AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



MARK SCHEME

4.4.1 PHOTOSYNTHESIS (PACK 2)

SCORE	PERCENTAGE
/239	%

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Q1.

(a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols

*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions
or particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

<u>40 – 50 °C</u>

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

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(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

Q2.

(a) photosynthesis

*do **not** accept other additional processes*

1

(b) (i) any **three** from, eg:

ignore time / apparatus

- mass of pondweed
  *<u>type</u> of pondweed = max **2***
  accept amount / volume / length / size
  ignore number / surface area of leaves / pondweed unqualified
- volume of water
  accept amount
- other reasonable features of the water
- light intensity
  accept distance between light source and tube / pondweed
- light colour
  accept light if neither colour nor intensity is given
- carbon dioxide
- temperature
- pH

3

(ii) any **one** idea from, eg:

ignore reference to cost

- how much oxygen they give off
- is pondweed poisonous to fish
- will fish eat pondweed
- is pondweed harmful to environment

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- how long the pondweed lives
- growth rate / size of pondweed
- reference to appearance / aesthetics
- availability

1

(c) magnesium / Mg

accept iron / Fe
ignore ion and $^{+}$ or $^{-}$
ignore nitrate

1

[6]

Q3.

(a) 7.15 to 7.45 <u>am</u> **and** 7.15 to 7.45 <u>pm</u>

***both** required, either order*
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33

allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used
  allow more food made than used
- so plant able to grow / flower
  accept plant able to store food

2

[5]

Q4.

(a) (i) 70

*award **2** marks for correct answer irrespective of working*
*allow **1** mark for 30 + 10 + 24 + 6 (with wrong answer or no answer), do **not** award this sum if other figure(s) are included in the addition*

2

(ii) 6

*award **2** marks for correct answer irrespective of working*
*award **2** marks for correct answer to (a)(i) – 64 (ecf)*

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*award **1** mark either for 70 – 64 or answer to (a)(i) – 64 with no answer or incorrect answer*

2

(b) photosynthesis.

1

[5]

Q5.

(a) (i) colour of light / bulb / lamp

allow wavelength for colour
allow bulb alone
*do **not** accept light / colour unqualified*

1

(ii) any **one** from eg

- temperature
  allow heat
- light intensity **or** distance between lamp and plant / tube
  allow amount / brightness of light
  ignore light unqualified
- carbon dioxide
  allow symbols
- other light in room
  allow use a dark room
- mass / size / amount / age / type of pondweed
  allow same piece of pondweed
  ignore pondweed unqualified
- volume / amount of water
  ignore reference to time

1

(iii) improved reliability

*allow for reliability **or** less likely to lose count*

or

can spot anomalies / changes

allow reference to calculating a mean / average
ignore reference to accuracy / precision / fair

1

(b) (i) green

1

(ii) any **two** from:

ignore references to colour

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- least / less bubbles / gas / oxygen / mean
  *reference to least / less needed only once, in context, for **2** marks*
- least / less photosynthesis
- least / less glucose / sugar / carbohydrate / food made
  only penalise no once, ie
  *no bubbles = **0** mark*
  *no bubbles so no photosynthesis = **1** mark*
  allow most / more green light reflected (by chloroplasts)

2

[6]

Q6.

(a) add mineral ions to the soil

extra box ticked cancels the mark

1

(b) increasing the temperature

*each extra box ticked cancels **1** mark*

1

turning lights on at night

1

[3]

Q7.

any **three** from:

*maximum **2** marks if only advantages **or** only disadvantages given*
ignore references to cost unqualified

advantages: (max 2)

ignore reference to fresher

- less transport / example of transport **or** less fuel used
  accept implication eg less food miles
  allow no transport / fuel costs
- less pollution / example
  accept eg less carbon dioxide / smaller carbon footprint
  allow no pollution / example
- support of local / UK economy / farmers

disadvantages: (max 2)

- not available all year
- may require use of heat / light

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- (production of) heat / light causes pollution

[3]

Q8.

(a) (i) increase (and then level off) **and** max / up to at 0.15 (%) (carbon dioxide)

ignore references to oxygen concentration only

ignore mention of 23

1

(ii) $\underline{CO_2}$ is limiting at low CO_2 / at first

ignore specific numbers

1

light is limiting at high CO_2 / at end

1

(b) ***mark both parts together***

effect: (oxygen) falls

1

explanation: (oxygen) used for respiration

***if no other marks** awarded allow (effect) no change **and** (explanation) no photosynthesis for **1** mark*

1

(c) more chlorophyll / chloroplasts

1

allows more photosynthesis / description

for both marks must refer to more at least once

1

[7]

Q9.

(a) root

1

(b) (i) chlorophyll

1

(ii) absorbs / traps / takes in light

*do **not** accept attracts / solar energy /sunshine / sun*

1

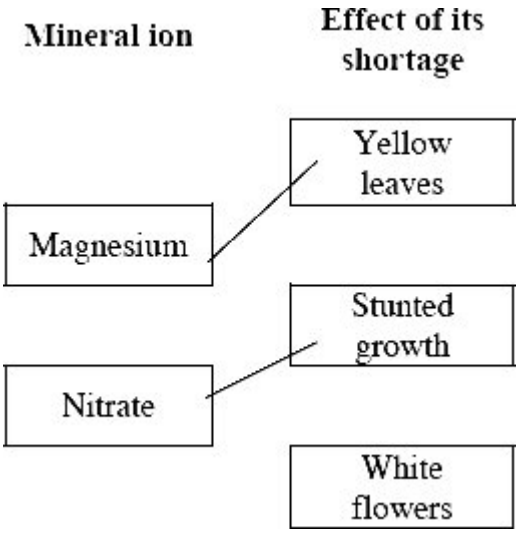
(for) photosynthesis

accept to make food / glucose / sugar/ biomass

1

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(c)



1 *mark per correct line*

extra line from a mineral ion cancels the mark

2

[6]

Q10.

(a) (i) oxygen produced

1

(ii) any **one** from:

- average / mean / median
  ignore reliable / precise / accurate
- some may be anomalous
  allow some may not float

1

(b) (i) *do **not** allow answers in terms of time only*

*if candidate answers in terms of comparing rate of change then the rate of change of photosynthesis must be in the correct direction for **1** mark*

any **two** from:

- low intensity / below 12.5 / 2.5 - 12.5 (units of light) flat wrack /it, rate of photosynthesis faster **or** saw wrack rate of photosynthesis slower
  allow any value in range
- high intensity / above 12.5 / 12.5 - 15 (units of light) flat wrack / it,rate of photosynthesis slower **or** saw wrack rate of photosynthesis faster
  allow any value in range
- same (rate) at 12.5 units

2

(ii) any **two** from:

- saw wrack receives less light

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accept converse if clear reference to bladder wrack

- less photosynthesis
  if first and second responses, 'less' needed only once

  or
  less carbohydrate / sugar / starch production

- when tide is in **or** at high tide **or** any tide above low tide
  accept saw wrack covered by water / submerged longer / more
  reference to position on shore is insufficient

2

[6]

Q11.

(a) the starch is stored for later use.

1

(b) (i) any **two** from:
*do **not** accept temperature-apply list principle*
ignore reference to time

- carbon dioxide (concentration)
- light intensity
  *allow **one** mark for light if neither intensity or colour are awarded*
- light colour / wavelength
- pH
- size / amount plant
- same / species / type plant
  allow 'the plant'
- amount of water <u>in the tube</u>
  ignore amount of water alone

2

(ii) number / amount of bubbles **or** amount of gas / oxygen
allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval
allow how long it bubbles for
*do **not** accept time bubbles start / stop*
ignore speed / rate bubbles
ignore instruments
*do **not** accept other factors eg temperature*

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*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature

allow heat / °C / cold

1

(ii) carbon dioxide / CO_2

CO2 / CO^2 / Co_2 / Co^2 / co_2 / co^2

*do **not** accept CO / 2CO*

1

[7]

Q12.

(a) any **one** from:

- (type of / amount of) soil / minerals / nutrients / pH
- amount of water / time of watering
- space between plants / plants and wall
- time for growth

list principle

ignore carbon dioxide / same number of plants / food

*do **not** allow temperature / light / exposure to wind*

1

(b) (i) North wall

1

(ii) nugget

list principle

1

(c) has not tested all varieties / nugget / champion against all walls

*do **not** allow repeat experiment*

1

[4]

Q13.

(a) (i) water / H_2O

allow hydrogen oxide

1

oxygen / O_2 / O

allow upper and lower case symbols and superscripts

answers must be in this order

1

(ii) respiration in the plant

allow clear indication of correct response

1

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(b) light (no light) / light intensity

ignore references to the card / covered / uncovered

1

chlorophyll (no chlorophyll) / chloroplast

*allow leaf colour **or** both green **and** white given*

1

(c) (i) no light (received) **or** it's dark

allow no photosynthesis
*do **not** allow little light / photosynthesis*
ignore sun

apply list principle for other factors

1

(ii) no chlorophyll / chloroplasts (present)

allow no / little photosynthesis
*allow white **or** not green **or** little chlorophyll / few chloroplasts*

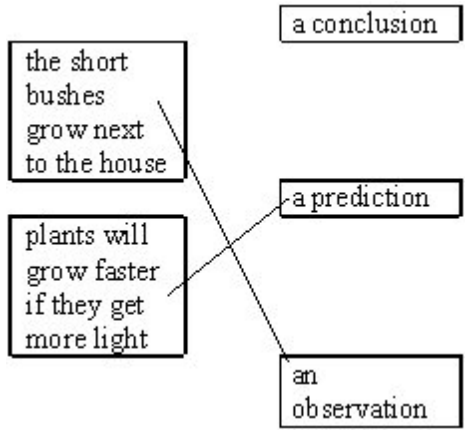
apply list principle for other factors

1

[7]

Q14.

(a) (i)



*both correct = **2** marks*
*one correct = **1** mark*

extra line from a statement cancels the mark

2

(ii) 1st space: carbon dioxide

allow CO_2 (ignore superscript)

*do **not** allow CO alone*

1

2nd space: glucose / sugar / starch / carbohydrate

1

(b) (i) any **one** from:

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- move lamp or change distance between lamp and plant
  ignore measure the distance
- change wattage / power of (light) bulb
  *do **not** accept just "change bulb"*
- change voltage / power supply to the (light) bulb
- change the number of lamps
- put translucent material between lamp and plant
  accept examples, eg tracing paper / filters
  *do **not** accept coloured filters*

1

(ii) rises

1

levels off
ignore numbers

1

(iii) idea that it levels off

or

does not increase at all light intensities

or

it only increases to a certain amount
*answers should relate to photosynthesis and **not** to bubbling*

1

[8]

Q15.

(a) photosynthesis

1

(b) oxygen

1

(c) chlorophyll

1

(d) starch

1

[4]

Q16.

(a) any **three** from:

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- ((mean) mass) increases up to 7 / 8 units (of light) then levels off
- light limiting factor up to 7 / 8 units
- for photosynthesis
  must be in correct context
- other factor / temperature limiting above 7 / 8 units

3

(b) any **two** from:

- cost of providing conditions / heat / light / CO_2
- effect of treatment on profit
  allow too much of factor is wasteful
- relevant use of data from graph eg limiting factors
- named other factors eg fertiliser / pest control / weeds / density of planting
  allow taste / appearance

2

(c) **nitrate function**

produce amino acids / proteins / enzymes
ignore DNA
*do **not** allow chlorophyll*

1

nitrate deficiency

stunted growth
allow description
ignore plant dies

1

magnesium function

produce chlorophyll
ignore chloroplasts

1

magnesium deficiency

yellow leaves / plant
ignore plant dies

1

[9]

Q17.

(a) (i) L.H.S. – water / H_2O

1

R.H.S. – oxygen / O_2

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accept H^2O
accept O^2 / O

1

(ii) chlorophyll

must make it clear that it is the chlorophyll
*do **not** credit chloroplast on its own*
*do **not** accept chloroplast / chlorophyll*
without indication that it is chlorophyll

1

(b) (i) light intensity / temperature is high enough for higher rate or light / temperature is not limiting

1

low CO_2 available or not enough CO_2 available **or** rate would be higher with more CO_2

1

(ii) temperature

allow water / rain
allow (too) cold / hot as a minimum
allow wave length / frequency / colour
ignore ions
ignore heat

1

[6]

Q18.

(a) burning fossil fuels / coal / gas / oil

accept driving <u>vehicles</u> / eg cars
accept coal-fired power station
accept car emissions
ignore combustion unqualified
*do **not** accept power station unqualified*
*do **not** accept <u>using</u> fossil fuels*

1

(b) (i) (SO_2) makes it acidic / makes acid rain / lowers pH

1

(ii) any **one** from:

(SO_2) kills leaves reduces number of leaves reduces leaf area
or smaller leaves causes fewer leaves to grow
ignore correct extras, eg
withered, yellow etc

1

(c) any **two** from:

(fewer leaves / less leaf S.A) so less photosynthesis

less food / less sugar / less starch supplied (to roots / to stems)

(SO_2) lowers pH of soil / makes soil acidic

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ions (/minerals / salts / nutrients) less available (to plants)

accept don't get enough nutrients

2

[5]

Q19.

(a) carbon dioxide/CO_2

1

(b) through the roots/root hairs

*do **not** accept leaves*

1

(c) oxygen

1

sugar/glucose/other named sugar/starch/carbohydrate

1

(d) award one mark for each mark point

n.b. accept chloroplast for chlorophyll

*n.b. credit the candidate who answers **in** terms of the white areas of the leaf*

chlorophyll is green

e.g. green areas have chlorophyll

1

chlorophyll/green is needed for photosynthesis

e.g. it is only in green areas that photosynthesis can take place

after this point do not penalise a candidate if they do not refer to photosynthesis

1

light is needed

e.g. it does not happen in the dark
*do **not** accept sunshine/sun*

1

photosynthesis produces/makes starch

e.g. starch is made

so

e.g. 'you need light to make starch' scores 3rd and 4th marking points

'you need chlorophyll and light for photosynthesis' scores on the 2nd and 3rd marking points

'photosynthesis makes starch and you need green leaves and light for it to work' scores

on the 2nd, 3rd and 4th marking points

1

[8]

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Q20.

(a) water [1]

oxygen [1]

(sun) light or solar [1]

*do **not** accept sun's*

chlorophyll [1]

*do **not** accept chloroplasts*

4

(b) any **two** from:

stored as fructose
stored as sucrose
stored as starch
stored as oil **or** lipid
moved or transported away <u>in the phloem</u>

*do **not** accept "stored" by itself*

respired or burnt up for energy or
fuel changed to protein
changed to cellulose
changed to fructose
changed to starch
changed to oil or lipid

*do **not** accept "food for plant"*
*do **not** accept "used up" by itself*

2

(c) (i) roots or root hair (cells)

1

(ii) the mineral salts are (dissolved) in water [1]

water transports salts throughout the plant
or water enables osmosis or diffusion to take place [1]

2

(d) (i) plants grow better with some nutrients than none
or
plants grow better with nitrates than without

comparison is needed
accept "faster" as equivalent to "better"
accept don't grow well with only water

1

(ii) 0.14(g)

*units **not** needed*

1

(iii) making protein **or** amino acids

*do **not** accept help them grow*
*accept named protein **or** DNA **or** chlorophyll*

1

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any **two** from:

(iv) type **or** variety **or** starting weight **or**

2

(iii) size of seedlings

keep the environment the same
*only if light **or** temperature **or** day length not already credited*

light
temperature not heat
time of growth

*do **not** accept the same equipment*
*do **not** accept help them grow*

1

day length
amount of culture solution **or/**size of

accept named protein, DNA chlorophyll

boiling tube
number of seedlings per tube
pH
CO_2
humidity

[15]

Q21.

(a) carbon
water
oxygen

light

chlorophyll

starch

***1** mark each*

6

(b) leaf **(or** named part of leaf)
or
chloroplasts

accept anywhere green
do not credit chlorophyll unless qualified

1

(c) water through the roots
or
root hairs
or
by osmosis

*do **not** credit where the candidate is unclear about which is which*

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1

CO_2 through the leaf
or
stomata
or
by diffusion

1

(d) any **one** point:

increased CO_2 concentration
increased water supply
increased temperature (up to a point)
increased light (intensity)

*accept altered light quality by less green **or** increasing other colours*

accept increased duration of exposure to light

*do **not** credit sun **or** sunshine*

accept CO_2 from respiration

1

[10]

Q22.

(a) (i) light **or** solar

*do **not** credit sun's energy*

*do **not** credit radiant*

1

(ii) chlorophyll

1

(iii) chloroplast

1

(iv) CO_2 **+** H_2O

reactants identified (accept words)

1

$C_6H_{12}O_6 + O_2$

products identified (accept words)

1

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

balanced equation

1

(b) any **two** from:

increased CO_2 concentration

increased water supply

increased temperature (up to a point)
increased light intensity

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*do **not** accept heat or warmth*

altered light quality by less green **or** increasing other colours

2

(c) any **four** points

- palisade (mesophyll)
- lots of chloroplasts **or** chlorophyll **or** main site for photosynthesis **or** absorb maximum amount of light
- guard cells
- CO_2 in **or** O_2 out **or** water vapour out
- controls size of stoma **or** pores in leaf

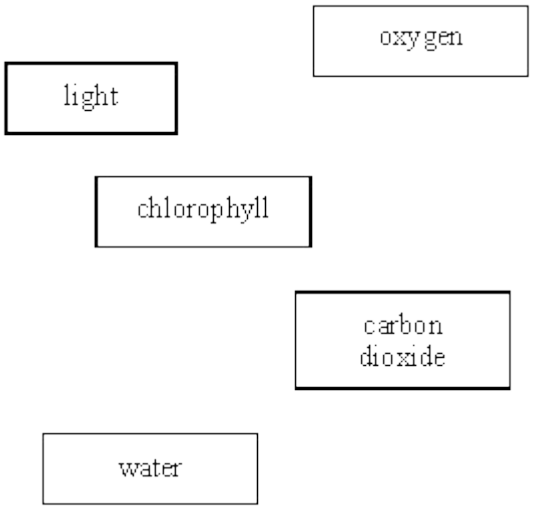
***allow** stomata*

4

[12]

Q23.

(a)



5

(b) (i) sugar **or** carbohydrate

1

(ii) it can be stored **or** it is insoluble

accept it has no osmotic effect

1

(iii) any **one** from:
respires it **or** releases **or** transfers energy
turns it **or** stores it as fructose **or**

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sucrose **or** lipid **or** protein **or**
cellulose

1

(c) (i) photosynthesis

1

(ii) any **one** from:
flat surface
stomata
thin
chloroplasts
veins
large surface area
air spaces
*do **not** accept chlorophyll*

1

[10]

Q24.

(a) reactants: $CO_2 + H_2O$

1

products: $C_6H_{12}O_6 + O_2$

1

balance:

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

1

(b) **1** mark each for any of the following ideas:

lower CO_2 concentration

lower light intensity

decrease water availability

alter light wavelength **or** colour
accept more green light

2

(c) (i) scales correctly constructed
i.e. equal intervals along each axis

1

points plotted correctly

1

appropriate line correctly drawn
*accept dot to dot **or** line of best fit*
cancel if line extends through zero or beyond 50°C

1

(ii) 18 – 19 (bubbles per minute)

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1

(iii) heat denatures enzymes **or** destroys membranes **or** ruptures cells **or** destroys cells

do not accept kills enzymes

1

[10]

Q25.

Does not contain chlorophyll which is needed to absorb light **or** energy

each for 1 mark

[2]

Q26.

(a) (i) e.g. mussels/caddis loach

for 1 mark

1

(ii) 3 of:
carbon dioxide
water
chlorophyll/chloroplasts
light

any 3 for 1 mark each

3

(b) 6 of e.g.
some plant/animal material not digested by consumers passes out with faeces
respiration releases energy used in movement lost as heat
some 'lower' organisms die energy transferred to decomposers/detritivores thence to environment

any 6 for 1 mark each

6

[10]

Q27.

(a) carbon dioxide
oxygen

2

(b) (i) e.g. rubber plant/fern

1

(ii) because can tolerate low light levels

1

(iii) yellow parts of leaf do not contain chlorophyll therefore more light needed for photosynthesis

2

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(iv) no leaves/only have stem only have small area which can photosynthesise

2

[8]

Q28.

(a) (i) June

for 1 mark

1

(ii) April
max. light
photosynthesis makes sugars/substances needed for growth

for 1 mark each

3

(b) 2 of:
temperature
carbon dioxide availability
water
chlorophyll

any 2 for 1 mark each

2

[6]

Q29.

(a) 21.5 – 22 ***and*** 27 – 27.5

for 1 mark

1

(b) *ideas of*
limiting factor / shortage of
e.g. light / carbon dioxide / water / chlorophyll

each for 1 mark
(allow 1 for 'maximum / optimum rate of enzyme activity if no reference to limiting factors) (ignore denaturation)

2

(c) 21.5 – 22° C

*(allow **first** figure from answer to (i) so that no 'double-penalty but only if this first answer is 20 or greater)*

maximum rate of photosynthesis / highest / fastest

but related to flat part of curve

most economical heating / cheapest related to heating

must relate to the temperature the candidate has given
each for 1 mark

3

[6]

Q30.

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(a) Sun / sunlight / light

for 1 mark

1

(b) (i) 21.5 – 22 ***and*** 27 – 27.5

for 1 mark

1

(ii) ideas of limiting factor / shortage of
e.g. light / carbon dioxide / water /chlorophyll

each for 1 mark
(allow 1 for 'maximum' rate of enzyme activity if no reference to limiting factors)
(ignore reference to dematuring)

2

(iii) 21.5 – 22° C

(allow first figure from answer to (i) so that no 'double-penalty' <u>but</u> not below 20)

maximum rate of photosynthesis
(can relate to any number on 'flat')

most economical heating (must relate to left end of 'flat'
each for 1 mark

3

[7]

Q31.

(a) water / damp / wet
or
suitable temperature / warm / heat / hot
or
light / sun
(*accept* rooting powder / soil qualified e.g. fine / nutrients / fertiliser / minerals)
(*do NOT allow* oxygen / carbon dioxide / food)

for 1 mark

1

(b) *advantage*
quick / cheap / several from one plant / known outcome / same as <u>parent</u>
(*reject* all the same)
disadvantage
<u>all</u> the same / all get same disease

for 1 mark each

2

[3]

Q32.

(a) (i) carbon dioxide / CO_2 (*reject* CO)

(ii) oxygen / O_2 / O (*reject* water vapour)

for 1 mark each

2

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(b) (provides) energy

for 1 mark

1

[3]

Q33.

(a) (i) carbon dioxide / CO_2 (*reject* CO)

(ii) oxygen / O_2 / O (water vapour neutral)

for 1 mark each

2

(b) (provides) energy

for one mark

1

(c) starch insoluble therefore water not taken in by osmosis

or

sugar is soluble / has small molecules may diffuse out therefore lost

*(*ignore *ref. to cells bursting)*

or

starch has large molecules

cannot diffuse therefore retained

for 1 mark each

3

[6]

Q34.

(a) low in winter / named months /when the days are short

accept increases in spring / Dec – June

1

high in summer / named month(s) / (when days are long

decreases in autumn / June – December

1

reasonable quantitative statement

accept any reasonable calculated / translated quantitative statement

higher in summer than in winter for 2 marks

comparative statements may be worth 2 marks

but

8/11 times higher in summer than in winter for 3 marks

1

(b) no artificial light given in summer / light only given in winter

since natural light greatly exceeds minimum / 600 J (required to produce tomatoes)

accept day length if linked to light energy

OR

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light only given in winter

as natural light less than the minimum
needed (to grow them) or 600 J

OR

for 2 marks:
percentage increase in growth from artificial] light only significant in winter

2

[5]

Q35.

plants

1

carbohydrates

accept oxygen

1

carbon dioxide

accept water
(these words must be in this order)

1

[3]

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