<table>
<tr><th>Question</th><th>Marking Guidelines</th><th>Marks</th><th>Notes</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th></th><th>Photosyn-thesis</th><th>Anaerobic respiration</th><th>Aerobic respiration</th></tr>
<tr><td>ATP produced</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Occurs in organelles</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>Electron transport chain involved</td><td>✓</td><td></td><td>✓</td></tr>
</table>
</td><td>3</td><td>1 mark per column
Mark ticks only. Ignore anything else if different symbols such as crosses are used as well.
If crosses are used instead of ticks allow cross as equivalent to a tick.
Reject tick with a line through ✓✗</td></tr>
<tr><td>1(b)</td><td>ADP + P_i ⟶ ATP;</td><td>1</td><td>Both sides correct, but allow other recognised symbols or words for phosphate ion. Reject P unless in a circle.
Accept = as equivalent to arrow
Accept reversible arrow
Ignore any reference to kJ/water</td></tr>
<tr><td>1(c)</td><td>1. Energy released in small/suitable amounts;
2. Soluble;
3. Involves a single/simple reaction;</td><td>2 max</td><td>1. In context of release, not storage. Ignore producing energy/manageable amounts.
2. Reject "broken down easily/readily" Reject "quickly/easily resynthesised"</td></tr>
</table>

1(d)	1. ATP is unstable; 2. ATP cannot be stored / is an immediate source of energy; 3. Named process uses ATP ; 4. ATP only releases a small amount of energy at a time;	2 max	3. Accept processes such as active transport, muscle contraction, glycolysis. Reject answers such as keeping warm, movement, respiration, metabolism, growth.

Question	Marking Guidelines	Marks	Notes
2(a)	1. High temperature allows enzymes to work faster/allows more collisions/ allows more e-s complexes to be formed ***OR*** A lot of light so light not limiting; 2. Photosynthesis reactions are faster/more photosynthesis;	2	1. Accept enzymes more effective. Ignore references to respiration. Ignore references to optimum (temperature or light)
2(b)(i)	Gross productivity = net productivity + respiratory loss/respiration;	1	Accept any correct rearrangement of this equation Accept recognisable abbreviations Reject respiratory rate
2(b)(ii)	1. Respiration slower /less respiration; 2. Light-dependent reaction/photosynthesis less affected by temperature increase; 3. Lower (energy) loss;	2 max	1. Unspecified references refer to August . Allow converse of respiration faster but must specify July / higher temperature 3. Unspecified references refer to August . Allow converse of higher loss but must specify July "Lower respiratory losses (in August)" can meet both points 1 and 3 and gain 2 marks.
2(c)	1. Stored as fat/glycogen/biomass; 2. Used for growth/movement/reproduction / process involved in growth/movement/reproduction;	2 max	1. Reject stored energy. Ignore respiration
2(d)	1. More heat/energy is lost (in March)/colder (in March); 2. Maintain/regulate body temperature/more heat generated; 3. By respiration/metabolism;	2 max	2. Accept keep warm

Question	Marking Guidelines	Marks	Notes
3(a)(i)	1. Gases / correct named gas not released; 2. Conditions (in digester) can be controlled; 3. Products/named product can be collected; 4. Open ponds associated with health risk/environmental damage/eutrophication;	2 max	Correct named gases include: methane, carbon dioxide, hydrogen sulphide, nitrogen oxides 1. Allow substance = product 4. Accept 'pond' in any context
3(a)(ii)	1. Respiration causes temperature increase/release of heat; 2. Enzymes would be denatured/microorganisms killed;	2	
3(b)(i)	1. Increase algae/algal bloom; 2. Light blocked out; 3. Plants can't photosynthesise / plants and/or algae die; 4. Bacteria/saprobionts/EW feed off/breakdown dead organisms; 5. Bacteria/saprobionts/EW use up oxygen/bacteria respire/BOD rises;	3 max	On its own, the word eutrophication does not gain a mark, the stages need to be described. EW = equivalent word
3(b)(ii)	1. Acts as soil conditioner/improves drainage/ aerates soil/increases organic content of soil; 2. Contains other elements/named element/wider range of elements; 3. Production of artificial fertiliser energy-consuming; 4. Less leaching / slow release (of nutrient);	1 max	Unspecified answers relate to natural fertiliser. Ignore references to cost / eutrophication 2. i.e. elements other than nitrogen, phosphorus and potassium

Question	Marking Guidelines	Marks	Notes
4(a)	Births per thousand/given number of the population and per year/given period of time;	1	Accept if expressed as equation births per year (x 1000) total population (in that year)
4(b)(i)	1. Females have higher life expectancies; 2. UK has higher life expectancies;	2	
4(b)(ii)	1. Females tend to outlive males linked to reason e.g. male risk of CVD more males smoke/drink to excess males involved in fighting / war; 2. Medical care/vaccination programmes better in UK/infectious disease common in Sudan; 3. More food/better diet in UK; 4. Food preservation/sanitation/clean water supply better in UK;	2 max	1. Females healthier is insufficient 2. Credit specific examples of medical care, for example during childbirth 4. Principle underlying this mark is bacterial contamination of food/water

Question	Marking Guidelines	Mark	Comments
5(a)(i)	Stroma (of chloroplasts);	1	Reject: stoma
5(a)(ii)	2;	1	
5(b)	1. As oxygen (concentration) increases less Rubisco/RuBP reacts/binds with carbon dioxide; 2. Competitive inhibition / competition between oxygen and carbon dioxide for rubisco/enzyme/active site; 3. Less RuBP formed/regenerated (to join with carbon dioxide);	2 max	1. Accept - as oxygen (concentration) increases more Rubisco/RuBP reacts/binds with oxygen 1. Accept – less GP/more phosphoglycolate formed as oxygen (concentration) increases 2. Accept oxygen and carbon dioxide are complementary to active site
5(c)	1. Less glycerate 3-phosphate/GP produced; 2. (Less) triose phosphate to form sugars/protein/organic (product)/any named photosynthetic product; 3. Less RuBP formed/regenerated;	3	1. Accept one GP formed rather than two GP 3. Accept RuBP takes longer to form

Question	Marking Guidelines	Mark	Comments
6(a)	0.8;	1	
6(b)(i)	1. Aerobic respiration; 2. Increase in uptake (of oxygen) with growth/reproduction/division of yeast cells; 3. Glucose/nutrients/oxygen decreases/becomes limiting / cells die / ethanol/toxins form / heat produced / anaerobic respiration occurs;	3	1. Allow description e.g. respiration using oxygen 1. Accept 'oxidative phosphorylation' 3. Ignore any reference to time 3. Accept decrease in oxygen being linked to oxygen being 'used up' or equivalent
6(b)(ii)	1. (Ethanol produced) by anaerobic respiration / from pyruvate in anaerobic conditions; 2. (Ethanol / anaerobic respiration) increases as oxygen (uptake/concentration) decreased; 3. Decreases as glucose is used up / ethanol kills cells;	2 max	1. 'Fermentation' is not enough on its own
6(c)	1. Oxygen uptake decreases/stopped; 2. Oxygen is final (electron) acceptor/combines with electrons (and protons); 3. Ethanol produced sooner / more ethanol produced;	3	3. Accept ethanol produced at any specified time before 16 hours

Question	Marking Guidelines	Mark	Comments
7(a)(i)	Nitrification/oxidation;	1	Accept 'nitrifying'
7(a)(ii)	Denitrification;	1	Accept 'denitrifying'
7(b)	1. (Nitrogen) to ammonia/NH_3/ammonium; 2. Produce protein/amino acids/ named protein/DNA/RNA;	2	1. Do not disqualify mark for any references to ammonia being converted to nitrite, nitrate etc 2. Do not disqualify mark for any references to protein being formed from nitrogen, nitrite or nitrate
7c)	1. Soil has low(er) water potential / plant/roots have higher water potential; 2. Osmosis from plant / diffusion of water from plant;	2	1. Reference to water potential gradient is sufficient if correct direction of gradient or water movement is outlined 1. Accept WP or Ψ for water potential 2. Accept plant takes up less/not enough water by osmosis 2. Reference to movement of minerals by osmosis negates mark