1. D

2. B

3. D

4. C

5. C

6. C

7. A

8. C

9. D

10. A
11. A

12. C

13. A

14. C

15. (a) sodium/Na

(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);  

(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;  

(d) (i) sodium/Na

(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.*
(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

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

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Source</th>
<th>Optimum pH</th>
<th>Substrate</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amylase</td>
<td>Salivary gland</td>
<td>7</td>
<td>starch/amylose/glycogen;</td>
<td>maltose/short polysaccharides/dextrin;</td>
</tr>
<tr>
<td>Lipase</td>
<td>Pancreas;</td>
<td>Allow any pH in range 7–9</td>
<td>Lipids</td>
<td>Fatty acids and glycerol</td>
</tr>
</tbody>
</table>

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.

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

(b) (i) disaccharide 1
(ii) hydrolysis

(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);

(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;

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);

(b) a particular yeast (growing in natural milk) contains lactase;
bio-technology 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 bio-technology’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);
bio-technology produced in one part of world is more useful in another;
(e) 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;

(Plus up to [2] for quality)

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 rRNA; 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
(e) **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;  

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

20. (a) **Award [11] 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)  
<table>
<thead>
<tr>
<th>passive</th>
<th>active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffusion / osmosis / facilitated diffusion</td>
<td>active transport / ion pumps / exocytosis / pinocytosis / phagocytosis</td>
</tr>
<tr>
<td>a second passive method <em>(from above)</em></td>
<td>a second active method; <em>(from above)</em></td>
</tr>
<tr>
<td>does not require energy</td>
<td>requires energy/ATP;</td>
</tr>
<tr>
<td>down concentration gradient</td>
<td>against concentration gradient;</td>
</tr>
<tr>
<td>no pumps needed</td>
<td>requires protein pumps;</td>
</tr>
<tr>
<td>oxygen across alveoli / other example</td>
<td>glucose absorption in ileum / other example;</td>
</tr>
</tbody>
</table>

*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
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;
icc 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)