

Organisms (Continuity and change) practice questions

24 questions • 84 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 84

Reproduction **Spec D3.1**

1 PAPER 1A STYLE**[1 mark]**

Which statement describes an advantage of asexual reproduction compared with sexual reproduction?

- A. ☐ It produces offspring with new combinations of alleles.
- B. ☐ It produces offspring that are well adapted if the environment changes.
- C. ☐ It produces genetically identical offspring of a parent adapted to an existing environment.
- D. ☐ It increases genetic variation within a population.

2 PAPER 1B STYLE**[5 marks]**

The table shows the concentrations of four hormones in the blood of a woman on selected days of one menstrual cycle (arbitrary units, data for practice). (a) Identify the day on which ovulation most probably occurred. [1] (b) Explain the change in LH concentration between day 10 and day 14. [2] (c) Explain why the endometrium breaks down after day 26. [2]

Hormone concentrations (arbitrary units)				
Day	FSH	LH	Oestradiol	Progesterone
2	8	6	4	1
10	6	8	14	1
14	14	58	18	2
21	3	5	10	16
26	4	4	5	4

3 PAPER 2A STYLE**[4 marks]**

(a) Outline what happens to the sperm and egg nuclei after a sperm's membrane fuses with the egg membrane. [2] (b) Outline how hormones are used at the start of IVF treatment. [2]

PAPER 2B STYLE

[7 marks]

Explain how flowering plants promote fertilization by gametes from different plants.

[illegible]

PAPER 2A STYLE

[3 marks]

(a) Distinguish between seed dispersal and pollination. [1] (b) Outline how food reserves are mobilized when a seed germinates. [2]

[illegible]

PAPER 1A STYLE

[1 mark]

HL only

Which feature occurs in oogenesis but not in spermatogenesis?

- A. ☐ Mitosis of germ cells
- B. ☐ Two divisions of meiosis
- C. ☐ Unequal division of cytoplasm during meiosis
- D. ☐ Differentiation of haploid cells

PAPER 2A STYLE

[4 marks]

HL only

(a) Outline the role of the acrosome reaction in fertilization. [1] (b) Explain how a pregnancy test strip detects pregnancy. [3]

[illegible]

HL only

Explain the hormonal control of pregnancy and childbirth.

[illegible]

Inheritance Spec D3.2

9

PAPER 1A STYLE

[1 mark]

Pink-flowered four o'clock plants (*Mirabilis jalapa*) are self-pollinated. Which ratio of offspring phenotypes is expected?

- A. ☐ 3 red : 1 white
- B. ☐ 1 red : 2 pink : 1 white
- C. ☐ All pink
- D. ☐ 9 red : 3 pink : 3 white : 1 other

10

PAPER 1A STYLE

[1 mark]

A woman who is a carrier of haemophilia has children with a man who does not have haemophilia. What is the probability that their first child is a son with haemophilia?

- A. ☐ 0
- B. ☐ 0.25
- C. ☐ 0.5
- D. ☐ 1.0

11

[3 marks]

The table describes part of a family pedigree for a rare genetic condition. Deduce, with reasons, whether the allele causing the condition is dominant or recessive, and whether it is autosomal or sex-linked.

Individuals in the pedigree			
Individual	Sex	Affected?	Parents
I-1	Male	No	Not shown
I-2	Female	No	Not shown
II-1	Female	Yes	I-1 and I-2
II-2	Male	No	I-1 and I-2
II-3	Male	Yes	I-1 and I-2

[illegible]

12

[5 marks]

Students measured the heights of two groups of 16-year-olds. The table summarises the results (data for practice). (a) Calculate the interquartile range for group X. [1] (b) Determine whether a student of 188 cm in group X would be an outlier. Show your working. [2] (c) Compare the two groups. [1] (d) Suggest why height shows continuous variation. [1]

Height (cm)					
Group	Minimum	Q1	Median	Q3	Maximum
X	151	162	168	172	188
Y	149	155	160	166	176

Answer =

[illegible]

13

[6 marks]

[illegible]

14

[1 mark]

HL only

A. ☐ Crossing over between sister chromatids in prophase I

B. ☐ Random orientation of bivalents at metaphase I

C. ☐ Separation of sister chromatids in anaphase II

D. ☐ Replication of DNA before meiosis

F2 offspring	
Phenotype	Observed number
Purple tall	194
Purple short	48
White tall	46
White short	32

[illegible][illegible]

Homeostasis Spec D3.3

17 PAPER 1A STYLE

[1 mark]

Why is negative feedback, not positive feedback, used in homeostasis?

- A. ☐ It amplifies changes so that the response is faster.
- B. ☐ It returns a variable to the set point from values above and below it.
- C. ☐ It keeps a variable exactly at the set point without any fluctuation.
- D. ☐ It only works when a variable rises above the set point.

18 PAPER 1A STYLE

[1 mark]

Which is an effect of glucagon on its target cells?

- A. ☐ Muscle cells insert more glucose transporters into their membranes.
- B. ☐ Liver cells convert glucose to glycogen.
- C. ☐ Liver cells break down glycogen and release glucose into the blood.
- D. ☐ β cells increase their secretion of insulin.

19 PAPER 1B STYLE

[5 marks]

Two adults each drank a solution containing 75 g of glucose after fasting overnight. Their blood glucose concentration was then measured every 30 minutes (data for practice). (a) Calculate the percentage increase in blood glucose for person A between 0 and 30 minutes. [1] (b) Describe the changes in blood glucose for person A. [2] (c) Person B has type 2 diabetes. Explain the differences between the results for B and A. [2]

Blood glucose concentration (mmol L ⁻¹)		
Time (min)	Person A	Person B
0	5.0	7.5
30	8.0	12.5
60	6.5	14.0
90	5.5	13.0
120	5.0	11.5

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C [1]

2. [5]

- (a) day 14 / when LH peaks [1]
- (b) LH rises sharply / LH surge from 8 to 58 units [1]
- (b) oestradiol concentration rises to a high level / from 14 to 18 units [1]
- (b) high oestradiol stimulates (pituitary) LH secretion / positive feedback [1]
- (c) progesterone falls / from 16 to 4 units [1]
- (c) because the corpus luteum degenerates (no pregnancy / no hCG) [1]
- (c) progesterone no longer maintains the endometrium [1]
- [max 5]

3. [4]

- (a) sperm nucleus enters the egg; tail and mitochondria destroyed [1]
- (a) nuclear membranes of sperm and egg nuclei dissolve [1]
- (a) chromosomes from both take part in one (joint) mitosis producing two diploid nuclei [1]
- (b) drug suspends normal secretion of (FSH/LH) hormones / down-regulation [1]
- (b) large / artificial doses of FSH injected [1]
- (b) to induce superovulation / many follicles develop [1]
- [max 4: max 2 for each part]

4. [7]

- male gametes are inside pollen grains; female gametes are inside ovules [1]
- pollination is transfer of pollen from anther to stigma [1]
- cross-pollination is transfer to a different plant (of the same species) [1]
- pollen and stigma mature at different times (in the same flower) [1]
- separate male and female flowers on one plant (e.g. maize) [1]
- separate male and female plants (e.g. holly) [1]
- animals / insects carry pollen between plants, attracted by petals / scent / nectar [1]
- wind carries pollen between plants [1]
- self-incompatibility genes / S alleles cause pollen from the same plant to be rejected [1]
- pollen with an allele matching the stigma / style fails to germinate / tube stops growing [1]
- self-pollination leads to inbreeding, which reduces genetic diversity / vigour [1]
- pollen tube grows down the style to the ovule so the male gamete can fuse with the egg [1]
- [max 7]

5. [3]

- (a) pollination moves pollen from anther to stigma (before fertilization) whereas dispersal moves seeds away from the parent plant (after fertilization) [1]
- (b) water absorbed, activating enzymes / gibberellin production [1]
- (b) amylase digests starch into maltose / sugars OR proteases digest proteins into amino acids [1]
- (b) soluble products transported to the embryo for respiration / growth [1]
- [max 3]

6. [1] HL only

C C [1]

7. [4] HL only

- (a) acrosome releases enzymes that digest (a path through) the zona pellucida so the sperm can penetrate it [1]
- (b) detects hCG (in urine) [1]
- (b) hCG is produced by the embryo / developing placenta [1]
- (b) mobile monoclonal antibodies (with coloured marker) bind hCG [1]
- (b) immobilised antibodies in the test line bind the hCG complex producing a coloured line [1]
- (b) control line shows the test has worked [1]
- [max 4]

8. [6] HL only

- embryo / trophoblast secretes hCG [1]
- hCG maintains the corpus luteum [1]
- corpus luteum secretes progesterone (and oestradiol) [1]
- progesterone maintains the endometrium / prevents menstruation [1]
- progesterone inhibits contractions of the uterus / myometrium [1]
- placenta takes over progesterone secretion (after about 3 months) [1]
- at the end of pregnancy progesterone levels fall [1]
- allowing oxytocin secretion (by the posterior pituitary) to increase [1]
- oxytocin stimulates contractions of the myometrium [1]
- contractions / stretching of the cervix stimulate more oxytocin secretion [1]
- positive feedback so contractions become stronger / more frequent until birth [1]
- [max 6]

9. [1]

B B [1]

10. [1]

B B [1]

11. [3]

- recessive because II-1 / II-3 is affected but neither parent (I-1, I-2) is [1]
- so both parents must be carriers / heterozygous [1]
- autosomal because a daughter (II-1) is affected while her father (I-1) is not [1]
- if X-linked recessive, an affected daughter's father would have to be affected [1]
- [max 3]

12. [5]

- (a) $172 - 162 = 10$ cm [1]
- (b) $1.5 \times 10 = 15$; $172 + 15 = 187$ cm (ECF) [1]
- (b) $188 > 187$ so it is an outlier [1]
- (c) group X has a higher median (168 vs 160 cm) OR group Y has a larger IQR / spread (11 vs 10 cm) [1]
- (d) polygenic / controlled by many genes [1]
- (d) and environmental factors such as nutrition [1]
- [max 5]

13. [6]

- PKU is caused by a recessive allele [1]
- of an autosomal gene / gene not on a sex chromosome [1]
- gene codes for the enzyme that converts phenylalanine to tyrosine [1]
- affected individuals are homozygous recessive / pp [1]
- two carrier / heterozygous parents have a 0.25 / 1 in 4 chance of an affected child [1]
- shown with a Punnett grid: Pp $\times$ Pp gives PP, Pp, Pp, pp [1]
- heterozygote has one dominant allele coding for functional enzyme [1]
- one allele produces enough enzyme to convert phenylalanine [1]
- so heterozygote has the same phenotype as homozygous dominant / is a carrier [1]
- phenylalanine builds up in affected individuals damaging the brain unless a low-phenylalanine diet is followed [1]
- [max 6]

14. [1] HL only

B B [1]

15. [5] HL only

- (a) no significant difference between observed and expected (9:3:3:1) results / genes assort independently / genes unlinked [1]
- (b) $9/16 \times 320 = 180$ [1]
- (c) $14.0 > 7.815$ [1]
- (c) difference is statistically significant / unlikely to be due to chance ($p < 0.05$) [1]
- (c) reject the null hypothesis [1]
- (c) genes are probably linked / on the same chromosome [1]
- (c) parental types (purple tall, white short) more frequent than expected [1]
- [max 5]

16. [4] HL only

- (a) C and F on one vertical line, c and f on the other (alleles shown alongside the lines) [1]
- (b) genes are linked / loci close together on the same chromosome [1]
- (b) alleles on one chromosome tend to be inherited together / do not assort independently [1]
- (b) only crossing over between the loci separates them, which is infrequent [1]
- (c) coloured shrunken and colourless full [1]
- [max 4]

17. [1]

B B [1]

18. [1]

C C [1]

19. [5]

- (a) $(8.0 - 5.0) \div 5.0 \times 100 = 60\%$ [1]
- (b) rises to a peak (8.0 mmol L^{-1}) at 30 minutes [1]
- (b) then falls back to the starting value / 5.0 mmol L^{-1} by 120 minutes [1]
- (c) B starts higher / rises higher / stays high (above 11 mmol L^{-1} at 120 min) [1]
- (c) B's target cells are resistant / less responsive to insulin [1]
- (c) so liver / muscle cells absorb less glucose / convert less to glycogen [1]
- (c) A secretes insulin which returns glucose to the set point by negative feedback [1]
- [max 5]

20. [3]

- obesity / high body mass [1]
- physical inactivity / lack of exercise [1]
- diet high in sugar / fat / refined carbohydrates [1]
- increasing age / family history / genetic factors / ethnicity [1]
- treatment: low-sugar diet / regular exercise / weight loss / drugs that improve insulin sensitivity / insulin injections [1]
- [max 3: max 2 for risk factors]

21. [7]

- negative feedback control [1]
- peripheral thermoreceptors in the skin detect the fall in temperature [1]
- hypothalamus detects / compares with the set point (about 37°C) [1]
- hypothalamus sends nerve impulses to effectors [1]
- vasoconstriction of arterioles supplying skin capillaries [1]
- less blood near the surface so less heat lost (by radiation) [1]
- shivering: rapid contractions of skeletal muscle generate heat from respiration [1]
- uncoupled respiration in brown adipose tissue releases heat instead of producing ATP [1]
- hair erection traps an insulating layer of air [1]
- hypothalamus stimulates the pituitary (TSH) to increase thyroxine secretion [1]
- thyroxine raises the metabolic rate so more heat is generated [1]
- sweating reduced / stops [1]
- behavioural responses, e.g. putting on clothes / seeking warmth [1]
- [max 7]

22. [1] HL only

B B [1]

23. [5] HL only

- (a) excretion is removal of metabolic wastes (e.g. urea) whereas osmoregulation is regulation of osmotic concentration / water balance [1]
- (b) osmoreceptors in the hypothalamus detect high blood osmotic concentration [1]
- (b) pituitary gland increases ADH secretion [1]
- (b) ADH causes aquaporins to move from intracellular vesicles into collecting duct cell membranes [1]
- (b) collecting duct becomes more permeable to water [1]
- (b) water reabsorbed by osmosis into the concentrated medulla [1]
- (b) medulla kept concentrated by active transport of Na^+ out of the ascending limb of the loop of Henle [1]
- [max 5]

24. [4] HL only

- (a) $12500 \div 14450 \times 100 = 86.5\%$ (accept 86–87%) [1]
- (b) the same / constant ($750 \text{ cm}^3 \text{ min}^{-1}$) in both states [1]
- (c) flow to the gut falls from 1400 to $600 \text{ cm}^3 \text{ min}^{-1}$ [1]
- (c) vasoconstriction of arterioles supplying the gut [1]
- (c) blood diverted to skeletal muscles, which need more oxygen / glucose for respiration [1]
- [max 4]