1. D

[1]

2. B

[1]

3. D

[1]

4. C

[1]

5. C

[1]

6. C

[1]

7. A

[1]

8. C

[1]

9. D

[1]

10. A

[1]

11. A

[1]

12. C

[1]

13. A

[1]

14. C

[1]

15. (a) sodium/Na
1

(b) unclear correlation between V and T;
depends on the nature of the substrate and its concentration;
sometimes high V with low T (*e.g.* experiment 1 for sucrose) /
sometimes high V with high T (*e.g.* experiment 2 for NaCl); 2 max

(c) higher salt/NaCl concentrations increase T and V;
increase in puddling with increase in salt/NaCl;
no clear relationship between the number of visits and the concentration of salt/NaCl; 2 max

(d) (i) sodium/Na
1

(ii) retention of sodium/Na from laboratory solutions and natural puddles;
definite loss of potassium from laboratory solutions but loss/gain uncertain from natural puddles;
slight loss of magnesium from laboratory solutions and uncertain gain/loss from natural puddles;
calcium uncertain in both cases / variation in data for calcium;
more conclusive results in laboratory solutions / conditions more reliable in laboratory solutions / greater variation in natural puddles;
Accept reference to error bars/ranges in data in place of uncertainty. 3 max

(e) males have longer/wider digestive tracts for greater absorption of fluid;
ileum of males has greater surface area;
which allows faster/more absorption in males than in females; 2 max

(f) puddling provides needed sodium/Na because their (larval) food does not supply enough sodium/Na;
sodium/Na needed for neural activity;
greater flight/neural activity in males than in females;
Accept other reasonable suggestions. 1 max

[12]

16. (a) *Award **[1]** for every two correct.*

Enzyme	*Source*	*Optimum pH*	*Substrate*	*Products*
Amylase	Salivary gland	7	starch/amylose / glycogen;	maltose/short polysaccharides /disaccharides /dextrin;
Lipase	Pancreas;	*Allow any pH in range 7–9*	Lipids	Fatty acids and glycerol

2 max

(b) rate of digestion at body temperature would be too slow / enzymes increase the rate of digestion;
enzymes break large molecules down into small/soluble molecules;
for absorption/diffusion into blood; 2 max

(c) labelled sac-shaped gall bladder with a duct;
tubule/(bile) duct shown connecting gall bladder directly to small intestine/duodenum / tubule/(bile) duct merging with the pancreatic duct before entering small intestine; *Alternative answers are accepted because of variations in human anatomy.*
pancreas drawn with pancreatic duct connected to small intestine and pancreas labelled; 3
A duct is preferred to a line, but since this is a diagram, both are acceptable.

[7]

17. (a) fructose/ribose/deoxyribose/ribulose/other monosaccharides apart from glucose and galactose 1

(b) (i) disaccharide 1

(ii) hydrolysis 1

(c) it allows people who are lactose intolerant/have difficulty digesting lactose to consume milk (products);
galactose and glucose taste sweeter than lactose reducing need for additional sweetener (in flavoured milk products);
galactose and glucose are more soluble than lactose / gives smoother texture / reduces crystalization in ice cream;
(bacteria) ferment glucose and galactose more rapidly (than lactose) shortening production time (of yogurt/cottage cheese); 3 max

(d) less denaturation / enzymes last longer at lower temperatures;
lower energy costs / less energy to achieve 5°C compared to 48°C;
reduces bacterial growth / reduces (milk) spoilage;
to form products more slowly / to control rate of reaction; 2 max

[8]

18. (a) monosaccharides are single sugars and disaccharides are two sugars and polysaccharides are multiple sugars;
hydrolysis is the addition of water to split a molecule into smaller fragments;
–OH and –H are added to the fragments;
disaccharides are split/digested into two single sugars;
polysaccharides are broken/digested into smaller fragments (*e.g.* disaccharides);
process depends on enzyme control (in organisms); 4 max

(b) a particular yeast (growing in natural milk) contains lactase;
biotechnology companies can grow/culture the yeast;
lactase (an enzyme) is extracted from the yeast;
natural milk contains lactose/milk sugar;
when added directly to milk, lactase converts lactose into simpler forms;
same effect when milk is passed past immobilized (on surface or beads) lactase;
simpler forms of sugar (glucose and galactose) are easily absorbed (in the small intestine);
a commercial market exists for lactose-free milk / lactose-free milk is example of biotechnology's economic impact;
some people are lactose intolerant/cannot digest lactose in milk/have lost lactase activity in intestinal cells;
consuming lactose-free milk allows lactose intolerant people to be nourished by milk without discomfort (abdominal cramps and diarrhoea);
many Asians are lactose intolerant whereas less common among other groups (northern Europeans and some Africans);
biotechnology produced in one part of world is more useful in another; 6 max

(c) food must be in a small enough form to leave the gut and enter the bloodstream;
physical breakdown is not enough / chemical breakdown is necessary;
enzymes are required for the chemical breakdown of food;
enzymes increase the rate of digestion;
enzymes are biological catalysts;
enzymes allow digestion to occur at body temperature;
enzymatic digestion is a sequential process *e.g.* from protein to peptide to amino acid;
specific location for each reaction with specific conditions/environments *e.g.* stomach high acidity;
most enzymes work extracellularly / some enzymes work intracellularly;
variations in pH throughout digestive tract promote the activity of different digestive enzymes / different enzymes have different optimal pHs;
amylases digest carbohydrate to monosaccharides;
proteases digest proteins to amino acids;
lipases digest fats to fatty acids and glycerol; 8 max

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

[20]

19. (a) structure — collagen;
transport—transthyretin / hemoglobin;
enzyme/catalyst — lysozyme;
movement — actin / tubulin;
hormones — insulin;
antibodies — immunoglobulin;
storage —albumin;
Accept any other valid function of proteins with a named example. For example, sodium potassium pump, but do not accept simply "in membranes" without a clear function.
*To award **[4 max]**, responses need a function of protein and a named example.*
Only accept the first four answers. 4 max

(b) made of protein;
made of <u>rRNA</u>;
large subunit and small subunit;
three tRNA binding sites;
Aminacyl/A, Peptidyl/P and Exit/E;
mRNA binding site (on small subunit);
70S in prokaryotes / 80S in eukaryotes;
can be free / bound to RER (in eukaryotes); 6 max

(c) RNA polymerase; *(polymerase number is not required)*
binds to a promoter on the DNA;
unwinding the DNA strands;
binding nucleoside triphosphates;
to the antisense strand of DNA;
as it moves along in a 5′→3′ direction;
using complementary pairing/A-U and C-G;
losing two phosphates to gain the required energy;
until a terminator signal is reached (in prokaryotes);
RNA detaches from the template and DNA rewinds;
RNA polymerase detaches from the DNA;
many RNA polymerases can follow each other;
introns have to be removed in eukaryotes to form mature mRNA; 8 max

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

[20]

20. (a) *Award **[1]** for each structure clearly drawn and correctly labelled.*
phospholipid bilayer — with head and tails;
hydrophilic/phosphate/polar heads and hydrophobic/hydrocarbon/fatty acid/non-polar tails labelled;
integral protein —embedded in hydrophobic region of the phospholipids bilayer;
protein channel—integral protein showing clear channel/pore;
peripheral protein—on the surface;
glycoprotein with carbohydrate attached on outside;
cholesterol — shown embedded in bilayer;
thickness indicated (10 nm); *(allow 7 nm to 13 nm)* 5 max

(b)

passive	active
Diffusion / osmosis / facilitated diffusion	active transport / ion pumps / exocytosis / pinocytosis / phagocytosis
a second passive method *(from above)*	a second active method; *(from above)*
does not require energy	requires energy/ATP;
down concentration gradient	against concentration gradient;
no pumps needed	requires protein pumps;
oxygen across alveoli / other example	glucose absorption in ileum / other example;

Both the passive and active movements must be contrasted to receive a mark.
*Award **[3 max]** if no examples are given. Responses do not need to be shown in a table format.* 4 max

(c) water is transparent / light passes through water;
this allows organisms to live below the surface / plants to photosynthesize;
hydrogen bonds between water molecules make water cohesive;
this gives water a high surface tension allowing animals to live on the surface / maintains lung structure (pleural membranes);
helps in water movement through plants/transpiration;
water has a high latent heat of vaporization / *OWTTE*;
evaporation/sweating/transpiration leads to cooling;
water has a high specific heat capacity / *OWTTE*;
this provides a stable environment for water organisms;
water is a universal solvent;
can transport materials around organisms/plants/animals;
can be a solvent for chemical reactions in organisms;
ice is less dense than water / water has a maximum density at 4°C;
surface (pond/lake/ocean) freezes first, allowing organisms to survive in the water below;
Accept hydrogen bonds between water and other substance makes water adhesive from AHL. 9 max

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

[20]