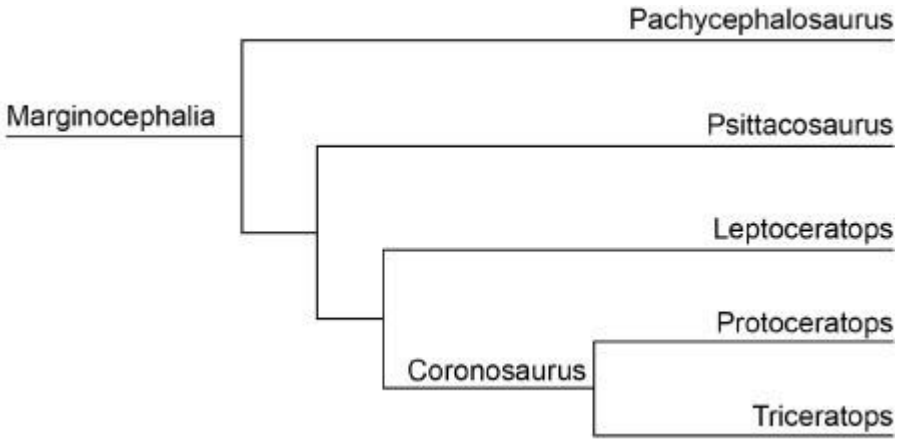
Microorganisms have a more simple structure than a trilobite.	☐
Stromatolites are found in older rock than trilobites.	☐
Stromatolites are layers of minerals left behind by millions of microorganisms.	☐
Stromatolites structures are larger than trilobite fossils.	☐
Trilobites lived in the sediment on the sea floor.	☐

(2)

Figure 2 shows an evolutionary tree drawn from the fossil record in the 1970s.

The evolutionary tree is for a group of dinosaurs.

Figure 2



(d) Scientists in the 1970s did radiocarbon dating on all the fossils.

Which fossil gave the earliest radiocarbon date?

_____

(1)

(e) Suggest which **two** types of dinosaur fossils showed the most similar features.

_____

(1)

(f) Give **one** reason why this evolutionary tree might **not** be correct.

_____

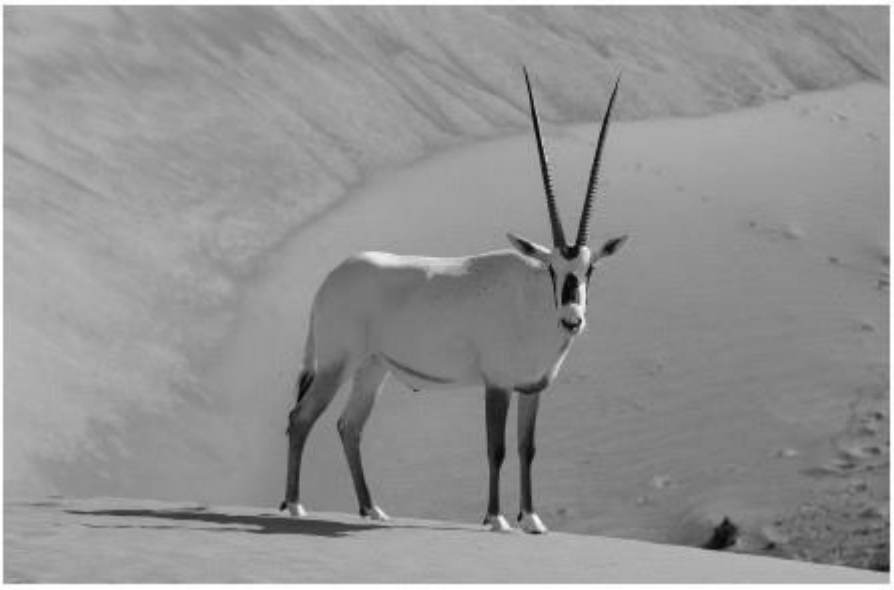
_____

(1)

(Total 8 marks)

2 The Arabian oryx (*Oryx leucoryx*) is a mammal that was once extinct in the wild.

The image shows an Arabian oryx.



(a) What is the genus of the Arabian oryx?

Tick **one** box.

leucoryx ☐ *Oryx* ☐ *Oryx leucoryx* ☐

(1)

(b) Give **two** adaptations of the Arabian oryx to living in hot desert environments.

Use information from the image.

1. _____

_____

2. _____

_____

(2)

(c) The Arabian oryx uses its long horns to fight for territory and mates.

Describe how the long horns could have evolved.

_____

_____

_____

_____

_____

_____

(3)

Arabian oryx from many different zoos were interbred so that they could be reintroduced to the wild.

(d) What is the name of this method of increasing the population of endangered animals?

Tick **one** box.

Breeding programme	☐
Genetic modification	☐
Natural selection	☐
Selective breeding	☐

(1)

(e) Explain why it was important to use Arabian oryx from many different zoos instead of one zoo.

_____

_____

(1)

(Total 8 marks)

3 Moose are animals that eat grass.

Figure 1 shows a moose.

Figure 1

© Wildnerdpix/iStock/Thinkstock

Figure 2 shows a food chain.

Figure 2

Grass ⟶ Moose ⟶ Wolves

(a) Name the secondary consumer shown in **Figure 2**.

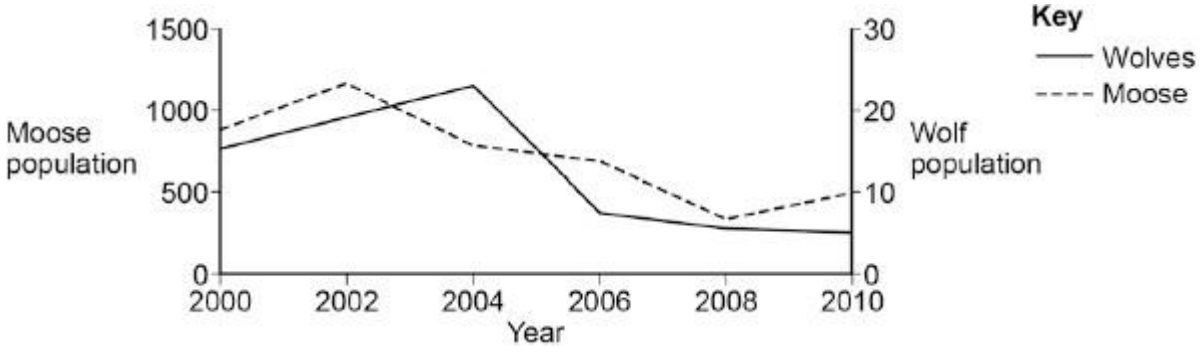
_____

(1)

(b) **Figure 3** shows how the moose population and wolf population have changed in one area.

This is a predator-prey cycle.

Figure 3



In 2004 the line on **Figure 3** for wolves is above the line for moose.

How does **Figure 3** show that there are more moose than wolves in 2004?

_____

_____

(1)

(c) Suggest why the moose population decreased between 2002 and 2004.

Use information from **Figure 3**.

_____

_____

(1)

(d) The number of wolves is one biotic factor that could affect the size of the moose population.

Give **two** other biotic factors that could affect the size of the moose population.

1. _____

_____

2. _____

_____

(2)

(e) Moose have distinct characteristics such as antlers.

Describe how moose may have evolved to have large antlers.

(5)

(Total 10 marks)

4 This question is about reproduction.

(a) Describe the difference between the way hormonal and non-hormonal methods of contraception work.

Give **one** example of each method of contraception.

(3)

The urine of women using hormonal methods of contraception contains high levels of progesterone.

Concentrations of 1–3 ng/dm^3 of progesterone are found in the water of rivers near sewage outflow points.

Scientists investigated the effect of different concentrations of progesterone in water on fish reproduction.

This is the method used.

1. Prepare tanks of water containing different concentrations of progesterone.

2. Put a breeding pair of fish into each tank.

3. Record the number of eggs produced per day by the female in each tank for 14 days.

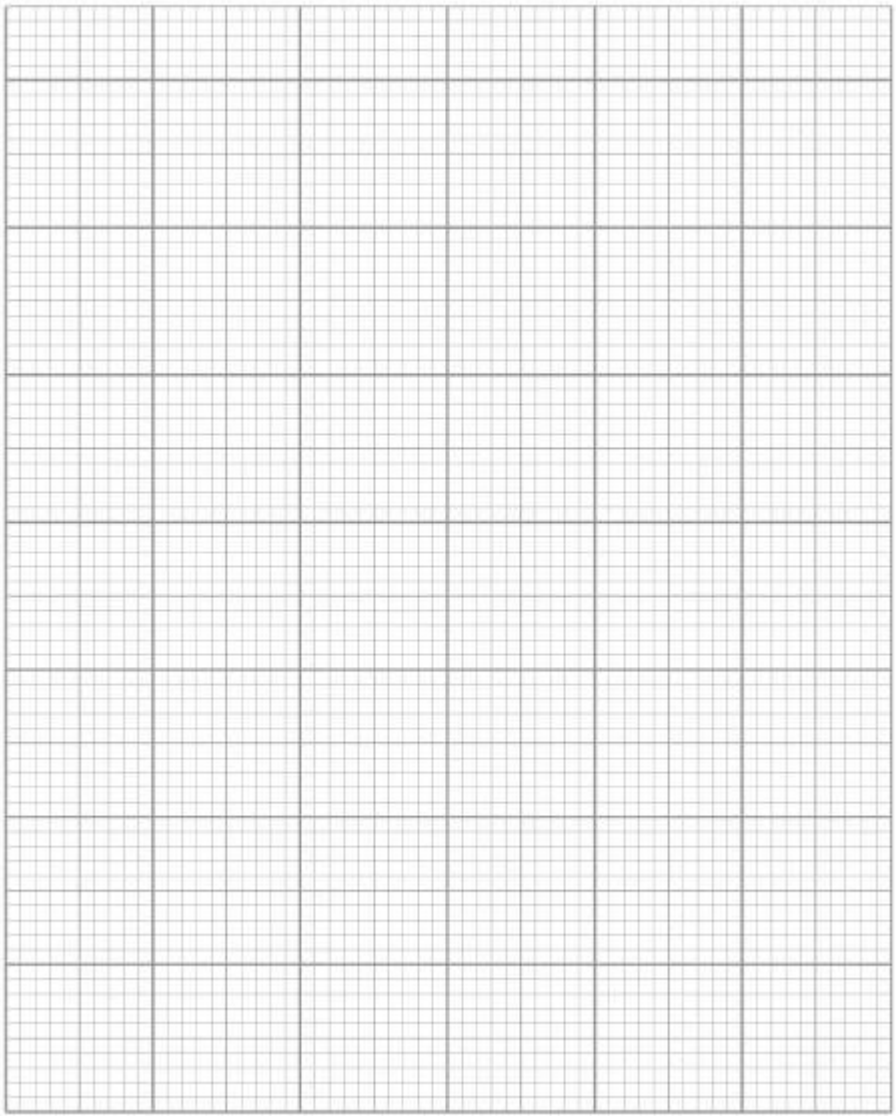
The table shows the results.

Concentration of progesterone in water in ng/dm^3	**Mean number of eggs produced per day**
0.0	28.6
0.8	4.5
1.5	3.2
3.0	2.8
10.0	1.1
20.0	0.2

(b) Plot the data from the table on the grid.

You should:

- label each axis
- use a suitable scale
- draw a line of best fit.



(4)

(c) Describe the effect on fish reproduction of the concentrations of progesterone found in rivers near sewage outflows.

Use data from your graph.

_____

_____

_____

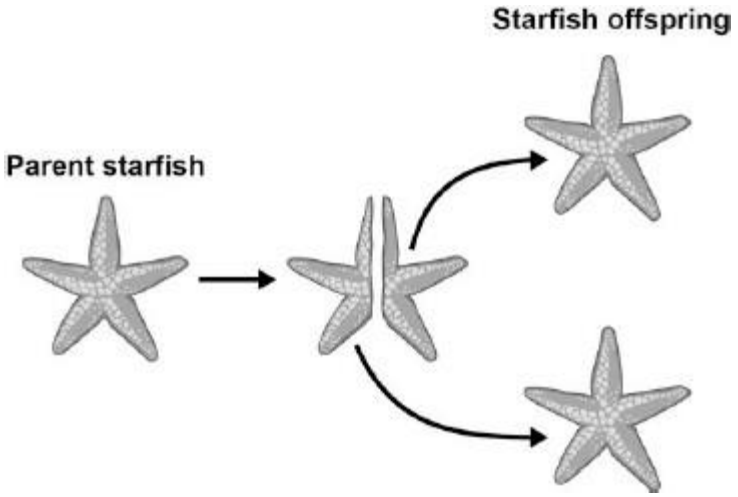
_____

(2)

(Total 9 marks)

5 Starfish can split in half. Each half can then grow new arms to form offspring.

This process is shown in the figure below.



(a) What process produces the starfish offspring?

Tick **one** box.

Asexual reproduction ☐

Fertilisation ☐

Selective breeding ☐

Sexual reproduction ☐

(1)

(b) More cells are produced as the starfish grows more arms.

What process will produce more cells in the starfish as they grow?

_____

(1)

(c) All the offspring produced are genetically identical.

What name is given to genetically identical organisms?

_____

(1)

(d) Each body cell of the parent starfish contains 44 chromosomes.

How many chromosomes are in each body cell of the offspring?

_____

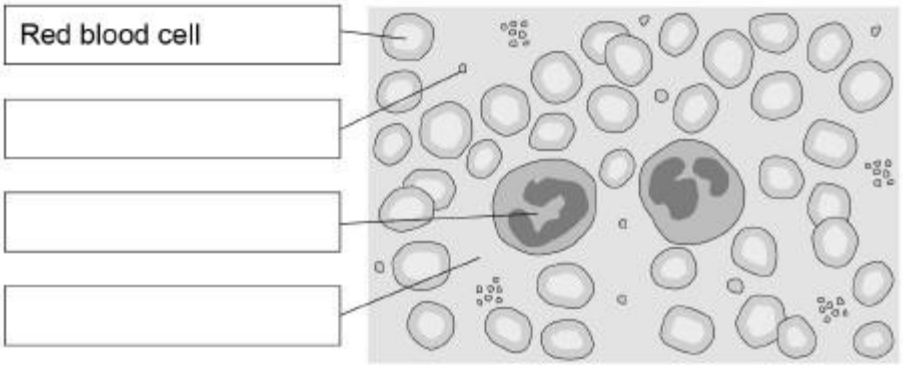
(1)

(Total 4 marks)

6 **Figure 1** shows an image of blood viewed with a microscope.

(a) Label **Figure 1**.

Figure 1



(3)

(b) The mean concentration of red blood cells in an adult is 5.5×10^6 cells per mm^3

$1\ mm^3 = 0.000001\ dm^3$

Calculate the mean number of red blood cells in 1 dm^3

Give your answer in standard form.

Mean number of red blood cells in 1 dm^3 = _____

(3)

(c) Calculate the number of red blood cells in an adult who has 5.2 dm^3 of blood.

Use your answer from part (b).

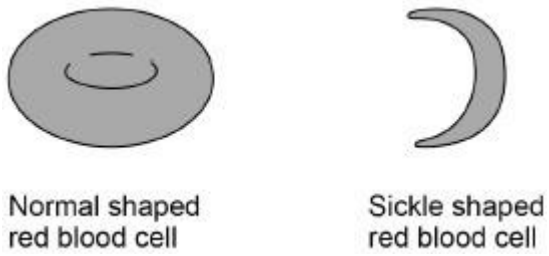
Number of red blood cells in an adult = _____

(1)

Sickle cell disease is an inherited disorder that causes some red blood cells to have a sickle shape.

Figure 2 shows two red blood cells.

Figure 2



(d) A person only has sickle cell disease if two copies of the sickle cell allele are inherited.

What does this tell us about the sickle cell allele?

(1)

(e) Explain how the shape of the red blood cells in a person with sickle cell disease could affect how much oxygen reaches their muscles.

(6)

(f) Suggest **one** symptom of sickle cell disease.

(1)

(Total 15 marks)

1 (a) remains / traces of organisms

1

from millions of years ago

1

(b) no individuals of a species still alive

1

(c) microorganisms have a simpler structure than a trilobite

1

stromatolites are found in older rock than trilobites

1

(d) Marginocephalia

1

(e) Protoceratops **and** Triceratops
(in either order)

allow

*Coronosaurus **and** Triceratops*

or

*Coronosaurus **and** Protoceratops*

or

*Marginocephalia **and** Pachycephalosaurus*

1

(f) any **one** from:
- the fossil record is not complete
- new fossils may have been found since 1970s
- DNA / chemical analysis may have given new information

1

[8]

2 (a) *Oryx*

1

(b) any **two** from:
- white / light colour (to reduce thermal gain)
- short fur (to reduce thermal insulation)
- little body fat
- large hooves (to walk in sand)
- camouflaged (against sand by light colour)

2

(c) any **three** from:
- variation in population
- animals with longest horns more likely to survive / reproduce
- passing on alleles for long horns
- repeated over many generations

3

(d) breeding programme

1

(e) any **one** from:

- to increase genetic diversity

  *do **not** accept to increase biodiversity*
- species may be unable to cope if environment changes
- all susceptible to same diseases / inbreeding problems

  allow otherwise all offspring would have similar genes or a decreased gene pool
- prevents inbreeding

1

[8]

3 (a) wolves

1

(b) moose and wolves are on different scales

1

(c) wolf population has increased so more moose are eaten

*do **not** accept there are more wolves than moose*

1

(d) any **two** from:

- (other) predators

  allow correct examples

  allow 'humans hunting moose'
- (new) pathogens

  allow diseases
- competition

2

(e) any **four** from:

- variation (within species) of antler size

  allow description relating to antlers
- (caused by) different genes
- as a result of sexual reproduction / process of meiosis / mutation
- (phenotype) most suited to environment most likely to survive and breed

  ignore natural selection unqualified
- genes for large antlers (more likely to be) passed on to next generation

4

reference to mate selection
or
fighting
or
gaining territory
or
competition for mates
or
avoiding predation

1

[10]

4 (a) (hormonal uses chemicals / synthetic) hormones to prevent an egg being released

allow 'to prevent maturation of eggs'

1

(non-hormonal has a barrier which) prevents the sperm reaching an egg **or** prevents implantation

1

a correct example of each type

1

(b) suitable scales and axes labels correct

1

all points plotted accurately

*allow **1** mark for 5 accurate points*

2

line of best fit

*allow a bar chart for max **3** marks*

1

(c) decrease egg production

1

by between 6–10 times

allow ecf from their graph

1

[9]

5 (a) asexual reproduction

1

(b) mitosis

1

(c) clones

1

(d) 44

1

[4]

6 (a) platelets

1

white blood cells

1

plasma

this order only

1

(b) 5500 000

1

(55 000 000 × 1000 000 =) 5500 000 000 000

1

5.5×10^{12}

1

(c) $(5.5 \times 10^{12} \times 5.2 =) 2.86 \times 10^{13}$

allow ecf from part (b)

allow 28 600 000 000 000

1

(d) it is recessive

allow it is not dominant

1

(e)

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 • red blood cells carry oxygen • rbc contain haemoglobin • haemoglobin carries / binds to oxygen • sickle cells are smaller or have smaller volume • sickle cells contain less haemoglobin • less oxygen carried • smaller SA:volume ratio • oxygen enters rbc by diffusion • slower / decreased diffusion • less oxygen delivered per minute or slower rate of delivery • blood vessels blocked (due to cell shape)	

6

(f) any **one** from:

- breathlessness
- tiredness
- less able to do exercise
- pain (in muscles)
- muscle fatigue
- anaemia

1

[15]