Surname	Date	Tutor
First name(s)		

BioWelsh

GCE A LEVEL

BW-A2-4.1-W1

TOPIC WORKSHEET 1 – 4.1 HUMAN REPRODUCTION

BIOLOGY – A2 unit 4

Variation, Inheritance and Options

Suggested time: 2 hours 55 minutes

For Tutor's use only

Question	Maximum Mark	Mark Awarded	Question	Maximum Mark	Mark Awarded
1.	9		9.	7	
2.	9		10.	9	
3.	9		11.	8	
4.	9		12.	8	
5.	10		13.	9	
6.	7		14.	8	
7.	11		15.	9	
8.	10		Total	132	

ADDITIONAL MATERIALS

In addition to this worksheet, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name and the date in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you are working on screen, write your answers on paper and number each one clearly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question. The worksheet is out of **132** marks.

The assessment of the quality of extended response (QER) will take place in question **15**.

The quality of written communication will affect the awarding of marks.

This worksheet is written by BioWelsh in the style of the WJEC A level Biology examination, following the WJEC specification (topic 4.1). It is not an official WJEC paper.

Tutor only

Answer **all** questions.

1. **Image 1.1** shows the route taken by spermatozoa from the testis to the outside of the body, and two glands that add fluid to them.

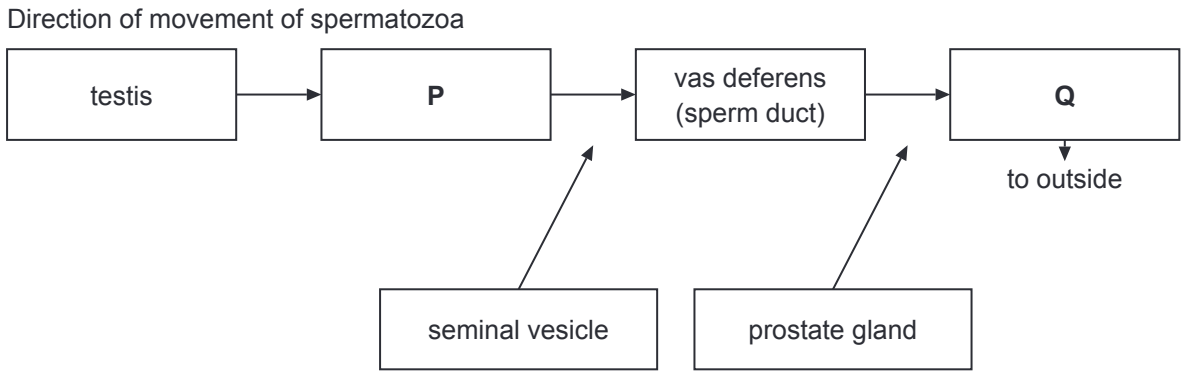

Image 1.1

(a) Name the structures labelled **P** and **Q**. [2]

P .....

Q .....

(b) State **one** function of structure **P**. [1]

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(c) The fluid from the seminal vesicles contains fructose. Explain why this is important for the spermatozoa. [2]

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(d) The prostate gland secretes an alkaline fluid. Suggest why this helps the spermatozoa to survive in the vagina. [2]

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Tutor only

(e) A vasectomy is a sterilisation operation in which each vas deferens is cut and tied. Explain why the man still produces semen but is infertile. [2]

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Tutor only

2. **Image 2.1** is a drawing made from a prepared slide of a section through part of a seminiferous tubule and the tissue around it. It is not drawn to scale.

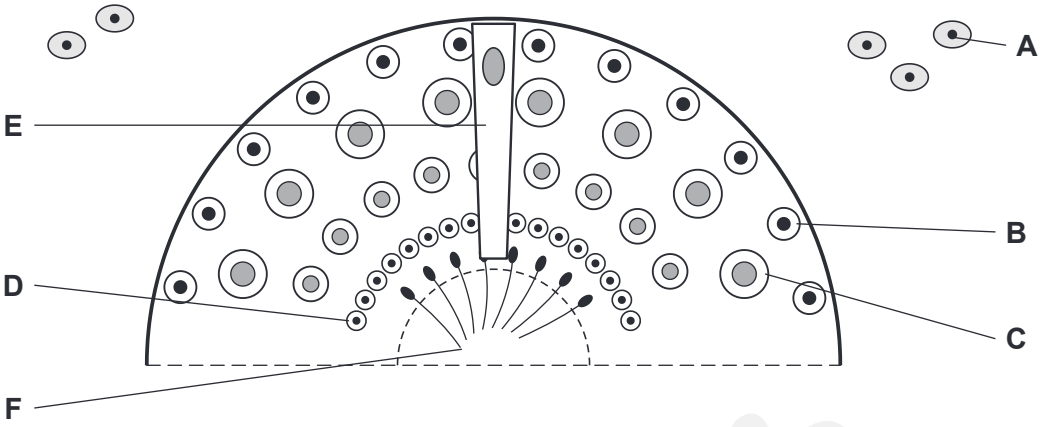

Image 2.1

(a) Identify the cells labelled **A**, **B**, **C** and **D**. [2]

A .....

B .....

C .....

D .....

(b) Name the cell labelled **E** and give **two** of its functions. [3]

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(c) State what is found in region **F** and explain your answer. [2]

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Tutor only

(d) Cells **A** secrete testosterone. Suggest why they are found between the tubules and close to blood capillaries. [2]

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Tutor only

3. **Image 3.1** shows the stages in the production of spermatozoa.

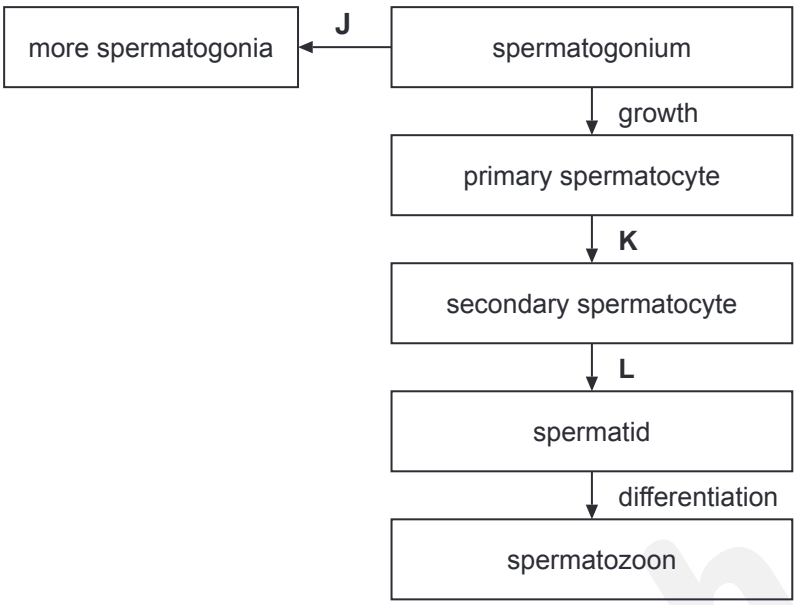

Image 3.1

(a) Name the types of cell division represented by **J**, **K** and **L**. [2]

J .....

K .....

L .....

(b) A human spermatogonium contains 46 chromosomes. Complete **Table 3.2** to show the number of chromosomes in each cell. [2]

Table 3.2

Cell	Number of chromosomes
primary spermatocyte	.....
secondary spermatocyte	.....
spermatozoon	.....

(c) Calculate how many spermatozoa can be produced from 50 primary spermatocytes. [1]

Number = ...

Tutor only

(d) Explain why it is important that gametes are haploid. [2]

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(e) A man is heterozygous for four genes, each on a different pair of homologous chromosomes. Ignoring crossing over, calculate how many genetically different spermatozoa he can produce for these genes. Explain your answer. [2]

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4. **Image 4.1** is a light micrograph of part of a mature follicle from a human ovary.

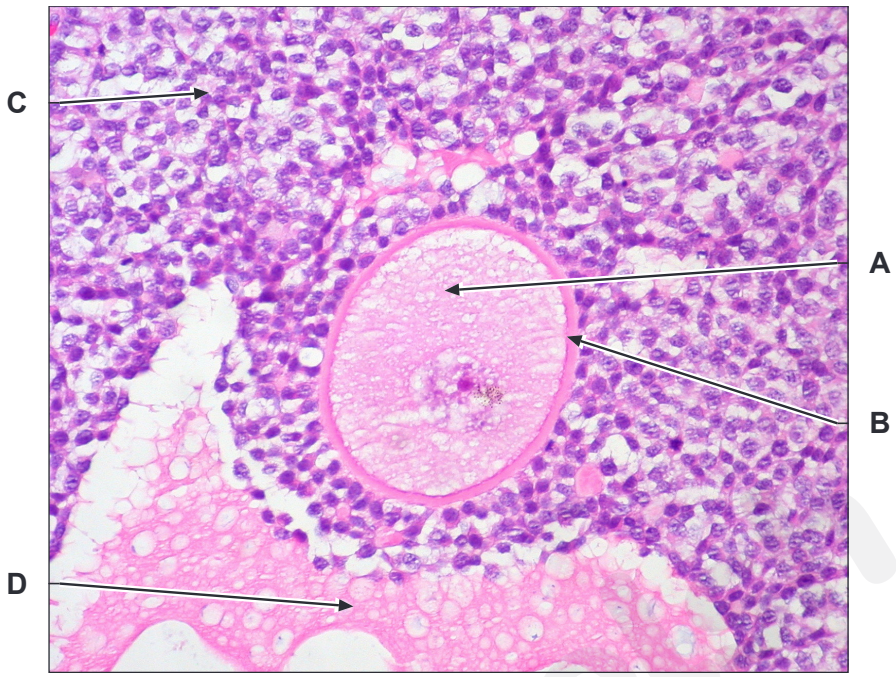

Image 4.1

(a) Identify the structures labelled **A**, **B**, **C** and **D**. [2]

A .....

B .....

C .....

D .....

(b) The oocyte in **Image 4.1** measures 42 mm across in a printed copy of the micrograph. The magnification of the print is × 400. Calculate the actual diameter of the oocyte in µm. [2]

Diameter = ... µm

(c) State the name given to this type of mature follicle and the name of the process by which it releases its oocyte. [2]

Follicle .....

Process .....

Tutor only

(d) After the oocyte is released, the remaining follicle cells develop into a new structure. Name the structure and the hormone it secretes. [2]

Structure .....

Hormone .....

(e) Suggest why it is an advantage that cells **C** are packed closely around the oocyte and have many connections with it. [1]

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Tutor only

5. Oogenesis begins before a female is born. At birth the ovaries contain primary oocytes arrested in prophase of meiosis I. From puberty, one secondary oocyte is usually released in each menstrual cycle. **Table 5.1** shows the approximate number of primary oocytes in both ovaries at different ages.

Table 5.1

Age / years	0 (birth)	13	25	37	51
Number of primary oocytes	1 000 000	300 000	150 000	25 000	1 000

(a) Describe how a primary oocyte becomes a secondary oocyte, and state when meiosis II is completed. [3]

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(b) Suggest why the divisions in oogenesis are unequal. [1]

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(c) A woman ovulates once in each 28-day cycle from age 13 to age 51 and is never pregnant. Calculate the number of secondary oocytes she releases. Give your answer to the nearest whole number. Take one year as 365 days. [2]

Number = ...

(d) Use your answer to (c) and **Table 5.1** to calculate the percentage of the primary oocytes present at birth that are ever released. [1]

Percentage = ... %

Tutor only

(e) Use **Table 5.1** and your answer to (d) to suggest what happens to most primary oocytes. [1]

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(f) Compare spermatogenesis with oogenesis by giving **two** differences. [2]

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Tutor only

6. **Image 6.1** shows a human spermatozoon. It is not drawn to scale.

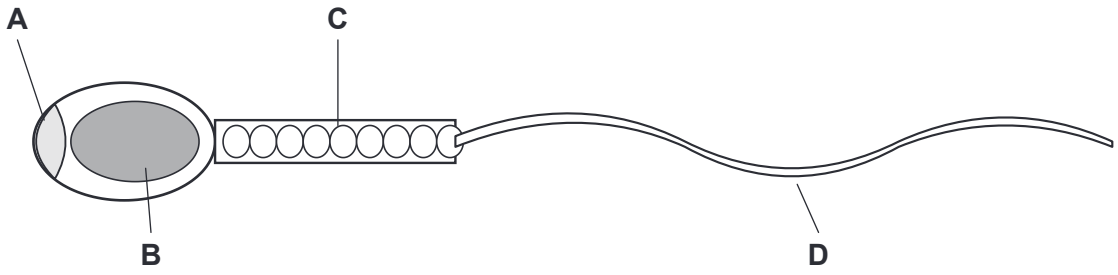

Image 6.1

(a) Complete **Table 6.2** by naming structures **A**, **C** and **D** and stating the function of each. [3]

Table 6.2

Letter	Name	Function
A	.....	.....
C	.....	.....
D	.....	.....

(b) Spermatozoa can swim at about 3 mm per minute. The distance from the cervix to the site of fertilisation in the oviduct is about 17.5 cm. Calculate the minimum time for a spermatozoon to swim this distance, in hours. [2]

Time = ... hours

(c) Some men are infertile because their spermatozoa have no acrosome. Explain why. [2]

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Tutor only

7. The events of fertilisation happen in the oviduct, usually within 24 hours of ovulation.

(a) Describe the events from the moment a spermatozoon reaches the zona pellucida until the nuclei of the two gametes fuse. [4]

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(b) Explain why the cortical reaction is essential. [2]

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Table 7.1 shows the stages of the early embryo after fertilisation.

Table 7.1

Time after fertilisation	Stage	Position
30 hours	2 cells	oviduct
3 days	16 cells (morula)	oviduct
5 days	blastocyst, about 100 cells	enters uterus
7 days	implantation begins	uterus

(c) The embryo divides by mitosis as it moves along the oviduct, as shown in **Table 7.1**. Describe what happens at implantation. [3]

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Tutor only

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(d) In an ectopic pregnancy the blastocyst implants in the oviduct. Suggest why damage to the cilia lining the oviduct increases the risk of an ectopic pregnancy. [2]

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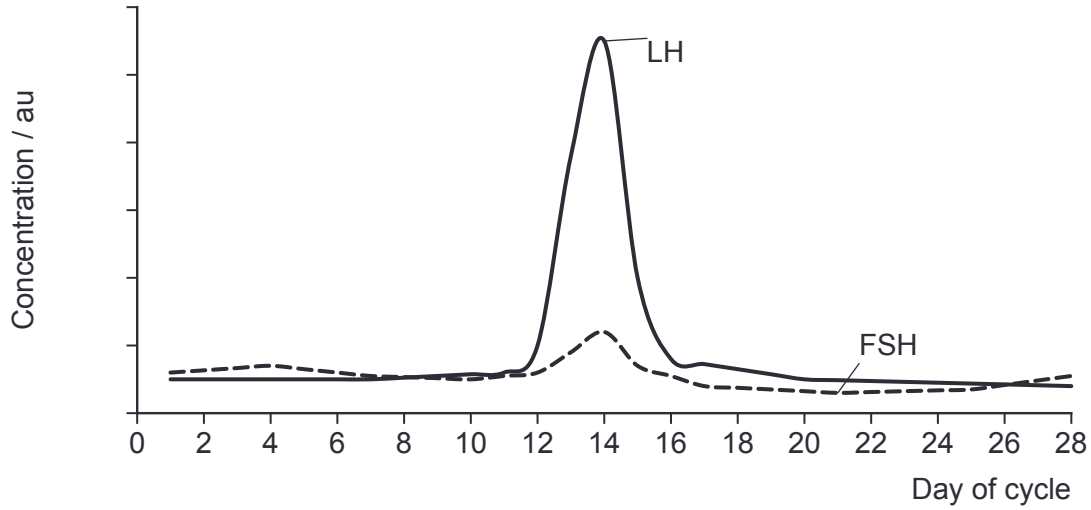
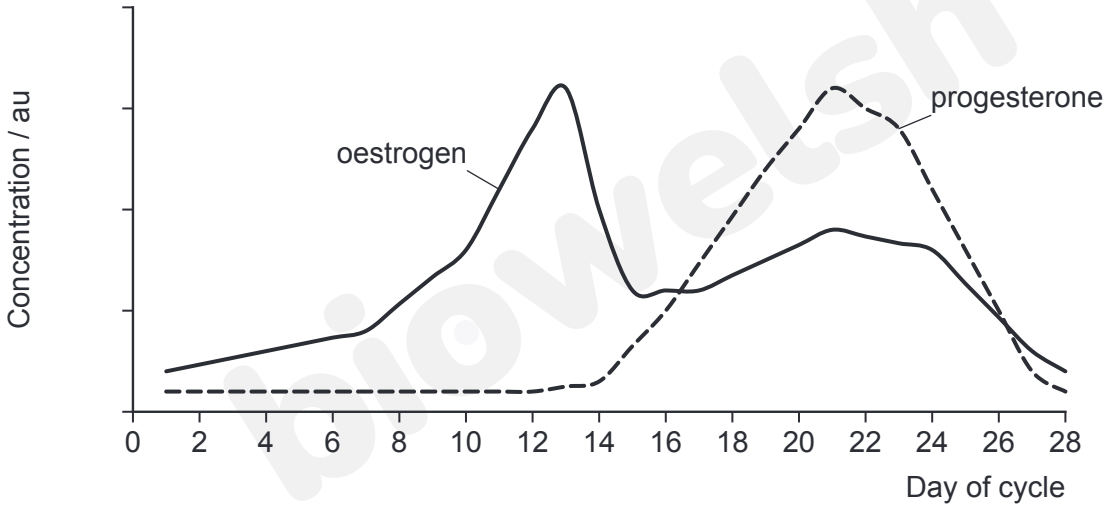
Tutor only

8. **Graph 8.1A** and **Graph 8.1B** show the concentrations of four hormones in the blood of a woman during one 28-day menstrual cycle.



Graph 8.1A



Graph 8.1B

(a) Name the gland that secretes FSH and LH. [1]

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(b) Use **Graph 8.1A** to state the day on which ovulation is most likely to occur. Give a reason for your answer. [2]

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Tutor only

(c) Explain how oestrogen causes the changes in LH concentration between day 10 and day 14. [3]

(d) Explain why the concentrations of FSH and LH stay low between day 16 and day 26. [2]

(e) Explain the changes in progesterone concentration after day 21 and their effect on the uterus. [2]

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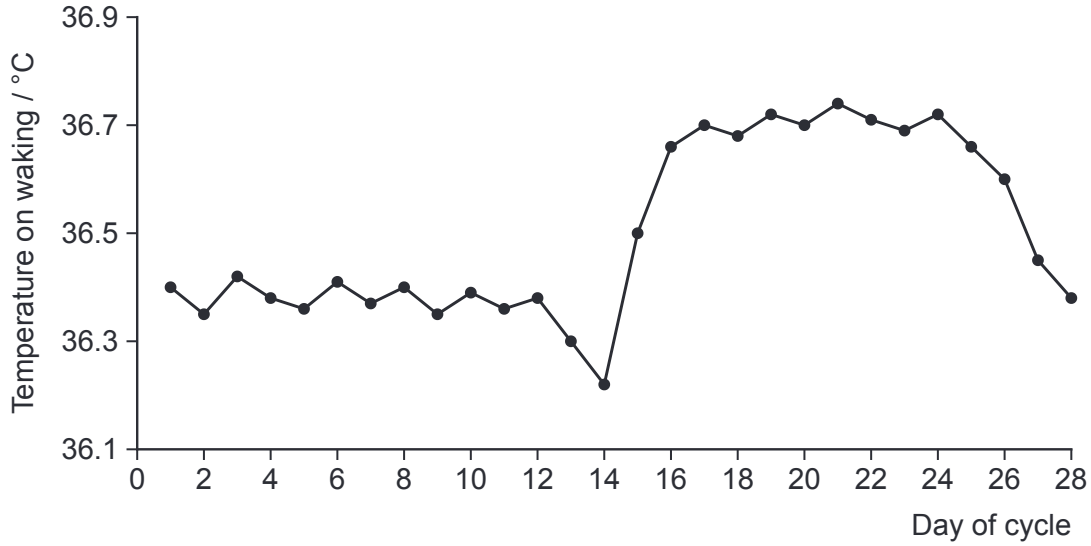
Tutor only

9. Progesterone raises body temperature slightly. A woman measured her temperature each morning on waking during one menstrual cycle. **Graph 9.1** shows her results.



Graph 9.1

(a) Calculate the mean temperature for days 17 to 24. [1]

Mean = ... °C

(b) Use **Graph 9.1** and your knowledge of the menstrual cycle to explain the rise in temperature after day 14. [2]

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(c) The temperature fell after day 24. Explain what this shows about whether the woman became pregnant in this cycle. [2]

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Turn over.

Tutor only

(d) Suggest **two** reasons why this method is unreliable for predicting the day of ovulation. [2]

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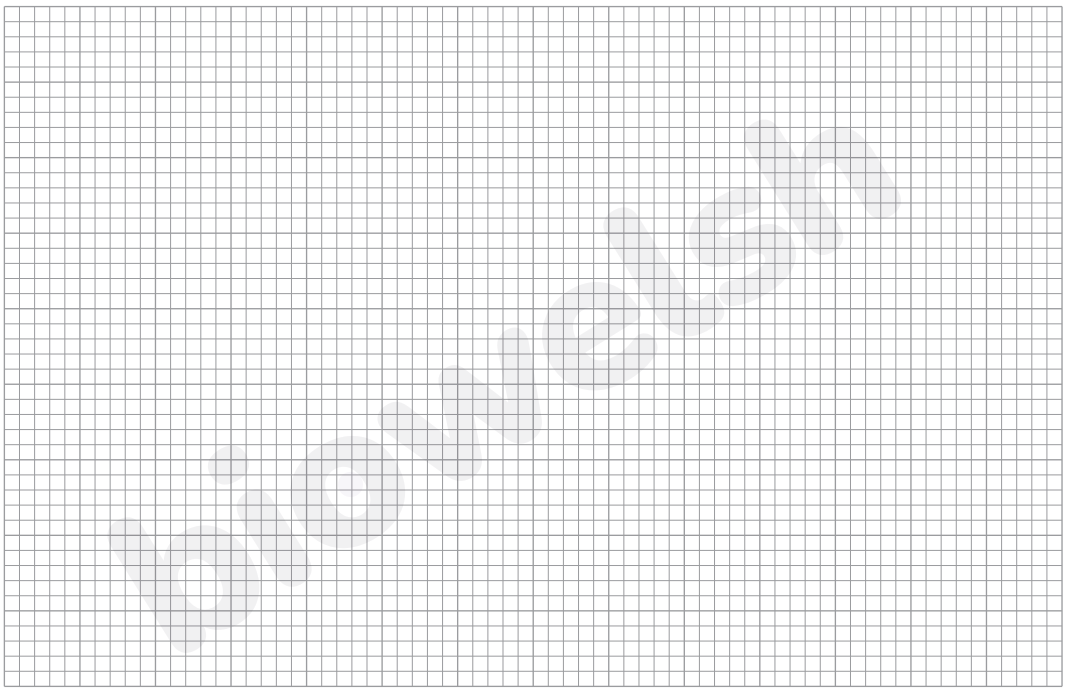
Tutor only

10. During a pregnancy, a doctor measured the concentration of human chorionic gonadotrophin (hCG) in a woman's blood. **Table 10.1** shows the results.

Table 10.1

Weeks after fertilisation	1	2	3	4	6	8	10	12	16	20
hCG / thousand units dm^{-3}	0.1	1.5	12	40	90	120	110	70	30	20

(a) Plot a graph of the data in **Table 10.1** on the grid below. Join the points with straight lines. [4]



(b) State where hCG is produced and explain its role in early pregnancy. [3]

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(c) Suggest why the concentration of hCG falls after week 10, without the pregnancy ending. [2]

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Tutor only

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Tutor only

11. **Image 11.1** is a light micrograph of a section through a chorionic villus from a placenta at the end of pregnancy.

Image 11.1

(a) Blood cells **X** are in the space outside the villus. Blood cells **Y** are inside a capillary in the villus. Identify whose blood each belongs to. [1]

X .....

Y .....

(b) Structure **Z** is the thin layer of cells covering the villus. Explain how the structure of the villi makes exchange across the placenta efficient. [3]

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(c) State **two** substances that pass from the foetus to the mother across the placenta. [1]

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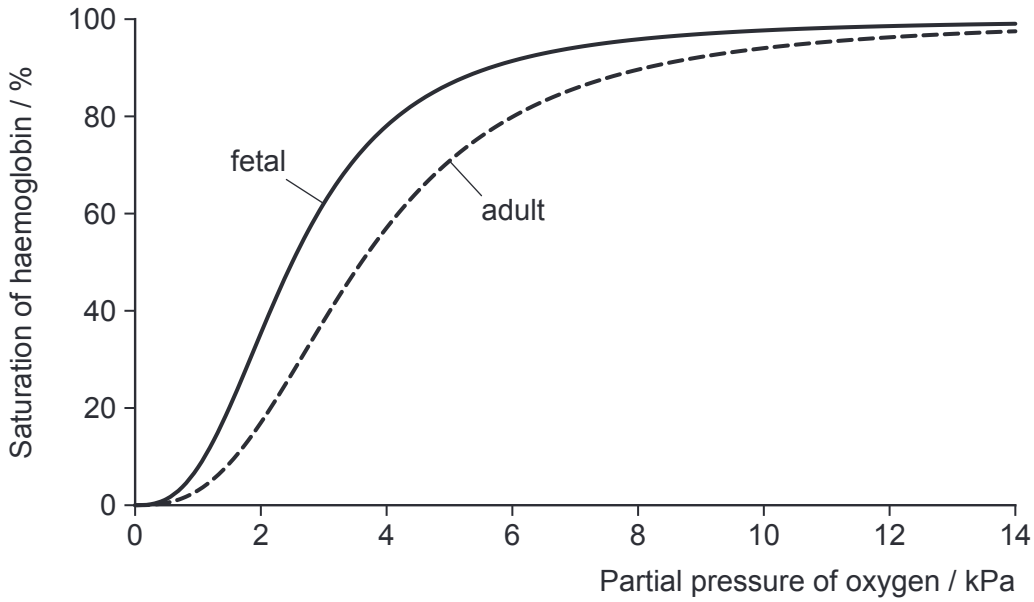
Turn over.

Tutor only

Graph 11.2 shows oxygen dissociation curves for fetal and adult haemoglobin.



Graph 11.2

(d) (i) In the placenta the partial pressure of oxygen is about 4 kPa. Use **Graph 11.2** to find the difference in saturation between fetal and adult haemoglobin at this partial pressure. [1]

Difference = ... %

(ii) Explain why the difference in the curves is important for the foetus. [2]

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Tutor only

12. The blood of the mother and the blood of the foetus do not mix. **Table 12.1** shows whether some substances cross the placenta.

Table 12.1

Substance	Relative molecular mass	Crosses the placenta
ethanol	46	yes, rapidly
glucose	180	yes
insulin	5 800	very little
IgG antibody	150 000	yes
IgM antibody	900 000	no

(a) Explain why it is important that the blood of the mother and the foetus do not mix. [2]

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(b) Use **Table 12.1** to suggest how IgG antibodies cross the placenta, and why this is useful to the baby after birth. [2]

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(c) Use **Table 12.1** to suggest why ethanol (alcohol) crosses the placenta rapidly. [1]

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(d) Removing the ovaries before the seventh week of pregnancy usually ends the pregnancy. Removing them after the twelfth week does not. Use your knowledge of the hormones of pregnancy to explain these observations. [3]

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Tutor only

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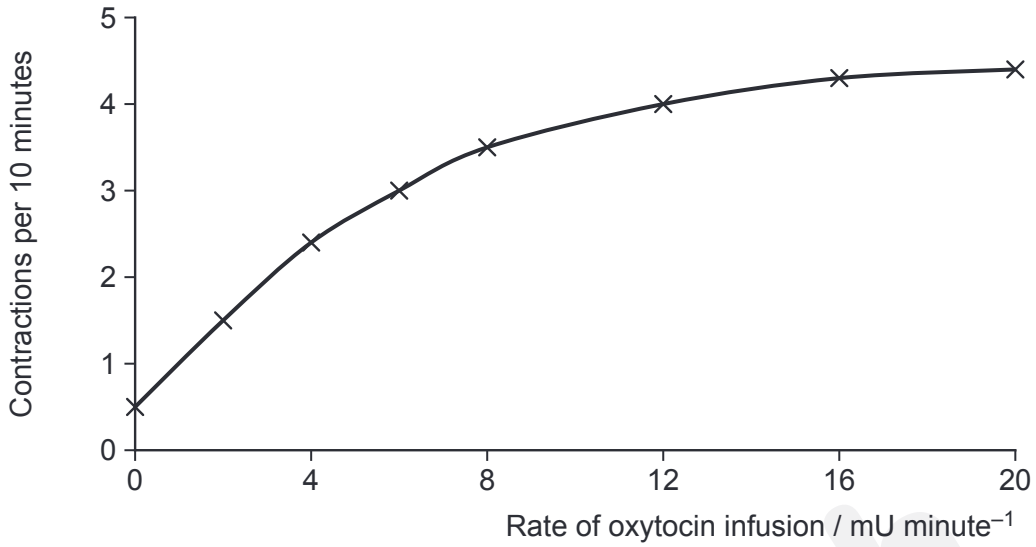
Tutor only

13. At the end of pregnancy the concentration of progesterone falls and the concentration of oestrogen rises. Oxytocin is released and the muscles of the uterus contract. In a study, oxytocin was given by a drip to women whose labour had slowed down. **Graph 13.1** shows the mean number of contractions at different rates of infusion.



Graph 13.1

(a) Name the gland that releases oxytocin into the blood. [1]

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(b) Explain why the fall in progesterone is needed before labour can begin. [2]

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(c) Describe the relationship shown in **Graph 13.1**. [2]

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(d) Doctors aim for 3 to 4 contractions per 10 minutes. Suggest why the infusion rate is kept below 12 mU minute^{-1}. [2]

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Tutor only

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(e) In natural labour, contractions push the baby's head against the cervix, which causes more oxytocin to be released. Explain why this is an example of positive feedback. [2]

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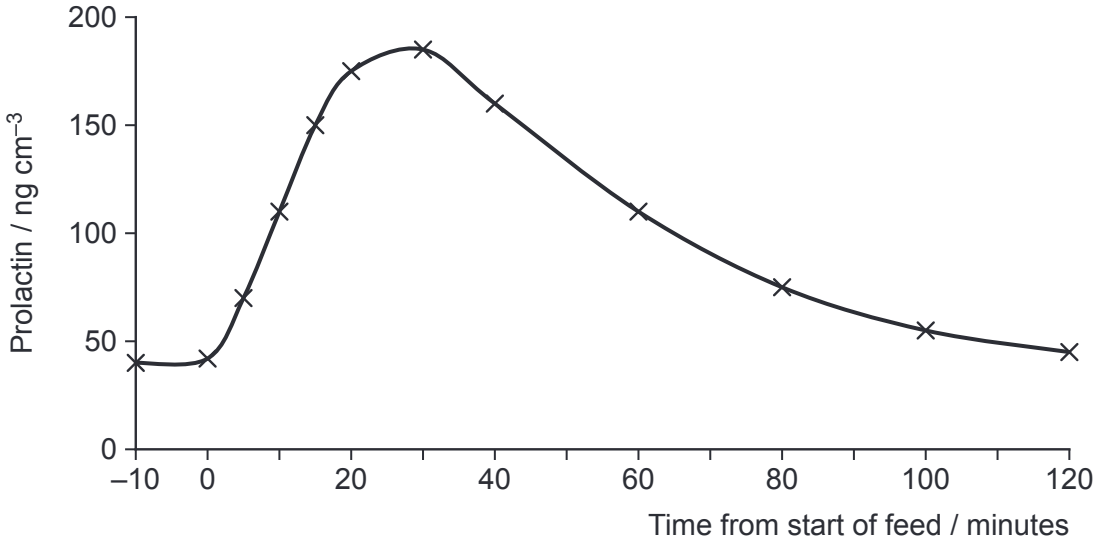
Tutor only

14. After birth, a mother breastfed her baby for 20 minutes. **Graph 14.1** shows the concentration of prolactin in her blood before, during and after the feed. The feed started at 0 minutes.



Graph 14.1

(a) Calculate the percentage increase in prolactin concentration from the start of the feed to its maximum value. [2]

Percentage increase = ... %

(b) Explain how suckling causes the change in prolactin concentration shown in **Graph 14.1**. [2]

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(c) Prolactin and oxytocin have different roles in lactation. Complete **Table 14.2**. [2]

Table 14.2

Hormone	Role in lactation
prolactin	.....
oxytocin	.....

Tutor only

(d) Milk production does not begin until after birth, even though prolactin concentration rises during pregnancy. Suggest why. [2]

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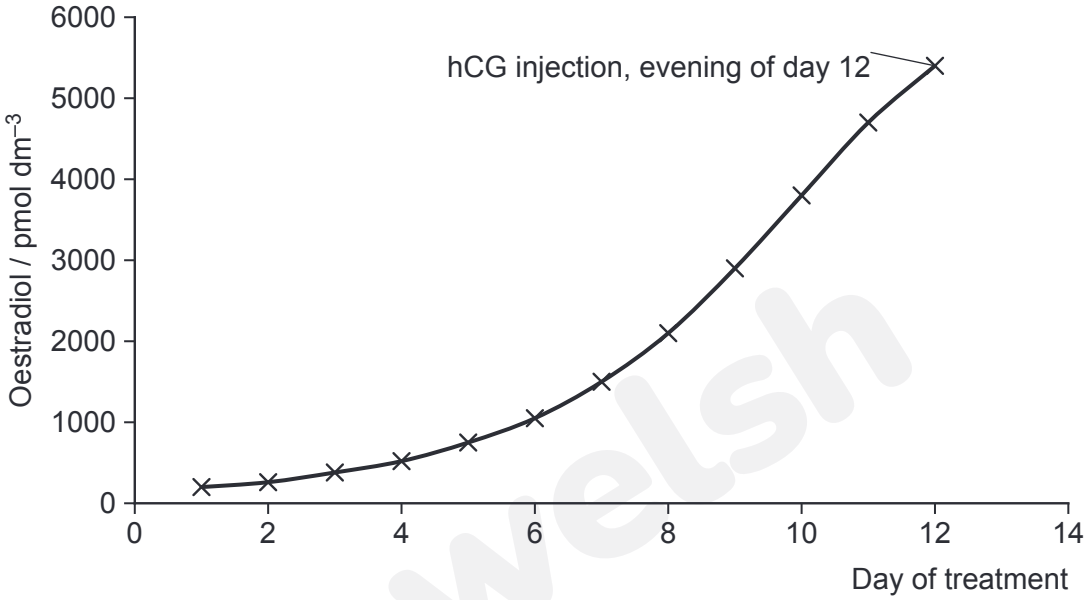
Tutor only

15. In one form of IVF treatment, a woman is given daily injections of FSH from day 1 to day 11. The growth of her follicles is monitored and, when several are mature, she is given an injection of hCG, which acts like LH. The oocytes are collected from the follicles about 36 hours later and fertilised in the laboratory. After 5 days, one blastocyst is placed in her uterus. **Graph 15.1** shows the concentration of oestradiol, a form of oestrogen, in her blood during the treatment.



Graph 15.1

Describe and explain the roles of FSH and LH in a natural menstrual cycle. Use **Graph 15.1** and the information above to explain the purpose of each stage of this IVF treatment. Describe the events that must then happen for the blastocyst to implant and for the pregnancy to be maintained. [9 QER]

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END OF WORKSHEET

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A Tutor Meets Tutee project

BioWelsh worksheets are written and checked by Tutor Meets Tutee tutors for WJEC A level Biology students.

Mark this worksheet with the BioWelsh mark scheme **BW-A2-4.1-W1** (MS).

Acknowledgements

Image 4.1: Micrograph: Ed Uthman, CC BY 2.0 (Wikimedia Commons, 'Graafian Follicle, Human Ovary'), https://creativecommons.org/licenses/by/2.0. Letters and label lines added.

Image 11.1: Micrograph: Mikael Häggström, CC0 (Wikimedia Commons, 'Histology of chorionic villus at term'). Letters and label lines added.

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