16. Inheritance

16.1 Passage of Information from Parents to Offspring

Paper 4

Marking Scheme

Q1.

(a)(i)	*any **one** from:* **1** same / equal, size / length ; **2** same, shape / position of centromere ; **3** same banding pattern ;	**1**

Q2.

(a)	*any **two** from:* **1** one / single, set of chromosomes ; **2** have **n** (number of) chromosomes / half of diploid number ; **3** chromosomes not in homologous pairs / only one of each homologous pair ; **4** each chromosome is different in, size / shape / genes / loci ;	**2**
(b)	*sexual reproduction*: **B** and **D** ; *mitosis*: *two from* **A**, **B**, **C**, **D** ; *meiosis*: **D** ;	**3**
(c)	*any **three** from:* **1** to maintain, chromosome / diploid, number ; **2** from parents to offspring / from generation to generation ; **3** to give genetic variation in, gametes / offspring / horses ; **4** too many / extra, sets of chromosomes cause (named) problems ;	**3**

Q3.

(a)	haploid is one (complete) set of chromosomes ; diploid is two (complete) sets of chromosomes ; *if only comparative statement = max 1* e.g. haploid is n chromosomes and diploid is 2n haploid is half the number of chromosomes as diploid / AW	**2**
(b)	*prophase I* chromosomes / chromatin, condense / shorten / fatten **I** DNA **or** homologous chromosomes pair up / bivalents form **or** crossing over / synapsis / chiasmata formation ; *metaphase I* homologous (pairs of) chromosomes / bivalents, line up on the, equator / metaphase plate **or** random / independent, assortment, of homologous (pairs of) chromosomes / bivalents ; *anaphase I* chromosome(s) / one of each pair of chromosomes, moves (to pole / end of cell) ; *telophase I* chromosomes reach the opposite, poles / centrosomes / centrioles / end of cell **or** chromosomes decondense / chromatin formation / chromosomes become diffuse ;	**4**
(c)	cytokinesis ;	**1**

Q4.

	*any **four** from:* **1** DNA / chromatin / chromosomes / chromatids, condense ; **2** homologous chromosomes, pair up / undergo synapsis / form bivalents / form tetrads ; **3** crossing-over ; **4** between non-sister chromatids ; **5** detail of crossing over ; **6** chromosomes (stay) joined at, cross-over points / chiasmata ;	**4**

Q5.

(a)	involve mitosis: **1 / 3** ; involve meiosis: **4** ; produces new genetic variation: **2 / 4** ; shows only haploid cells: **1 / 5** ; **ignore 2** shows only diploid cells: **3** ; **ignore 2**	**5**

(b)	*any **four** from:* 1 genetic variation ; 2 due to, crossing over / independent assortment ; 3 some will, be adapted (to changing environment) / survive **or** avoids whole population being wiped out / **ora** ; 4 (allows) stage **1** / stage **3** / asexual reproduction ; 5 (allows) random, mating / fertilisation / fusion of gametes ; 6 some have advantageous combinations of alleles ; 7 AVP ; e.g. *ref. to* dormancy	**4**

Q6.

(b)	*any **four** from:* 1 homologous chromosomes, pair up / form bivalents ; 2 at prophase I ; 3 independent assortment / random orientation **or** independent segregation ; 4 (happens) at metaphase I **or** at anaphase I ; 5 one chromosome of (each) pair has dominant allele and one has recessive ; 6 four, combinations / permutations / different gametes ; 7 worked example / diagram ;	**4**

Q7.

(a)(i) **2**

statement	meiosis	mitosis
chromosome number is maintained	×	✓
homologous chromosomes pair up	✓	×
sister chromatids separate	✓	✓
occurs in prokaryotes	×	×

all 4 rows correct = 2 marks
2/3 rows correct = 1 mark

A yes / no for ✓ / ×

(a)(ii) **4**

*any **four** from:*

similarities
1 (both / meiosis) produce 4 (cells) ;

2 (both / meiosis) halve chromosome number / haploid / n / one set of chromosomes ;

3 (both / meiosis) produce genetically different cells ;

Differences – must be comparative statements
4 sperm is a gamete whereas a pollen grain is, not a gamete / a gametophyte ;

5 sperm cell has one (haploid) nucleus whereas pollen grains contain two (haploid) nuclei ;

6 sperm mitosis then meiosis whereas pollen grain cells meiosis then mitosis ;

7 *ref. to* primary spermatocyte versus (pollen grain) mother cell ;

Q8.

(a)(i) **4**

any 4 of:
1 chromosomes become visible ;

2 condensation / coiling / supercoiling ; **A** description

3 nuclear envelope or nuclear membrane, disintegrates / disappears ;

4 nucleolus, disintegrates / disappears ;

5 centrioles migrate to (opposite) poles ; **I** centrosomes

6 spindle forms / microtubules assemble ;

7 synapsis / bivalents form / homologous chromosomes pair up ;

8 chiasmata formation / crossing over ;

(a)(ii) **2**

any 2 of:
1 (homologous chromosomes / bivalents) line up randomly on the, equator / metaphase plate ;

2 produces (many) different chromosome combinations ;

3 number of possible combinations is 2^n ;

4 new combinations of maternal and paternal alleles ;

Q9.

(a)(i)	metaphase, **II** / **2** ;	**1**
(a)(ii)	*any two from* **1** spindle (fibres) / microtubules, contract / shorten ; **2** chromosome(s), move / pulled, to pole(s) / centriole(s) ; **3** centromeres, move / lead / pulled, first ; **4** homologous chromosomes separate **or** pair (of chromosomes) / bivalent, pulled apart ;	**2**

(a)(iii)	*any two from* **1** non-sister chromatids ; **2** swap / exchange, alleles / sections of DNA ; **3** chiasmata ; **4** (giving) new / different, allele combinations **or** recombination ;	**2**