1 **(a)**	carbon ; hydrogen ; oxygen ; nitrogen ; sulfur ; [4 max]	**R** CHONS
(b)	1 N / nitrogen, fixation ; 2 bacteria / *Rhizobium* ; **R** 'nodules are bacteria' 3 convert, nitrogen / N_2 / AW, into, ammonia / NH_3 / ammonium / NH_4^+ / amino acid(s) ; 4 plants use (fixed) nitrogen to make, amino acids / proteins / AW ; [3 max]	N-fixing bacteria = 2 mar **R** to nitrite / nitrate **A** plants use NH_3 / NH_4^+
(c)	1 (dead plants) eaten by, animals / detritivores / scavengers ; 2 e.g. earthworms / termites / AW ; 3 ref. their faeces / increase in surface area ; 4 decay / decomposition ; **A** decomposers 5 by, bacteria / fungi / saprophytes / saprotrophs ; 6 break down proteins to amino acids ; 7 deamination ; 8 ammonia / NH_3 / NH_4 ; 9 ammonia to <u>nitrite</u> ; 10 <u>nitrite</u> to nitrate ; **A** one mark for ammonia to nitrate 11 nitrification / nitrifying bacteria ; 12 *Nitrosomonas* / *Nitrobacter* in correct context of nitrification ; [6 max]	MP3 must be related to MP1 or 2 **A** even if linked to incorrect organism **R** if wrong type of bacteria (e.g. N-fixing) **A** if in context of MP1 or 2 but do not award twice protein → ammonia / AW = 1 mark if 6, 7, 8 not given **R** 'nitride' unless qualified by NO_2 **R** nitrate unqualified by nitrite or ammonia

1	**(d)**	1 light intensity ; **A** limited sunlight / lack + of sunlight / sunshine 2 light duration ; **A** day length 3 water / moisture availability ; **A** drought / flood / humidity / soil water 4 carbon dioxide, availability / concentration / tension / level ; 5 temperature ; 6 competition / overcrowding / space / weeds ; 7 grazing / herbivores / predation / primary consumers ; 8 pests ; 9 parasites / disease ; 10 use of (inappropriate) herbicides / nearby use of herbicides ; **A** drift of herbicides / weed killers 11 pollution / sulphur dioxide / acid rain ; 12 soil pH / depth of soil / type of soil / poor soil / oxygen in the soil ; 13 wind speed ; 14 salt concentration of soil ; [3 max]	**R** heat / warmth **R** oxygen unqualified
	(e)	*accept ora with population starting to increase about day 40* 1 small population to start with ; 2 takes time for eggs to hatch ; 3 not enough food / soya bean plants not grown enough / AW ; 4 aphids, not sexually mature / cannot breed / finding mates ; 5 too cold / too wet / AW (another appropriate weather condition) ; 6 ref. to, predators / ladybirds ; 7 ref. to, parasites / disease ; 8 ref. to, pesticides / insecticides ; 9 no immigration ; 10 competition (between aphids, with another pest) ; 11 AVP ; [3 max]	*do not expect knowledge of aphid biology* ***I** names of phases (lag, log)* ***I** 'adjusting to surroundings'* refs. to soya must refer to food for aphids **A** few soya plants / competition for food / soya grows slowly **R** unfavourable conditions unqualified (e.g. correct ref. biotic and abiotic factors)
		[Total: 19]	

2 **(a)** **(** reserves last longer for walking / ora **;**
(approx) 4 times longer / other use of figures **;** [2]

(ii) glucose **and** <u>muscle</u> glycogen **;** [1]

(iii) fat **and** carbohydrate **;** [1]

(iv) *award two marks if correct answer (16.6 / 17) is given*
if no answer or incorrect answer award one mark for correct working

1660 / 100 **OR** 5800 / 350 **OR** average of the two
16.57 / 16.58 / 16.59 / 16.6 / 17 (kJ per gram) **;;** **R** rounding down to 16.5 [2]

(b) **(** <u>muscle</u>, growth / development / repair **; A** 'make / build up, muscle' [1]

(ii) to build up, energy / glycogen, reserves / stores **;**
muscle / liver, glycogen **;**
converted to fat / stored as fat **;** [2]

(c) **(** $C_6H_{12}O_6 \longrightarrow 2C_3H_6O_3$ (+ energy released)

1 mark for glucose + lactic acid formulae correct **;**
1 mark for balanced equation **;** **R** if anything else given ($CO_2 + H_2O$) [2]

(ii) **1** short, time / distance, for sprint *or* long, time / distance, for marathon **;**
2 sprint needs (lots of) energy quickly / marathon needs energy over long period **;**
3 sprint oxygen supply not sufficient / oxygen supplied during marathon **;**
4 anaerobic does not need oxygen / aerobic needs oxygen **;**
5 lactic acid, removed after sprint / would build up in marathon **;**
6 ref to muscle, fatigue / cramp / pain **;**
7 ref to oxygen debt **;**
8 AVP **;** e.g. fat has higher energy content useful for marathon [max 4]

(iii) glycogen in liver broken down to glucose **;**
correct ref to <u>glucagon</u> **; R** if 'glucagon breaks down glycogen…'
glucose from liver enters the blood **; R** 'excreted into blood'
idea that balances use of glucose **; A** 'replaces glucose used up' [max 2]

[Total: 17]