2 Structure and functions in living organisms

2.1 describe the levels of organisation in organisms: organelles, cells, tissues, organs and systems

(b) (i)	same/similar cells / cells with the same function / all muscle cells / eq;	ignore group of cells alone allow group of cells working together	1
(b)	made from tissue(s) + perform a specific function / eq;		1
2(a)(i)	tissue(s) that carry out (same) function / different cell types that carry out (same) function / eq;		1
(ii)	heart;		1
(iii)	1. n vous / CNS; 2. br thing / respiratory / ventilation; 3. d estive; 4. cretory / urinary; 5. keletal; 6. en crine / hormonal;		3 max
(iv)	reproductive / immune / lymphatic;		1

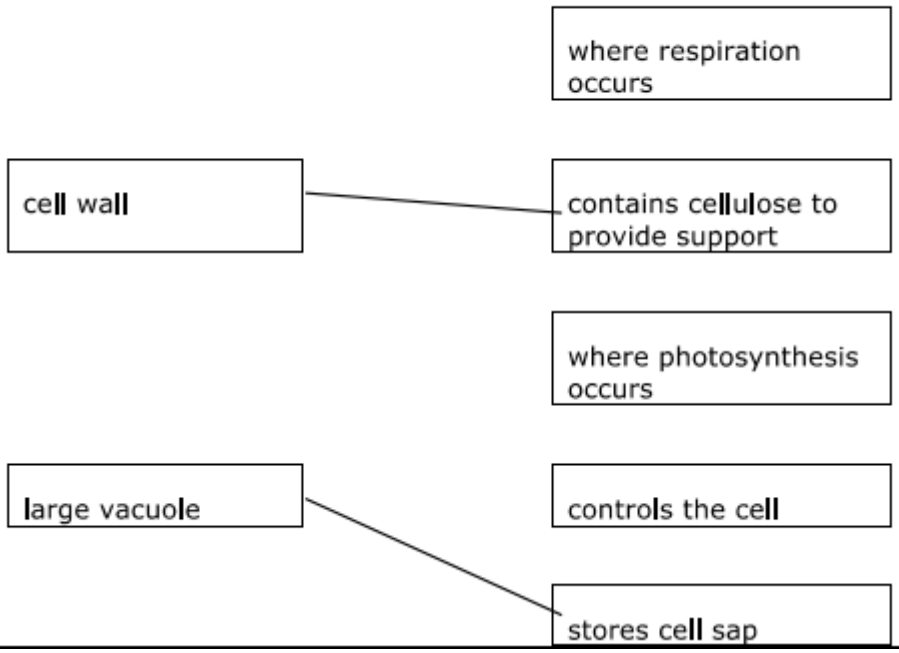
2.2 describe cell structures, including the nucleus, cytoplasm, cell membrane, cell wall, mitochondria, chloroplasts, ribosomes and vacuole

(c)	The following named and labelled correctly: cell wall; cell membrane; nucleus; chloroplast; cytoplasm; vacuole; 5 to 6 correct = 3 3 to 4 correct = 2 1 to 2 correct = 1	ignore mitochondria and ribosomes	3

2.3 describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, mitochondria, chloroplasts, ribosomes and vacuole

1 (a)	E; C;		2

4(a)(ii) One mark for each correct line



(2)

2.4 know the similarities and differences in the structure of plant and animal cells

(b) (i)	cell wall / cellulose; vacuole; chloroplast / chlorophyll; starch;	Max 2	

4 (a) (i)	correctly labelled;	ignore other labels if label line goes to wall and membrane = 0	1
(ii)	cell wall; chloroplast; vacuole;	ignore chlorophyll	3

2.5B explain the importance of cell differentiation in the development of specialised cells

4 (d)	A description to include any **two** from the following: • stem / meristematic cells (1) • **differentiate** (1) • by changing shape / size/ metabolic ability(1) • becomes a named cell eg root hair cell / muscle cell / neurone (1)		**(2)**

1	(a)(i)	1. gain entry / break through egg membrane / break into egg / penetrate egg / eq; 2. chromosomes / DNA / genes / alleles / genetic material;	1. Ig re digest / fertilise 2. Ignore nucleus	2
	(ii)	1. respiration; 2. ATP / energy;		2
	(iii)	swim / move / eq;		1
	(b)	1. dendrites connect with other neurones / eq; 2. axon carries/allows impulse / eq; 3. myelin sheath for protection / insulation / faster impulse / eq; 4. connected to muscle fibres / allows impulse to reach muscle fibres / enables muscle fibres to contract / synapses with muscle fibres;		Max 2

1(b)	Any **two** structures from the list with at least **one** matched adaptation: Structures (maximum of 2) • biconcave shape (1) • no nucleus (1) • thin membrane (1) • flexible / small (1) • contains haemoglobin (1) (matched) adaptation (maximum of 2) • large surface area / increase oxygen uptake (1) • to increase amount of haemoglobin / oxygen-carrying capacity (1) • so short distance for diffusion (1) • to get through capillaries (1) • to bind oxygen (1)		**(3)**

2.6B understand the advantages and disadvantages of using stem cells in medicine

4(a)	**A** differentiate into any type of cell		**(1)**
1(b)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • embryonic stem cells can be stimulated to produce cells of the retina (1) • which can be transplanted into a patient's eye to replace the damaged cells (1)		**(2)**

2.7 identify the chemical elements present in carbohydrates, proteins and lipids (fats and oils)

2.8 describe the structure of carbohydrates, proteins and lipids as large molecules made up from smaller basic units: starch and glycogen from simple sugars, protein from amino acids, and lipid from fatty acids and glycerol

2.9 *practical: investigate food samples for the presence of glucose, starch, protein and fat*

5(a)	1. iodine; 2. bl / black / blue black = starch; 3. Benedict' / eq; 4. heat / se water bath / eq; 5. r / orange / yellow / green = glucose;	if iodine for glucose goes blue black = 0 only award Mp1 and Mp3 if linked to correct test heat must be linked to Benedict's	4 max

2.10 understand the role of enzymes as biological catalysts in metabolic reactions

2.11 understand how temperature changes can affect enzyme function, including changes to the shape of active site

(c)	(i)	1. re movement / more (kinetic) energy / eq; 2. re collisions / more enzyme substrate complexes / eq;		2
	(ii)	1. denatured; 2. ctive site; 3. shape altered / bonds broken / eq; 4. substrate no longer fits / eq;	1. Ig re inactive / destroyed 1. Reject death	3

2.12 *practical: investigate how enzyme activity can be affected by changes in temperature*

2(a)	(i)	safety glasses / wear gloves ;	Ignore lab coat / tie hair back / eq	1
	(ii)	11/ eleven;		1
(b)	(i)	remove starch / solution from surface of syringe / eq;	Ignore get into syringe	1 1
	(ii)	mix contents / mix amylase and starch / eq;	Mix alone = 0 Allow enzyme and starch	1
	(iii)	keep at correct temperature / keep temperature constant / eq;	Ignore fair test	
(c)	(i)	1. volume / concentration of amylase; 2. volume / concentration of starch; 3. volume / concentration of iodine / drops of iodine; 4. volume / concentration of mixture;	Allow amount only once	2
	(ii)	temperature;	Ignore time	1
(d)		1. 6 minutes / between 5 and 6 minutes / eq; 2. iodine stays yellow / orange / brown / iodine stays same colour / colourless / not blue black; 3. no starch present; 4. digested/broken down ;	Reject 6-7 mins	3

(e)(i)	1. fewer wells with blue black colour / more wells yellow / orange / brown / colourless / eq; 2. starch digested sooner / quicker / reaction completed sooner / eq;		2	
(ii)	1. enzymes work faster at 40^{0}C / ref to optimum / eq; 2. more (kinetic) energy / molecules move faster / eq; 3. more collisions / more enzyme substrate complexes /eq;	Ignore ref to denature	2	

2.13 understand how enzyme function can be affected by changes in pH altering the active site

(b) (i)	enzymes; optimum; denatured / destroyed / eq;	ignore references to low pH and high pH	2	

2.14B *practical: investigate how enzyme activity can be affected by changes in pH*

1(a)

pH of amylase solution	diameter in mm
2	10 ± 1
4	(15)
7	20 ± 1
9	14 ± 1;
13	(10)

1

(b) (i)	1. digestion / break down; 2. no starch;	Breaks down all the starch = 2 Breaks down starch = 1	2 max
(ii)	1. (amylase/enzyme) denatured at pH 2 or 13 / low or high pH; 2. optimum / works best at pH 7; 3. enzymes work less well at pH 9 or pH 4;		2 max
(c)	pH;		1
(d))	1. volume of amylase; 2. concentration of amylase; 3. same amylase / source of amylase; 4. depth of agar; 5. time;	Mp 1 ignore amount Ignore concentration of starch / agar / iodine	3 max
(ii)	1. 0 for pH 2 and pH 13; 2. wider for pH 7 than at 20 ^{O}C;	Check position of wells	2

2.15 understand the processes of diffusion, osmosis and active transport by which substances move into and out of cells

(b) (i)	LHS / water level lower than RHS / sucrose level;	labelling not required	1
(ii)	osmosis;	ignore diffusion	1

(b) (i)	1. movement of water; 2. from dilute to more concentrated solution / eq; 3. through partially permeable membrane / eq;		2

(ii)	1. no/less oxygen; 2. respiration / energy / ATP; 3. active transport / active uptake;		3

3(a)(i)	diffusion / osmosis		**(1)**
3(a)(ii)	active transport	active transportation	**(1)**

5 (a)	1. osmosis; 2. water out; 3. dilute to concentrated solution / high conc. of water to low conc. of water / high to low water potential; 4. membrane leaves cell wall / plasmolysis / flaccid;		3 max

2.16 understand how factors affect the rate of movement of substances into and out of cells, including the effects of surface area to volume ratio, distance, temperature and concentration gradient

3 (a)	protect eyes / prevent blindness / eq;		1
(b)	1. diffusion; 2. hi concentration to low concentration / eq;		2

(d) (i)	surface area 24 unit cm^2;; or surface area 2400 unit mm^2;;	If number wrong but units cm^2 or mm^2 = 1	Max 2
(ii)	volume 8 unit cm^3;; or volume 8000 unit mm^3;;	If number wrong but units cm^3 or mm^3 = 1	Max 2

3 (e)		Cube A	Cube B	Cube C		3
	largest surface area	✓;				
	largest surface area to volume ratio			✓;		
	greatest proportion of cube coloured red			✓;		
(f)	1. hum s/larger organisms have smaller SA:VOL ratio; 2. ffusion; 3. too slow / less efficient / therefore less (relative) penetration / eq; 4. ne to move oxygen / nutrients / named substance; 5. ss flow / circulatory system / eq;					3 max

2.17 *practical: investigate diffusion and osmosis using living and non-living systems*

(ii)	(in distilled water) 1. water into cells; 2. outside solution/distilled water more dilute / down concentration gradient / eq; 3. cell membrane against cell wall / eq; 4. turgid; (allow converse in salt solution for each point) 1. water leaves cell; 2. outside solution/distilled water less concentrated / eq; 3. cell membrane shrinks away from cell wall /eq 4. plasmolysed / flaccid;			4
(c)	1. water into red blood cell / eq; 2. cells burst / haemolysis / eq; 3. no cell wall;			2

4 (a) (i)	9.8(03922%);; allow one for 0.51 in working			2
(ii)	different masses / different sizes / valid comparison;			1
(b)	water enters / water in / eq; dilute to more concentrated solution / eq; partially permeable membrane / eq;		interpret the term concentration alone as being water molecules	3
(c)	<table><tr><th>Cube of side in cm</th><th>SA in cm^2</th><th>Volume in cm^3</th><th>SA/Vol ratio</th></tr><tr><td>(0.5)</td><td>(1.5)</td><td>(0.125)</td><td>(12)</td></tr><tr><td>(1.0)</td><td>6</td><td>1</td><td>6</td></tr><tr><td>(2.0)</td><td>24;</td><td>8;</td><td>3;</td></tr></table>		one mark for each pair	3
(d)	more osmosis / faster (small cubes) / greater % increase / greater % change / eq; larger SA:Vol ratio (of small cubes);		allow converse	max 2
(e)	cell wall; cell membrane; cytoplasm; vacuole; nucleus; chloroplast;		5 to 6 = 3 3 to 4 = 2 1 to 2 = 1	max 3

9 (a)	movement of particles/ions/molecules/gases/ from high concentration to low concentration / eq;	Ignore substance	1
(b) (i)	1.4 / 1.43 / 1.43 recurring;;	Allow one mark for 4.3 ÷ 3	2
(ii)	1. as dye concentration increases diameter/ diffusion increases; 2. rate of increase reduces/levels at higher concentrations;	eg. 0.1 to 0.2 increases by 0.8 but 0.2 to 0.4 increases by only 0.3;	2
(iii)	1. higher dye concentration means more molecules/particles; 2. higher concentration gradient / eq;		2
(c)	1. volume of dye / number of dye drops / mass of dye / same dye; 2. depth of agar / size of wells / amount of jelly / concentration of agar; 3. temperature;	Ignore time / pH / size of plate	2 max

2.18 understand the process of photosynthesis and its importance in the conversion of light energy to chemical energy			
1 (a) (i)	A description linking two of the following: • photosynthesis (1) • carbon dioxide (absorbed) (1) • (using) water (1) • (sun)light (absorbed) (1) • by chlorophyll/chloroplasts (1)	Ignore energy/Sun Accept equation for 2 marks	(2)
2.19 know the word equation and the balanced chemical symbol equation for photosynthesis			
(iii)	carbon dioxide + water; glucose + oxygen; allow correct chemical formula	2	
(a)	$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$;;	unbalanced but correct =1 eg $CO_2 + H_2O \longrightarrow$ $C_6H_{12}O_6 + O_2$; words alone = 0	2
2.20 understand how varying carbon dioxide concentration, light intensity and temperature affect the rate of photosynthesis			
(b) (i)	Two from: 1. mperature 2. light (intensit 3. carbon dioxide / CO_2;; Then: 4. indication of level of abiotic factor during the day; 5. stated effect on rate of photosynthesis;		Max 4
(ii)	1. ss photosynthesis; 2. (more) transpiration / evaporation / loss of water / eq; 3. wilti / loss of turgor / stomata close / less mineral ion transport; 4. less carbon dioxide uptake; 5. enzymes denature / change in shape of active site / eq;	1. gnore less respiration 4. gnore gas exchange	Max 4

2.21 describe the structure of the leaf and explain how it is adapted for photosynthesis

2	large surface area; thin (leaf); upper epidermis / cuticle; transparent / lets light through; chloroplasts / chlorophyll; palisade (mesophyll); close to surface; absorb light; spongy (mesophyll); diffusion; stomata / guard cells; carbon dioxide; xylem; water; ignore if transpired	mark points independently allow carbon dioxide and water if given in an equation	max 6

(b)	(i)	1. many chloroplasts; 2. absorb/trap/capture light; 3. (closely) packed / found near (upper) surface / eq;	1. Ignore chlorophyll	2 max
	(ii)	1. air spaces / eq; 2. diffusion of gas / CO_2 / O_2;		2
	(iii)	1. open/close stomata/pores / change size of stomata/pores; 2. allow CO_2 in / H_2O out / O_2 out;	2. all gas and direction must be correct for the mark	2

5(a)(i)		1. up r epidermis; 2. tr sparent / lets light through / no chloroplasts;	waxy cuticle is transparent = 1	2
	(ii)	1. p isade; 2. d sely packed / aligned vertically / eq; 3. i a of many / lots of chloroplasts; 4. sorb / take in / trap light;	ignore lots of chlorophyll	3 max
	(iii)	1. ongy; 2. a spaces; 3. ffusion / movement of gases / gas exchange / eq; 4. xylem vascular bundle; 5. tr sport water;	Ignore phloem	3 max
	(iv)	1. gua cell; 2. op / close; 3. let in carbon dioxide / water loss / transpire / evaporate / eq;	Ignore stomata Ignore gas exchange	2 max

4	(a)	(trap/absorb) light / eq; chlorophyll; photosynthesis / starch / glucose / eq;	ignore trap energy	2
	(b)	A cell wall; B vacuole; C cytoplasm;		3

2	(a) (i)	A: palisade (cell) / mesophyll / vacuole; R spongy B: guard cell;	2	
	(ii)	reduce water loss/transpiration/evaporation; prevent entry of microorganisms; Ignore waterproof	1	

2.22 understand that plants require mineral ions for growth, and that magnesium ions are needed for chlorophyll and nitrate ions are needed for amino acids

5(a)	(i)	amino acids / protein / DNA / RNA / nucleic acid;		1
	(ii)	amino acids; protein / DNA;		2
(b)		chlorophyll; amino acid / protein / peptide / polypeptide / DNA / RNA / nucleic acid;	Ignore chloroplast	2

2.23 *practical: investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll*

3 (a)	1. r eated / 3 readings / 3 times / average / more than once / eq; 2. similar pattern for red / for green); 3. anomaly ignored in calculation of average for blue light;		Max 2
(b)	measuring cylinder / syringe / scale on the side / eq;	Ignore measure volume	1
(c)	colour / wavelength of light;	Light alone = 0	1
(d)	1. ss of plant / size of plant / length of plant / amount of plant; 2. ecies of plant / type of plant / same plant; 3. age of plant; 4. t perature (of water) / room temperature; 5. mass/amount of sodium hydrogen carbonate / conc. of carbon dioxide / eq; 6. lume/amount of water / volume of indicator / eq; 7. ght intensity / light duration / eq;	Ignore heat Same size test tube/beaker = 0 Ignore time Ignore same funnel exit	max 3

(c)	(i)	C; A;		2
	(ii)	starch removed / starch used / no starch / eq; (converted to) glucose; respiration / energy;		2
	(iii)	boil (in ethanol) / heat (in ethanol)/ eq; ethanol / alcohol; no naked flame / water bath / hot water / in water / eq;	allow water mark if linked to boil / heat	3
	(iv)	iodine / iodide;		1

2.24 understand that a balanced diet should include appropriate proportions of carbohydrate, protein, lipid, vitamins, minerals, water and dietary fibre

2.25 identify the sources and describe the functions of carbohydrate, protein, lipid (fats and oils), vitamins A, C and D, the mineral ions calcium and iron, water and dietary fibre as components of the diet

2.26 understand how energy requirements vary with activity levels, age and pregnancy

2(a)	S scale linear and half grid used for plotting; L lines straight and through points; A axis correct way + units for energy in kJ; P points plotted correctly; K key;	If not linear lose S and P Histogram means lose S and L for Max 3 Line to origin means lose L	5
(b)	1. increases energy requirement / eq; 2. decreases from 25;	Increases up to a point and then decreases = 1 Decrease/level off at 41 = 0	2
(c)	1. (more) muscle contraction; 2. (more) respiration; 3. (more) energy/kilojoules required; 4. (more) food / glucose required / eq;	Allow converse More energy for respiration = 2 Ignore reference to age 3. Allow calories	3

2.27 describe the structure and function of the human alimentary canal, including the mouth, oesophagus, stomach, small intestine (duodenum and ileum), large intestine (colon and rectum) and pancreas

4(a)	1. amylase; 2. digests starch / breaks down starch; 3. maltose; 4. lubricates / moisten / soften food / eq;	 Mp 3 allow glucose Mp 4 ignore makes it easier to swallow	2 max

(d) (i)	rectum;		1
(ii)	anus;		1

2.28 understand how food is moved through the gut by peristalsis

(c)	peristalsis; contraction; muscles; pushed / squeezed / waves / eq;		3

2.29 understand the role of digestive enzymes, including the digestion of starch to glucose by amylase and maltase, the digestion of proteins to amino acids by proteases and the digestion of lipids to fatty acids and glycerol by lipases

3 (a)

Large food molecule	Enzyme involved in digestion	Small food molecule produced
starch	amylase	glucose / maltose;
protein;	protease	amino acids / polypeptides / peptides;
lipid	lipase;	fatty acids / glycerol;

Ignore simple sugars

5

(iii)	digested / broken down / large to small molecules; protease / pepsin / enzyme; amino acids / peptides; HCl / acid / low pH;	allow ref to digestion break down anywhere only allow the term enzyme if in stomach reject trypsin	max 3

(b)	1. m th / saliva / salivary gland; 2. ylase / maltase / carbohydrase; (ONCE) 3. p creas / <u>small</u> intestine / eq; 4. maltose / glucose;	3. low small intestine if linked to absorption 4. Ig re sugar	Max 3

2.30 understand that bile is produced by the liver and stored in the gall bladder

(b)	b le; emulsifies / large drops to small drops / eq; neutralise / optimum pH / alkaline;		2

2.31 understand the role of bile in neutralising stomach acid and emulsifying lipids

1 (a) (i)	A; (C) B; A;		Only one letter in each box	3
(ii)	1. (le) <u>emulsification</u> / <u>emulsifies</u>; 2. small(er) d ps / increased surface area / more drops; 3. optimum pH / correct pH / best pH; 4. ipase) is an enzyme; 5. d estion / breakdown; 6. i o <u>fatty acids</u> / into <u>glycerol</u>;			4

2.32 understand how the small intestine is adapted for absorption, including the structure of a villus

(b)(i)	villus / villi;	allow phonetic spelling	1
(ii)	1. larg surface area; 2. crovilli ; 3. pillaries; 4. vement of blood / concentration gradient / eq; 5. o cell thick / thin wall / thin / short distance; 6. ffusion; 7. active ansport;	1. ignor many villi idea 4. ig re cell wall	5
(b)	1. large surface area / microvilli; 2. thin / short diffusion distance / eq; 3. blood / capillaries / eq; 4. permeable; 5. lacteal;	Ignore many villi / long villi	3

2.33B practical: investigate the energy content in a food sample

3 (a)	smaller surface area to volume ratio; less heat loss / more energy measured / eq; heats up slowly / avoid boiling / eq;	accept converse	2
(b)	insulation / lid / cover / eq; less heat/energy loss; burning food close to tube / eq; less heat/energy loss; quick transfer of burning food / eq; less heat/energy loss; stir / eq; even temperature; avoid draft / wind; less heat/energy loss; digital thermometer ; precision / eq; use calorimeter / burn in oxygen; all food burnt / less heat/energy loss;	mark in discrete pairs reject idea of more bread ignore repeat	2

1 (a) (i)	helps combustion / helps burning / eq;			1
(ii)	1. crease surface area / more surface / longer distance / longer time / eq; 2. (tter) heat transfer (to water) / heat more of the water / heat water better / eq;			2
(iii)	distribute heat / spread heat / spread temperature / even out temperature / make all the water the same temperature / eq;			1
(b) (i)	7.5;			1
(ii)	6300;	if not 6300 use number from (i) to calculate correct answer in (ii) eg 7140 is acceptable if 8.5 in (i)		1

2.34 understand how the process of respiration produces ATP in living organisms

2.35 know that ATP provides energy for cells

2.36 describe the differences between aerobic and anaerobic respiration

(ii)	no <u>oxygen</u>;	ignore no air	1

2.37 know the word equation and the balanced chemical symbol equation for aerobic respiration in living organisms

1(b)(i)	(oxygen + glucose →) water + carbon dioxide	both water and carbon dioxide are required in either order. Accept H_2O + CO_2 Ignore: energy reject wrong symbols eg H2O or H^2O	**(1)**

2.38 know the word equation for anaerobic respiration in plants and in animals

2.39 *practical: investigate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms*

(b)	lim ter; (clear to) cloudy / (clear to) milky / eq; or hydrogen carbonate indicator; (orange to) yellow / eq;		2 max

3(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • same temperature to act as control (1) • to provide the optimum temperature for enzyme action in the peas (1)	**(2)**

3(b)(i)

- headed table with units (1)
- accurately completed table (1)

	A	B	C
O_2 used /ml at 10 mins	0.8	0.1	0.0
O_2 used /ml at 20 mins	1.6	0.1	0.0
O_2 used /ml at 30 mins	2.4	0.1	0.0

negative values do not need to be shown if table heading states oxygen used/lost

accept time in row 1 as an alternative

(2)

3(b)(ii)

2.4 ÷ (30 × 60) (1)

= 0.0013 (ml/second) (1)

accept 1.6 ÷ (20 × 60)
accept 0.8 ÷ (10 × 60)

award full marks for correct numerical answer without working

maximum one mark if no unit conversion

(2)

3(b)(iii)

An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):

- the peas in respirometer A are germinating so using up oxygen (1)
- during the process of respiration to release energy for growth (1)

(2)

3(c)

Any one improvement from:
soda lime (1)

- cotton wool soaked with potassium hydroxide (1)

accept other relevant chemical that would remove carbon dioxide

(1)