**1.** D

[1]

**2.** A

[1]

**3.** C

[1]

**4.** C

[1]

**5.** D

[1]

**6.** A

[1]

**7.** (a) anaphase 1

(b) growth (through increasing cell number);  
embryonic development;  
tissue production/repair;  
(asexual) reproduction; 2 max

(c) uncontrolled mitosis/cell division 1

(d) pair of homologous chromosomes moves in same direction/does not  
separate during anaphase I / chromatids move in same direction/do  
not separate during anaphase II;  
leaving a cell with an (some) extra chromosome(s)/missing  
chromosome(s);  
an example; *(e.g. Down syndrome / trisomy 21)*; 2 max

[6]

**8.** (a) two genetically identical nuclei/daughter cells formed during mitosis  
(so hereditary information in DNA can be passed on);  
two copies of each chromosome/DNA molecule/chromatid needed;  
helicase unwinds the DNA/double helix;  
to allow the strands to be separated;  
helicase separates the two (complementary) strands of DNA;  
by breaking hydrogen bonds between bases; 4 max

(b) DNA replication is semi-conservative;  
DNA is split into two single/template strands;  
nucleotides are assembled on/attached to each single/template strand;  
by complementary base pairing;  
adenine with thymine and cytosine with guanine / A with T and C with G;  
strand newly formed on each template strand is identical to other  
template strand;  
DNA polymerase used;  
*Marks may be awarded for any of the above points if clearly presented in  
a well-annotated diagram.* 5 max

(c) sequence of stages is prophase → metaphase → anaphase → telophase;  
chromosomes condense/supercoil/become shorter and fatter in prophase;  
spindle microtubules grow (from poles to equator) in prophase/metaphase;  
nuclear membrane breaks down in prophase/metaphase;  
spindle microtubules attach to the centromeres/chromosomes in metaphase;  
chromosomes line up at equator in metaphase;  
centromeres divide / (paired) chromatids separate / chromosomes  
separate into two chromatids in metaphase/anaphase;  
(sister) chromatids/chromosomes pulled to opposite poles in anaphase;  
spindle microtubules disappear in telophase;  
nuclear membrane reforms around chromosomes/chromatids in telophase;  
chromosomes/chromatids decondense in telophase; 9 max

*(Plus up to* ***[2]*** *for quality)*

[20]

**9.** (a) *Award* ***[1]*** *for each of the following clearly drawn and correctly labelled.*head and midpiece/mid-section/body;  
tail/flagellum; *(at least four times length of the head and containing fibres)*acrosome; *(shown as distinct structure near front of head)*nucleus; *(occupying more than half the width or length of head)*mitochondria; *(as repetitive structures inside membrane of mid piece)*centriole; *(between head and midpiece)*(plasma) membrane; *(shown as single line covering whole cell)*microtubules; *(in 9 plus 2 array)* 5 max

(b) crossing over/chiasmata formed during prophase I of meiosis;  
pairing of homologous chromosomes/synapsis;  
chromatids break (at same point); (*do not accept chromatids overlap)*non-sister chromatids join up/swap/exchange alleles/parts;  
X-shaped structure formed / chiasmata are X-shaped structures;  
chiasma formed at position where crossing over occurred;  
chiasmata become visible when homologous chromosomes unpair;  
chiasma holds homologous chromosomes together (until anaphase);  
*Accept the above points in an appropriately annotated diagram.* 5 max

(c) non-disjunction;  
chromosomes/chromatids do not separate / go to same pole;  
non-separation of (homologous) chromosomes during anaphase I;  
due to incorrect spindle attachment;  
non-separation of chromatids during anaphase II;  
due to centromeres not dividing;  
occurs during gamete/sperm/egg formation;  
less common in sperm than egg formation / function of parents’ age;  
Down syndrome due to extra chromosome 21;  
sperm/egg/gamete receives two chromosomes of same type;  
zygote/offspring with three chromosomes of same type / trisomy /  
total 47 chromosomes;  
*Accept the above points in an appropriately annotated diagram.* 8 max

*(Plus up to* ***[2]*** *for quality)*

[20]