

# 6.6 Hormones, Homeostasis & Reproduction

## Question Paper

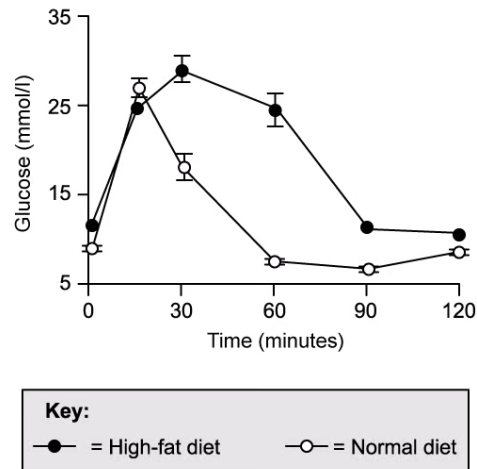
Course	DP IB Biology
Section	6. Human Physiology
Topic	6.6 Hormones, Homeostasis & Reproduction
Difficulty	Hard

**Time allowed:** 70  
**Score:** /58  
**Percentage:** /100

### Question 1a

a)

A group of scientists wanted to investigate the control of blood glucose in mice. They fed one group of mice with a normal diet and another group with a 'high fat' diet containing a high level of both fat and sugar for three weeks beforehand. They then measured their blood glucose over a period of 2 hours directly after a meal. Their results are shown below.



Explain the change in blood glucose levels for the **normal diet** mice during the first 90 minutes after the meal.

[4 marks]

[4 marks]

### Question 1b

b)

After the first 90 minutes, the normal diet mice show an increase in blood glucose despite no more food being eaten.

Explain why blood glucose increases despite no food being consumed.

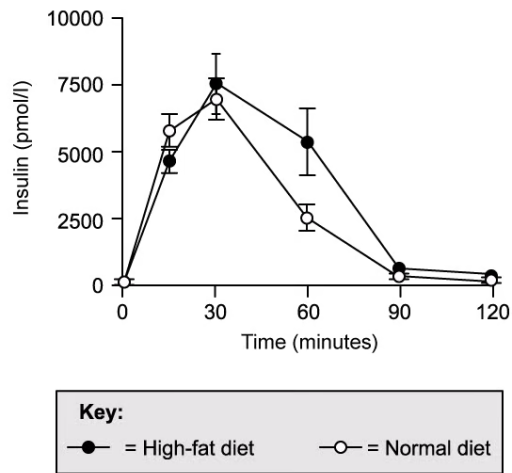
[2 marks]

[2 marks]

### Question 1c

c)

At the same time as measuring blood glucose the scientists in part a) also measured blood insulin levels. Their results are shown below.



With reference to the changes in insulin, suggest an explanation for the difference in the blood glucose changes between the two groups of mice shown in part a).

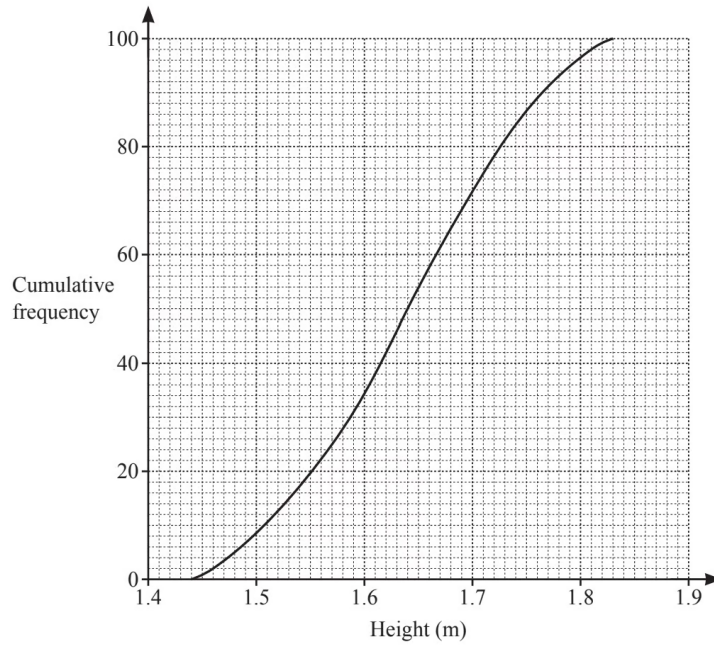
[2 marks]

[2 marks]

**Question 1d**

d)

After carrying out the investigation detailed in parts a) and c), the scientists gave the high fat diet mice supplements of a drug called a DDP-4 inhibitor in their drinking water. The effects of the functional DDP-4 enzyme in the body are shown below.



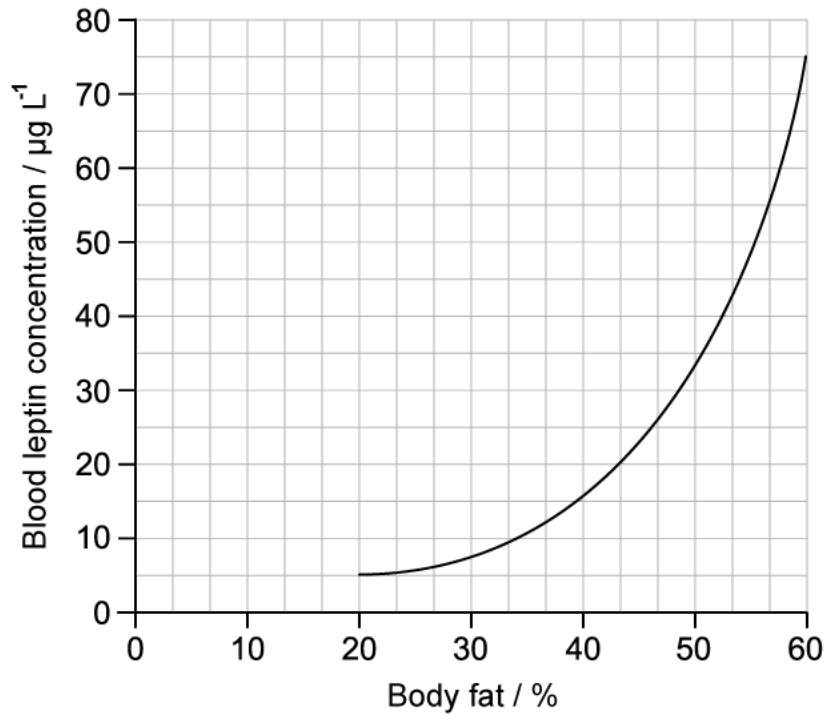
Suggest, with a reason, how the administration of DDP-4 inhibitors might affect the blood-glucose levels of the high fat diet mice.

[2 marks]

[2 marks]

**Question 2a**

a)  
The graph below shows blood leptin concentration and body fat percentage in adult humans.



i)  
Calculate the percentage increase in blood leptin concentration when body fat percentage increases from 20 % to 60 %.

**[2 marks]**

ii)  
Explain the association between body fat percentage and blood leptin concentration shown in the graph.

**[1 mark]**

**[3 marks]**

**Question 2b**

b)  
Research carried out in mice has shown that high levels of leptin can induce weight loss in mice with a high body fat percentage.

i)  
State how high levels of leptin can lead to weight loss in mice.

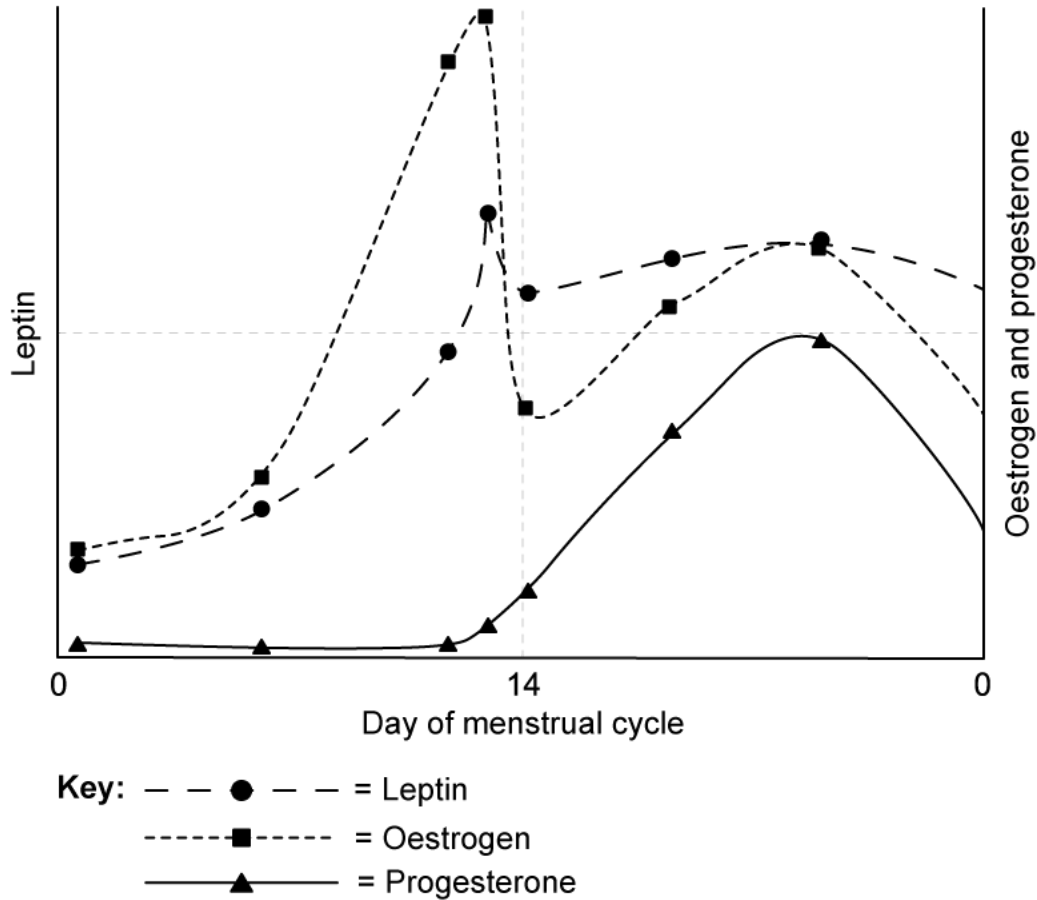
**[1 mark]**

ii)  
Suggest why humans with a high body fat percentage might continue to gain weight despite the results shown in part a) above and the evidence collected from research with mice.

**[2 marks]****[3 marks]**

**Question 2c**

c)  
Levels of the hormone leptin were recorded, along with levels of some reproductive hormones, in a group of 250 regularly menstruating, healthy women. The average results over one menstrual cycle are shown below.



One conclusion from the results of the study was that leptin could be involved with the process of ovulation.

Evaluate this conclusion.

[3 marks]

[3 marks]

**Question 2d**

d)

Suggest, with a reason, **one** other possible conclusion that could be drawn about the role of leptin in reproduction from the results in part c).

**[2 marks]****[2 marks]**



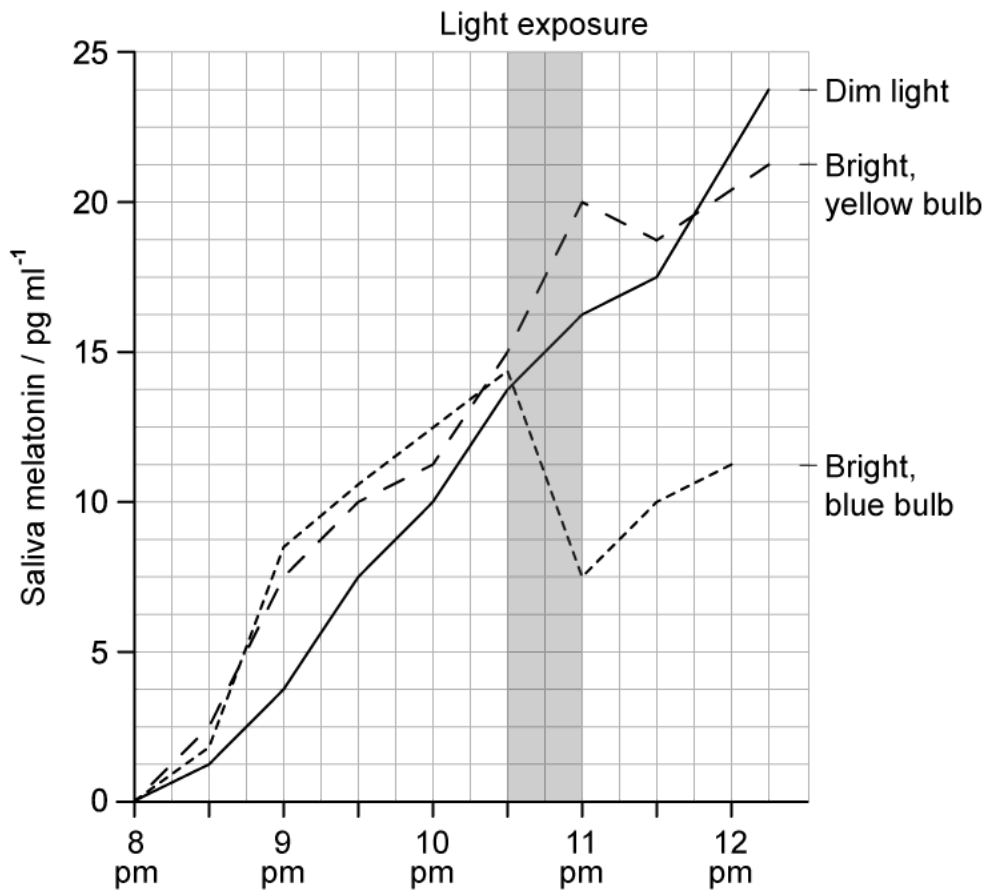
**Question 3a**

a)

A group of scientists studied the effect of exposure to bright bathroom lights late in the evening on melatonin levels. Subjects attended a sleep clinic where they were allocated to three different light exposure groups; dim light, bright yellow light, and bright blue light.

Over the course of a week, all of the subjects spent most of each evening carrying out normal activities under dim light, before each group was exposed to a 30 minute period of either continuing dim light, bright yellow light, or bright blue light between 10:30 and 11 pm to simulate exposure to bathroom light.

The saliva melatonin levels of all groups were measured at 30 minute intervals throughout the evening and an average is taken for each light condition. The results are shown below.



Describe the effect of the 30-minute period of light exposure on melatonin levels.

[3 marks]

[3 marks]

### Question 3b

b)

A student was changing the light bulb in their bathroom and concluded, after reading the data in part a), that the best bulb type for improving their sleep would be a bright, yellow bulb.

Evaluate the student's conclusion using information from part a).

[3 marks]

[3 marks]

### Question 3c

c)

One of the roles of melatonin is to bind to cell membrane receptors on pancreas cells and slow down the secretion of insulin.

i)

Describe the effect that the binding of melatonin to receptors on pancreas cells will have on the body.

[2 marks]

ii)

Suggest a benefit of the effect described in part i) during the period at which melatonin levels are high.

[1 mark]

[3 marks]

**Question 3d**

d)

A mutation known as the G allele has been identified in some individuals. The G allele is thought to increase the sensitivity of cells to melatonin. Individuals who regularly undertake shift work at night and who also have the G allele are thought to be at particularly high risk of diabetes.

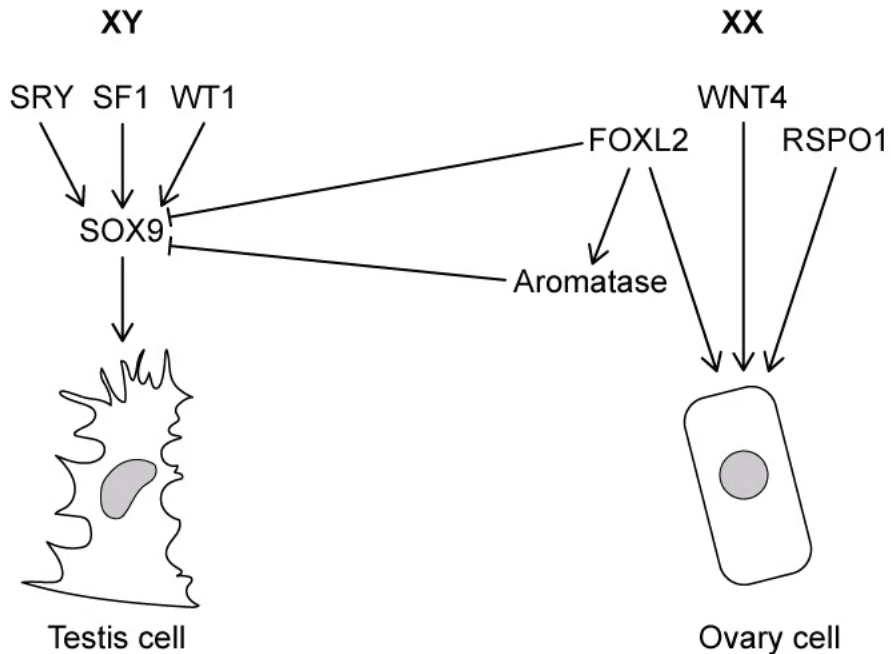
Use the information provided in parts c) and d) to suggest why individuals with the G allele who regularly work night shifts are thought to be at greater risk of type 2 diabetes.

**[2 marks]****[2 marks]**

**Question 4a**

a)

The image below shows some of the gene pathways that could be involved with sex determination in mammals. Note that 'switching on' a gene refers to activation, while 'switching off' refers to inhibition, e.g. the diagram shows that the gene WT1 activates expression of the gene SOX9.



**Key:**  $\longrightarrow$  = Switches on gene     $\longrightarrow|$  = Switches off gene

Including information in the image above, outline the role of SRY in determining biological sex.

[3 marks]

[3 marks]

### Question 4b

b)  
Suggest, with a reason, a possible outcome resulting from mutations in the following genes shown in part a).

i)  
SF1 [2 marks]

ii)  
FOXL2 [2 marks]

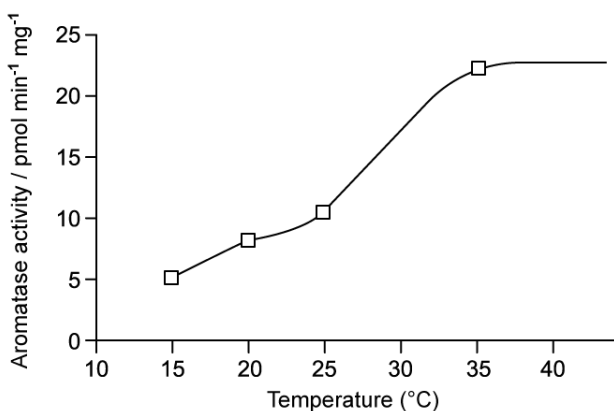
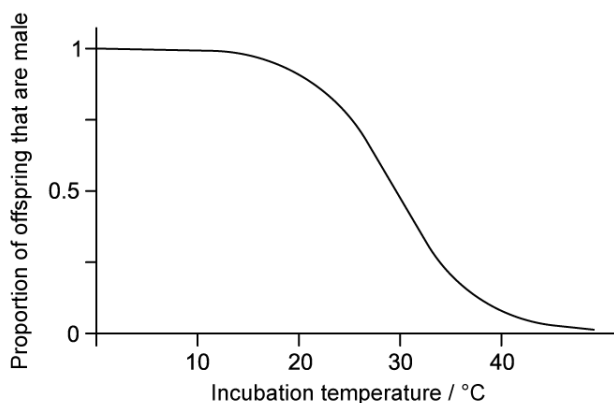
[4 marks]

### Question 4c

c)

Biological sex in some species of reptile is determined by the temperature at which the reptile eggs are incubated during a thermosensitive period of development. There has been some suggestion among scientists that the enzyme aromatase may be involved in temperature-related sex determination in these reptiles.

A possible example of this is in sea turtles. The graphs below show the effect of developmental temperature on sea turtle sex (top) and on the activity of the enzyme aromatase (bottom).



Use information provided here and in part a) to suggest how aromatase activity may determine sex in sea turtles.

[2 marks]

[2 marks]

### Question 4d

d)

Suggest, with a reason, how the current global warming trends may impact populations of the sea turtles described in part

c).

[2 marks]

[2 marks]

### Question 5a

*One mark is available for clarity of communication throughout this question.*

a)

Draw a labelled diagram of the male reproductive system.

[7 marks]

[7 marks]

**Question 5b**

b)

Describe the role of hormones in the regulation of the menstrual cycle.

**[8 marks]****[8 marks]**