6.1
Cell cycle regulation and cancer

**Similarities**
- bind to enzymes (1); not at the active site (1); cell regulation (1); specific (1).

**Differences**
- inhibitors stop the activity of enzymes (1); cyclins activate enzymes (1).

**Summary Questions**
1. Mitosis is the process of replicating and diving the genome (1); cytokinesis is the physical division of the cell (1).
2. DNA has been checked for errors (1); change in sequence of bases is a mutation (1); (leads to) change in amino acid sequence (1); function of protein dependent on, 3D shape / tertiary structure (1); tertiary structure dependent on primary structure (1); primary structure is sequence of amino acids (1).
3. a. Mutations occur during DNA replication (1); indefinite replication, increases chances of mutation / accumulation of mutations (1); increased chance of harmful mutation (1).
   b. indefinite replication (1); cancer / formation of tumour (1).
4. a. DNA is double stranded (1) b. $3 \times 10^9 / 50$ (1); $6 \times 10^7$ (1)
   c. many origins of replication (1); idea of simultaneous replication of different lengths (1)
   d. (prokaryotic) genome, is shorter / has fewer genes / has no introns (1)

6.2

**Summary Questions**
1. Chromosomes only become visible under the microscope during mitosis/meiosis (1). DNA needs to replicate for cell division. Chromosomes consist of two sister chromatids, which are identical copies of DNA (1).
2. So that each daughter cell has identical DNA after mitosis/cell division (1); and correct number of chromosomes (1) i.e., diploid after mitosis and haploid after meiosis.
3. Animal cells cleavage furrow forms around middle of cell (1); furrow pulls inwards and fuses (1); plants cells furrow cannot form due to cell wall (1); vesicle assemble across centre of cell and fuse (1).
4. Prophase – 92 chromosomes have replicated G1 – zero replication has not occurred yet
5. Plant root tips continually grow at regions called meristems (1). Meristems are a good source of cells for studying mitosis as they are constantly diving (1). Plant cells are easy to obtain (1) and prepare for microscopy (1).

6.3

**Summary Questions**
1. a. Meiosis I / the first division is a reduction division as each daughter cell is haploid (1).
   b. Gametes are the sex cells and two sex cell (one from each parent) must combine to produce a diploid offspring (1); therefore gametes must contain only half the number of chromosomes/DNA, i.e., be haploid, otherwise with each new generation the number of chromosomes would increase (1).
2. A pair of same chromosomes, one from each parent (1); which have the same genes but can have different alleles of each gene (1).
3. Anther(s) from a flower should be used (1); prepare a squash slide (1); use stain (1); observe using microscope (1).
4. Crossing over – homologous chromosomes pair up (in prophase), non-sister chromatids entangle (chiasmata) (1); and exchange genes/ alleles when they pull apart (at anaphase) (1). This produces new combinations of alleles. **Independent assortment** – pairs of homologous chromosomes (meiosis I)/chromosomes (meiosis II) line up on the equator (at metaphase) and each (pair/chromosome) orientates independently (1); before being separated to opposite poles of the cell (at anaphase) (1). This produces new combinations of alleles.
(1 mark for each allele pair)
b Creating different allele pairs during meiosis is an important source of genetic variation (1); in a population. Genetic variation is important for the process of natural selection (1); giving individuals in a population characteristics/traits that might confer an advantage (1); in changing environment (1); for example pathogen resistance. If there was no genetic variation in a population, the entire population would be vulnerable to such an external factor and there would be no opportunity for adaptation (1).

6.4
Summary Questions
1 Squamous (1); flattened cells provide thin surface (1) e.g. (alveoli) in lungs (1); diffusion of gases (1); ciliated (1); (have cilia), for movement, of cell / liquid outside cell (1); e.g. trachea (1); movement of mucus (1).
2 Any two appropriate examples with detail of structure related to function. (2 marks each).
3 A tissue is a collection of cells (1); that work together (1); an organ is a collection of tissues (1); that work together (1).
4 Digestive system is a group of organs working together carry out a function (1); pancreas produces digestive enzymes (1); stomach contains acid for digesting food (1); liver produces bile to aid digestion of fats (1); small intestine digests and absorbs soluble food (1); large intestine absorbs water from undigested food, producing faeces (1).

6.5
Gene therapy using stem cells
1 Bone marrow contains stem cells (1); stem cells can differentiate (1); into T cells (1); immune system is functional (1).
2 Tissue (from) donor is not a good match (1); rejection (1); transplanted cells destroyed (1); patients own cells used in gene therapy (1); no chance of rejection (1).
3 Another gene damaged during process (1); mutation of (another gene) (1); (lead to) uncontrolled cell division (1).

Plant stem cells and medicines
Medicines are (often) derived from plants (1); many plants destroyed (in production of medicine) (1); using stem cells reduces number of plants destroyed (1).

Summary Questions
1 Pluripotent – stem cells that can form all tissue types but not whole organisms (1). Only present in embryos (1). Multipotent – stem cells that can only form a range of cells within a certain type of tissue (1). For example, bone marrow is multipotent (or any appropriate answer) (1).
2 Shoot tips / root tips (1); (meristematic tissue contains) dividing cells (1); (leading to) growth (1); new cells / stem cells can differentiate (1); (leading to) specialisation (1).
3 Embryos left over from fertility treatment (1); discarded anyway (1); embryos now created (to supply stem cells) (1); embryos then destroyed (1); religious objections (1); life begins at conception (1); embryo has rights (1); ownership of genetic material (1); (incurable) diseases cured (1); improved quality of life (1).
4 a stem cells, divide and specialise (1); damaged tissue replaced (1)
b Progress of Parkinson’s disease delayed by drugs (1); symptoms of Alzheimer’s disease reduced using drugs (1); drugs are only short term measure (1); possible side effects of drugs (1); idea of stem cell therapy will lead to repair of tissue so, long term / permanent treatment (of both) (1); no / few, side effects (1).