Passage of Information from Parents to Offspring (16.1): Cambridge (CIE) A Level Biology 9700 Exam Questions by T

22 questions · 65 marks · about 78 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · Paper 4 · October/November 2018 (42) · Q3(a)(i) · 1 mark

3 Mammals such as sheep, *Ovis aries*, and goats, *Capra hircus*, are important agricultural animals that are sometimes kept together in mixed flocks. Very occasionally, live offspring are born from a mating between a male sheep and a female goat.

In sheep 2n = 54 and in goats 2n = 60.

(a) (i) Calculate the diploid chromosome number of the hybrid offspring of a sheep and a goat.

Question 2 · Paper 4 · May/June 2023 (42) · Q2(a) · 2 marks

2 **(a)** In sexual reproduction, meiosis occurs to produce haploid gametes from a diploid cell.

Explain the meaning of the terms haploid **and** diploid.

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 3 · Paper 4 · May/June 2023 (42) · Q2(b) · 4 marks

(b) Describe the behaviour of **chromosomes** during the main stages of meiosis I in animal cells.

prophase I .....

.....

.....

.....

metaphase I .....

.....

.....

.....

anaphase I .....

.....

.....

.....

telophase I .....

.....

.....

.....

[4]

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

2 Yeasts are unicellular organisms from the kingdom Fungi. *Saccharomyces cerevisiae* is one species of yeast that can carry out either asexual reproduction by mitosis or sexual reproduction by meiosis.

Budding in *S. cerevisiae* is a process where a small daughter cell forms as a bud on the parent cell. The bud contains a copy of the parent cell nucleus and it eventually separates from the parent cell to form a new cell.

S. cerevisiae can exist in two forms: haploid cells or diploid cells.
- Haploid cells can be one of two different mating types: **a** and α.
- Haploid cells can only mate with other haploid cells of the opposite mating type.

Fig. 2.1 shows the life cycle of *S. cerevisiae* with its asexual and sexual reproductive stages.

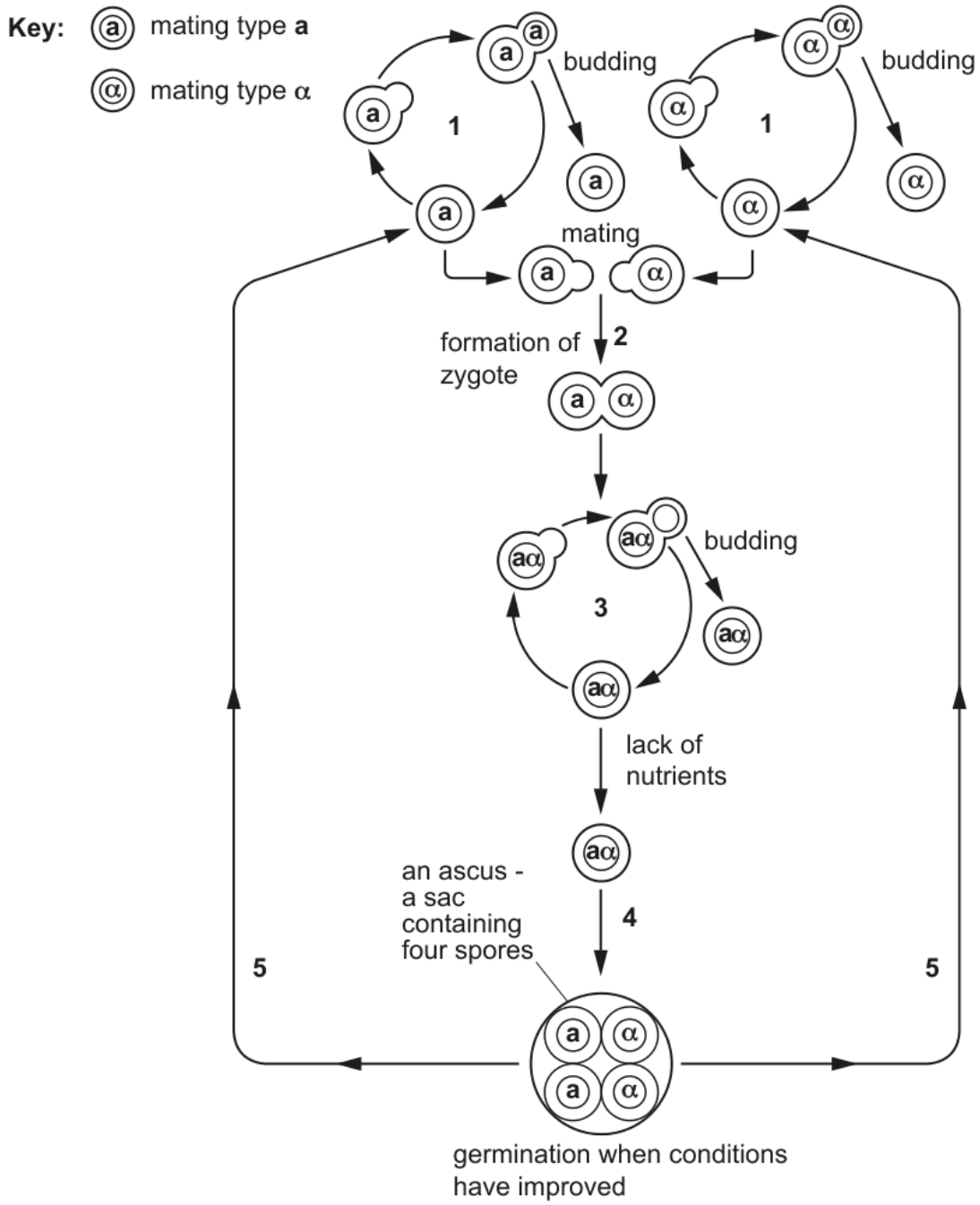


Fig. 2.1

(a) With reference to Fig. 2.1, state the numbers of the stages **1–5** that:

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 5 · Paper 4 · October/November 2023 (42) · Q2(b) · 4 marks

(b) When there is a lack of nutrients, cells made in stage **3** will carry out stage **4** to make spores, which germinate only when conditions improve.

Suggest **and** explain how the type of reproduction that makes spores during stage **4** is advantageous for *S. cerevisiae* in a changing environment.

.....

.....

.....

.....

.....

.....

.....

Question 6 · Paper 4 · May/June 2024 (41) · Q6(a)(i) · 1 mark

6 Many different genes are involved in the production of pigments in mammals. One example is the *TYR* gene.

(a) In humans the *TYR* gene is located on chromosome 11.

Fig. 6.1 shows the homologous pair for chromosome 11.

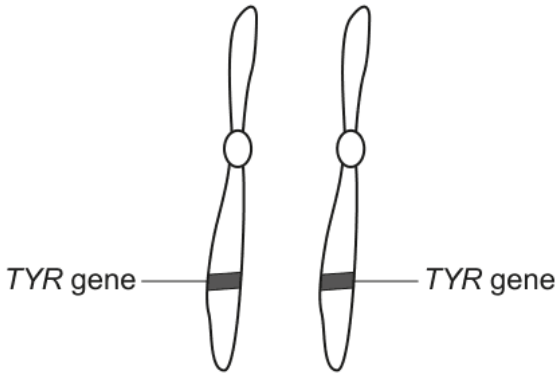


Fig. 6.1

(i) Homologous chromosomes have the same genes located at the same loci.

State one **other** feature shared by homologous chromosomes.

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 7 · information from earlier in the question

7 (a) Fig. 7.1 shows two chromosomes in one stage of meiosis.

The letters G to M represent the dominant alleles of seven genes and the letters g to m represent the recessive alleles of the same seven genes.

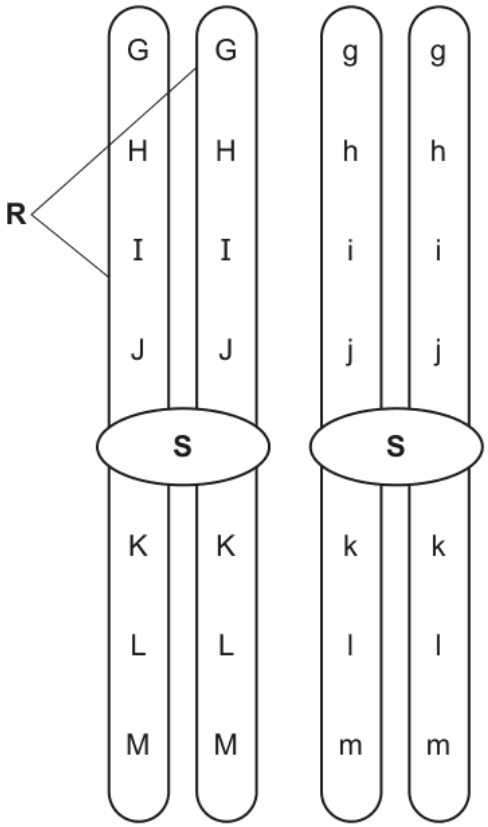


Fig. 7.1

Question 7 · Paper 4 · February/March 2021 (42) · Q7(a)(ii) · 3 marks

(ii) State **three** features visible on Fig. 7.1 that identify the chromosomes as a homologous pair.

.....

.....

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

(iii) Fig. 7.2 shows the same two chromosomes a little later in the same stage of meiosis. Crossing over is beginning to occur at point **T**.

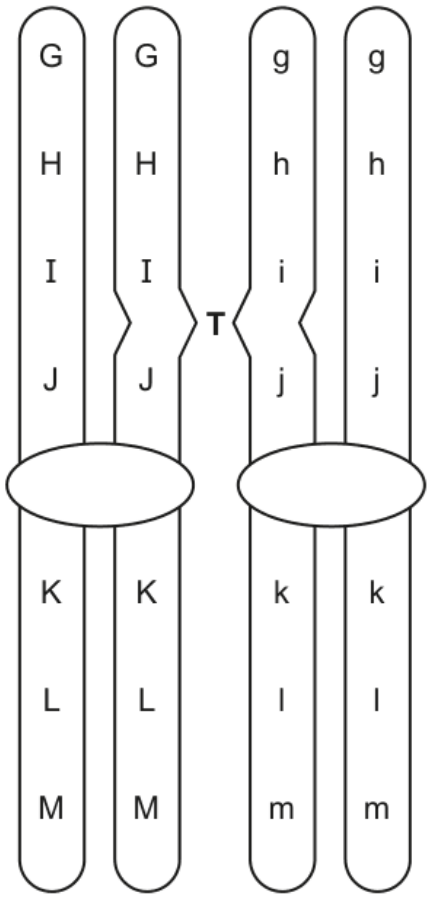


Fig. 7.2

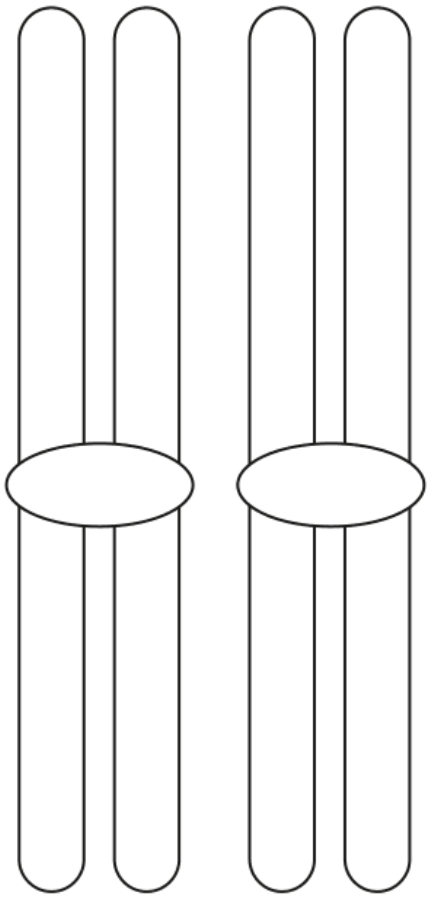


Fig. 7.3

Fig. 7.3 shows an outline of the same two chromosomes after crossing over has occurred.

Complete Fig. 7.3 by writing in the letters of the alleles along both chromosomes. Take care to clearly show the difference between letters representing dominant alleles and letters representing recessive alleles.

[2]

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 9 · Paper 4 · February/March 2021 (42) · Q7(c) · 3 marks

(c) Crossing over results in genetic variation.

Explain how random assortment of homologous chromosomes also results in genetic variation.

.....

.....

.....

.....

.....

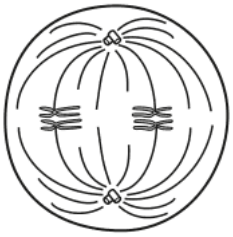
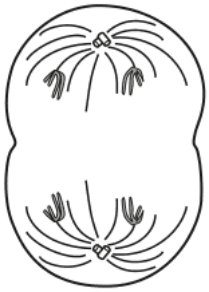
.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

5 Meiosis is described as a reduction division because the number of chromosomes in the daughter cells is reduced by half.

(a) Table 5.1 describes some of the events that take place during four of the different stages of meiosis in an animal cell.

Table 5.1

stage of meiosis	spindle fibres	diagram
metaphase I	attach to centromeres and arrange homologous pairs of chromosomes at the equator of the cell	
anaphase I		
	re-form spindle in daughter cells	
telophase II	disassemble	

Complete Table 5.1 by:

- outlining the behaviour of the spindle fibres during anaphase I
- identifying the stage of meiosis in which spindle fibres re-form the spindle in daughter cells
- drawing a diagram to show telophase II.

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 11 · Paper 4 · February/March 2023 (42) · Q5(b) · 4 marks

(b) Explain the need for a reduction division during meiosis.

.....

.....

.....

.....

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

8 Fig. 8.1 shows a cell from the testis of a locust at the late prophase I stage of meiosis.



Fig. 8.1

Explain how the behaviour of the chromosomes in prophase I of meiosis results in the appearance shown in Fig. 8.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 13 · Paper 4 · May/June 2018 (42) · Q3(a)(i) · 4 marks

3 Within a population, the variation for one characteristic is usually the result of genetic and environmental causes.

(a) Meiosis is one source of genetic variation.

(i) Describe the events that take place during prophase I of meiosis in an animal cell.

.....

.....

.....

.....

.....

.....

.....

.....

Question 14 · Paper 4 · May/June 2018 (42) · Q3(a)(ii) · 2 marks

(ii) Explain how independent assortment of homologous chromosomes leads to genetic variation during meiosis I.

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 15 · Paper 4 · February/March 2022 (42) · Q4(a)(i) · 1 mark

4 (a) Meiosis is an important process that contributes to genetic variation in a population.

Fig. 4.1 shows a pair of homologous chromosomes during prophase I of meiosis.

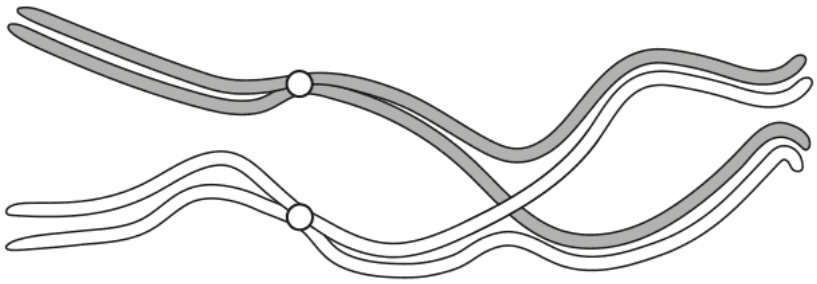


Fig. 4.1

(i) On Fig. 4.1, use the letter **C** with a label line to identify where crossing over occurs. [1]

Question 16 · Paper 4 · February/March 2022 (42) · Q4(a)(ii) · 4 marks

(ii) Describe how crossing over produces genetic variation in a population.

.....

.....

.....

.....

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

5 Fig. 5.1 shows a photomicrograph of a single plant cell in a stage of meiosis.



Fig. 5.1

Describe the stage of meiosis shown in Fig. 5.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

2 (a) Meiosis and cytokinesis occur in the male reproductive organs (anthers) of plants to make pollen grains. Cells which carry out meiosis are known as pollen mother cells.

Fig. 2.1 shows five stages of meiosis in a pollen mother cell.

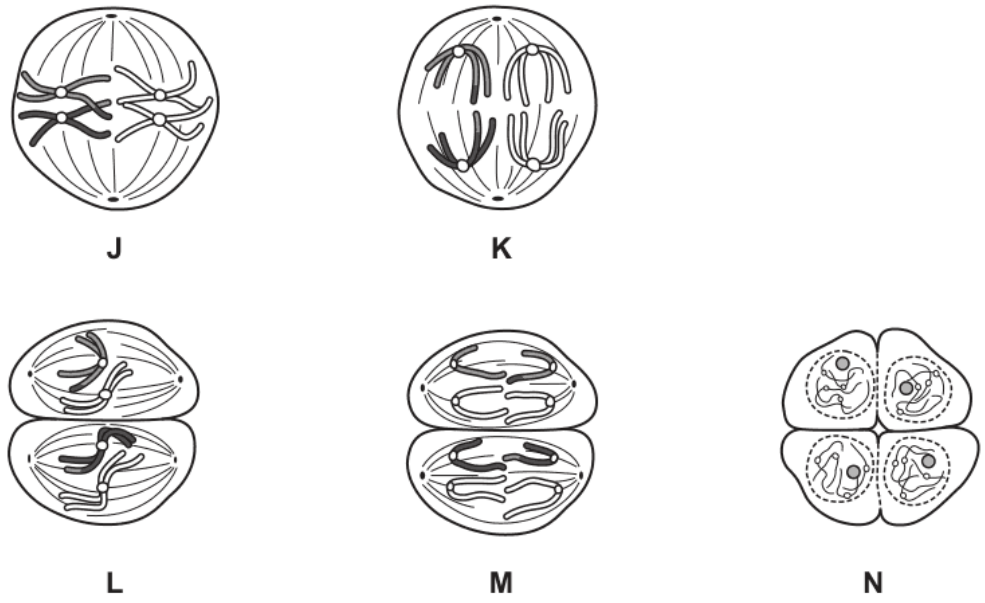


Fig. 2.1

Use the letters **J**–**N** in Fig. 2.1 to state **all** the stages that show:

anaphase .....

cells containing pairs of homologous chromosomes .....

crossing over .....

haploid cells .....

[4]

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 19 · Paper 4 · May/June 2025 (42) · Q4(a) · 3 marks

4 Sexual reproduction in plants and animals involves:

- the formation of gametes as a result of meiosis
- the process of fertilisation.

(a) In most species of plants and animals, the cell that is formed as a result of fertilisation is diploid and contains homologous chromosomes.

Explain why the cell that is formed as a result of fertilisation is a diploid cell **and** contains homologous chromosomes.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 20 · Paper 4 · May/June 2025 (42) · Q4(b) · 2 marks

(b) State the name of the stage in meiosis when reduction division occurs **and** explain a reason for your choice.

stage in meiosis .....

reason .....

.....

.....

[2]

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 21 · Paper 4 · May/June 2025 (42) · Q4(c)(i) · 2 marks

(c) Microscope slides can be prepared for viewing with a light microscope to show the different stages of meiosis in plant cells.

In the male reproductive organ of plants, meiosis takes place in cells known as pollen mother cells.

Fig. 4.1 and Fig. 4.2 show photomicrographs of two different stages of meiosis in pollen mother cells from a lily plant, *Lilium*.



Fig. 4.1

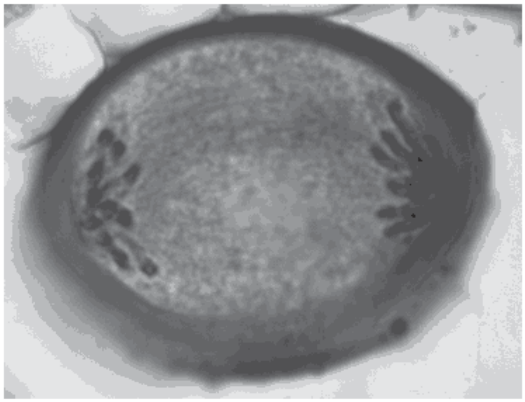


Fig. 4.2

(i) Identify the stages of meiosis shown in Fig. 4.1 **and** Fig. 4.2.

Fig. 4.1 .....

Fig. 4.2 .....

[2]

Question 22 · Paper 4 · May/June 2025 (42) · Q4(c)(ii) · 1 mark

(ii) The cells formed at the end of meiosis in a *Lilium* pollen mother cell each have 12 chromosomes.

State the number of sister chromatids found in a *Lilium* pollen mother cell at the start of meiosis.

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Mark schemes

Question 1 · Paper 4 · October/November 2018 (42) · Q3(a)(i) · 1 mark

3(a)(i)	57 ;	1

Question 2 · Paper 4 · May/June 2023 (42) · Q2(a) · 2 marks

2(a)	haplоid is one (complete) set of chromosomes ; diploid is two (complete) sets of chromosomes ; *if only comparative statement = max 1* e.g. haploid is n chromosomes and diploid is 2n haploid is half the number of chromosomes as diploid / AW	**2**

Question 3 · Paper 4 · May/June 2023 (42) · Q2(b) · 4 marks

2(b)	*prophase I* chromosomes / chromatin, condense / shorten / fatten **I** DNA **or** homologous chromosomes pair up / bivalents form **or** crossing over / synapsis / chiasmata formation ; *metaphase I* homologous (pairs of) chromosomes / bivalents, line up on the, equator / metaphase plate **or** random / independent, assortment, of homologous (pairs of) chromosomes / bivalents ; *anaphase I* chromosome(s) / one of each pair of chromosomes, moves (to pole / end of cell) ; *telophase I* chromosomes reach the opposite, poles / centrosomes / centrioles / end of cell **or** chromosomes decondense / chromatin formation / chromosomes become diffuse ;	**4**

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 4 · Paper 4 · October/November 2023 (42) · Q2(a) · 5 marks

2(a)	involve mitosis: **1 / 3 ;** involve meiosis: **4 ;** produces new genetic variation: **2 / 4 ;** shows only haploid cells: **1 / 5 ; ignore 2** shows only diploid cells: **3 ; ignore 2**	**5**

Question 5 · Paper 4 · October/November 2023 (42) · Q2(b) · 4 marks

2(b)	*any **four** from:* 1 genetic variation **;** 2 due to, crossing over / independent assortment **;** 3 some will, be adapted (to changing environment) / survive **or** avoids whole population being wiped out / **ora ;** 4 (allows) stage **1** / stage **3** / asexual reproduction **;** 5 (allows) random, mating / fertilisation / fusion of gametes **;** 6 some have advantageous combinations of alleles **;** 7 AVP **;** e.g. *ref. to* dormancy	**4**

Question 6 · Paper 4 · May/June 2024 (41) · Q6(a)(i) · 1 mark

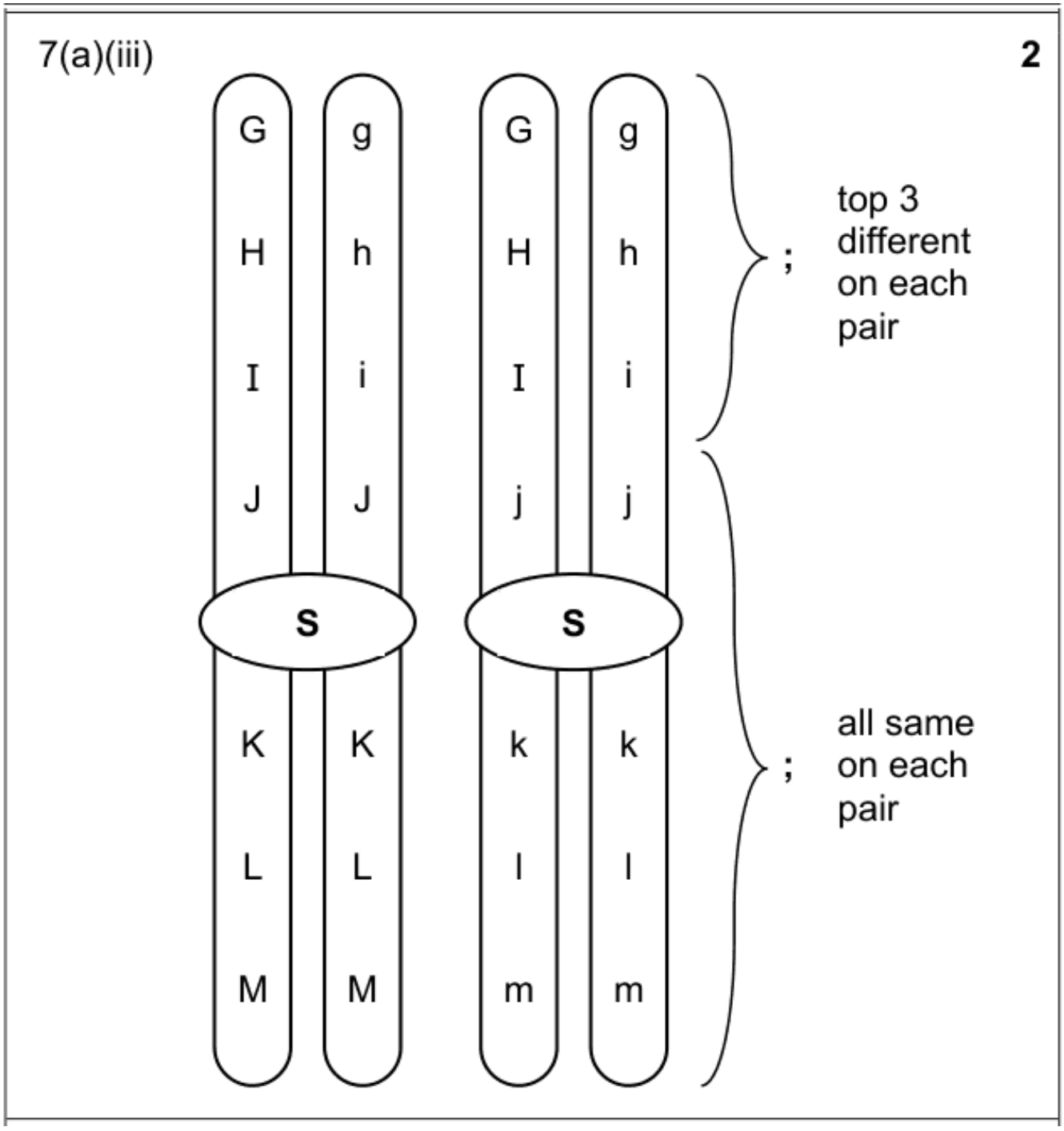
6(a)(i)	*any **one** from:* **1** same / equal, size / length **;** **2** same, shape / position of centromere **;** **3** same banding pattern **;**	**1**

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

7(a)(ii)	*any **three** from:* 1 have **same** genes ; **R** same number of genes 2 (genes at) same, loci / position on a chromosome ; 3 same position of, **S** / centromere ; 4 same length ; 5 forms bivalent ;	**3**

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 8 · Paper 4 · February/March 2021 (42) · Q7(a)(iii) · 2 marks



Question 9 · Paper 4 · February/March 2021 (42) · Q7(c) · 3 marks

7(c)	*any **three** from:*	**3**
	1 homologous chromosomes / bivalents, align independently of each other ;	
	2 at the, equator / metaphase plate ;	
	3 *idea that* this leads to different combinations of chromosomes in the daughter cells ;	
	4 results in new combinations of alleles ;	
	5 AVP ; e.g. in humans 2^{23} / 2^{n}, different combinations	

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

5(a)

stage of meiosis	spindle fibres
metaphase I	attach to centromeres and arrange homologous pairs of chromosomes at the equator of the cell
anaphase I	(contract to) pull, centromeres / chromosomes, towards poles / to centrioles ;
prophase II ;	re-form spindle in daughter cells
telophase II	disassemble

4

diagram

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 11 · Paper 4 · February/March 2023 (42) · Q5(b) · 4 marks

5(b)	*any **four** from:* 1 (meiosis / reduction division) produces gametes ; 2 (two) gametes fuse / fertilisation occurs, to form a zygote ; 3 zygote will have maternal and paternal chromosomes / AW ; 4 gametes, are haploid / are *n* / have half the normal number (of chromosomes) ; 5 so the zygote, is diploid / 2*n* ; 6 prevents, doubling of chromosome number / polyploidy / having too many chromosomes **or** allows chromosome number to remain constant ;	**4**

Question 12 · Paper 4 · May/June 2023 (41) · Q8 · 4 marks

8	*any **four** from:* **1** DNA / chromatin / chromosomes / chromatids, condense ; **2** homologous chromosomes, pair up / undergo synapsis / form bivalents / form tetrads ; **3** crossing-over ; **4** between non-sister chromatids ; **5** detail of crossing over ; **6** chromosomes (stay) joined at, cross-over points / chiasmata ;	**4**

Question 13 · Paper 4 · May/June 2018 (42) · Q3(a)(i) · 4 marks

3(a)(i)	*any 4 of:* 1 chromosomes become visible ; 2 condensation / coiling / supercoiling ; **A** description 3 nuclear envelope or nuclear membrane, disintegrates / disappears ; 4 nucleolus, disintegrates / disappears ; 5 centrioles migrate to (opposite) poles ; **I** centrosomes 6 spindle forms / microtubules assemble ; 7 synapsis / bivalents form / homologous chromosomes pair up ; 8 chiasmata formation / crossing over ;	**4**

Question 14 · Paper 4 · May/June 2018 (42) · Q3(a)(ii) · 2 marks

3(a)(ii)	*any 2 of:* 1 (homologous chromosomes / bivalents) line up randomly on the, equator / metaphase plate ; 2 produces (many) different chromosome combinations ; 3 number of possible combinations is 2^n ; 4 new combinations of maternal and paternal alleles ;	**2**

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 15 · Paper 4 · February/March 2022 (42) · Q4(a)(i) · 1 mark

4(a)(i)	label line to where white chromatid crosses over grey chromatid ;	1

Question 16 · Paper 4 · February/March 2022 (42) · Q4(a)(ii) · 4 marks

4(a)(ii)	*any **four** from:* 1 (crossing over is) between non-sister chromatids ; 2 (non-sister chromatids have) different combinations of alleles ; 3 exchange alleles ; 4 (chromatids have) new combinations of alleles ; 5 linkage groups broken ; 6 *idea that* gametes have unique combination of alleles ; 7 random fusion of gametes (during fertilisation) ;	4

Question 17 · Paper 4 · February/March 2025 (42) · Q5 · 5 marks

5	*any **five** from:* 1 (meiosis) II ; 2 two cells are visible / four groups of chromosomes ; 3 anaphase ; 4 as two groups of chromosomes per daughter cell ; 5 centromeres / kinetochores, attached to, spindle fibres / microtubules ; 6 spindle fibres / microtubules, shorten / contract ; 7 to pull, (daughter) chromosomes / (sister) chromatids, to opposite poles / described ; 8 the centromeres lead with the chromosome arms following behind / AW ; 9 reference to no nuclear envelope ;	5

Question 18 · Paper 4 · October/November 2025 (44) · Q2(a) · 4 marks

2(a)	*anaphase:* **K** and **M** ; *cells containing pairs of homologous chromosomes:* **J** and **K** ; *crossing over:* **J** ; *haploid cells:* **L** and **M** and **N** ;	4

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 19 · Paper 4 · May/June 2025 (42) · Q4(a) · 3 marks

4(a)	*any **three** from:* 1 (diploid) cell formed from (two) haploid gametes ; 2 (diploid) cell has two sets of chromosomes / one set of chromosomes from each gamete ; 3 (homologous chromosomes) maternal and paternal chromosomes ; 4 (homologous chromosomes) has same, genes / loci / banding pattern / centromere position / size / length ;	**3**

Question 20 · Paper 4 · May/June 2025 (42) · Q4(b) · 2 marks

4(b)	anaphase 1 / telophase 1 ; separation of, homologous chromosomes / bivalent ;	**2**

Question 21 · Paper 4 · May/June 2025 (42) · Q4(c)(i) · 2 marks

4(c)(i)	*Fig. 4.1* metaphase 2 ; **A** anaphase 2 *Fig. 4.2* telophase 1 ; **A** anaphase 1	**2**

Question 22 · Paper 4 · May/June 2025 (42) · Q4(c)(ii) · 1 mark

4(c)(ii)	48 ;	**1**

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.