3.13 Biology: Cells, Microscopy and Genetics: 1-hour Pack

Total Marks

ISEB Common Entrance Biology (13+) · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

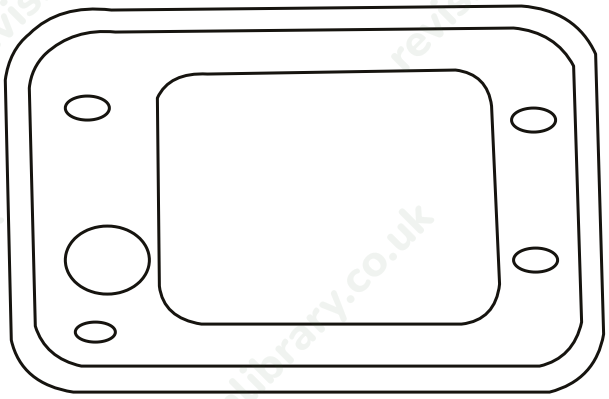
1 Differences between individuals of the same species are called variation.

(a) State two causes of variation between individuals of the same species. **(2)**

(b) A mutation is a random change to an organism's DNA. Explain how a mutation could introduce a new source of variation into a population. **(2)**

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2 The image below is an original drawing of a plant cell viewed through a microscope. The drawing includes a scale bar, labelled '50 micrometres (50 um)'. When measured with a ruler on the original drawing, the scale bar is 25 mm long.



50 micrometres (50 um)

(a) Calculate the magnification of the drawing. **(2)**

.....

(b) A chloroplast inside the cell has a real diameter of 5 micrometres. Calculate how long this chloroplast should appear in the drawing, in mm, at this magnification. **(2)**

.....

(c) State why photographs or drawings of specimens taken with a microscope should include a scale bar or a stated magnification. **(1)**

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3 The table below compares mitosis and meiosis, two types of cell division. Some information is missing.

Feature	Mitosis	Meiosis
Number of divisions	one	X
Number of new cells produced	two	Y
Chromosome number in each new cell, compared with the parent cell	the same as the parent cell	Z
Are the new cells genetically identical to each other?	yes	no
Type of cell produced	body (somatic) cells	gametes (sex cells)

(a) State the missing values X, Y and Z in the table. **(3)**

(b) Explain why it is important that gametes contain half the number of chromosomes of normal body cells. **(2)**

(c) State the parts of the human body where meiosis takes place. **(1)**

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4 In humans, the ability to roll your tongue is controlled by a single gene. The allele for tongue rolling (R) is dominant over the allele for non-rolling (r).

(a) State what is meant by the term 'dominant allele'. **(1)**

(b) Two parents are both heterozygous for this gene (genotype Rr). Draw a genetic diagram (Punnett square) to show all the possible genotypes of their children. **(2)**

(c) State the expected ratio of tongue-rollers to non-rollers among the children, and calculate the percentage chance that a child of these parents will not be able to roll their tongue. **(2)**

.....

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5 A drawing of an onion cell is 4 mm long and the magnification is x40. Calculate the real length in mm.

- ☐ A) 1 mm
- ☐ B) 0.1 mm
- ☐ C) 10 mm
- ☐ D) 160 mm
- ☐ E) 0.01 mm

---

6 In a drawing, a pollen grain is 60 mm wide. Its real width is 100 micrometres. Calculate the magnification of the drawing.

- ☐ A) x600
- ☐ B) x60
- ☐ C) x0.6
- ☐ D) x1200
- ☐ E) x6000

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7 The real length of a hair is 2 mm. It is drawn at a magnification of x400. Calculate the length of the drawing in mm.

- [ ] A) 8000 mm
- [ ] B) 200 mm
- [ ] C) 800 mm
- [ ] D) 402 mm
- [ ] E) 0.005 mm

---

8 In a drawing, a pollen grain is 12 mm wide. Its real width is 20 micrometres. Calculate the magnification of the drawing.

- [ ] A) x240
- [ ] B) x6000
- [ ] C) x60
- [ ] D) x0.6
- [ ] E) x600

---

9 In a drawing, a red blood cell is 20 mm wide. Its real width is 40 micrometres. Calculate the magnification of the drawing.

- [ ] A) x0.002
- [ ] B) x0.5
- [ ] C) x800
- [ ] D) x500
- [ ] E) x50

---

10 A pollen grain is drawn 80 mm wide at a magnification of x1000. Calculate its real width in micrometres.

- [ ] A) 80 micrometres
- [ ] B) 0.08 micrometres
- [ ] C) 12.5 micrometres
- [ ] D) 8 micrometres
- [ ] E) 80000 micrometres

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11 A cheek cell is drawn 8 mm wide at a magnification of x400. Calculate its real width in micrometres.

- [ ] A) 3200 micrometres
- [ ] B) 20 micrometres
- [ ] C) 50 micrometres
- [ ] D) 2 micrometres
- [ ] E) 0.02 micrometres

---

12 A cheek cell is drawn 60 mm wide at a magnification of x1000. Calculate its real width in micrometres.

- [ ] A) 6 micrometres
- [ ] B) 0.06 micrometres
- [ ] C) 60000 micrometres
- [ ] D) 600 micrometres
- [ ] E) 60 micrometres

---

13 The real width of a cheek cell is 50 micrometres. It is drawn at a magnification of x500. Calculate the width of the drawing in mm.

- [ ] A) 10 mm
- [ ] B) 25000 mm
- [ ] C) 250 mm
- [ ] D) 25 mm
- [ ] E) 0.1 mm

---

14 A drawing of an onion cell is 25 mm long and the magnification is x50. Calculate the real length in mm.

- [ ] A) 5 mm
- [ ] B) 1250 mm
- [ ] C) 0.5 mm
- [ ] D) 0.05 mm
- [ ] E) 2 mm

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15 A drawing of a leaf cell is 10 mm long and the magnification is x500. Calculate the real length in mm.

- [ ] A) 0.02 mm
- [ ] B) 0.2 mm
- [ ] C) 0.002 mm
- [ ] D) 50 mm
- [ ] E) 5000 mm

---

16 In a drawing, a cheek cell is 40 mm wide. Its real width is 100 micrometres. Calculate the magnification of the drawing.

- [ ] A) x4000
- [ ] B) x40
- [ ] C) x0.4
- [ ] D) x800
- [ ] E) x400

---

17 A pollen grain is drawn 12 mm wide at a magnification of x200. Calculate its real width in micrometres.

- [ ] A) 6 micrometres
- [ ] B) 60 micrometres
- [ ] C) 600 micrometres
- [ ] D) 2400 micrometres
- [ ] E) 0.06 micrometres

---

18 A drawing of a leaf cell is 1000 mm long and the magnification is x500. Calculate the real length in mm.

- [ ] A) 0.5 mm
- [ ] B) 500000 mm
- [ ] C) 500 mm
- [ ] D) 2 mm
- [ ] E) 20 mm

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19 A red blood cell is drawn 80 mm wide at a magnification of x800. Calculate its real width in micrometres.

- ☐ A) 0.1 micrometres
- ☐ B) 1000 micrometres
- ☐ C) 100 micrometres
- ☐ D) 10 micrometres
- ☐ E) 64000 micrometres

---

20 A class investigates camouflage. They scatter 100 small paper 'moths' onto a patch of green grass: 50 are green and 50 are brown. One student acts as a 'predator' and has 30 seconds to collect as many moths as possible. The results are shown in the table.

Moth colour: Green, Brown
Number collected: 12, 34

Moth colour	Number collected
Green	12
Brown	34

(a) Calculate the percentage of each colour of moth that was collected by the predator. **(3)**

(b) Use these results to explain which colour of moth was better camouflaged against the green grass. **(2)**

(c) Suggest one way this investigation could be made a fairer test. **(1)**

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21 A drawing of an insect's leg is 100 mm long. The real length is 0.2 mm. Calculate the magnification.

- [ ] A) x99.8
- [ ] B) x0.002
- [ ] C) x100.2
- [ ] D) x20
- [ ] E) x500

---

22 The real width of a cheek cell is 80 micrometres. It is drawn at a magnification of x200. Calculate the width of the drawing in mm.

- [ ] A) 2.5 mm
- [ ] B) 16000 mm
- [ ] C) 16 mm
- [ ] D) 160 mm
- [ ] E) 0.4 mm

---

23 Dark skin (S) is dominant over light skin (s) in a simplified model. Two parents with dark skin have a child with light skin. State whether this child is homozygous or heterozygous.

(1)

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24 A drawing of a hair is 80 mm long. The real length is 0.2 mm. Calculate the magnification.

- [ ] A) x79.8
- [ ] B) x4000
- [ ] C) x80.2
- [ ] D) x400
- [ ] E) x16

---

25 Huntington's disease is a genetic disorder caused by a dominant allele (H). The recessive allele (h) does not cause the disorder. A parent with genotype Hh (affected) has a child with an unaffected parent (hh). Calculate the percentage probability that the child will inherit Huntington's disease (genotype Hh).

(1)

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26 The real length of a hair is 0.05 mm. It is drawn at a magnification of x400. Calculate the length of the drawing in mm.

- [ ] A) 400.05 mm
- [ ] B) 20 mm
- [ ] C) 8000 mm
- [ ] D) 2 mm
- [ ] E) 200 mm

---

27 Petal colour can be modelled simply using one gene, where the allele for red petals (R) is dominant over the allele for white petals (r). A mother plant and father plant both have red petals, but their offspring has white petals. State whether the offspring is homozygous or heterozygous for this gene.

(1)

---

28 A drawing of an insect's leg is 20 mm long. The real length is 0.1 mm. Calculate the magnification.

- [ ] A) x200
- [ ] B) x19.9
- [ ] C) x20.1
- [ ] D) x0.005
- [ ] E) x2

---

29 Widow's peak (W) is dominant over straight hairline (w). Two heterozygous parents (Ww) both have widow's peaks. State the expected ratio of widow's peaks to straight hairlines, and the percentage with straight hairlines.

(1)

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30 A drawing of an onion cell is 25 mm long. The real length is 0.05 mm. Calculate the magnification.

- [ ] A) x25.05
- [ ] B) x0.002
- [ ] C) x500
- [ ] D) x1.25
- [ ] E) x24.95

---

31 A red blood cell measures 0.007 mm in diameter. A student draws it at x2000 magnification. Calculate the diameter it should be drawn.

(1)

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32 A drawing of an insect's leg is 200 mm long. The real length is 2 mm. Calculate the magnification.

- [ ] A) x0.01
- [ ] B) x100
- [ ] C) x400
- [ ] D) x202
- [ ] E) x198

---

33 Pea plant seed colour is determined by one gene where yellow seeds (Y) are dominant over green (y). Two yellow seed plants produce a green seed plant. State the genotype of the green seed plant.

(1)

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34 In a drawing, a cheek cell is 40 mm wide. Its real width is 50 micrometres. Calculate the magnification of the drawing.

- [ ] A) x8000
- [ ] B) x0.8
- [ ] C) x80
- [ ] D) x2000
- [ ] E) x800

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35 Attached ear lobes are inherited as a recessive trait (e) and unattached lobes are dominant (E). A girl with attached ear lobes has genotype ee. State whether she is homozygous or heterozygous for this gene.

(1)

36 A drawing of an onion cell is 2 mm long. The real length is 0.05 mm. Calculate the magnification.

- ☐ A) x1.95
- ☐ B) x2.05
- ☐ C) x0.1
- ☐ D) x40
- ☐ E) x0.025

37 Convert the actual red blood cell length of 0.08 mm into micrometres (1 mm = 1000 micrometres).

(1)

38 A plant cell is drawn 32 mm wide at a magnification of x400. Calculate its real width in micrometres.

- ☐ A) 80 micrometres
- ☐ B) 0.08 micrometres
- ☐ C) 12800 micrometres
- ☐ D) 8 micrometres
- ☐ E) 12.5 micrometres

39 A cheek cell is actually 0.06 mm long. A student wants to draw it at x400 magnification. Calculate the length it should be drawn.

(1)

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40 A drawing of an onion cell is 800 mm long. The real length is 2 mm. Calculate the magnification.

- ☐ A) x4000
- ☐ B) x400
- ☐ C) x798
- ☐ D) x1600
- ☐ E) x802

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41 A biology student draws a plant cell at x500 magnification, making it 50 mm long. The student decides to redraw the cell at x1200 magnification. The actual cell length is 0.1 mm. Calculate the length she should draw it at x1200.

(1)

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42 A drawing of a leaf cell is 400 mm long. The real length is 2 mm. Calculate the magnification.

- ☐ A) x200
- ☐ B) x800
- ☐ C) x398
- ☐ D) x0.005
- ☐ E) x402

---

43 In fruit flies, red eye colour is controlled by a single gene. The allele for red eyes (R) is dominant over the allele for white eyes (r). When two heterozygous parents are crossed, state the expected ratio of red-eyed to white-eyed offspring, and calculate the percentage chance that an offspring will have white eyes.

(1)

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Question 1

(a) genetic variation, i.e. differences in genes/alleles inherited from parents **B1**

(a) environmental variation, i.e. differences caused by an organism's surroundings or lifestyle (e.g. diet, exercise, climate) **B1**

(a) Answer: Genetic differences and environmental differences.

(b) a mutation can change a gene, sometimes producing a new allele/new version of a characteristic that did not exist before in the population oe **B1**

(b) if this new allele is passed on to offspring through reproduction, it can increase the genetic variation within the population oe **B1**

(b) Answer: A mutation can create a new allele; if inherited by offspring, this adds new genetic variation to the population.

Question 2

(a) converts 50 um to 0.05 mm, then 25 / 0.05 oe **M1**

(a) x500 cao **A1**

(a) Answer: x500

(b) converts 5 um to 0.005 mm, then 0.005 x 500 oe (ft from (a)) **M1**

(b) 2.5 (mm) cao (ft) **A1**

(b) Answer: 2.5 mm

(c) so that the actual (real) size of structures in the image can be calculated or compared with other images oe **B1**

(c) Answer: So the real size of structures can be worked out or compared.

Question 3

(a) X = two **B1**

(a) Y = four **B1**

(a) Z = half (of the number in the parent cell) **B1**

(a) Answer: X = two; Y = four; Z = half.

(b) so that when two gametes combine (fuse) at fertilisation oe **B1**

(b) the resulting offspring (zygote) has the normal, full number of chromosomes, rather than double the normal amount oe **B1**

(b) Answer: So that fertilisation restores the normal chromosome number, instead of doubling it each generation.

(c) the testes (in males) and the ovaries (in females), i.e. the reproductive organs/gonads **B1**

(c) Answer: The testes and the ovaries.

Question 4

(a) an allele whose characteristic appears in the phenotype even if only one copy of it is present, i.e. it masks the effect of a recessive allele oe **B1**

(a) Answer: An allele whose characteristic shows even if only one copy is present.

(b) correct gametes shown for each parent: R and r from each parent **M1**

(b) correct genotypes shown in the grid: RR, Rr, Rr, rr **A1**

(b) Answer: Punnett square: RR, Rr, Rr, rr.

(c) ratio of 3 (rollers) : 1 (non-roller) identified from the Punnett square, ft from (b) **M1**

(c) 25% cao **A1**

(c) Answer: 3:1; 25%

Question 5

B (0.1 mm) **B1**

Answer: B) 0.1 mm

Question 6

A (x600) **B1**

Answer: A) x600

Question 7

C (800 mm) **B1**

Answer: C) 800 mm

Question 8

E (x600) **B1**

Answer: E) x600

Question 9

D (x500) **B1**

Answer: D) x500

Question 10

A (80 micrometres) **B1**

Answer: A) 80 micrometres

Question 11

B (20 micrometres) **B1**

Answer: B) 20 micrometres

Question 12

E (60 micrometres) **B1**

Answer: E) 60 micrometres

Question 13

D (25 mm) **B1**

Answer: D) 25 mm

Question 14

C (0.5 mm) **B1**

Answer: C) 0.5 mm

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Question 15

A (0.02 mm) **B1**

Answer: A) 0.02 mm

Question 16

E (x400) **B1**

Answer: E) x400

Question 17

B (60 micrometres) **B1**

Answer: B) 60 micrometres

Question 18

D (2 mm) **B1**

Answer: D) 2 mm

Question 19

C (100 micrometres) **B1**

Answer: C) 100 micrometres

Question 20

(a) correct method shown for at least one colour, e.g. 12 / 50 x 100 oe **M1**

(a) green: 24% cao **A1**

(a) brown: 68% cao **A1**

(a) Answer: Green: 24%. Brown: 68%.

(b) the green moths were better camouflaged **B1**

(b) because a much lower percentage of green moths were caught (24%) than brown moths (68%), so fewer green moths were spotted by the predator against the green grass oe **B1**

(b) Answer: Green moths, since far fewer of them were caught than brown moths.

(c) use the same student as 'predator' each time, use the same time limit, use the same viewing distance, or scatter the moths in the same random pattern each time (any one) oe **B1**

(c) Answer: For example, use the same predator and the same time limit each time.

Question 21

E (x500) **B1**

Answer: E) x500

Question 22

C (16 mm) **B1**

Answer: C) 16 mm

Question 23

Homozygous (recessive) (oe) **B1**

Answer: Homozygous (recessive)

Question 24

D (x400) **B1**

Answer: D) x400

Question 25

50% (oe) **B1**

Answer: 50%

Question 26

B (20 mm) **B1**

Answer: B) 20 mm

Question 27

Homozygous (recessive) (oe) **B1**

Answer: Homozygous (recessive)

Question 28

A (x200) **B1**

Answer: A) x200

Question 29

3:1; 25% (oe) **B1**

Answer: 3:1; 25%

Question 30

C (x500) **B1**

Answer: C) x500

Question 31

14 mm (oe) **B1**

Answer: 14 mm

Question 32

B (x100) **B1**

Answer: B) x100

Question 33

yy (oe) **B1**

Answer: yy

Question 34

E (x800) **B1**

Answer: E) x800

Question 35

Homozygous (recessive) (oe) **B1**

Answer: Homozygous (recessive)

Question 36

D (x40) **B1**

Answer: D) x40

Question 37

80 micrometres (oe) **B1**

Answer: 80 micrometres

Question 38

A (80 micrometres) **B1**

Answer: A) 80 micrometres

Question 39

24 mm (oe) **B1**

Answer: 24 mm

Question 40

B (x400) **B1**

Answer: B) x400

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Question 41

120 mm (oe) **B1**

Answer: 120 mm

Question 42

A (x200) **B1**

Answer: A) x200

Question 43

3:1; 25% (oe) **B1**

Answer: 3:1; 25%

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