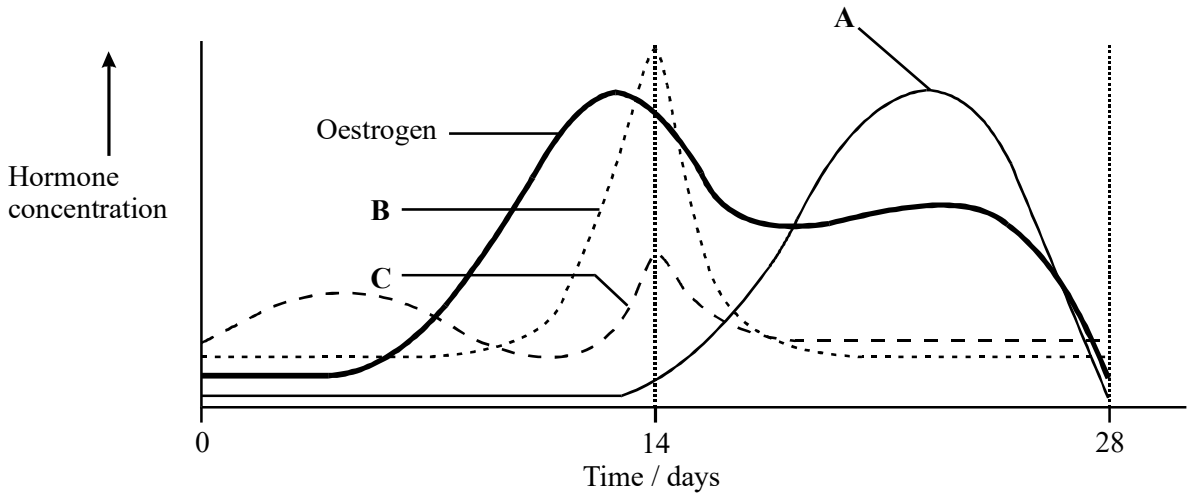


1. The graph shows the changes in concentration of the hormones responsible for controlling the menstrual cycle.



WD Phillips and TJ Chilton *A Level Biology* Oxford University Press 1989

- (i) Which curve, **A**, **B** or **C**, shows changes in the concentration of FSH?

.....

(1)

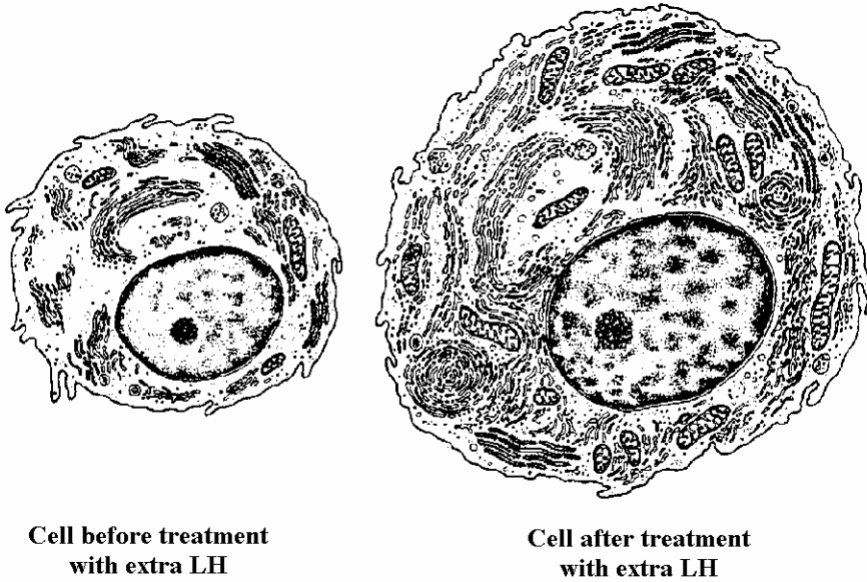
- (ii) Explain how the release of FSH is controlled by negative feedback.

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(2)

(Total 3 marks)

2. Some men are infertile because they do not produce sufficient LH. The drawings show a Leydig cell from a testis before and after such a person had been treated with extra LH. Both drawings are to the same scale.



Source: AUSTIN AND SHORT, *Reproduction in Mammals, Book 3* (Cambridge University Press) 1984

- (a) Calculate the percentage increase in diameter of the cell as a result of this treatment. Show your working.

Answer.....

(2)

- (b) (i) Describe **two** effects of LH on the ultrastructure of the cell as seen in the drawings.

1.....

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2.....

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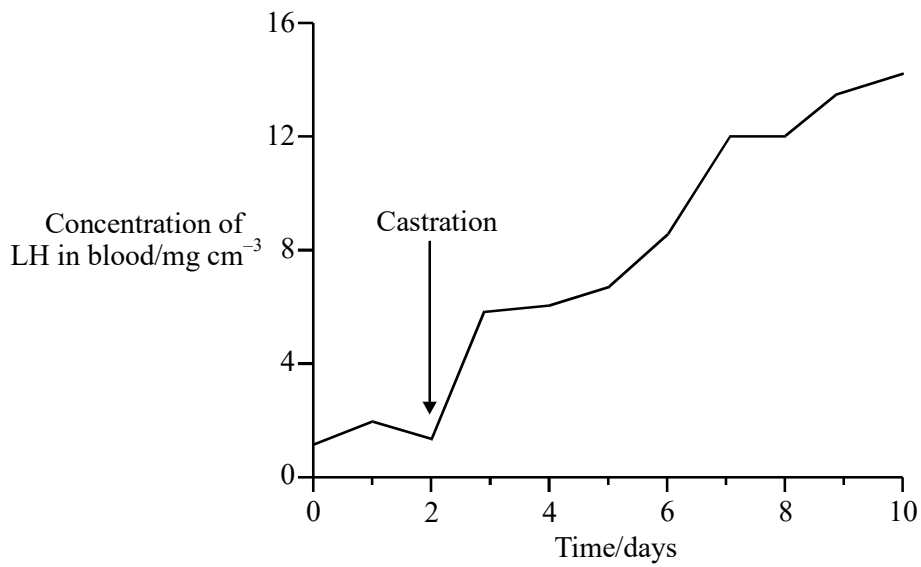
(2)

(ii) Suggest **two** ways in which these differences might lead to an increase in testosterone secretion by this cell.

- 1.....
- .....
- 2.....
- .....

(2)

(c) Farm animals may be castrated, an operation which involves removing the testes. The graph shows the change in the concentration of LH in the blood of a sheep following castration.



Explain how this graph provides evidence that a negative feedback mechanism normally controls blood LH concentration.

- .....
- .....
- .....
- .....

(2)

- (d) In one piece of research, an animal was injected with a small amount of LH. After 7 days there was a change in both the number of LH receptors on the cell surface membranes of the Leydig cells and the production of cyclic AMP. Using this information, suggest how LH stimulates the Leydig cells to produce testosterone.

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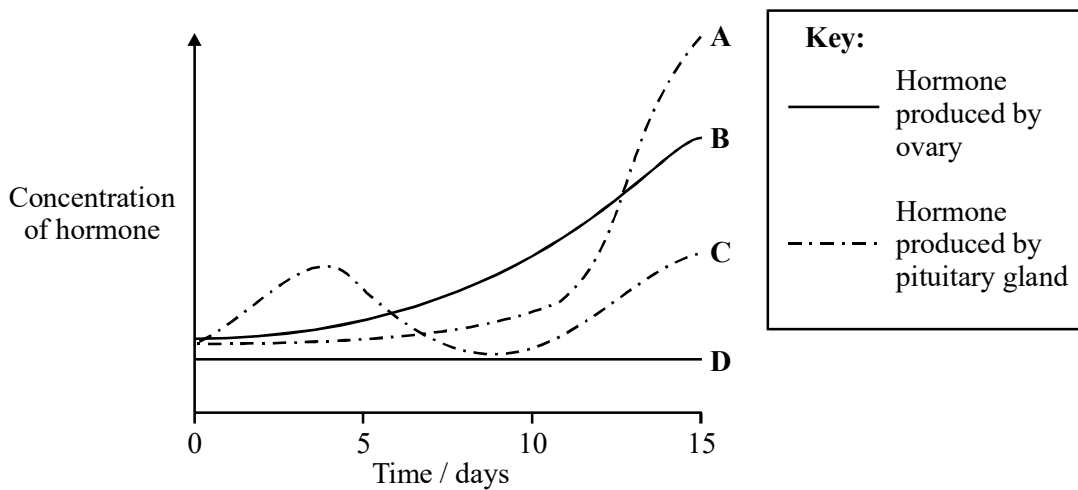
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(3)  
(Total 11 marks)

3. The graph shows the concentrations of four hormones in the first 15 days of a menstrual cycle.



- (a) (i) Name hormone A.

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(1)

- (ii) Describe what happens to the concentration of hormone **D** over the remainder of this menstrual cycle. Assume that pregnancy did not occur.

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(2)

- (b) Explain how hormone **B** may act as a contraceptive.

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(2)

(Total 5 marks)

4. *Read the following passage.*

**Contraceptives of the future**

We are so used to thinking about steroid hormones being used as contraceptives that we tend to forget that there is another possibility – peptide contraception. Gonadotrophin-releasing hormone (GnRH) is a peptide produced by the hypothalamus. It triggers the release of FSH from the pituitary gland. It is a small molecule consisting of just ten amino acids and can be made synthetically. By changing individual amino acids, a range of similar molecules called analogues can be produced. When these compounds were first produced, it was thought that they might be useful in treating infertility. It was something of a surprise when it was discovered that some of them actually inhibited ovulation. Here, then, is a possibility for a new type of contraceptive. Its great advantage would be that, in contrast to steroids, it would not have any side effects on organs such as the breast and uterus. A possible disadvantage, however, is that it may not be possible to take peptide contraceptives orally.

5

10

Another interesting possibility is immunological contraception. In this field, one of the most promising ideas at present is the immunisation of women against the membrane which surrounds the egg cell, the zona pellucida (or 'zona' for short). What has to be done is to isolate a specific zona antigen and determine its amino acid sequence. Recombinant DNA technology can then be used to produce sufficient zona antigen for trials to begin. Immunisation with zona antigen should lead to the production of anti-zona antibodies. Experiments with laboratory animals have shown that this technique could indeed prevent fertilisation.

A third approach is to immunise women against pregnancy itself. Human chorionic gonadotrophin (hCG) is a hormone produced by the embryo at the end of the first week of life. It is essential for a successful pregnancy. The hormone is a protein consisting of an  $\alpha$  subunit which is identical to that found in FSH, LH and TSH, a hormone which is indirectly responsible for controlling the metabolic rate of the body. hCG also has a specific  $\beta$  subunit. Studies in monkeys have shown that animals which have been immunised against the  $\beta$  subunit cannot maintain a pregnancy.

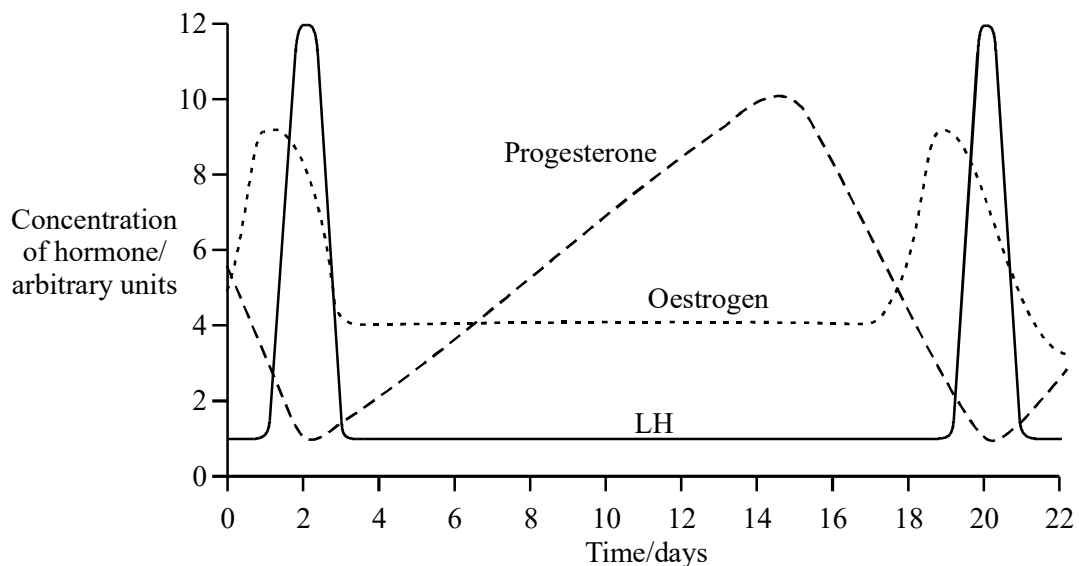
Source: adapted from COLIN RUSSELL AUSTIN and ROGER VALENTINE SHORT, *Reproduction in Mammals* vol 5, *Manipulating Reproduction* (Cambridge University Press) 1986

Using information in the passage and your own knowledge, answer the following questions.

- (a) Explain why GnRH could be used to treat infertility in women (line 7). (2)
- (b) GnRH works by attaching to protein receptor molecules on the cell surface membranes of its target cells.
- (i) Explain how some GnRH analogues can inhibit ovulation (line 8). (3)
- (ii) Suggest why peptide contraceptives, in contrast to steroids, would not have any side effects on organs such as the breast and the uterus (line 10). (2)
- (c) Explain why it might not be possible to take peptide contraceptives orally (lines 10-12). (1)

- (d) Recombinant DNA technology can be used to produce large amounts of zona antigen from suitable bacteria. In producing zona antigen in this way:
- suggest why the amino acid sequence of the zona antigen has to be determined (line 16); (1)
  - describe how enzymes and vectors may be used to insert DNA coding for the zona antigen into suitable bacteria. (3)
- (e) Describe how immunisation with zona antigen should lead to the production of anti-zona antibodies (line 18). (3)
- (f) Explain how immunising women against hCG could prevent pregnancy. (3)
- (g) Explain why the vaccine against hCG is made from the  $\beta$  subunit of the hormone rather than the  $\alpha$  subunit. (2)
- (Total 20 marks)**

5. The graph shows changes in the concentration of some hormones during the oestrous cycle of a cow.



(a) Between which days is fertilisation most likely to be successful? Explain your answer.

Days .....

Explanation .....

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(2)

(b) Did the cow become pregnant during this cycle? Give the evidence from the graph for your answer.

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(1)

(Total 3 marks)

6. (a) The oestrous cycle in a female mammal is controlled by hormones. Describe the part played by FSH and LH in the control of the oestrous cycle.

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(5)



(b) The oestrous cycle of female sheep can be synchronised by giving them low doses of progesterone. When the treatment is stopped, the sheep come into oestrus a short time later.

(i) Explain why low doses of progesterone prevent oestrus in sheep.

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(2)

(ii) Explain why sheep come into oestrus a short time after progesterone treatment is stopped.

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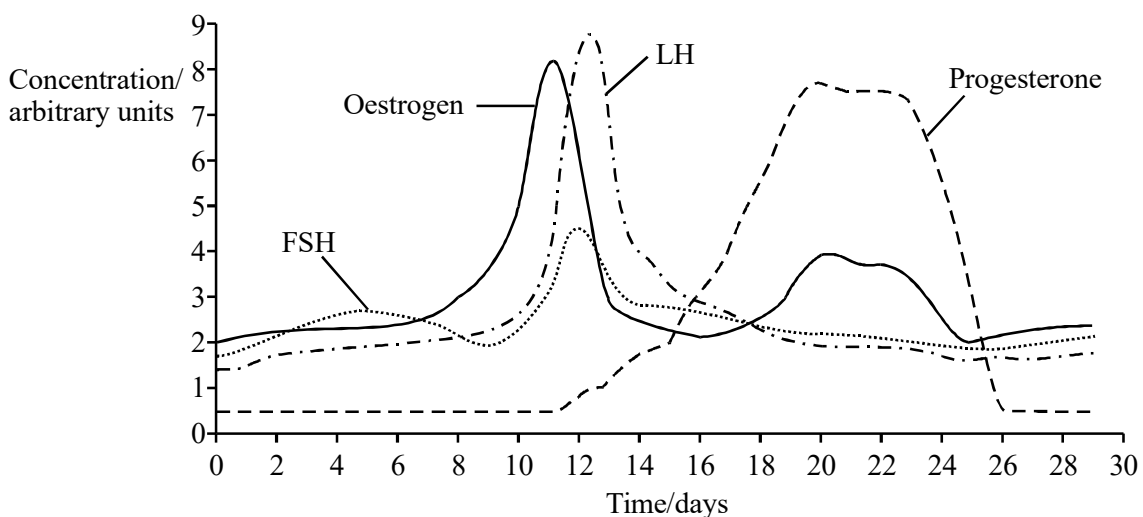
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(2)

(Total 9 marks)

7. The graph shows how the concentrations of various hormones in a woman's blood varied during one menstrual cycle.



- (a) (i) In this cycle, ovulation occurred on day 12. Give **one** piece of evidence from the graph which supports this.

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(1)

- (ii) Suggest why sexual intercourse at any time between days 10 and 13 could have resulted in fertilisation of an ovum.

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(2)

- (b) (i) Oestrogen is present in some contraceptive pills. Explain how oestrogen acts as a contraceptive.

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(2)

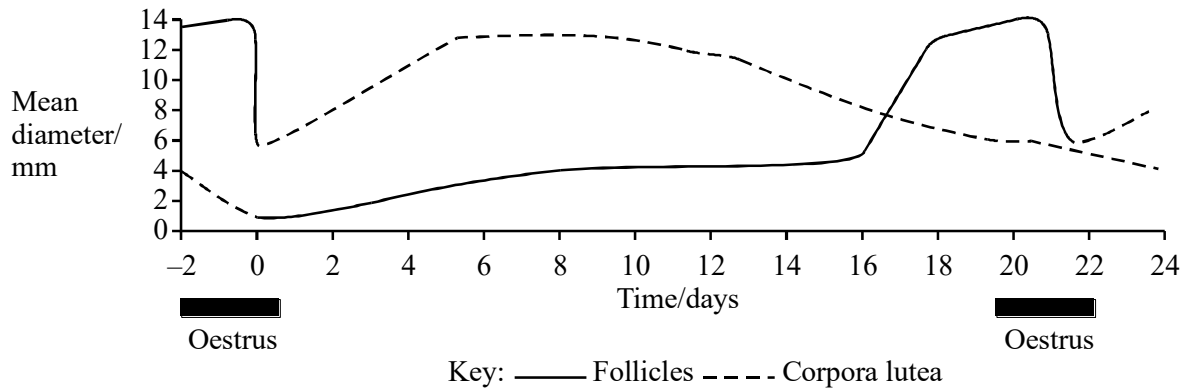
- (ii) Apart from oestrogen, which of the other hormones shown in the graph may be included in oral contraceptives?

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(1)

**(Total 6 marks)**

8. The graph shows how the diameters of the follicles and corpora lutea vary during the oestrous cycle of a pig.



- (a) In this cycle, ovulation occurred on day 21. Explain how the graph gives evidence for this.

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(2)

The table shows how the concentrations of the hormones progesterone and oestrogen vary during the oestrous cycle of the pig.

Time / days	Concentration of hormone in the blood / arbitrary units	
	Progesterone	Oestrogen
0	1.8	1.0
2	4.7	0.9
4	9.0	0.9
6	12.1	0.9
8	12.0	0.9
10	8.7	0.9
12	3.5	0.9
14	0.9	1.7
16	0.6	2.1
18	0.6	6.0
20	1.1	3.2
22	3.7	0.9
24	7.5	0.9

- (b) Use the table and the graph to explain why the presence of oestrogen in the female pig's urine can be used to predict the start of oestrus.

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(2)

- (c) Describe and explain the relationship between the diameter of the corpora lutea and the concentration of progesterone in the pig's blood between days 0 and 14.

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(2)

- (d) Use the data and your own knowledge to explain how changing concentrations of oestrogen and progesterone regulate the oestrous cycle.

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(6)

- (e) A herd of female pigs can be given synthetic progesterone in their diet for about 14 days. They then all come into oestrus 5 days later.

- (i) Why is it useful for a farmer to be able to determine when oestrus will occur?

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(1)

- (ii) In Sweden and Norway, public opinion is against feeding reproductive hormones to pigs. Give a biological explanation upon which this opinion could be based.

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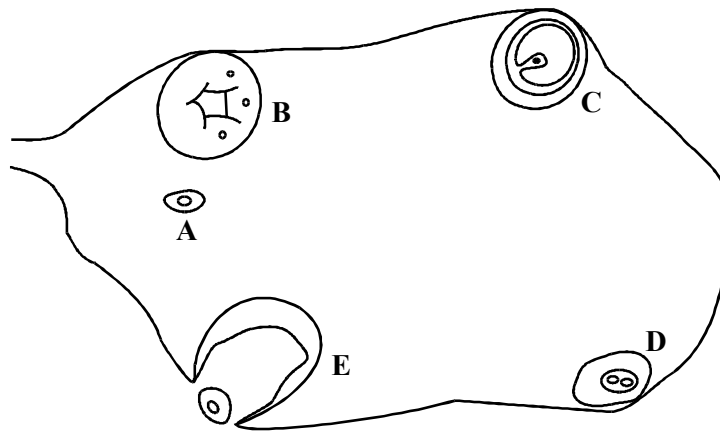
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(2)  
(Total 15 marks)

9. (a) The diagram shows structures present in an ovary during an oestrous cycle of a mammal.



- (i) Starting with structure A, give the structures A to E in the order in which they appear in an oestrous cycle.

A ..... .. (1)

- (ii) Which of these structures produces most of the progesterone during an oestrous cycle?

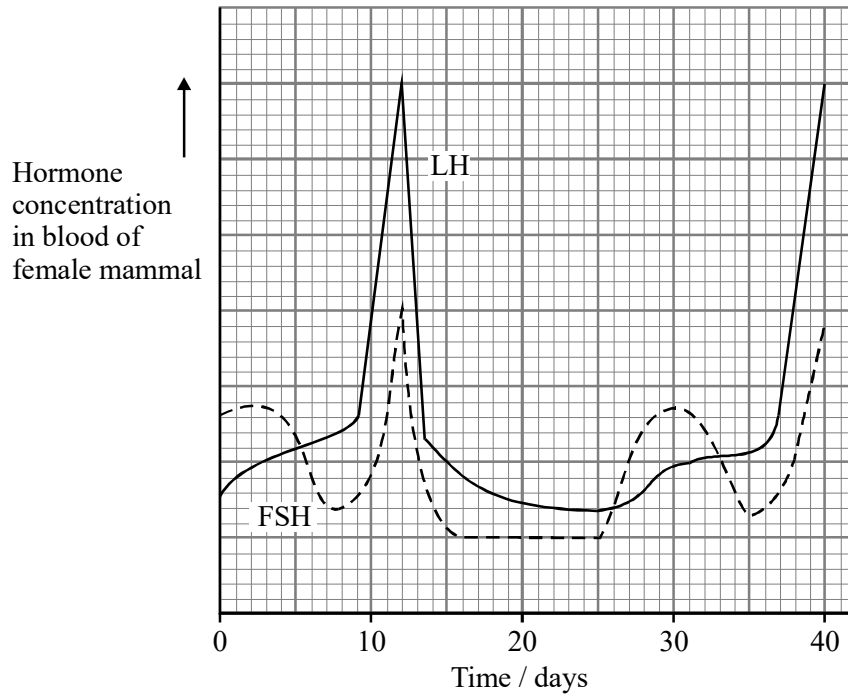
(1)

(iii) Describe **one** effect of progesterone on the uterus.

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(1)

(b) The graph shows the concentration of the hormones LH and FSH over 40 days.



(i) On which day would you expect this mammal to ovulate?

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(1)

(ii) Give the evidence from the graph which shows that pregnancy did not occur.

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(1)

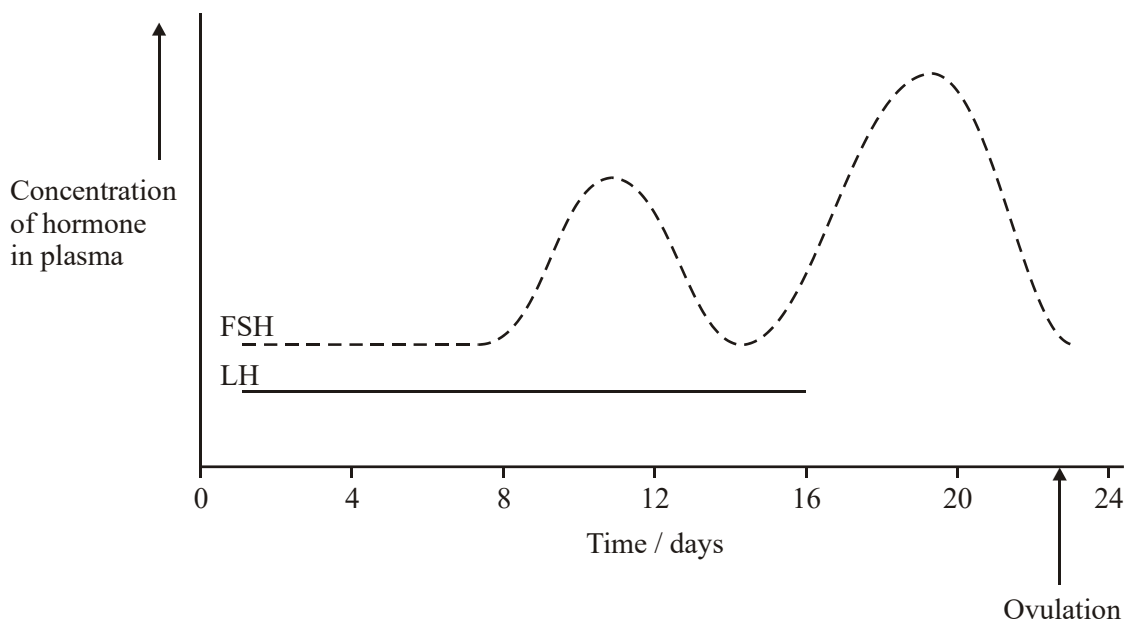
(Total 5 marks)

10. (a) Give **two** effects of FSH on the ovary of a mammal.

- 1 .....
- .....
- 2 .....
- .....

(2)

(b) The graph shows the concentration of FSH and LH during the oestrous cycle of a female horse (mare). The mare was not pregnant.



(i) Complete the curve on the graph to show the likely concentration of LH between days 16 and 24.

(2)

(ii) What would happen to the concentration of FSH after day 24 if the mare became pregnant?

- .....
- .....

(1)



- (c) Breeders of racehorses can use progesterone to ensure mares come into oestrus at a particular time. Progesterone is given to the mare every day for 10 days. Ovulation occurs between 7 and 13 days after the last dose of progesterone.

- (i) Explain why progesterone prevents oestrus.

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(2)

- (ii) Explain why the mare ovulates a few days after the last dose of progesterone.

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(2)

(Total 9 marks)

- 11.** Write an essay on the following topic. You should select and use information from different parts of the specification. Credit will be given not only for the biological content, but also for the selection and use of relevant information, and for the organisation and presentation of the essay.

Negative feedback and its importance in biology.

(Total 25 marks)

12. (a) The table describes some reproductive hormones in a female mammal. Complete the table by adding the name of the hormone which matches each description.

Hormone	Description
	Produced by the corpus luteum
	Produced by the pituitary gland and stimulates growth of the corpus luteum
	Produced by the developing follicle

(3)

- (b) Menopause is the time when women stop ovulating and the menstrual cycle stops. There are very few follicles remaining in the ovaries of a woman at menopause. Explain why the FSH concentration in the blood rises at menopause.

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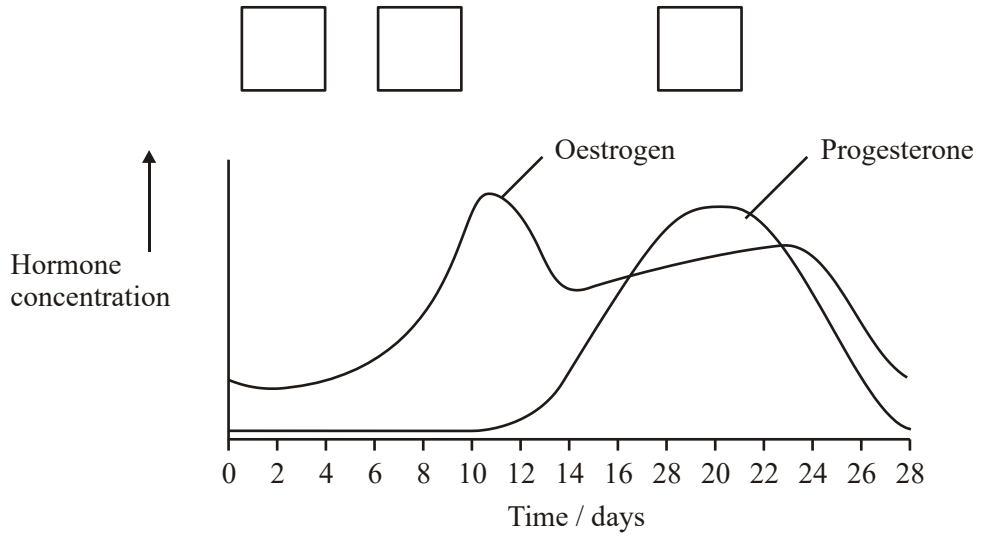
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(3)

**(Total 6 marks)**

13. (a) The graph shows the concentrations of two hormones during one sexual cycle of a human female. The diagram shows structures that produce these hormones.



Structures



- (i) Write the appropriate letters in the graph to show the order in which the structures labelled **P** to **R** appear during the cycle.

(1)

- (ii) Name the hormone that causes structure **Q** to develop.

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(1)

- (b) Describe **two** effects of progesterone on the uterus.

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(2)

(c) Explain how oestrogen in contraceptive pills prevents fertilisation from taking place.

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(2)

(d) The sexual cycles of some female farm animals can be synchronised by giving them low doses of progesterone. When this treatment is stopped the animals come into oestrus a few days later. Explain how the withdrawal of progesterone causes them to come into oestrus.

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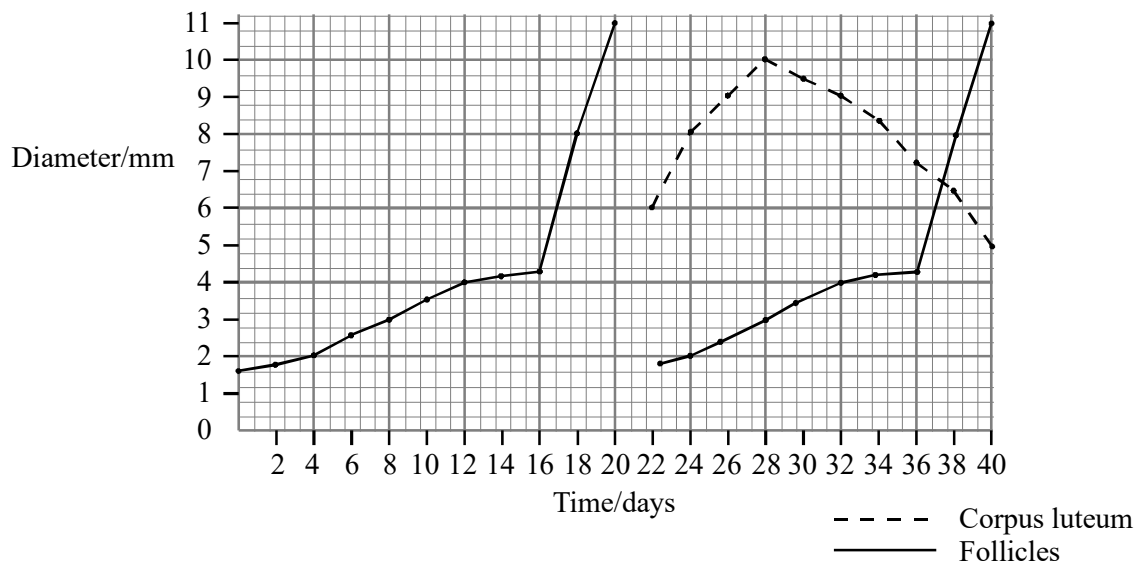
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(2)

(Total 8 marks)

14. The graph shows the change in the diameter of developing ovarian follicles and a corpus luteum in a human ovary over 40 days.



- (a) When would fertilisation be most likely to occur? Explain your answer.

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(2)

- (b) Describe **two** pieces of evidence which show that fertilisation did not occur during the 40 days.

(i) .....

.....

(ii) .....

.....

(2)

- (c) One type of infertility can be treated by using a drug called clomiphene. Clomiphene works by preventing the negative feedback of hormone X on FSH production.

(i) Name hormone X.

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(1)

(ii) Explain how excess hormone X can cause infertility.

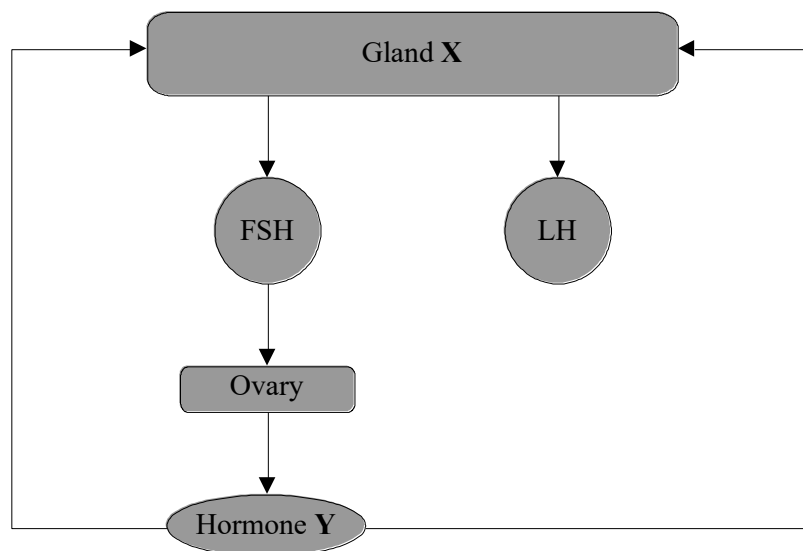
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(1)

**(Total 6 marks)**

15. The diagram shows the relationship between some of the glands and hormones controlling the oestrus cycle.



- (a) (i) Name gland X.

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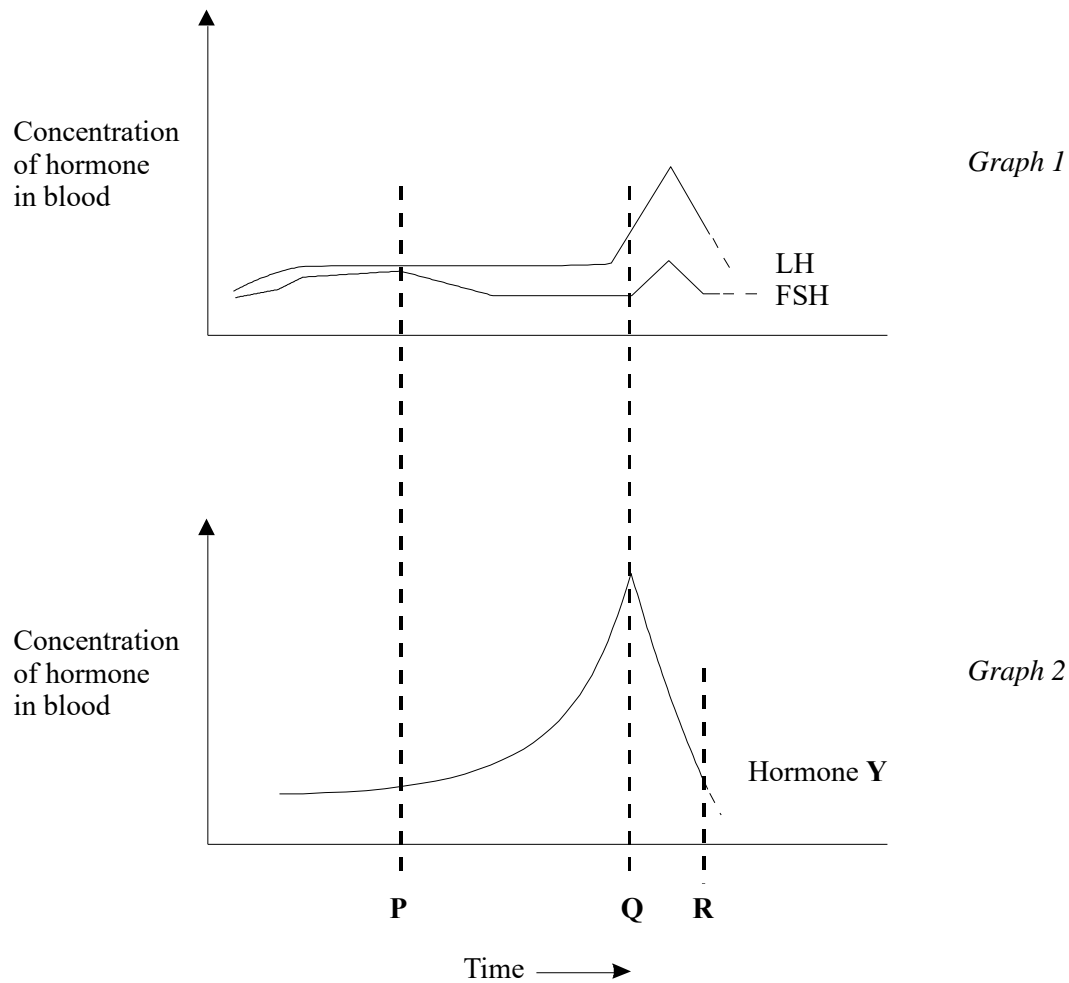
(1)

- (ii) Name hormone **Y**.

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(1)

The graphs show the change in concentrations of follicle stimulating hormone (FSH), luteinising hormone (LH) and hormone **Y** in the blood, during part of an oestrous cycle.



- (b) (i) Use the letter '**O**' to show on graph 1 when ovulation is most likely to occur.

(1)

- (ii) What is the term given to the effect hormone **Y** has on FSH between times **P** and **Q**?

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(1)

(iii) What causes the change of concentration of hormone **Y** between times **Q** and **R**?

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(1)  
(Total 5 marks)

**16.** Hormones and the nervous system are involved in controlling the functions of the body.

(a) During the oestrous cycle in a mammal, one or more follicles mature. Ovulation then takes place. Describe the part played by hormones in controlling these events.

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(6)



(b) The ears of a rabbit play an important part in helping the animal to keep its body temperature constant. After a period of exercise, the insides of a rabbit's ears become redder in colour as the blood flow to the skin surface increases. Explain how the different components of nervous communication are involved in the process leading to the response shown by the rabbit's ears.

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(6)  
(Total 12 marks)

17. (a) Describe the role of hormones in controlling the development of the changes associated with puberty in girls.

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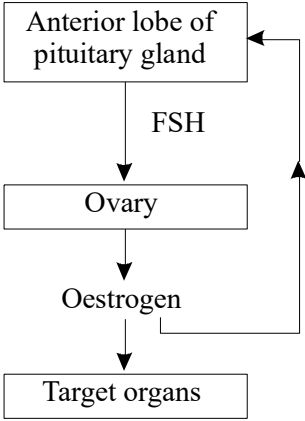
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(6)

(b) The diagram shows the way in which hormones control the first part of the menstrual cycle.



- (i) Some oral contraceptives contain oestrogen. Using information from the diagram, explain how these oral contraceptives function.

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(3)

- (ii) The ovaries of women who have passed through the menopause no longer contain active follicles. The concentration of oestrogen and of FSH in the blood change after menopause. Use information from the diagram to explain why.

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(3)

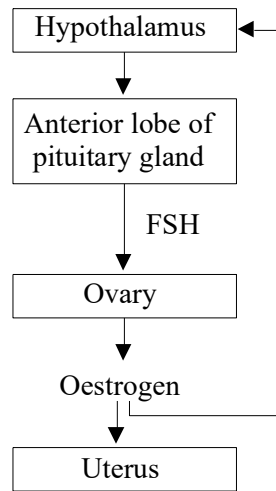
**(Total 12 marks)**

18. (a) Complete the table which gives information about some of the hormones which control the oestrous cycle.

Hormone	Site of secretion	Target organ	One effect
Luteinising hormone (LH)	..... .....	..... .....	..... .....
Oestrogen	ovary	uterus	stimulates growth of uterine lining
Progesterone	ovary	uterus	..... .....

(4)

- (b) The diagram shows the way in which hormones are involved in controlling part of the oestrous cycle.



- (i) Some women only produce very small amounts of FSH. Explain why these women are infertile.

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(1)

(ii) Clomiphene is a drug used to treat this type of infertility. It blocks the action of oestrogen. Explain how treatment with clomiphene could be used to stimulate production of ESH.

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(2)  
(Total 7 marks)

19. S A pollen grain contains the male gamete of a flowering plant. Two ways by which pollen grains can be spread to the female reproductive organs of another plant are

- by wind
- by insects which visit the flowers to collect food, such as nectar.

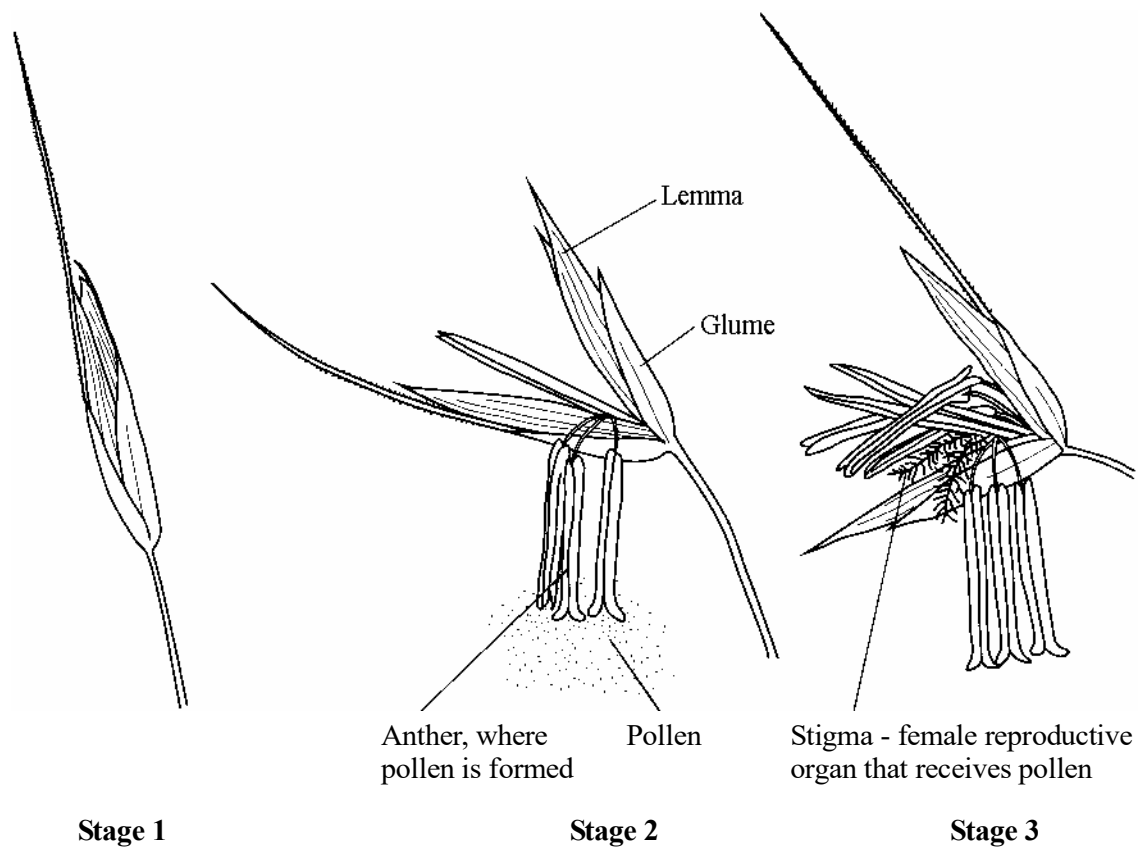
(a) Suggest **two** advantages for flowering plants of using insects rather than wind to spread their pollen.

1 .....  
.....  
2 .....  
.....

(2)

- (b) Grasses are wind-pollinated. **Figure 1** shows drawings of three stages of development of a grass flower.

**Figure 1**



Use evidence from the drawings to explain **two** ways in which the grass flower is adapted for spreading pollen to another plant by wind.

1 .....

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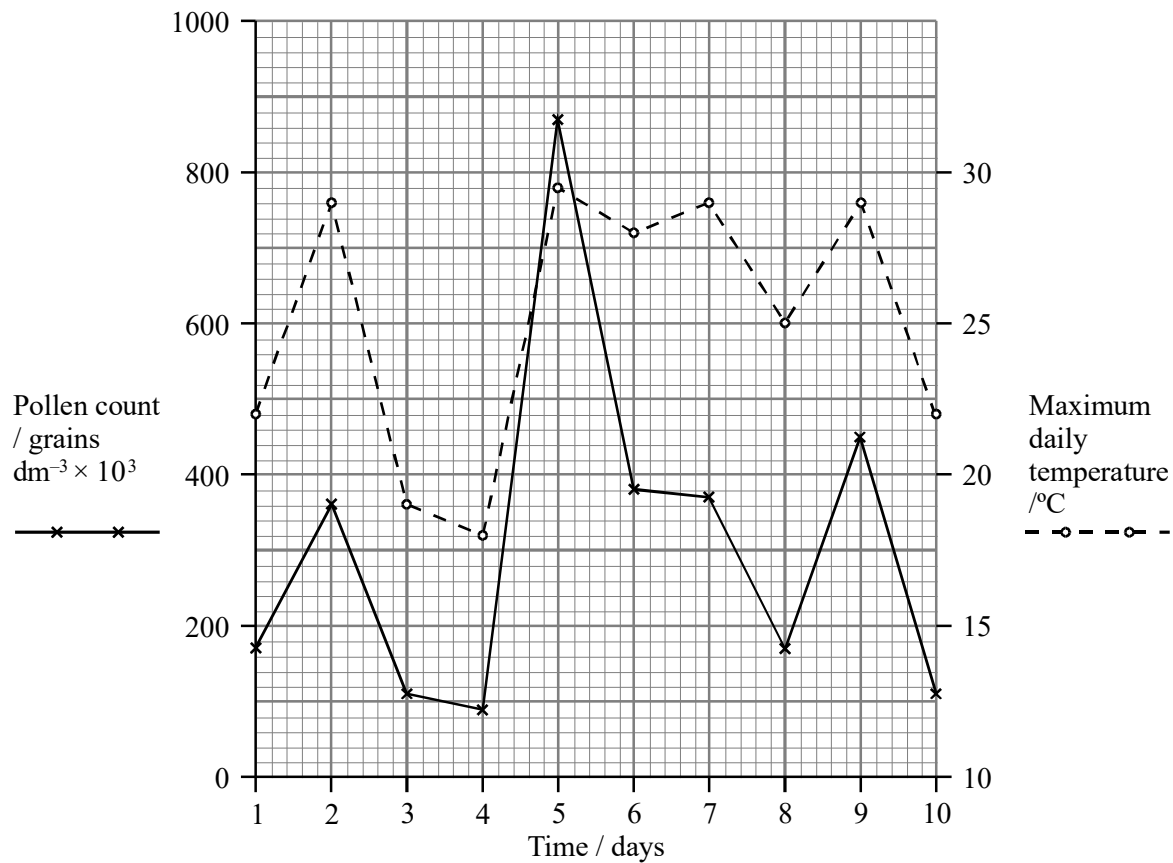
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(2)

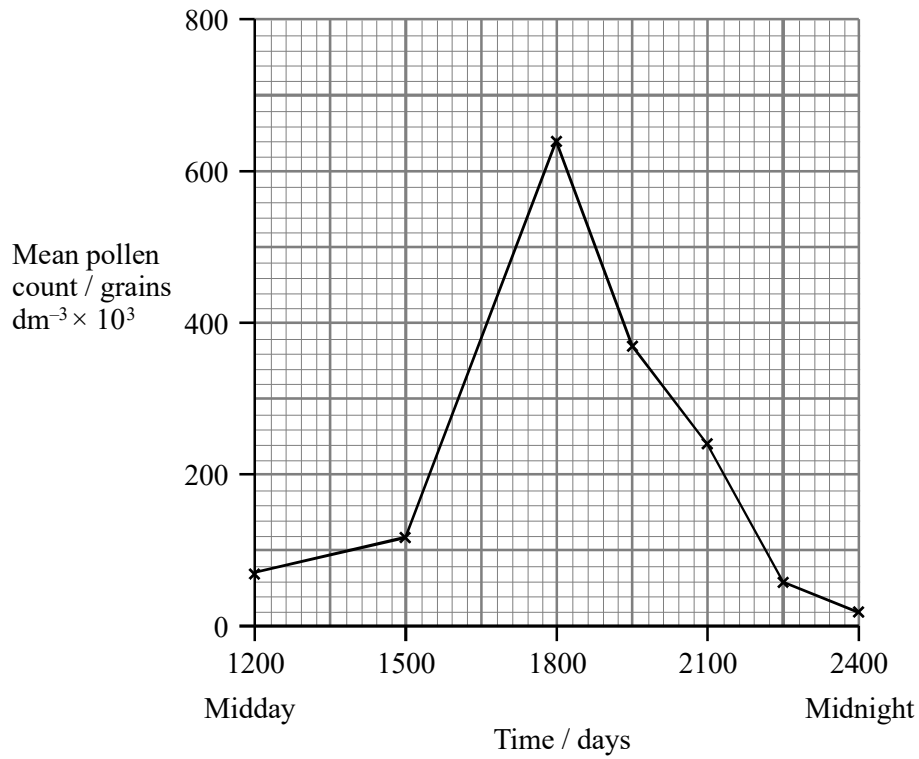
- (c) **Figure 2** shows the total grass pollen count and the maximum daily temperature over a period of ten days in June at one particular place. **Figure 3** shows the mean pollen count at different times between midday and midnight in June in the same area

**Figure 2**





**Figure 3**



- (i) Describe the relationship between the total pollen count and the maximum daily temperature.

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 .....

(2)

- (ii) The pollen counts shown in **Figure 2** were taken at the same time in the early evening each day. Explain why it was important to take the counts at the same time each day.

.....  
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(1)

- (d) Grass pollen grains are released from the anthers when the walls of the anthers burst open.  
Using the information given in parts (b) and (c), suggest a possible mechanism that could result in the pattern of pollen release shown.

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(2)

- (e) Each species of grass has a short period in the summer during which it flowers and releases pollen. For most species this period is only about two weeks.  
Suggest **one** advantage to a species of having such a short flowering period.

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(1)

(Total 10 marks)

- 20. (a) Explain how oestrogen in an oral contraceptive prevents conception.

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(3)

- (b) In an experiment, human females were exposed to sweat produced by human males. The nervous activity of the hypothalamus was found to increase when the females were exposed to the sweat.

The human hypothalamus produces a hormone which stimulates FSH production.

Suggest how exposure to the male sweat could result in increased oestrogen production.

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(3)  
(Total 6 marks)

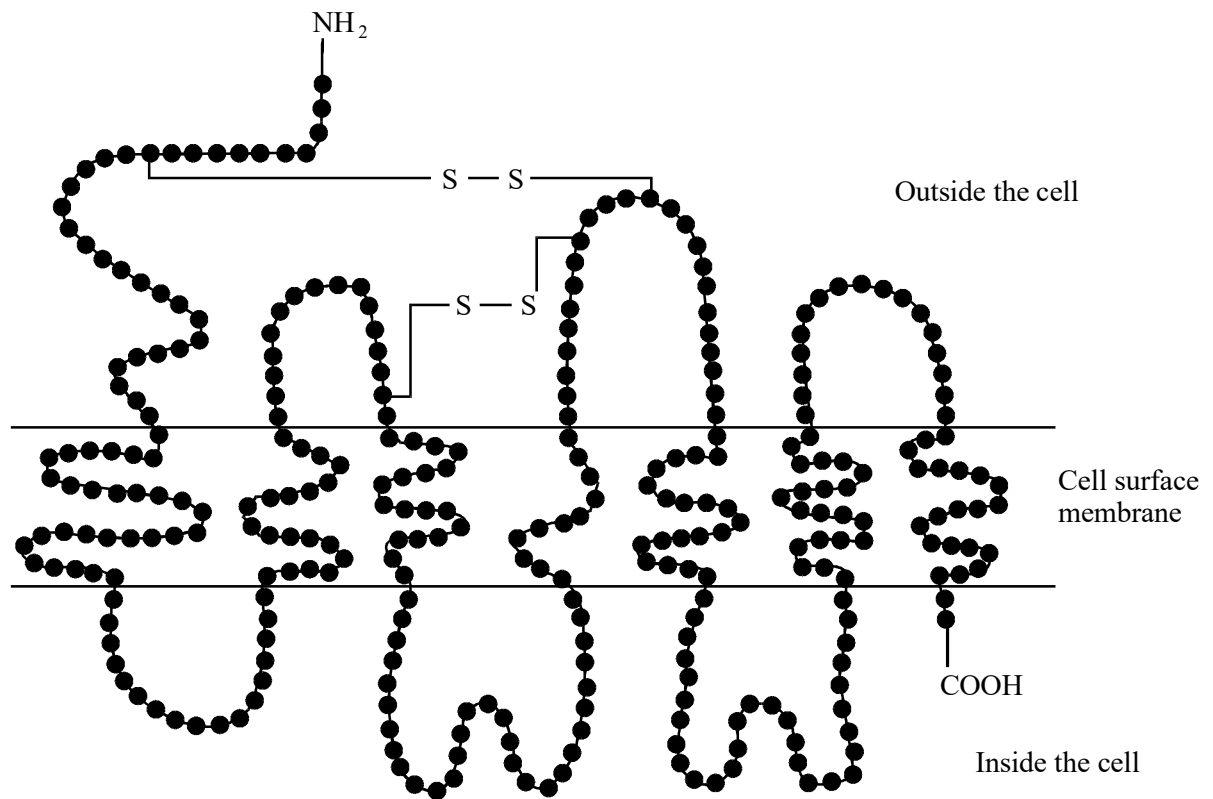
- 21. (a) Give **one** function of LH in females.

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(1)

In males, FSH stimulates sperm production and LH causes the release of testosterone. A hormone stimulates the release of FSH and LH by attaching to receptor molecules in the surface membrane of cells in the pituitary gland. The diagram shows one receptor molecule for this hormone.



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- S (b) (i) Give **two** pieces of evidence from the diagram which suggest that the receptor molecule is a protein.

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(2)

- (ii) Explain how the tertiary structure of this protein is important for its function as a receptor molecule.

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(2)

- (c) Research has identified a substance which could be used as a male contraceptive pill. This substance binds to the receptor molecules in the pituitary gland and stops the release of FSH, but allows the release of LH to continue.

- (i) Explain **one** advantage of the substance not inhibiting LH release.

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(2)

- S** (ii) This substance is not a protein. Explain why a protein could **not** be used as an oral contraceptive.

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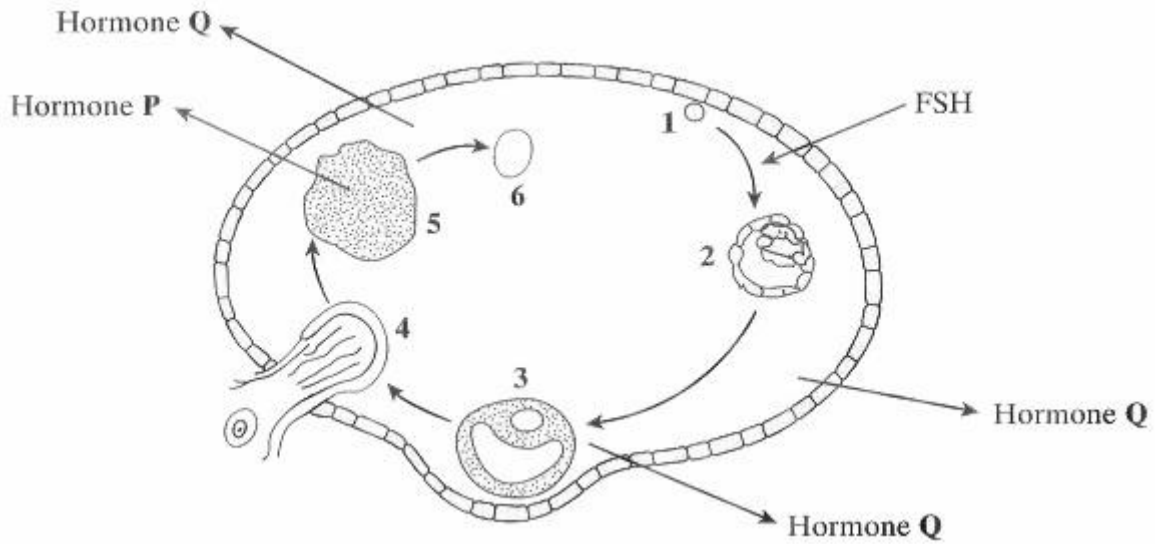
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(2)

(Total 9 marks)

22. The diagram shows the events that occur in the human ovary during one menstrual cycle.



(a) (i) Describe the role of follicle stimulating hormone (FSH) in the menstrual cycle.

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(2)

S (ii) FSH is a globular protein and specifically targets cells in the ovary. Explain how the structure of FSH accounts for this specific targeting.

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(3)

(b) (i) Name the hormones **P** and **Q**.

**P** .....

**Q** .....

(2)

(ii) After the menopause, when the menstrual cycle ceases, hormone secretion by the ovary is much reduced. Explain why the blood of post-menopausal women contains high levels of FSH.

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(2)

**(Total 9 marks)**