GCE AS

Biology

Summer 2009

Mark Schemes

Issued: October 2009

MARK SCHEMES (2009)

Foreword

Introduction

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

CONTENTS

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Biology

Assessment Unit AS 1

assessing

Module 1: Cell Biology

[ASB11]

MONDAY 1 JUNE, AFTERNOON

MARK SCHEME

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold

Section A

1

	Active transport	Diffusion	Facilitated diffusion
Involves carrier molecules	✓	✗	✓
Involves energy expenditure	✓	✗	✗
Occurs against a concentration gradient	✓	✗	✗

[1] for each correct column [3] 3

2 **(a)** Condensation; [1]

(b) Between carbons 1 and 6; [1]

(c) Easier to add more glucose/faster to release glucose/compact shape; [1]

(d) Glycogen; [1]

(e) Chains held together by hydrogen bonds/many chains cross-linked; [1] 5

3 **(a)** A: chloroplast;
B: mitochondrion;
C: nucleolus;
D: cell wall; [4]

(b) Measured length is 120 mm = 120 000 μm;
actual length is 120 000 ÷ 32 000 = 3.75 μm; [2] 6

4 **(a)** First low plateau on graph/between time 0 and 12 hours; [1]

(b) Cytokinesis is taking place/cell splitting in two; [1]

(c) **Any three from**
- DNA mass is constant during G1/G2
- DNA replication doubles the mass of the DNA/takes place between 12 and 16.8 hours
- during the synthesis/S phase of cell cycle
- separation of DNA occurs during anaphase/when the chromatids are pulled apart
- DNA mass per nucleus is halved during telophase/when daughter-nuclei form [3] 5

5 **(a)** A three base code provides 64 possible codes/a two base code provides 16 codes;
needed to code for 20 different amino acids; [2]

(b) **(i)** UGG; [1]

(ii) Glutamic acid is replaced;
by valine (in the polypeptide sequence); [2]

(iii) The sequence of amino acids/primary structure in the polypeptide is different;
alters the shape of the protein/tertiary structure/active site/R group interaction; [2] 7

6 **(a)** Temperature;
more collisions between enzyme and substrate at higher temperatures (up to 37 °C)/denaturation at very high temperatures (over 37 °C);
or
enzyme/substrate concentration;
more chance of collisions between enzyme and substrate with higher enzyme/substrate concentration; [2]

(b) 200 mg digested in 50 minutes/4 mg per min;
240 mg h^{-1}; [2]

(c) **Any three from**
- the optimal pH for gastric protease is 3.0
- the optimal pH for pancreatic protease is 8.0
- at optimal pH the reaction time is shortest/at other pHs the reaction time increases
- pancreatic protease is active over a wider pH range [3]

(d) **Any two from**
- at the optimal pH the enzyme most readily attaches to the substrate (protein)/the active site is complementary to the substrate
- at other pHs the tertiary structure/active site is altered
- the enzymes are adapted to different pH conditions since their shape at that pH is optimal for substrate attachment/amino acid sequences differently affected by pH/gastric protease is adapted to the low pH of the stomach
- pH influences the ionic/hydrogen bonds (and so influences the shape of the active site) [2] 9

7 **(a)** Restriction endonuclease; [1]

(b) **Any four from**
- a plasmid (T_i plasmid) is used
- cut with the same restriction endonuclease
- "sticky ends" allow complementary end to H-bond
- DNA ligase anneals the insulin gene in the plasmid
- by helping form covalent bonds between the sugar and phosphate groups/form phosphodiester bonds
- bacteria are treated with calcium ions/heat to allow uptake of the plasmids [4]

(c) **Any two from**
- insulin is a protein and so cannot be absorbed
- ingested insulin would be digested/broken down/hydrolysed
- absorbed amino acids could not be reassembled into insulin (due to lack of a functional gene)
- other appropriate response [2]

(d) GM plants flower out of season/when other plants are not flowering/to reduce chances of cross pollination; [1] 8

Section A **43**

Section B

8 The process of osmosis:

At least three points (maximum five points)
- osmosis is the diffusion/passive movement of water
- through a differentially permeable membrane/the phospholipid layer
- from a region of high water potential to a region of lower water potential
- water potential has two components, the solution potential and the pressure potential/$\psi_{cell} = \psi_s + \psi_p$
- water potential of pure water is zero since all of the water molecules are free
- in solutions, some of the water molecules form a shell around the solutes (and are no longer free)/reference to hydration shells
- the presence of solutes causes the solute potential to be negative
- pressure potential arises as a result of fluid being in a confined space/is generally positive

Effects in animal and plant cells:

At least five points (maximum seven points)
- in a hypotonic/dilute solution cells will gain water
- animals cells will swell and eventually burst
- since animal cells have no cell wall/plant cells do not burst since they possess a cell wall
- in plant cells the protoplast swells and pushes against the cell wall
- the point at which the protoplast is just touching the cell wall is known as incipient plasmolysis
- thereafter a wall pressure/turgor develops and resists further uptake of water
- until the cell becomes fully turgid when no more water can enter
- in a hypertonic/concentrated solution cells will lose water
- animals cells may be said to crenate
- in plants cells the protoplast shrinks and pulls away from the cell wall/cells become plasmolysed
- except at points where adjacent protoplasts are joined via plasmodesmata [10]

Consider QWC:

2 marks: The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.

1 mark: The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks: The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2]

	12
Section B	**12**
Total	**55**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Biology

Assessment Unit AS 2

assessing

Module 2: Physiology and Ecology

[ASB21]

FRIDAY 12 JUNE, AFTERNOON

MARK SCHEME

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold

Section A

1

Crypts of Lieberkühn	Invaginations in the mucosa/ at the base of the villi	Contain Paneth cells/ production of new epithelial cells/production of digestive enzymes
Goblet cell	Cell within the epithelium with a goblet-shaped invagination	Secretion of mucus to protect/ lubricate the lining of the ileum
Lacteal	Blind-ending lymph vessel within each villus	Absorption/transport of fats
Muscularis mucosa	Layer of muscle at the base of the mucosa (and extending into each villus)	Movement of the villi/ improving contact with the products of digestion

[$\frac{1}{2}$] each [4] 4

2 **(a)** The air spaces facilitate the diffusion of air through the plant (air not being available from the aquatic environment);
oxygen is required for respiration in stem/root tissues; [2]

(b) Stomata are on the upper surface since this is the only surface in contact with air/if they were on the lower surface the leaf would waterlog/water loss is not an issue;
large air spaces are present for flotation; [2] 4

3 **(a)** Gross productivity equates to photosynthetic production/equivalent;
net productivity equates to photosynthesis production less respiratory usage;
[2]

(b) **Any three from**
- net productivity is positive/the leaf grows when photosynthesis exceeds respiration
- the leaf will grow between the temperatures of 0 °C and 31 °C
- greatest growth occurs at circa 20 °C
- net productivity is negative/growth ceases/leaf dies at temperatures above 31 °C [3] 5

4 **(a)** **Any two from**
- detritivores/decomposers
- competing herbivores (e.g. insects)
- plant respiration [2]

(b) Humans are feeding as primary consumers in food chain 1 (rather than as secondary consumers in food chain 2)/there is one less link in the food chain;
energy is lost in the transfer between trophic levels/during respiration/as heat; [2]

(c) Improved health of intestine/higher vitamin intake/lower cholesterol intake/reduced risk of cardiovascular problems, e.g. atherosclerosis/other appropriate response; [1]

(d) Application of artificial fertilisers to the grassland;
promotes growth of plants/greater harvest;
or
drainage schemes/improved soil structure;
encouraging aerobic soil conditions/promoting activity of nitrifying bacteria (increased nitrate levels);
or
application of herbicides to the grassland;
reduces competition from other plants;
or
application of pesticides to the grassland;
reduces grazing by other herbivores (insects, etc.);
or
strip grazing;
better utilisation of available grass by cattle;
or
selective breeding/genetic manipulation of grasses;
increased growth/hardiness/competitiveness/pest resistance; [2] 7

5 **(a)** The partial pressure of oxygen decreases at higher altitudes;
[Do not allow decreased concentration] [1]

(b) Increase in the rbc count allows an increased oxygen uptake;
compensates for the reduced saturation of haemoglobin/for reduced ppO_2; [2]

(c) Haemoglobin has a higher affinity for oxygen/oxygen dissociation curve lies to the left;
haemoglobin saturates at lower ppO_2;
or
Larger chest/lung capacity;
greater volume inhaled with each breath compensates for lower ppO_2;
or
Increased blood volume;
Increases blood oxygen carrying capacity/loading capability;
or
other appropriate response;
and its consequence; [2]

(d) Increased rbc count increases blood viscosity/reduces blood flow/clogging of capillaries/increase chance of clotting/increased risk of heart attack/ stroke; [1] 6

6 **(a)** **Any four from**
- water moves along the cell walls (by capillarity) via the apoplast pathway
- water may also move through the cytoplasm of cells via the symplast pathway
- most water moves via apoplast as it is the route of less resistance
- water may not pass through the endodermis by the apoplast pathway
- since it is prevented from doing so by the Casparian strip
- water passing through the endodermis via the symplast pathway comes under the control of the cells' metabolism
- ions are actively pumped into the xylem vessels and water follows by osmosis/water is essentially pumped into the xylem in the root [4]

(b) **Any four from**
- the evaporation of water from the mesophyll surface
- and subsequent diffusion through open stomata
- causes water to be drawn through the mesophyll cells (mostly apoplast pathway) and ultimately out of the leaf's xylem vessels
- creating a negative pressure in the leaf
- the forces of adhesion and cohesion maintain a continuous water column [4]
- the pulling up of water is known as the transpiration stream

(c) Lignification of xylem vessels prevents them from collapsing (under the negative pressures created)/lignin waterproofs the vessels; [1] 9

7 **(a)** The prey population will decrease as more is eaten by the predator; [1]

(b) **(i)** The grey seal population was larger in 2002/
other appropriate response; [1]

(ii) 60% of the prey consumed were sand eels;
116,000 × 0.6 (60% of the total mass of fish consumed in 2002);
69,600 tonnes of sand eels; [3]

(iii) **Any three from**

- proportionally less of the sand eels and cod were consumed in 2002 compared to 1985
- although sand eels and cod were the favoured species in both years
- amount of haddock, sea scorpions, plaice and other prey consumed increased in 2002
- as the main prey species populations are declining
- increased intraspecific competition in the grey seal population increased consumption of less favoured prey [3] 8

Section A **43**

Section B

8 Any ten points

Atrial systole:
- cardiac muscle cells are myogenic
- excitation wave is initiated at the SA-node
- electrical impulses discharged across atrial muscle triggers atrial systole
- electrical impulses cannot pass directly to the ventricle muscle (because of a sheet of non-conducting fibrous connective tissue between the atria and the ventricles)

Ventricular systole:
- AV-node "picks-up" the impulses from the atrial muscle
- impulses pass along the Bundle of His and Purkinje fibres to the ventricle wall
- ensures ventricular systole follows atrial systole
- ventricular systole increases pressure within the ventricles
- blood pressure increases from the base of the ventricles
- blood is forced against the AV-valves which close
- the chordae tendinae prevent the AV-valves blowing inside out (so preventing reflux of blood into the atria)
- closure of the AV-valves causes the first heart sound
- semilunar valves are blown open
- blood exits the ventricles via the pulmonary artery/aorta

Diastole:
- ventricular diastole results in a decrease in pressure within the ventricles
- semilunar valves close/as "pockets" fill with blood/ventricular pressure is less than the pressure in the artery
- closure of the semilunar valves causes second heart sound
- reflux of blood into the ventricles is prevented
- blood returns to the atria from the venae cavae or pulmonary veins (also during ventricular systole)
- as atria fill with blood, pressure increases/the AV-valves are pushed open during atrial diastole
- blood moves from atria to ventricles [10]

Consider QWC:

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1 mark: The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 mark: The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2] 12

Section B	**12**
Total	**55**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
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2009

Biology

Assessment Unit AS 3A

assessing

Module 3A: Practical Processes

[ASB31]

FRIDAY 12 JUNE, AFTERNOON

MARK SCHEME

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold

1 **(a)** Spot 3;
75 mm × 0.33 = 25 mm; [2]

(b) Spot 1 is glucose since it corresponds to the product of maltose hydrolysis;
Spot 2 is fructose since it corresponds to the other product of sucrose hydrolysis;
Spot 4 is sucrose since it not any of the others; [3]

(c) Use of Benedict's test;
no brick red precipitate produced with sucrose/remains blue; [2] 7

2 Drawing skills:
block diagram showing tissue layers;
all tissue layers drawn (completeness of drawing to show the tissues obvious in the photograph);
accurate representation of the photograph, i.e. a drawing rather than a diagram;
accurate positioning and proportionality of the tissue layers;
quality of drawing (e.g. clear – smooth and continuous – lines drawn, not sketchy); [5]

Annotations:
Any two from
1. Thick waxy cuticle on upper epidermis;
increase the waterproofing of the epidermis (reduces cuticular transpiration);
2. Double epidermal layer;
reduces loss of water from the palisade layer;
3. Epidermal hairs on lower epidermis;
reduce movement of air/maintain humid air immediately outside stomata pores/reduce diffusion gradient for moisture;
4. Few stomata;
reduces movement of air/maintain humid air immediately outside stomata pores/reduce diffusion gradient for moisture;
5. Leaf curvature;
reduces movement of air/maintain humid air immediately outside stomata pores/reduce diffusion gradient for moisture; [4] 9

3 **(a)** That the rate of transpiration is equal to the rate of water uptake (actually measured using the apparatus); [1]

(b) To prevent air collecting in the xylem vessels/air locks preventing water uptake;
the open end of the capillary tube is exposed to the air which is drawn up as the shoot takes up water;
to enable the air bubble to be moved back to the origin;
to allow the rate of transpiration to acclimatise to the surrounding conditions; [4]

(c) **(i)** **Any three from**

- transpiration is reduced when the plant is covered with a (clear) plastic bag since the air becomes more humid
- there are no air currents
- humid air reduces the diffusion gradient of moisture out of the plant/no air movement allows diffusion shells to build up
- transpiration is further reduced when the plant is covered with a black plastic bag since the stomata close in the dark
- thus the main route of water loss from the leaf is closed/only cuticular transpiration occurs [3]

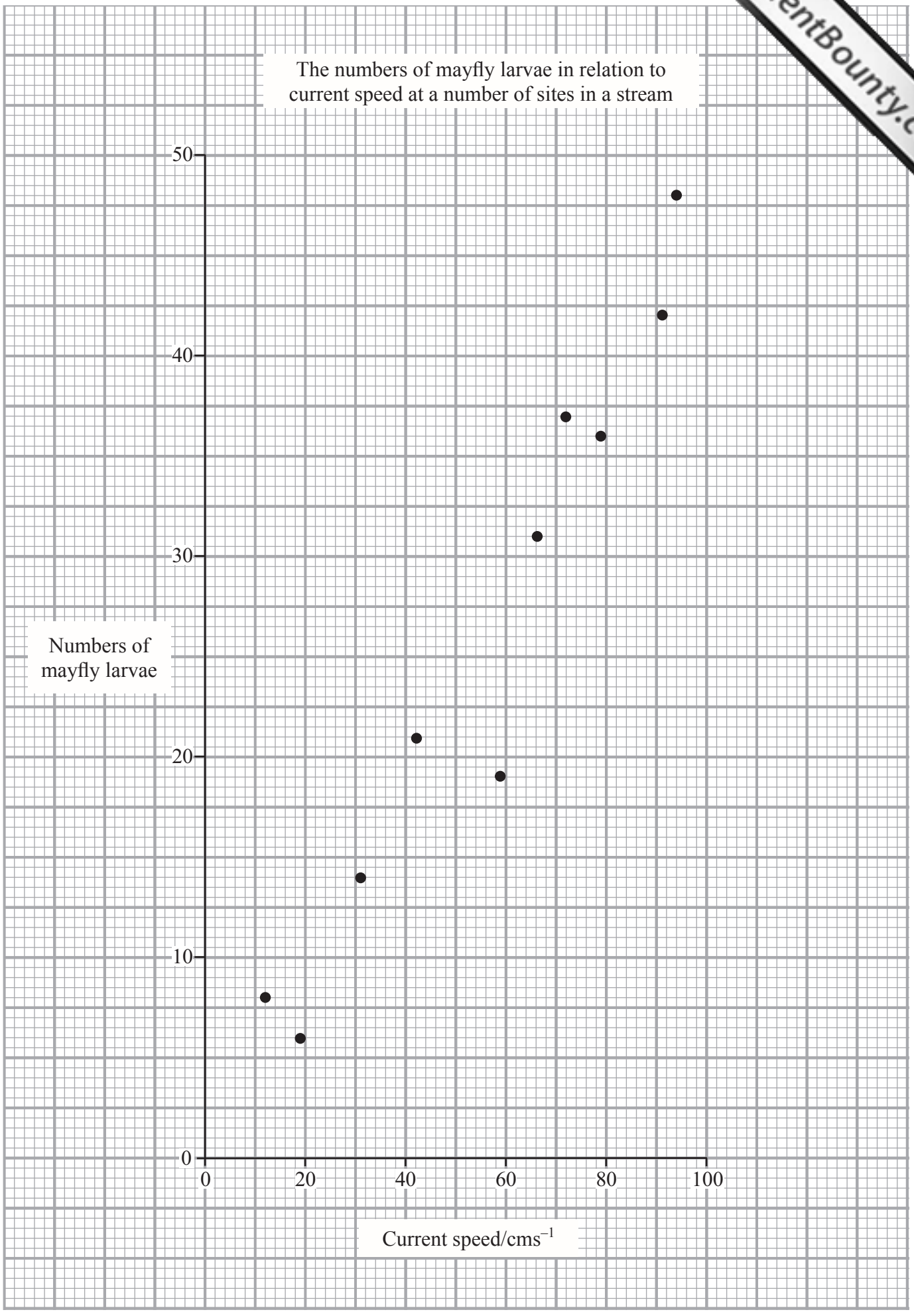
(ii) $90 \times 0.8 = 72\ mm^3$;
$72 \div 10 = 7.2\ mm^3\ min^{-1}$; [2]

(d) Different shoots may be different sized/differ in the number of leaves/ differ in the size of leaves/other appropriate response; [1] 11

4 **(a)** Caption;
scaling of the graph (using the graph paper to maximal effect);
current speed as the independent variable along the *x*-axis;
labels and units of measurement shown;
points accurately plotted;
no line/with line of best fit; [6]

(b) Greater numbers of mayfly are found where the water current is faster **[answer must indicate dependency]**;
greater oxygen availability where the current is faster;
water flowing over gills increases uptake of oxygen;
other appropriate suggestion (factor and benefit); [3]

(c) Larvae are in danger of being swept away;
may have a flattened shape to reduce resistance/may cling unto substrate with claws/may burrow into the substrate; [2] 11
other appropriate suggestion (problem and adaptation);



5 **(a)** The concentration of the urea/substrate concentration;
The amount of the ammonia produced/colour of test strip (classed 1 to 7); [2]

(b) **Any four from**

- different concentrations are produced by diluting the 2% urea solution
- same volume of concentrations of urea solutions are prepared/same volume of urease suspension is added to each concentration of urea solution
- temperature of reaction mixtures are kept constant using a water bath
- a test strip is dipped in each reaction mixture after a certain period of time from commencement of the reaction (e.g. 10 minutes)
- the test strips are compared with the colour chart/and the ammonia levels (1 to 7) recorded [4]

(c) Difficulty in judging test colour against colour chart/other appropriate response; [1]

(d) A control experiment is identical to the other set-ups except that the variable under investigation (i.e. urea concentration) is omitted (i.e. replaced with water);
Controlled variables are those not under investigation (but which influence the results) and so should be kept constant (i.e. volumes of solutions, time of testing, temperature); [2]

(e) Replication (of each urea concentration); [1] 10

Consider QWC

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Total **50**