**M1.**(a)     protein

**1**

(b)     (i)      (more) magnesium gives more growth / more leaves / more duckweed

*if converse must be clear that less magnesium gives less growth*

**1**

(ii)     **A** gave highest number of leaves / plants **or** more than others

*it equals* ***’A’***

*use of numbers must compare* ***A*** *with at least one other*

**or**

**A** gave most growth / most duckweed **or** more than others

*allow faster / fastest / better / best growth*

*allow more growth with nitrate / less growth without nitrate*

*do not allow ‘no’ growth without nitrate*

(c)    (i)      mark (c) as a whole

sensible method:

e.g. mass / weighing

*ignore dry or fresh*

*allow other sensible method involving measuring eg length of roots – ignore ‘size’ of roots or measure roots unqualified*

**1**

(ii)     corresponding explanation:

*ignore accuracy*

e.g. includes roots / includes whole plant**or**leaves vary in size**or**(length / mass / surface area given in c(i)) is a continuous variable

**1**

**[5]**

**M2.**          (a)    water

**1**

oxygen

*in this order only*

*accept correct chemical symbols*

*allow H2O / OH2*

**1**

(b)     allow light (in / through) / need light

*do* ***not*** *accept attracts light*

*ignore heat / moisture / carbon dioxide*

*ignore so the plants can be seen*

*accept the converse, ie the black plastic bag would not let light in (1)*

**1**

for photosynthesis / make sugar / glucose

*so there would be no photosynthesis (1)*

*do* ***not*** *allow make food unqualified*

**1**

(c)     Increase (in leaves / new leaves)

*ignore growth unqualified*

**1**

(then) level off **or** number of (new) leaves (then) stays the same

**1**

numerical statement eg max at 3 tablets / 5 (new) leaves

*should refer to one of the first two marking points*

*for every extra tablet get 1 extra leaf =* ***2*** *marks*

*for every extra tablet get 1 extra leaf then it levels off =* ***3*** *marks*

**1**

**[7]**

**M3.**(a)     (i)      LHS = water

*accept H2O*

*do* ***not*** *accept H2O / H2O*

**1**

RHS = oxygen

*accept O2*

*do* ***not*** *accept O / O2 / O2*

**1**

(ii)     light / sunlight

*ignore solar / sun / sunshine*

*do* ***not*** *allow thermal / heat*

**1**

(iii)    chloroplasts

*allow chlorophyll*

**1**

(b)     (i)      20

**1**

(ii)     any **one** from:

•        light (intensity)

•        temperature.

**1**

(c)     (i)      To increase the rate of growth of the tomato plants

**1**

(ii)     Because it would cost more money than using 0.08%

**1**

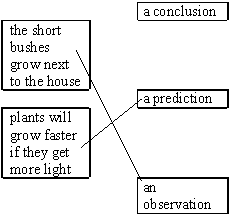
Because it would not increase the rate of photosynthesis of the tomato plants any further

**1**

**[9]**

﻿

**M4.**          (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 CO2 (ignore superscript)*

*do* ***not*** *allow CO alone*

**1**

         2nd space: glucose / sugar / starch / carbohydrate

**1**

(b)     (i)      any **one** from:

•        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]**

**M5.**(a)     chlorophyll is needed for photosynthesis

**1**

light is needed for photosynthesis

**1**

(b)     increases

**1**

levels off / reaches a maximum / remains constant / stays the same / plateaus

*do* ***not*** *allow stops / stationary / peaks*

*allow stops increasing*

**1**

goes up to / reaches a maximum / levels off at (a rate of) 200 (arbitrary units)  
**or**levels off at 225 – 240 (light units)

*ignore references to other numerical values*

**1**

(c)     (i)      higher light intensity does not increase rate of photosynthesis

*accept the graph stays level (above this value)*

*allow stops increasing*

*allow the rate of photosynthesis stays the same (above this value)*

**1**

(ii)     any **two** from:

•        carbon dioxide (concentration)

•        temperature / heat

•        (amount of) chlorophyll / chloroplasts

*allow water*

*allow ions / nutrients*

*ignore ref to surface area of the leaf*

**2**

**[8]**

**M6.**          (a)     photosynthesis

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

**1**

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

*ignore time / apparatus*

•        mass of pondweed

*type 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

•        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]**

**M7.**(a)    The starch is stored for use later

*no mark if more than one box is ticked*

**1**

(b)     (i)      any **two** from:

*do* ***not*** *accept temperature*

*apply list principle*

*ignore reference to time*

•        carbon dioxide (concentration)

•        light intensity

•        light colour / wavelength

|  |  |
| --- | --- |
|  |  |

*allow* ***1*** *mark for light if neither intensity or colour are awarded*

•        pH

•        size / amount of pondweed / plant

•        same / species / type pondweed

•        amount of water in the tube

*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 of bubbling*

*ignore instruments*

*do* ***not*** *accept other factors eg temperature*

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

**1**

(c)     (i)      temperature

*allow heat / cold / °C*

**1**

(ii)     carbon dioxide / CO2

*allow CO2*

*do* ***not*** *accept CO2*

**1**

**[7]**

**M8.**          (a)    less carbon dioxide used   
**or** higher carbon dioxide (concentration) in jar

*do* ***not*** *allow no carbon dioxide used or no change in carbon dioxide*

**1**

because less photosynthesis **or** light was a limiting factor

*do* ***not*** *allow no photosynthesis*

**1**

(b)     magnesium / Mg

*do* ***not*** *allow manganese / Mn*

*allow iron / Fe*

*ignore nitrates*

**1**

**[3]**

**M9.**(a)    any **one** from:

*ignore ‘check temperature’*

•        add a water bath

•        heat screen

•        use LED

•        low energy bulb / described

**1**

(b)    (i)      rate / number of bubbles decreases

*accept converse with reference to increasing light* ***or*** *shorter distance*

**or**

less oxygen / gas released

*ignore reference to rate of photosynthesis*

**1**

(ii)     temperature / CO2 (concentration)

*accept ‘it was too cool’* ***or*** *not enough CO2*

*accept number of chloroplasts / amount of chlorophyll*

*allow heat*

*allow CO2*

*do* ***not*** *allow CO2*

**1**

(c)     Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](../resources/AG_BL/menus/Markingguidance.pdf), and apply a ‘best-fit’ approach to the marking.

**0 marks**No relevant content.

**Level 1 (1-2 marks)**There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

**Level 2 (3-4 marks)**There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.

**Level 3 (5-6 marks)**There is a detailed description of most of the structures and their functions.

**Examples of responses:**

•        epidermis

•        cover the plant

•        mesophyll / palisade

•        photosynthesises

•        phloem

•        xylem

•        transport.

**The following points are all acceptable but beyond the scope of the specification:**

•        (waxy) cuticle – reduce water loss

•        epidermis – no chloroplasts so allows light to penetrate

•        stomata / guard cells – allow CO2 in (and O2 out) **or** controls water loss

•        palisade (mesophyll) – many chloroplasts to trap light

– near top of leaf for receiving more light

•        spongy (mesophyll) – air spaces for rapid movement of gases

**6**

**[9]**

**M10.**Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a ‘best-fit’ approach to the marking.

**0 marks**No relevant content.

**Level 1 (1−2 marks)**The apparatus needed to measure the leaf is identified  
**or**the apparatus needed to measure light intensity is identified  
**or**an appropriate use of the tape measure is identified.

**Level 2 (3−4 marks)**There is a description of a leaf being measured at different locations  
**or**light being measured at different locations.

**Level 3 (5−6 marks)**There is a description of a leaf **and** light being measured at different locations  
**and**repetitions are included  
**or**a control variable is described  
**or**appropriate mathematical treatment of the data is described.

**Examples of points made in the response:**

•        use of tape measure to produce transect

•        transect placed coming out of shady area (e.g. woodland) into lighter area

•        repeat transects

•        samples at same height above ground

•        samples at same aspect (N / E / S / W) on trees

•        measurement of length, or width, of leaves using ruler

•        measure several leaves at each location

•        use of light meter to measure light intensity

•        repeat measurements of light intensity on several days

•        measure light intensities at same time of day

•        calculate mean for each location

•        plot graph of mean leaf length, or width, vs. light intensity.

*allow attempt to overcome other variables − eg soil water / soil pH / temperature*

**[6]**

**M11.**          (a)     7.15 to 7.45 am **and** 7.15 to 7.45 pm

***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]**

**M12.**          (a)     reactants: CO2 +H2O

**1**

products: C6H12O6 +O2

**1**

balance:

6CO2 + 6H2O  →  C6H12O6 +6O2

**1**

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

lower CO2 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)

**1**

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

*do not accept kills enzymes*

**1**

**[10]**

**M13.**(a)    LHS – carbon dioxide / CO2

*allow CO2*

*ignore CO2*

**1**

RHS

*in either order*

glucose / carbohydrate / sugar

*allow starch*

*allow C6H12O6 / C6H12O6*

*ignore C6H12O6*

**1**

oxygen

*allow O2 / O2*

*ignore O2 / O*

**1**

(b)     any **five** from:

•        factor 1: CO2 (concentration)

•        effect - as CO2 increases so does rate and then it levels off or shown in a graph

•        explanation:(graph increases) because CO2 is the raw material or used in photosynthesis / converted to organic substance / named eg**or**(graph levels off) when another factor limits the rate.

*accept points made via an annotated / labelled graph*

•        factor 2: temperature

*allow warmth / heat*

•        effect – as temperature increases, so does the rate and then it decreases or shown in a graph

*allow ‘it peaks’ for description of both phases*

•        explanation:(rise in temp) increases rate of chemical reactions / more kinetic energy

*allow molecules move faster / more collisions*

**or**(decreases) because the enzyme is denatured.

*context must be clear = high temperature*

*allow other factor plus effect plus explanation:*

*eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves*

*2nd or 3rd mark can be gained from correct description and explanation*

**5**

**[8]**

**M14.**          carbon dioxide concentration

**1**

          since atmospheric concentration very low / value give e.g. 0.03%

*allow carbon dioxide used up*

**1**

          temperature high

*allow if light chosen as a factor*

**1**

          light intensity high

*allow If temperature chosen as a factor*

**1**

**[4]**

**M15.**         (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

*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]**

**M16.**(a)     light is trapped / absorbed / used

*extra answers cancel mark*

*ignore solar / sunshine*

**1**

by chlorophyll / chloroplasts

*if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis*

**1**

(b)     (to make) starch (for storage)

*ignore ‘for growth’ unqualified*

*ignore respiration*

**1**

(to make) fat / oil (for storage)

**1**

(to make) amino acids / proteins / enzymes

**1**

(to make) cellulose / cell walls

*allow for active transport*

*allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone)*

*if no named examples, allow ‘to make* ***named*** *cell structures’ for max. 1 mark*

**1**

**[6]**

**M17.**(a)     LHS = water

**1**

RHS = glucose

**1**

(b)     any **three** from:

•        (measure) temperature

*ignore reference to fair test*

•        to check that the temperature isn’t changing

•        rate of reaction changes with temperature

•        temperature is a variable that needs to be controlled

*allow lamp gives out heat*

**3**

(c)     (i)      10

*correct answer =* ***2*** *marks*

*allow* ***1*** *mark for:  *

*allow* ***1*** *mark for correct calculation without removal of anomalous result ie 15*

**2**

(ii)     graph:

*allow ecf from* ***(c)(i)***

label on y-axis as ‘number of bubbles per minute’

**1**

**three** points correct = **1** mark

*allow ± 1 mm*

**four** points correct = **2** marks

**2**

line of best fit = smooth curve

**1**

(iii)    as distance increases, rate decreases – pro

*allow yes between 20 – 40*

**1**

but should be a straight line / but line curves – con / not quite pro

*allow not between 10 – 20*

*if line of best fit is straight line, allow idea of poor fit*

**1**

(d)     any **four** from:

•        make more profit / cost effective

•        raising temp. to 25 °C makes very little difference at 0.03% CO2

•        (at 20 °C) with CO2 at 0.1%, raises rate

•        (at 20 °C with CO2 at 0.1%) → >3x rate / rises from 5 to 17

•        although 25 °C → higher rate, cost of heating not economical

•        extra light does not increase rate / already max. rate with daylight

*accept ref to profits c.f. costs must be favourable*

**4**

**[17]**

**M18.**(a)     6H2O

*in the correct order*

**1**

C6H12O6

**1**

(b)     (i)      control

***do not accept*** *‘control variable’*

*allow:*

*to show the effect of the organisms*

***or***

*to allow comparison*

***or***

*to show the indicator doesn’t change on its own*

**1**

(ii)     snail respires

**1**

releases CO2

**1**

(iii)    turns yellow

**1**

plant can't photosynthesise so CO2 not used up

**1**

but the snail (and plant) still respires so CO2 produced

**1**

**[8]**