

1. (i) Purines pair with pyrimidines / adenine and thymine always pair as do cytosine and guanine;  
Number of A = T/C = G;  
(different organisms have) different base sequences;  
different amount of each base pairing; 3
- (ii) Presence of non-coding DNA/introns /junk / nonsense; 1
- [4]**
2. (a) (i) Purines pair with pyrimidines;  
A pairs with T;  
C pairs with G; max 2
- (ii) G = 26      T = 24      C = 26  
A = T      C = G 3
- (iii) Sequence of bases is important; 1
- (b) (i) A does not equal T      C does not equal G; 1
- (ii) DNA is not double stranded; 1
- [8]**
3. (a) **X** = Phosphate;      **I** Phosphoric acid      **R** additional wrong chemical  
**Y** = Pentose / Deoxyribose; 2
- (b) (i) 21    29  
17    17 ; 1
- (ii) DNA is double stranded;  
Pairing of bases / **A** pairs with **T** / **C** pairs with **G**;  
(**I** reference to bases being same as or equal to each other)  
Evidence of calculation of octopus figures; max 2
- [5]**
4. (a) Anaphase I;  
Chromosomes/ chromatid pairs / bivalents are separating;  
*Allow: "they" are separating* 2
- (b) 8; 1
- (c) 2; 1

- (c) So fertilisation / described can restore (diploid) number / prevent chromosome doubling at fertilisation / described;  
*Ignore references to "variation"* 1 [5]
5. (a) P = cytosine  
Q = deoxyribose / 5C sugar / pentose  
R = phosphate / phosphoric acid  
3 right = 2 marks  
2 right = 1 mark  
<2 right = 0 marks 2
- (b) DNA strand separates / H-bonds break; *accept „unzips“*  
New molecules formed have one 'old' strand and one 'new' strand; 2
- (c) 15% cytosine, therefore 70% adenine and thymine  
70% / 2 = 35%  
*Correct answer of 35% gains 2 marks.*  
*Incorrect answer clearly showing that  $C + G = A + T$  gains 1 mark* 2 [6]
6. (a) (i) A / identified (e.g. 7):  
has ½ mass of DNA in B / ¼ mass of DNA in C / would have ½ chromosome number of B / contains least DNA / has 23 chromosomes;  
*Reject haploid* 1
- (ii) 14 (arbitrary units);  
Diploid number of chromosomes re-established;  
Gametes are haploid (*or concept explained*) / each gamete will contain 7 units; 2 max
- (b) Separation of chromatid pairs / chromatids within a pair / chromosomes;  
*Reject „homologous chromosomes“* 1 [4]
7. (a) Identify those at risk from developing cancer;  
So as to avoid relevant environmental factors / enable early diagnosis;  
Identify risk in families; 2 max

(b) *Mutation of suppressor gene – up to 4 marks*

1. Mutation is a change in the DNA / sense strand;
2. Base sequence altered / e.g.;
3. Suppressor gene produces wrong instructions / has different code;
4. (Therefore) different amino acid sequence;
5. Different protein structure / non-functional protein;

*Malignant tumour – up to 2 marks*

6. Cell division by mitosis;
7. Tumour cells growth abnormal / continuous / uncontrolled / rapid;
8. Tumour cells spread / invade other tissues / form secondary tumours / metastasis;
9. Via blood / lymph system; 6 max

- (c) (i) Most lung cancer occurs in smokers / non-smokers also develop lung cancer;  
 Smoking increases the risk of lung cancer;  
 Smoking is an environmental factor for lung cancer;  
 Smokers' risk more than 4x that of non-smokers / correct ref to figures;  
 (But) only a small proportion of smokers develop lung cancer;  
 Smokers more likely to develop other lung disease than cancer; 3 max

- (ii) Do not know size of sample / might be small sample in study;  
 Genetic differences / predisposition;  
 Could be different age at which started to smoke;  
 Could be different number of cigarettes smoked per day;  
 Could be different tar levels in cigarettes smoked;  
 Could be different sexes in sample;  
 Other valid; 2 max

- (d) All exposed to same environmental conditions / factors / no regional variations;  
 Same level of pollution / example; reject *less pollution*  
 Similar diet / example;  
 Same water supply;  
 Easier to screen whole population;  
 Easier to follow family history / people related;  
 Identify genetic differences in those affected (since everything else the same) / less genetic diversity; 2 max

8. (a) (i) Correct sequence:  
 1. Interphase  
 2. Prophase  
 3. Metaphase  
 4. Anaphase  
 5. Telophase; 1
- (ii) Interphase; 1
- (b) Drawing: Two chromatids joined by centromere; [If > 1 picture drawn, allow if all correct]  
 Chromatids attached to spindle fibre by centromere;  
Labels: Centromere + chromatid + spindle fibre correctly labelled; 3
- (c) (i) 8 (\*)  
 (ii) 4 (\*) 1  
 (\*) both correct
9. (a) (i) B; 1  
 (ii) C; 1
- (b) Amount of DNA halved,  
 (At start of mitosis) DNA has replicated;  
 Chromatids/ chromosomes separate;  
 At anaphase;  
 Role of spindle; max 3
- (c) (i) Stage B would take longer/ would not occur/  
 graph would be flat/ not so steep; 1  
 (ii) No DNA synthesis so cells don't divide/ reduced DNA synthesis so  
 cells divide more slowly/ cytarabine inhibits cell division;  
 Stops/ slows formation of new cancer cells/ stops/  
 reduces spread of cancer: 2

[6]

[8]

10. (i) sugar or phosphate / S-P / nucleotide chain/backbone / original/parent DNA; 1
- (ii) X thymine; Y guanine; Z adenine;  
(Allow T, G and A) Reject: thiamine 3
- [4]**
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11. (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
- [7]**
- 
12. (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
- [5]**
- 
13. (a) antibiotic has diffused/spread/moved into agar;  
killed/inhibited bacteria; 2
- (b) largest clear area/inhibition zone/killed the most bacteria; 1
- (c) disrupts cell wall/prevents cell wall synthesis;  
stops DNA replication; 2
- [5]**

14. (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
- [4]**
15. (a) (i) base / named bases; 1  
*reject nucleotide or uracil*
- (ii) it has been produced by semi-conservative replication / one old strand  
and one new; one strand has <sup>15</sup>N bases and the other <sup>14</sup>N;  
*Accept light/ heavy N*  
(therefore) it is less dense / lighter; 2 max
- (iii) one band is in same position as generation 1;  
one band higher;  
*accept a line. N.B. need a visible gap* 2
- (b) (i) A = 31 and JT = 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; 2  
*ignore no base-pairing In this Question assume  
It means viral DNA*
- [9]**
16. (a) Diagram showing two identical molecules;  
Each with one original and one new strand; 2
- (b) (i) 7.31 – 7.36;  
Same as liver cell/blood cell/twice sperm cell; 2
- (ii) 5.78;  
Sperm cell + egg cell, both with 2.89/twice sperm cell; 2
- [6]**
17. (a) Phosphate;  
Deoxyribose; 2
- Q** Candidates must specify deoxyribose. This term is a  
specification requirement.  
Ignore anything that is not incorrect.

(b) 4; 1

(c) (i) 14; 1

(ii) 36; 1

*If (c)(i) incorrect accept [50 – (c)(i)]*

(d) Different proteins;  
Different genes;  
Different (DNA) base sequences; 2 max

**[7]**