1. (a) **two marks for named mutagenic agents**
x-rays, high energy radiation / particles;
chemical substances;
two marks for examples of mutations
deletion;
substitution;
addition;
two marks for idea of
incorrect pairing;
during replication; max 3

(b) nucleotides;
composition of a nucleotide,
4 bases named;
sugar-phosphate 'backbone';
two (polynucleotide) strands;
specific base-pairing;
example e.g. A–T / C–G;
hydrogen bonding;
'uncoiling' / 'unzipping';
semi-conservative replication;
DNA polymerase;
new complementary strands form / identical DNA molecule produced;
DNA inserted into plasmids;
which are self-replicating; max 9

[12]

2. (a) base/named base; 1

(b) semi-conservative replication;
contains one heavy and one light strand / half ^{14}N and half ^{15}N; 2

(c) one band in middle of tube and one higher up;
same position as above for third generation (ignore width of band); 2

[5]

3. (a) two chains/strands;
base pairing present/A-T/C-G;
hydrogen bonds easily broken; 2

(b) (i) base/named base; 1

(ii) DNA centrifuged;
in solution of caesium chloride;
separate depending on its mass/density/weight;
compared with position of band formed by ^{14}N/normal DNA;
DNA with ^{15}N further down the tube; 3

[6]

4. (a) regrows correct top;
from 'wrong' cytoplasm;
from nucleus that was present;
so something/mRNA from nucleus goes into cytoplasm
directing regrowth.
(*Accept same reasoning. for other sp.*) max 3

(b) separation between nucleus and site of protein synthesis/
growth of reproductive structure;
so must be messenger/mRNA that can go from nucleus to
site of synthesis. 2

[5]

5. (a) (i) **A** phosphate and deoxyribose / pentose / sugar (*but reject ribose*) 2

B base / named base (*but reject uracil*) 1

(ii) Hydrogen 1

(b) 986 2

Correct method but arithmetic error gains 1 mark (*e.g. 98.6*)

(c) *N. B. both structure and advantage needed for each mark*
Sugar – phosphate backbone gives strength;
Coiling gives compact shape;
Sequence of bases allows information to be stored;
Long molecule / coiling stores large amount of information;
Complementary base pairing enables information to be replicated / transcribed;
Double helix protects weak hydrogen bonds / double helix makes molecule stable;
Many hydrogen bonds together give molecule stability;
Prevents code being corrupted;
Hydrogen bonding allows chains to split for replication / transcription OR
molecule unzips <u>easily</u> for replication / transcription. 3

[9]

6. (a) Phosphate;
Sugar / deoxyribose / pentose; 2

(b)

	4	5	
4	6	2	

2

(c) Different genes are expressed in each;
Producing different enzymes / proteins; 2

[6]

7. (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

[6]

8. (a) one strand 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;
both strands act as template/complementary base pairing
occurs on both 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

[6]

9. (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)

[6]

10. (a) appropriately placed box; 1

(b) (i) B;

(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

[6]

11. (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 max

(b) 1 chromosomes shorten/thicken/supercoiling;
2 chromosomes (each) two identical 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 max

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

[13]

12. (a) (i) (D) B E A C; 1

(ii) metaphase; 1

(b) interphase/S phase; 1

(c) (i) 0.06 × 100;
6(%); 2

(correct answer 2 marks)

(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

[8]