Questions are for both separate science and combined science students unless indicated in the question

Q1.

The human body has two coordination systems:

- the nervous system
- the endocrine system.

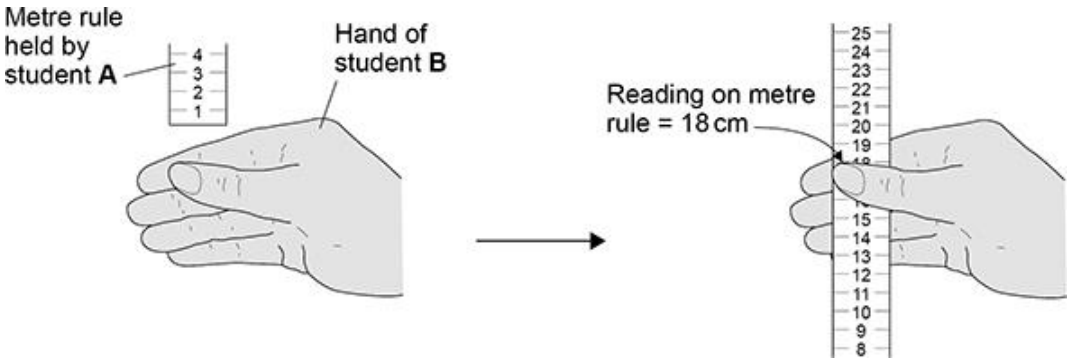
(a) Two students investigated human reaction time.

Student **A** held a metre rule above student **B**'s hand.

Student **A** then released the metre rule and student **B** caught the rule as quickly as possible.

Figure 1 shows the method used.

Figure 1



Suggest **two** ways to improve the students' method for measuring human reaction time.

1 _____

_____

2 _____

_____

(2)

(b) Student **B**'s reaction is coordinated by the nervous system.

Give **two** ways that coordination by the endocrine system is different from coordination by the nervous system.

1 _____

_____

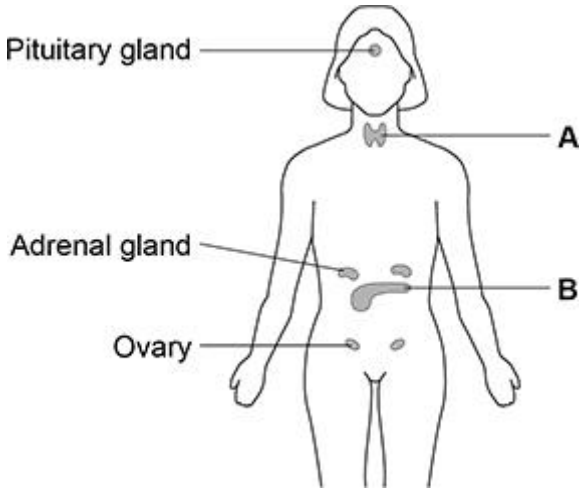
2 _____

_____

(2)

Figure 2 shows endocrine glands in a female.

Figure 2



(c) Name **one** hormone produced by gland **A**. **(HT only)**

_____

(1)

(d) Name **one** hormone produced by gland **B**.

_____

(1)

(e) The adrenal gland produces the hormone adrenaline.

Describe **two** effects of adrenaline on the human body. **(HT only)**

1 _____

_____

2 _____

_____

(2)

(f) Hormones can be used for controlling human reproduction.

Explain the use of hormones in:

- contraception
- the treatment of infertility.

(6)

(Total 14 marks)

Q2.

Conditions inside and outside of the human body often change.

Homeostasis helps the human body to survive changing conditions.

(a) Explain what is meant by the term 'homeostasis'.

(2)

The kidneys have an important role in homeostasis.

(b) Describe what happens to **glucose**, **protein** and **urea** in the kidneys. **(biology only)**

(4)

(c) Explain how ADH affects the production and concentration of urine by the kidneys. **(biology only) (HT only)**

(4)

(Total 10 marks)

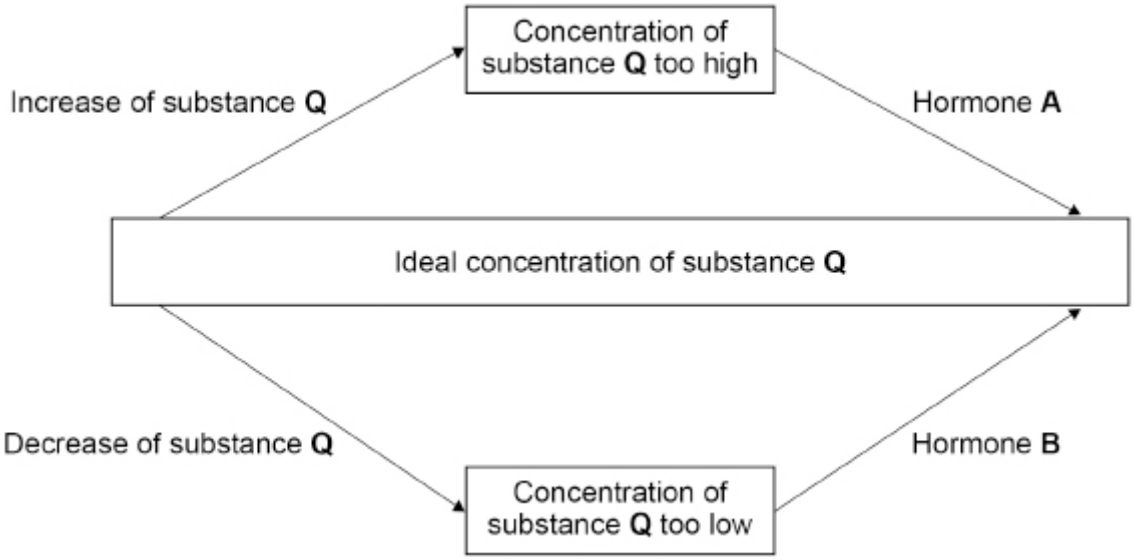
Q3.

Homeostasis is the regulation of the body's internal conditions.

Many internal conditions are controlled by hormones.

Homeostasis works by negative feedback control.

(a) The figure below shows how the concentration of substance **Q** in the blood is controlled by negative feedback.



Explain how the concentration of substance **Q** in the blood is controlled by negative feedback.

Use information from the figure above. **(HT only)**

_____

_____

_____

_____

_____

_____

(3)

(b) Thyroxine is a hormone produced by the thyroid gland.

A decrease in body temperature causes an increase in thyroxine production.

Explain how the production of thyroxine causes an **increase** in body temperature. **(HT only)**

_____

_____

_____

_____

(2)

(c) ADH is a hormone made by the pituitary gland.

ADH controls how much water is reabsorbed from the kidney tubules.

The table below shows effects of ADH.

Concentration of ADH in the blood in nanograms/dm^3	**Concentration of dissolved substances in urine in arbitrary units**	**Rate of urine production in cm^3/minute**
0.0	50	20.0
1.25	700	8.8
2.50	980	3.9
3.75	1110	1.8
5.00	1170	0.9

The concentration of ADH in a man's blood was 3.75 nanograms/dm^3.

The concentration of ADH in his blood decreased to 1.25 nanograms/dm^3.

Explain how the decrease in the concentration of ADH would cause the changes to the urine shown in the table above. **(biology only) (HT only)**

(4)

(Total 9 marks)

Q4.

Hormones are important for regulating the menstrual cycle.

During the menstrual cycle, eggs mature inside follicles in the ovaries.

A 27-year-old woman was infertile.

A doctor tested a sample of the woman's blood.

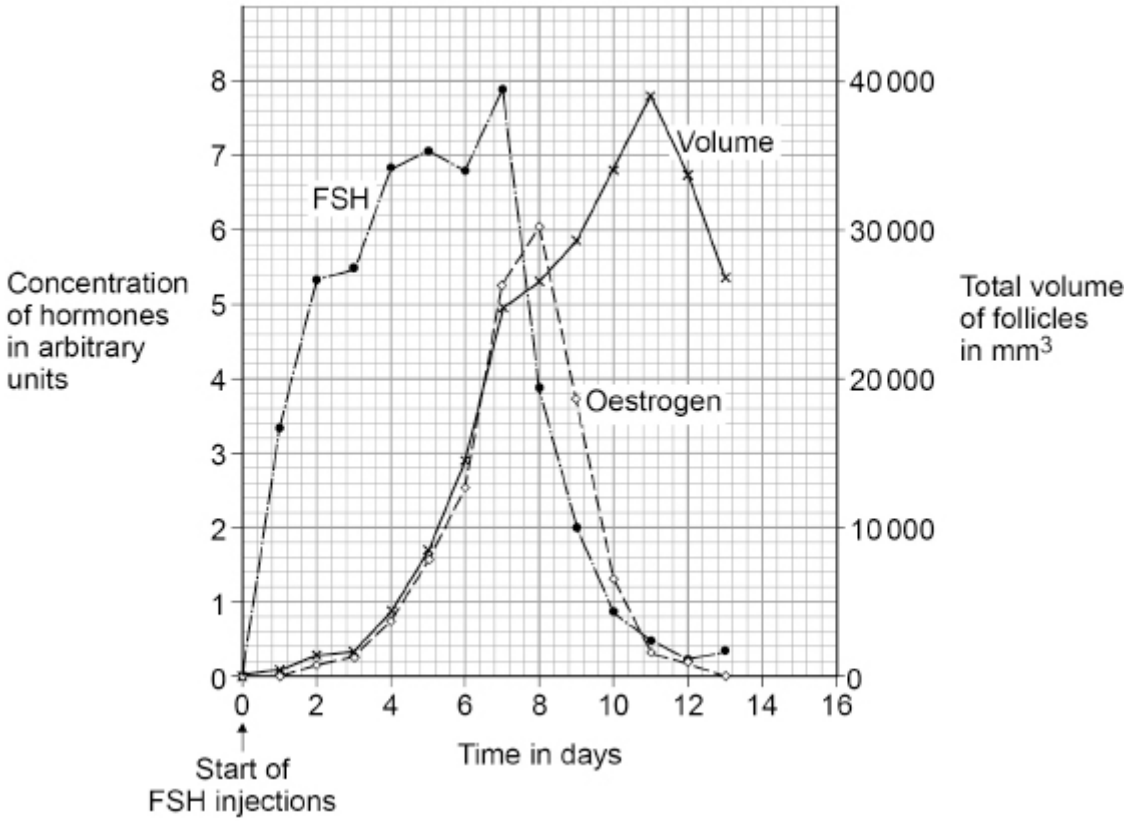
The test did **not** detect any follicle stimulating hormone (FSH) in the woman's blood.

The doctor gave the woman daily injections of FSH for 7 days.

The doctor measured:

- the concentration of FSH in the woman's blood
- the concentration of oestrogen in the woman's blood
- the volumes of developing follicles in the ovaries.

The figure below shows the results.



(a) Give evidence from the figure that the follicles in the ovaries release oestrogen. **(HT only)**

_____

_____

(1)

(b) Injection of FSH caused the development of a number of follicles.

The mean diameter of the follicles on day 11 was 22 millimetres.

Calculate the number of follicles in the woman's ovaries on day 11.

Assume each follicle is a sphere.

Volume of a sphere = $\frac{4}{3}\pi r^3$

r = radius
π = 3.14

Give your answer to the nearest whole number.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Number of follicles (to the nearest whole number) = _____

(5)

(c) Before treatment with FSH, the woman had underdeveloped breasts.

Explain why the lack of FSH in the woman's blood caused underdeveloped breasts.

_____

_____

_____

_____

(2)

(d) Usually males and females both produce FSH.

The woman had inherited a faulty gene for FSH production from each of her parents.

The woman's parents both produce FSH.

Show how the **woman's parents** could have a child that does **not** produce FSH.

You should:
- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols below:
  H = allele for making FSH
  h = allele for **not** making FSH
  (HT only)

(3)

(e) The woman continues to have injections of FSH.

The woman has a child with a man who is heterozygous for the FSH gene.

Explain why the probability that the child will be able to produce FSH is 0.5.
(HT only)

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

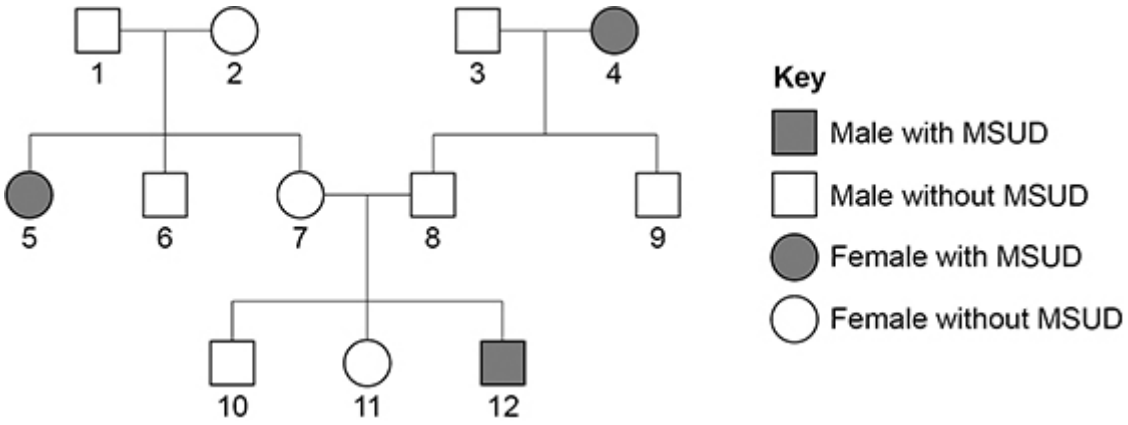
Q5.

Maple syrup urine disease (MSUD) is a rare inherited human condition.

MSUD is usually diagnosed early in childhood and can be controlled by having a low-protein diet.

Figure 1 shows the inheritance of MSUD in one family.

Figure 1



The allele for MSUD is recessive.

(a) Give **one** piece of evidence from **Figure 1** which shows that MSUD is a recessive condition.

_____

_____

(1)

(b) Persons **7** and **8** in **Figure 1** are expecting a fourth child.

Determine the probability that the child will have MSUD.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols:

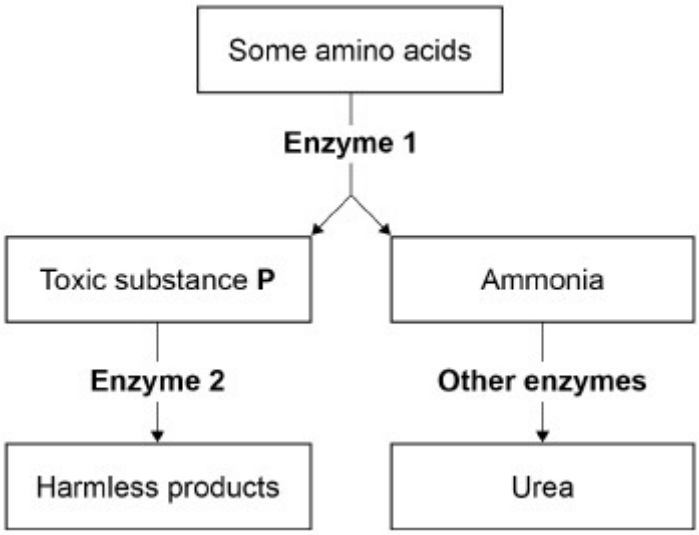
N = allele for **not** having MSUD
n = allele for MSUD.
(HT only)

Probability = _____

(4)

Figure 2 shows chemical reactions involved in the normal breakdown of some types of amino acid inside body cells.

Figure 2



A person with MSUD **cannot** make **Enzyme 2**.

(c) One of the final products shown in **Figure 2** is urea.

Where in the human body are the reactions shown in **Figure 2** most likely to occur?

Tick (✓) **one** box. **(biology only) (HT only)**

Kidney ☐

Liver ☐

Pancreas ☐

Small intestine ☐

(1)

Scientists can analyse blood samples or urine samples to see if a person has MSUD.

The test identifies high concentrations of toxic substance **P**, shown in **Figure 2**.

(d) Explain why the **blood** of a person with MSUD will have a high concentration of toxic substance **P**.

Use information from **Figure 2**. **(biology only) (HT only)**

(3)

(e) Explain why the **urine** of a person with MSUD will have a high concentration of toxic substance **P**. **(biology only) (HT only)**

(2)

(f) Explain why a person with MSUD must have a low-protein diet. **(biology only) (HT only)**

(3)

(Total 14 marks)