**1.** D [1]

**2.** (a) (i) (approximately) 1 **m 1
*Accept any value between 0*.5 **m *and* 1.0 **m*.*

(ii) (approximately) 10 m to 100 m 1
*Accept any value within this range.*

(b) rate of transport of materials across membrane
 and/or energy / heat is a function of surface area;
rate of metabolism is a function of mass to volume ratio;
as size increases the ratio between SA and volume decreases;
causing problems in transport / rate of exchange; 2 max

[4]

**3.** differentiation is development in different / specific ways;
cells carry out specialized functions / become specialized;
example of a differentiated cell in a multicellular organism;
cells have all genes / could develop in any way;
some genes are switched on / expressed but not others;
position / hormones / cell to cell signals / chemicals determine how a cell develops;
a group of differentiated cells is a tissue;

[4]

**4.** labelled diagram of generalized prokaryotic (P) and generalized eukaryotic
(E) animal cell 2 max
(*Marks must be awarded if the following comparisons
are made as either annotations to the diagram or in narrative / table form.)*P is usually smaller in size, E is larger;
both have cytoplasm / protoplasm;
P has no nucleus / nucleoid region, E has (membrane-bound) nucleus;
P has one chromosome / circular, E has two or more chromosomes;
P has DNA only, E has DNA with protein (histones);
P has no membrane-bound organelles, E has membrane-bound organelles;
E has mitochondria, P does not;
E has other example of organelle, P does not;
both can have a flagellum / flagella;
if flagella then E has 9+2 fibrils, P does not;
P can have pili / slime layer / capsule, E does not;
P can have plasmids, E does not;
both have ribosomes;
P has small ribosomes, E has larger ones;
both have cell membrane;
P has cell wall, E has no cell wall (in animal, plants have different type of cell wall);
E has centriole, P has no centriole;

[8]

**5.** *lysosome*: hydrolysis / digestion / break down of materials (macromolecules);
*Golgi Apparatus*: synthesis / sorting / transporting / secretion of cell products;
*rough endoplasmic recticulum*: site of synthesis of proteins (to be secreted) / intracellular transport of polypeptides to Golgi Apparatus;
*nucleus:* controls cell activities / mitosis / replication of DNA / transcription of DNA (to RNA) / directs protein synthesis;
*mitochondrion*: (aerobic) respiration / generates ATP; [5]

**6.** D [1]

**7.** (a) translates RNA into / synthesises polypeptides / proteins;
lysosomes;

mitochondria;
aerobic respiration / production of ATP;
*Do not accept production of energy.* 4

(b) eukaryotic;
membrane bound organelles / nucleus (as reason for being a eukaryote)
could be plant or animal;
probably animal because of the lysosomes; 2 max

[6]

**8.** *Award* ***[1]*** *per difference,
plant cells*:
have cell walls, animal cells do not;
have plastids / chloroplasts, animal cells do not;
have a large central vacuole, animal cells do not;
store starch, animal cells store glycogen;
have plasmodesomata, animal cells do not;

 *animal cells:*have centrioles, plant cells do not;
have cholesterol in the cell membrane, plant cells do not;
plant cells generally have a fixed shape / more regular whereas animal cells are more rounded;

[6]

**9.** *Award* ***[1]*** *for each of the following structures clearly drawn and labelled
correctly in a diagram of a plasma membrane*.
phospholipid bilayer;
protein channels / integral (intrinsic) membrane proteins;
peripheral (extrinsic) proteins associated with the membrane;
cholesterol embedded in the membrane;
glycoproteins / receptor proteins on the outside;
hydrophobic and hydrophilic portions of membrane indicated; *(both needed for* ***[1]****)*

[5]

***10.*** *phospholipid structure*
hydrophobic tail / hydrophilic head;
head made from glycerol and phosphate;
tail made from two fatty acids;
saturated / unsaturated fatty acid (in tail);

 *arrangement in membrane*phospholipids form a bilayer;
heads face outside the membrane / tails face inside the membrane /
hydrophobic interior / hydrophilic exterior of membrane;

 *A suitable annotated diagram may incorporate all or many of the above points.
Award* ***[5 max]*** *for a suitable diagram that is labeled correctly.*

phospholipids held together by hydrophobic interactions;
phospholipids layers are stabilized by interaction of hydrophilic heads
and surrounding water;
phospholipids allow for membrane fluidity / flexibility;
fluidity / flexibility helps membranes to be (functionally) stable;
phospholipids with short fatty acids / unsaturated fatty acids are more fluid;
fluidity is important in breaking and remaking membranes (*eg* endocytosis /
exocytosis);
phospholipids can move about / move horizontally / “flip flop” to
increase fluidity;
hydrophilic / hydrophobic layers restrict entry / exit of substances; 9 max

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

[9]

**11.** (a) *Must have both for* ***[1*]**.
diffusion is the movement of molecules from an area of high
concentration to an area of low concentration;
osmosis is the diffusion of water across a partially
permeable membrane; 1

(b) hydrophillic head groups point outward;
hydrophobic tails form a lipid bilayer;
forms a (phospholipid) bilayer;
ions and polar molecules cannot pass through
hydrophobic barrier;
helps the cell maintain internal concentration
and exclude other molecules; 2 max

(c) cellulose;structural support / protection / maintain turgor pressure; 2 [5]

**12.** (a) as the diameter of the molecule increases the permeability / relative ability
to move decreases (*accept converse*);
the relationship is logarithmic / non-linear / negative;
for molecules above 0.6 ( 0.1) nm relative ability to move changes little /
for molecules below 0.6 ( 0.1) nm relative ability to move changes rapidly; 2 max

(b) “*U-1*” *rule applies.*

(i) 10 mmol cm–3 cells hr–1 (*accept values within 5*); 1

(ii) 370 mmol cm–3 cells hr–1 (*accept values within  10*); 1

(c) (i) glucose uptake in facilitated diffusion levels out whereas uptake in simple
diffusion does not level out / continues to rise;
glucose uptake increases in both;
glucose uptake is higher in facilitated diffusion (than in simple diffusion);
glucose uptake in simple diffusion is constant / linear whereas in
facilitated diffusion uptake increases rapidly at the beginning / increase
is not constant; 3 max

(ii) little / no change in glucose uptake;
most / all (protein) channels in use; 2

[9]

**13.** through endocytosis large particles are brought into cells across membranes;
through exocytosis large particles are removed from cells;
by the formation of vesicles;
active transport requiring ATP;
uses protein pumps;
to move materials against concentration gradients;
protein channels enable facilitated diffusion of molecules
down concentration gradient;
the molecules are too large or too charged to diffuse
directly through the membrane;
small polar and non-polar molecules / gases;
can diffuse directly through the membrane;
from an area of high concentration to an area of low
concentration / down the concentration gradient (until equilibrium is reached);
osmosis is the passive movement of water molecules;
across a partially / selectively permeable membrane;
from a region of lower solute concentration to a region
of higher solute concentration;

[8]

**14.** prophase showing spindle fibres;
prophase showing condensed chromatin;
prophase showing replicated chromosomes;
metaphase showing replicated chromosomes lining up at the equator;
anaphase showing chromatids moving to opposite poles;
telophase showing nucleus reforming;
telophase showing cytokinesis occurring; 5 max
*The four diagrams must have the name of the phase, otherwise award* ***[3 max]****.
The four stages must be included to receive* ***[5]****. If correct number of
chromosomes is not shown award* ***[4 max]****.*

[5]

**15.** (a) *Award* ***[1]*** *for each structure clearly drawn and correctly labelled.*

 nucleus-smaller area than cytoplasm, surrounded by double membrane
with pores;

 mitochondrion-surrounded by double membrane, inner membrane has
infoldings;

 rough endoplasmic reticulum-stacked tubules with dots / small circles
on outer surfaces;

 Golgi apparatus-curved stacked tubules, small vesicles near ends of
tubules / sacs;

 ribosomes both attached to rER and free ribosomes in cytoplasm drawn
and labelled;

lysosome / nucleolus / nuclear envelope / nuclear pore / plasma membrane; 4 max

Award **[0]** if a plant cell is drawn.

Award **[3 max]** if a plant cell structure (such as the cell wall) is present.

(b) during interphase DNA replicates / produces two copies of genetic material;

sister chromatids are two identical DNA molecules held together by centromere;

sister chromatids are separated during mitosis to form two genetically

identical nuclei;

in prophase chromosomes shorten / thicken / become visible as double-stranded

chromosomes / joined sister chromatids;

chromosomes condense by supercoiling;

chromosomes attach to spindle microtubules at centromeres;

chromosomes begin to move towards equator / centre of cell;

during metaphase all chromosomes lined up at equator separately / not in

homologous pairs;

at start of anaphase centromeres divide separating sister chromatids;

separated sister chromatids known as (single stranded) chromosomes;

(identical sets of) chromosomes pulled to opposite poles;

move by contraction of microtubules;

nuclear envelope / membrane forms around each set of chromosomes; 8 max

Many of these points can be shown by correctly annotated diagrams.

Credit may be given for diagrams clearly illustrating these points.

(c) *Award* ***[4 max]*** *for any of the following general statements:*

stem cells are cells that retain the capacity to divide and have the ability to

differentiate along different paths into all types of cells / are pluripotent / totipotent;

stem cells are derived from blastocysts / human embryos, left over from

IVF / placenta / umbilical cord / some adult tissues;

new techniques / technologies rely on replacing diseased / dysfunctional cells with

healthy / functioning ones;

need to identify desired type of stem cell and grow in culture / special

solutions / controlled conditions;

develop biochemical solution that will cause cells to differentiate into desired

cell type;

develop means of implanting / integrating cells into patient’s own tissues so that

they function with the body’s natural cells;

danger of rejection of cells therefore need to suppress immune system;

must make sure new cells do not become overgrown / develop into

cancerous tumours;

Award **[2 max]** for a specific example ie: **[1]** for type of cells and **[1]** for proposed use:

*eg* retinal cells;

replace dead cells in retina to cure presently incurable diseases such as glaucoma

and macular degeneration;

*eg* graft new skin cells;

to treat serious burn victims;

*eg* nerve tissue;

help repair catastrophic spinal injuries / help victims of paralysis

regain movement; 6 max

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

[20]