

AQA AS Biology Unit 2 Chapter 7/8/9/11/12 DNA Answers

1.

- (a) (i) Continuous variation – range of values/not discrete categories/many categories/
no gaps; 1
- (ii) Crossing over / chiasmata;
Random segregation / independent assortment;
In meiosis I and meiosis II; max 2
- (b) Range influenced by single 'outlier' (*accept anomaly*) / converse for S.D.;
S.D. shows dispersion/spread about mean;
Range only shows highest and lowest values/extremes;
S.D. allows statistical use;
Tests whether or not differences are significant; max 2

2.

- (a) polygenic inheritance / several genes;
many categories / continuous range / single or multiple allele inheritance would
produce discrete categories / eq.; 2
- (b) (SE gives idea of) variability of mean;
time / population mean would lie within these limits in 68% / 70% / 2/3 of samples; 2

3.

- (a) (i) Polygenic – several different genes influence same feature;
Multiple allele – more than two alleles of one gene; 2
- (ii) Influence of environment/suitable example;
As they are genetically identical (with respect to flower length); 2
- (iii) All heterozygous for flower-length genes;
Parents were homozygous for long or short alleles / inherit (one) long allele from
one parent and (one) short allele (for each gene) from the other; 2
Accept these points from LABELLED genetic diagrams.
- (iv) Crossing over;
Independent assortment/random segregation;
Random fertilisation;
Environmental influence; 3 max
- (b) (i) Similarity – carry genes for same features / same genes / made from two
identical chromatids;
Difference – different alleles (of some/all genes)/different sequences of
bases/from different parents; 2
- (ii) Crossing over / chiasma formation; 1
- (iii) Prophase I; 1
- (iv) Produces new combinations of alleles;
Introduces (genetic) variation;
Into gametes / offspring; 2 max

4.

- (a) P = cytosine
Q = deoxyribose / 5C sugar / pentose
R = phosphate / phosphoric acid **2**
3 right = 2 marks
2 right = 1 mark
<2 right = 0 marks
- (b) DNA strand separates / H-bonds break; *accept 'unzips'*
New molecules formed have one 'old' strand and one 'new' strand; **2**
- (c) DNA has deoxyribose, mRNA has ribose;
DNA has thymine, mRNA has uracil; *accept T/U*
DNA double stranded, mRNA single stranded;
DNA is longer than mRNA; *ignore larger/smaller*
DNA has hydrogen bonds, mRNA doesn't; **2 max**
- (d) 15% cytosine, therefore 70% adenine and thymine
70% / 2 = 35% **2**
Correct answer of 35% gains 2 marks.
Incorrect answer clearly showing that C + G = A + T gains 1 mark

5.

- (a) nucleotide; **1**
- (b) (i) 21.4, 21.4; 28.6; **2**
- (ii) amounts of A and T / C and G/complementary bases different;
therefore no base-pairing; **2 max**
- (iii) both contain phosphate;
pentose/5C sugar;
both have nucleotides/are polymers;
both have purines/pyrimidines/bases/A/C/G; **2 max**

6.

- (a) (i) Ts opposite As and Cs opposite Gs; **1**
- (ii) Deoxyribose / pentose/5C sugar;
Phosphate/phosphoric acid; **2**
- (iii) Hydrogen; **1**
- (b) (i) The sequence of bases determines the sequence of amino acids;
Three bases code for one amino acid; **2**
- (ii) Makes stable / prevents degeneration of molecule /
allows copying/ replication; **1**

7.

- (a) Made up of many (similar) molecules/monomers/nucleotides/units; 1
Q Ignore "codons"
Reject "bases"
- (b) (i) Same base only part of code for one amino acid/
 the A in the code for arginine does not code for lysine as well; 1
Q A single mark is awarded here as candidates may simply respond in more general terms and still address the question.
- (ii) More than one code for one amino acid;
 CGA and CGC both code for arginine; 2
- (c) (i) Uracil; 1
- (ii)
- | mRNA | Base Z |
|------------|--------|
| Molecule X | 14 |
| Molecule Y | 26 |
- 1
- (iii) Transcribed/copied from different genes/chromosomes/pieces of DNA;
 Which would have different base sequences/order of bases;
 (mRNA base sequence) formed by complementary base pairing; 2 max

8.

- (a) 1 Sequence of bases in gene/on DNA determine amino acid sequence;
 2 Transcription to form mRNA;
 3 Codons on mRNA;
 4 Reference to base-pairing;
 5 A to U, T to A and C to G;
 6 Specific tRNA for each amino acid;
 7 Has anticodon to bind to mRNA codon;
 8 At the ribosome;
 9 Role of sites on ribosomes in translation. 6 max
- (b) (i) X is phosphate and Y is pentose/deoxyribose;
- (ii) Hydrogen; 2

- (c) (i) AZT binds to adenine/ A (on single DNA strand);
 But lacks phosphates/ OH;
 Unable to bind to another nucleotide;
 So (AZT) enzyme unable to form new strand/DNA; 2 max

9.

- (a) (i) A = phosphate and
B = Deoxyribose/ pentose/5-carbon sugar;
(Reject sugar) 1
- (ii) (Nitrogenous/organic) base(s);
(Accept any correctly named base)
Both bonds formed with the same base; 2
- (b) Prevents DNA replication/being copied;
Prevents production of proteins needed (for cell division);
Prevents transcription or a description e.g. forming mRNA;
Blocks (complementary) base pairing/hydrogen bonding;
Blocks (DNA/RNA) polymerase;
Prevents strands separating/helix or DNA unwinding/unzipping/prevents
H bonds breaking (if binds across helix); 3 max

10.

- (a) (i)

DNA	G	C	C	T	A	C	A	A	C	G	C	T
RNA	C	G	G	A	U							

; 1

- (ii) arg-met-leu-arg 1

11.

- (a)(i) R; 1
- (ii) P; 1
- (b)(i) hydrogen bonds; 1
- (ii) for replication / stability / protect code/bases; 1

(c)

	Number of bases			
	C	G	A	T
Strand A	11	19	15	9
Strand B	19	11	9	15

C and G columns correct = one mark, A and T columns correct = one mark) 2

12.

- (a) X, phosphate;
Y, deoxyribose/pentose/5-carbon sugar;
Z, (nitrogenous) base; (*accept named base*) 3
- (b) (specific) hydrogen (bonds); 1
- (c) thymine 28% so adenine 28%
therefore 44% cytosine and guanine;
therefore 22% cytosine; 2
- (*idea of equal amounts T and A, C and G – 1 mark, correct answer 2 marks*)

13.

- (a) appropriately placed box; 1
- (b) (i) B; 1
(ii) A; 2
- (c) (i) determines (sequence of) amino acids / specific protein produced / mRNA formation; 1
(ii) hydrogen bonds; 1
(iii) stability / protects bases / replication; 1

14.

- (a) 387; 1
- (b) (i) CCAG; 1
(ii) 5; 1

15.

- (a) (i) DACB 1
(ii) Attachment of centromeres;
Separation of (daughter) chromatids; 2
- (a) Meiosis halves the number of chromosomes;
Restoration of diploid number at fertilisation;
Introduces variation;
Correct reference to natural selection / survival; 2 max
- (c) (i) Sperm is haploid, liver is diploid / sperm formed by meiosis, liver cell formed by mitosis; 1
(ii) It has no nucleus; 1

16.

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|-----|-------|--|----------|
| (a) | (i) | 20 | 1 |
| | (ii) | 10 | 1 |
| | (iii) | 10 | 1 |
| (b) | (i) | (Daughter) chromatids will not separate / centromere won't divide;
<u>Centromere</u> attaches to spindle fibres;
<i>NOT 'chromosomes can't be pulled apart'. Ignore references to stages of mitosis.</i> | 2 |
| | (ii) | Red blood cells <u>formed</u> / <u>produced</u> by mitosis; | 1 |

17.

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|-----|-------|---|-------|
| (a) | (i) | Prophase; | 1 |
| | (ii) | Chromosomes/chromatids moved apart; | 1 |
| | (iii) | <i>A wide range of processes occurs during interphase. This list is by no means exhaustive, but we would expect to see answers such as:</i>

Increase in volume of cell/volume of cytoplasm / increase in mass / cell bigger;
increase in number of organelles;
synthesis of protein/named protein;
DNA replication/increase / chromosomes copied;
ATP synthesis / respiration; | max 2 |
| (b) | | Divide real length of bar (in mm)/10 by 0.02; | 1 |
| (c) | | 12/200 x 24 / single error in otherwise correct method;
1.44 hours (1 hour 26 min); | 2 |

18.

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|-----|-------|---|-------|
| (a) | (i) | where mitosis/division/growing/ occurs
(reject growing cells) | 1 |
| | (ii) | to distinguish chromosomes/chromosomes not visible without stain; | 1 |
| | (iii) | to let light through/thin layer; | 1 |
| (b) | (i) | 74 + 18/982;
= 9.4% / 9%;
(allow 1 mark for identifying prophase & metaphase i.e. 92 or correct method using wrong figures) | 2 |
| | (ii) | genetic differences/different types of garlic;
time of day; chance;
age of root tip;
water availability;
temperature;
nutrient availability;
(environmental factors = 1 but cannot be awarded in addition to a name environmental factor) | 2 max |

19.

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|-----|--|-------|
| (a) | Interphase/S-phase; | 1 |
| (b) | A D C E B; | 1 |
| (c) | Attachment of centromeres/chromosomes/chromatids;
Separation of centromeres/chromatids/chromosomes; | 2 |
| (d) | Halves chromosome number/haploid;
Diploid/full number restored at fertilisation;
<i>Allow correct reference to variation</i> | max 2 |

20.

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|-----|------|---|---|
| (a) | (i) | Attaches (chromosome) to spindle/holds (sister) chromatids together; | 1 |
| | (ii) | Separate chromatids/centromeres/chromosomes/ aligns chromosomes at equator; | 1 |
| (b) | (i) | n,n,2n; | 1 |
| | (ii) | X on arrow going from 2n to n; | 1 |

21.

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|-----|---------------------------------|--|---|
| (a) | Interphase/S-(phase)/synthesis; | 1 | |
| (b) | (i) | B;
Acts during DNA replication;
<i>Ignore reference to wrong named stage</i> | 2 |
| | (ii) | This is when chromosomes/ chromatids are separating;
Pulled by spindle fibres; | 2 |

22.

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|-----|---|---|
| (a) | mitosis;
genetically/ genes /genotype identical;
<i>(reject same genes)</i>
<i>(ignore references to asexual reproduction)</i> | 2 |
| (b) | (different)environmental conditions/named environmental factor/mutation; | 1 |
| (c) | dispersal / prevent overcrowding / competition / colonise ;
increased number of (proven) offspring; <i>(not quicker)</i> | 2 |

23.

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|-----|-------|---|---|
| (a) | (i) | Shorten/thicken /coil/condense; | 1 |
| | (ii) | (Line up) at equator (of spindle)/centromeres attach to spindle;
(accept move towards middle of the cell) | 1 |
| | (iii) | Chromosomes or chromatids moving apart/centromere divides; | 1 |
| (b) | | Telophase; | 1 |
| (c) | | (Cells with 9.4) replicated DNA/chromatids joined together / late
interphase/prophase/metaphase/before cell division; | 1 |
| | | (Cells with 4.7) single chromatids/DNA is not replicated/telophase/early
interphase;
(must be clear reference to which cells are being discussed) | 1 |

24.

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|-----|------|--|-------|
| (a) | (i) | Stage A is anaphase;
Chromatids/chromosomes moving apart/centomere divided; | 2 |
| | (ii) | Stage B is telophase;
Chromosomes are uncoiling;
(Accept new nuclei forming) | 2 |
| (b) | | Embryo split into separate <u>cells</u> ;
These (cells) are undifferentiated/totipotent;
Each cell grows by <u>mitosis</u> (into new embryo/organism); | 2 max |

25.

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|-----|---|-------|
| (a) | Centromeres divide/chromatids separate;
One chromatid/chromosome moves to each pole;
Spindle fibres shorten; | 2 max |
| (b) | Rate of removal (of tubulin) proportional to shortening of spindle fibres/
speed of movement of chromatids/fibres control speed of movement;
Provides force/pulls chromatids or chromosomes apart/movement linked
to shortening of fibres; | 2 |

26.

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|-----|------|---|-------|
| (a) | (i) | R S T P Q; | 1 |
| | (ii) | Q = telophase;
T = metaphase; | 2 |
| (b) | | DNA/chromosomes/chromatin replicated;
(Reject chromatids/genetic material)
Organelles/named organelle(s) replicated;
Increase in ATP/named compound/proteins synthesis;
Cells grow/ get bigger;
(Accept increase in cytoplasm) | 2 max |

27.

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|--|-------|
| (a) prophase; | 1 |
| (b) uncoiling/elongation (of chromosomes);
formation of nuclear membranes/two nuclei formed;
loss of spindle;
new cell membranes formed/two cells formed; | 2 max |
| (c) one mark for chromatid correctly labelled;
one mark for centromere correctly labelled; | 2 |
| (d) 6; | 1 |

28.

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|---|---|
| (a) (i) A anaphase; | 1 |
| (ii) (C) B,A,D; | 1 |
| (iii) (original) chromosome/DNA has been replicated;
each chromosome consists of two chromatids/
chromatids attached at centromere;
(accept reference to condensed state of chromosomes) | 2 |
| (b) (i) it has doubled/now 8; | 1 |
| (ii) chromosome/DNA replication but no
separation/anaphase/cell division; | 1 |

29.

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|--|-------|
| (a) (i) prophase;
chromosomes thickening/becoming visible; | 2 |
| (ii) anaphase;
chromatids/chromosomes moving to opposite poles/
ends of spindles; | 2 |
| (b) DNA replication;
synthesis of proteins/build-up of energy stores/growth/increase in
cytoplasm;
replication of organelles/named example; | 2 max |

30.

- | | | | |
|-----|-------|--|---|
| (a) | (i) | anaphase; | 1 |
| | (ii) | sister / identical <u>chromatids</u> (separate);
move to opposite poles / ends / sides; | 2 |
| (b) | (i) | interphase; | 1 |
| | (ii) | <u>ATP</u> production / protein synthesis / replication of centrioles; | 1 |
| | (iii) | 1.2; | 1 |
| (c) | | short duration of <u>interphase</u> ; | 1 |

31.

- | | | |
|-----|--|---|
| (a) | A and B = 23;
C = 46; | 2 |
| (b) | Zygote / fertilised egg; | 1 |
| (b) | <u>Chromatids</u> move apart / to (opposite) poles;
S / interphase;
Chromosome as chromatid pair / spindle forms / nuclear membrane
degenerates / chromosomes condense;
Cytokinesis / telophase; | 4 |

32.

- | | | |
|-----|---|---|
| (a) | Anaphase I;
<u>Chromosomes</u> / chromatid pairs / bivalents are separating;
<i>Allow: "they" are separating</i> | 2 |
| (b) | 8; | 1 |
| (c) | 2; | 1 |
| (c) | So fertilisation / described can restore (diploid) number / prevent
chromosome doubling at fertilisation / described;
<i>Ignore references to "variation"</i> | 1 |

33.

- | | | | |
|-----|------|--|-------|
| (a) | (i) | A / identified (e.g. 7):
has $\frac{1}{2}$ mass of DNA in B / $\frac{1}{4}$ mass of DNA in C / would have $\frac{1}{2}$
chromosome number of B / contains least DNA / has 23 chromosomes;
<i>Reject haploid</i> | 1 |
| | (ii) | 14 (arbitrary units);
Diploid number of chromosomes re-established;
Gametes are haploid (<i>or concept explained</i>) / each gamete will contain
7 units; | 2 max |
| (b) | | Separation of chromatid pairs / chromatids within a pair / chromosomes;
<i>Reject 'homologous chromosomes'</i> | 1 |

34.

(a)

Event	Division I / II	Phase (anaphase, metaphase, prophase or telophase)
1	I	telophase
2	I	prophase
3	II	anaphase
4	I	metaphase

One mark per row;,,,;

4

(b)

3;

1

35.

(a)

Chromosomes attach to equator/middle of cell/spindle;
Prophase;
Anaphase;
DNA replication/synthesis / chromosome copying/duplication;
Telophase;

5

(b)

(i)

Meiosis;

1

(ii)

32;

1

36.

(a)

Later fertilisation/cell fusion; (NOT just 'sexual reproduction')
Restoring diploid/original number/not doubling chromosome number;
[ALLOW ref '½ + ½']

2

(b)

Any three pairs from:
need comparison of meiosis and mitosis each time

Meiosis	Mitosis
(Homologous) chromosomes associate in pairs	(Homologues) independent/do not pair (IGNORE ref. separation)
Crossing-over/chiasmata formation	No crossing-over;
Two/(nuclear stages) divisions/ → 4 offspring cells	One/(nuclear stage) division/ → 2 offspring cells;
Genetically different (product)	Genetically identical (product);

[IGNORE refs. To location]

max 3

37.

(a)

(meiosis) anaphase I;
chromosomes are moving apart;
chromosomes still double structures;

3

(b)

chromosomes in each (homologous) pair twist around each other;
chromatids break and rejoin to chromatid on sister chromosome;
(accept points from a suitable diagram)

2

38.

- (a) More cells in udders/larger udders;
Cells are milk producing; 2
- (b) (i) $65\% \pm 2$; ;
Correct answer = 2 marks
Incorrect answer based on correct method = 1 2
- (ii) Yield falls (over time period);
BST increases yield by constant amount/BST yield falls at same rate;
So increased yield becomes higher proportion of yield; max 2
- (c) May not be cost-effective/ *not just cost*
Concerns over animal welfare/
Hormone may be present in milk/
Not acceptable for organic farmers/
May affect reproduction; - 1

39.

- (a) Chromosomes: C = 8 and D = 4;
DNA: C = 300 and D = 150; 2
- (b) (i) testis / ovary; 1
accept anther / carpel / stamen / testicle
- (ii) to make chromosomes / chromatids / DNA / genetic material
visible; 1

40.

- (a) (i) 95 - 100 minutes; 1
- (ii) It shows the distance between the (sister) chromatids increases at this point;
As they begin to separate/ move to opposite poles; 2
- (b) Chromatids cannot be seen;
Valid reason, e.g. chromosomes have not condensed / too diffuse /
still in interphase; 2
- (c) (i) Zygote; 1
- (ii) Avoids doubling of chromosomes number at each generation / maintains
chromosome number from generation to generation/
diploid/correct number/ 46 restored at fertilisation; 1

41.

- (a) (i) 6; 1
- (ii) On graph:
'F' on vertical rise from 3 to 6 pg;
'S' on vertical fall from 6 to 3 pg; 2
- (b) Crossing over / described;
Independent/random assortment / independent/random segregation /
described clearly (e.g. not just alignment); 2
Ignore reference to name of phase

42.

- | | | | |
|-----|------|---|---|
| (a) | (i) | Attaches (chromosome) to spindle/holds (sister) chromatids together; | 1 |
| | (ii) | Separate chromatids/centromeres/chromosomes/ aligns chromosomes at equator; | 1 |
| (b) | (i) | $n, n, 2n$; | 1 |
| | (ii) | X on arrow going from $2n$ to n ; | 1 |

43.

- | | | | |
|-----|------|--|---|
| (a) | | Prevents doubling of chromosome no. (at fertilisation) / restores <u>diploid</u> no. (at fertilisation);
<i>accept numerical example if clearly $n+n \rightarrow 2n$ / $\frac{1}{2} + \frac{1}{2} \rightarrow$ whole number</i> | 1 |
| (b) | (i) | Prophase I; | 1 |
| | (ii) | 9; | 1 |
| (c) | (i) | Crossing over / chromosomes exchanging parts / chromatids exchanging parts / chiasma formation;
Produces new combinations of alleles; | 2 |
| | (ii) | Independent/random AND assortment /segregation/described; | 1 |

44.

- | | | |
|-----|--|-------|
| (a) | 1 Homologous chromosomes pair up/ bivalents form;
2 Crossing over/ chiasmata form;
3 Produces <u>new combination</u> of alleles;
4 Chromosomes separate;
5 At random;
6 Produces varying combinations of chromosomes/ genes/ alleles (<i>not twice</i>) ;
7 Chromatids separated at meiosis II/ later; | 6 max |
|-----|--|-------|
- Independent assortment/ random segregation = marking points 4 and 5*

45.

- | | | | |
|-----|-------|---|-------|
| (a) | (i) | Polygenic – several different genes influence same feature;
Multiple allele – more than two alleles of one gene; | 2 |
| | (ii) | Influence of environment/suitable example;
As they are genetically identical (with respect to flower length); | 2 |
| | (iii) | All heterozygous for flower-length genes;
Parents were homozygous for long or short alleles / inherit (one) long allele from one parent and (one) short allele (for each gene) from the other;
<i>Accept these points from LABELLED genetic diagrams.</i> | 2 |
| | (iv) | Crossing over;
Independent assortment/random segregation;
Random fertilisation;
Environmental influence; | 3 max |
| (b) | (i) | Similarity – carry genes for same features / same genes / made from two identical chromatids;
Difference – different alleles (of some/all genes)/different sequences of bases/from different parents; | 2 |
| | (ii) | Crossing over / chiasma formation; | 1 |
| | (iii) | <u>Prophase I</u> ; | 1 |
| | (iv) | Produces new combinations of alleles;
Introduces (genetic) variation;
Into gametes / offspring; | 2 max |

46.

- | | | | |
|-----|-------|----|---|
| (a) | (i) | 2; | 1 |
| | (ii) | 1; | 1 |
| | (iii) | 2; | 1 |
- Q Ignore references to haploid and diploid in these answers.*
- | | | | |
|-----|-------|---|---|
| (b) | (i) | One mark for curve basically similar in shape to that plotted;
Two marks for curve basically similar in shape to that plotted and with values roughly twice those shown;;
<i>Q Max 1 if increase starts in regions E or G</i> | 2 |
| | (ii) | Telophase; | 1 |
| | (iii) | Shortening of spindle (fibres);
<i>Q Answer must relate to spindle but accept references to chromatids/chromosomes/centromeres being pulled/separated by the spindle fibres.</i> | 1 |

47.

- (a) Anaphase and since (chromosomes) are separating;
(Anaphase) I and homologous chromosomes present / cell is diploid /
pairs of chromatids still joined;
OR Anaphase I (no reasons / incorrect reasons) 1 mark 2 max
- (b) 0.13;
Q Allow $0.52 \div 4$ 1
- (c) (i) qrDE qrdE QRDe QRde ;; 2 marks
- OR If incorrect, but one allele from each gene in each of four
(genetically different) gametes ; 1 mark 2 max
- (ii) Produces variation in offspring / example described;
Different adaptations in offspring / some offspring better adapted /
allows for changing environment / different environment / example described; 2

48.

- (a) haploid cells produced/halves chromosome number;
fertilisation/fusion of gametes, diploid number restored;
chromosome number constant at each generation; 2 max
- (b) principle of 2 chromosomes per cell;
4 correct combinations, long with short; 2
- (c) (i) 8;
- (ii) 8; 2
- (d) (in males) more gametes produced / rapid gamete production / more lost; 1

49.

- (a) (i) Meiosis;
- (ii) Reference to homologous/pairs of chromosomes/bivalents;
One of each pair goes to each cell/gamete;
(In second division) centromere divides/chromatids separate;
(Accept crossing over/independent assortment for 1 mark) 3 max
- (b) (i) F between 'gamete-producing structure and zygote;
- (ii) M between '2N' and spores; 2
- (c) Advantage and explanation;;
- For example:
Many spores released nearby;
So more of nutrient source used/used more rapidly;
- Produces genetically identical fungi;
So all well suited to nutrient source/ environment; 2 max

50.

- (a) (i) Difference;
Example,
Sperm has flagellum; 1
- (ii) Explanation;
Example,
(Flagellum), so it can swim to the egg; 1
- (b) (i) Homologous chromosomes/chromosomes form pairs;
One (of each pair) goes to each cell produced; 2
- (ii) Restores diploid number at fertilisation;
Maintain chromosome number (from one generation to next); 2

51.

- (a) (i) R S T P Q; 1
- (ii) Q = telophase;
T = metaphase; 2
- (b) DNA/chromosomes/chromatin replicated;
(Reject chromatids/genetic material)
Organelles/named organelle(s) replicated;
Increase in ATP/named compound/proteins synthesis;
Cells grow/ get bigger;
(Accept increase in cytoplasm) 2 max

52.

(a)

Statement	Stage of mitosis				
	Interphase	Prophase	Metaphase	Anaphase	Telophase
Sister chromatids separate				√	
DNA replication occurs	√				
Chromosomes shorten and thicken		√			

(one mark for each correct row)

3

- (b)(i) short duration of interphase; 1
- (ii) 792 (minutes); (Allow 765) 1
- (c)(i) 3 chromosomes drawn;
1 from each homologous pair; 2
- (ii) produces haploid (cells) / chromosome number halved;
produces the diploid / maintains chromosome number; 2

53.

- (a) 6, 6;
12; 2
- (b) (i) between male and female aphids and gametes; 1
- (ii) when gametes fuse or at fertilisation diploid number is restored/
chromosome number maintained;
produces variation; 1 max
- (c) asexual reproduction quick;
so rapid increase in population;
in favourable conditions;
energy resources not used in producing males/economical use
of energy resources; 2 max
- (d) only eggs survive winter;
variation introduced;
sexual reproduction can occur; 1 max

54.

- (a) prophase – coil up/spiralise/condense;
(allow shorter/contract/become visible)
metaphase – move to equator or centre of cell / attach to spindle;
(reject if reference to pairing)
anaphase – chromatids separate/centromeres divide;
(reject chromosomes move to poles without further explanation)
telophase – uncoil; (allow lengthen/becomes less visible)
(allow labelled diagrams) 4

(b)

Mitosis	Meiosis
chromosome number remains same / cells produced diploid	chromosome number halved / cells produced haploid
cells produced identical / no variation in cells produced	cells produced not identical / variation in cells produced
only one division/2 cells produced	two divisions / 4 cells produced
somatic/ body cell formation/ used in AR/growth	used in gamete formation / reproductive cell formation / occurs in gonads/named gonad (reject occurs <u>in</u> gametes)

Accept

no pairing of chromosomes	pairing of chromosomes
no chiasma/crossing over	chiasma/crossing over (may occur)

2 max

55.

- (a) meiosis halves the chromosome number / from diploid to haploid/
produces haploid/n cells;
when gametes fuse/at fertilisation, the diploid number is restored;
this keeps the chromosome number constant/correct from one generation
to the next/after sexual reproduction;
introduces genetic variation/independent assortment/crossing over; 3 max
- (b) **M** between moss plant and spore; 1
- (c) (gamete **B**, *no mark*)
gamete **B** has/A does not have:
few reserves/nutrients;
smaller size;
flagella, so mobile; 2 max

56.

- (a) to get haploid/n/half number of chromosomes (in cells);
so that each cell gets one copy of each chromosome/gene/full set of genes;
so that fertilisation produces diploid/constant chromosome number;
results in independent assortment; 2 max
- (b) (i) 4; 1
- (ii) meiosis (has halved the chromosome number); 1
- (ii) (mitosis because) zygote gets two chromosomes from each gamete/
has four chromosomes;
(*accept haploid for two and diploid for four*)
gamete-producing plant has two chromosomes, so mitosis to
produce gametes with two; 2

57.

- (a) (i) 8 'chromatids' each side;
spindle drawn; 2
- (ii) 4 chromosomes;
1 from each homologous pair; 2
- (b) produces haploid cells / chromosome number halved;
fertilisation;
maintains the diploid / chromosome number (in next generation); 2 max

58.

1. DNA is double stranded / double helix;
2. Unwinds / separates / hydrogen bonds break;
3. Two strands / sense / antisense strands exposed / act as templates;
4. DNA nucleotides in nucleoplasm / link together / form polynucleotide;
5. Complementary base pairing / described;
6. Role of DNA polymerase;
7. Two identical copies of DNA made;
8. Each contains one of original strands / semi-conservative;

59.

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|-----|-------|--|-------|
| (a) | (i) | base / named bases;
<i>reject nucleotide or uracil</i> | 1 |
| | (ii) | it has been produced by semi-conservative replication / one old strand and one new;
one strand has ^{15}N bases and the other ^{14}N ; <i>Accept light / heavy N</i>
(therefore) it is less dense / lighter; | 2 max |
| | (iii) | one band is in same position as generation 1;
one band higher;
<i>accept a line. N.B. need a visible gap</i> | 2 |
| (b) | (i) | A = 31 and T = 31;
C = 19; | 2 |
| | (ii) | viral DNA single-stranded / not double-stranded;
evidence from table e.g. not equal amount of A and T / C and G / all different;
<i>ignore no base-pairing In this question assume 'It' means viral DNA</i> | 2 |

60.

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|-----|---|---|---|
| (a) | 1 | two strands therefore semi-conservative replication (possible); | |
| | 2 | base pairing/hydrogen bonds holds strands together | |
| | 3 | hydrogen bonds weak/easily broken, allow strands to separate; | |
| | 4 | bases (sequence) (exposed so) act as template /can be copied; | |
| | 5 | A with T, C with G / complementary copy; | |
| | 6 | DNA one parent and one new strand; | 4 |
| (b) | 1 | chromosomes shorten/thicken/supercoiling; | |
| | 2 | chromosomes (each) two <u>identical</u> chromatids/strands/copies (due to replication); | |
| | 3 | chromosomes/chromatids move to equator/middle of the spindle/cell; | |
| | 4 | attach to individual spindle fibres; | |
| | 5 | spindle fibres contract / centromeres divide / repel; | |
| | 6 | (sister) chromatids/chromosomes (separate) move to opposite poles/ends of the spindle; | |
| | 7 | each pole/end receives all genetic information/identical copies of each chromosome; | |
| | 8 | nuclear envelope forms around each group of chromosomes/chromatids/at each pole; | 7 |

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|-----|---|---|
| (c) | cancer cells killed, normal body cells survive;
cancer cells low oxygen (as blood supply cannot satisfy demand); | 2 |
|-----|---|---|

61.

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|-----|--|---|
| (a) | each strand copied/acts as a template;
(daughter) DNA one new strand and one original/parent strand; | 2 |
| (b) | (i) ^{15}N / tube B (DNA), more/greater density;
(reject heavier) | 1 |
| | (ii) DNA with one heavy and one light strand;
new/synthesised strand, made with ^{14}N / light strand; | 2 |
| (c) | 32;
28 32 26; | 2 |

62.

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|-----|--|---|
| (a) | (Free) nucleotides bind to exposed strands;
A to T and C to G;
To produce identical copies of DNA; | 2 |
| (b) | Forms new strands of DNA (molecules);
By joining together (single) nucleotides bound to existing strands; | 2 |
| (c) | Each new DNA molecule consists of one original (polynucleotide) strand
and one new one; | 1 |

63.

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|-----|--|---|
| (a) | P - phosphate;
Q - deoxyribose; (allow pentose/5-carbon sugar, reject sugar)
R - adenine; (reject base)
S - nucleotide; | 4 |
| (b) | DNA polymerase; | 1 |
| (c) | interphase/S phase; | 1 |

64.

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|-----|---|--------------------|
| (a) | one <u>strand</u> of original molecule in each new molecule/DNA; | 1 |
| (b) | (i) each base only pairs with one other/one specific base /
complementary base pairing;
example – pairing of adenine and thymine/cytosine and guanine/
purine and pyrimidine; | |
| | (ii) identical/exact copies made;
same base sequence as original DNA;
<u>both</u> strands act as template/complementary base pairing occurs
on <u>both</u> strands; | 3 (max 2 for (ii)) |
| (c) | two strands with specific base pairing;
large number of hydrogen bonds (between strands);
helix/coiling reduces chance of molecular damage / protects H bonds;
strong sugar-phosphate backbone;
(reject strong bonds between nucleotides) | 2 max |

65.

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|-----|-------|---|---|
| (a) | (i) | (D) B E A C; | 1 |
| | (ii) | <u>metaphase</u> ; | 1 |
| (b) | | interphase/S phase; | 1 |
| (c) | (i) | 0.06 x 100;
6(%);
<i>(correct answer 2 marks)</i> | 2 |
| | (ii) | more (cancer cells) killed, cancer cells divide more (often) (so are more likely to be killed, more susceptible); | 1 |
| | (iii) | longer time to recover;
reduced rate of mitosis / divide more slowly/increased doubling time; | 2 |