OCR
Oxford Cambridge and RSA

Accredited

A Level Biology B (Advancing Biology)
H422/02 Scientific literacy in biology
Sample Question Paper

Date – Morning/Afternoon
Version 2.0

Time allowed: 2 hours 15 minutes

You must have:
- the Advance Notice (inserted)

You may use:
- a scientific or graphical calculator

First name	
Last name	
Centre number	
Candidate number	

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

Answer **all** the questions.

1 This question is based on the Advanced Notice article **MYOKINES**, which is an insert.

(a) IL-6 is produced by muscle cells in response to physical exercise.

(i) Using the data in **Table 1.1**, determine the mode and mean IL-6 increase after a 1.5 hour cycle ride.

Determine the mode to **one** significant figure and the mean to **three** significant figures.

mode ..... mean ..... **[3]**

(ii) Based on the data in **Table 1.1**, how valid are the following conclusions?

The duration of exercise affects IL-6 concentration in blood.

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Running has a greater influence than cycling on IL-6 concentrations.

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[4]

(b) **(i)** Suggest how IL-6 increases the uptake of glucose from the blood plasma to muscle cells **and** how it increases glucose production in the liver.

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..... **[3]**

(ii)* *"IL-6 increases the risk of type 2 diabetes*."

Evaluate the evidence that supports or contradicts the above statement.

Use information from the article **MYOKINES**. **[6]**

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Additional answer space if required.

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(c) Studies F and H in **Table 1.2** both used knockout mice.

(i) Outline **one** way in which a gene can be inactivated in the knockout procedure.

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…… **[1]**

(ii) Suggest **one** reason why mice are used as the model organism in the knockout procedure.

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…… **[1]**

(d) Cytokines produced in muscles are called myokines. IL-6 is an example of a myokine.

Cytokines can act as chemical signals between immune cells.

Describe **one** specific role of cytokines in the immune system.

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…… **[2]**

2 Haemoglobin is a molecule that is found in most vertebrate species.

(a) A student outlined the structure of haemoglobin using the description below.

A molecule of haemoglobin consists of two alpha and two beta chains. Each polypeptide chain has a coenzyme called haem associated with it. The four polypeptide chains form a 3D tertiary structure consisting of 574 amino acids.

State **two** errors the student has made in their description above and suggest how the student should correct his statement.

Error 1: .....

Correction 1: .....

Error 2: .....

Correction 2: .....

[2]

(b) People travelling to high altitudes can develop altitude sickness because they produce more haemoglobin than normal, which results in thick, viscous blood.

Many people in Tibet live more than 4 000 m above sea level, but they do not develop altitude sickness.

Tibetan people have a variant of the EPAS1 gene that causes them to maintain relatively low haemoglobin levels in their blood.

(i) Describe how the Tibetan variant of the EPAS1 gene has become common in Tibetan populations.

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..... **[4]**

(ii) What type of adaptation is represented by the maintenance of low haemoglobin levels in Tibetan people?

..... **[1]**

(iii) State and explain **one** problem that a Tibetan person with the EPAS1 gene variant might experience.

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..... **[2]**

(iv) Suggest a practical technique that could be used to compare the relative number of erythrocytes in a Tibetan population with that of another population **and** state what this technique would show.

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..... **[2]**

(c) **Fig. 2.1** shows oxygen dissociation curves for both haemoglobin and myoglobin.

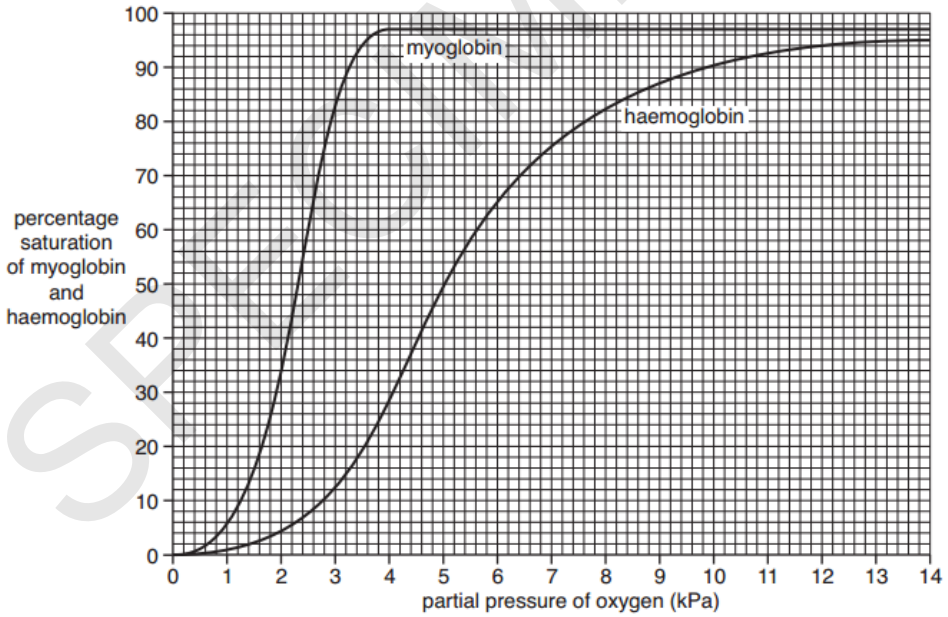

Fig. 2.1

The saturation of haemoglobin with oxygen increases as the partial pressure of oxygen is increased.

(i) Use **Fig. 2.1** to calculate the fastest rate of change in haemoglobin saturation as oxygen partial pressure increases. Determine the units for your answer.

answer …….. units ……**[3]**

(ii) Suggest where in the body a partial pressure of oxygen of 13 kPa would be found.

…….. **[1]**

(iii) **On Fig. 2.1**, sketch the oxygen dissociation curve for human fetal haemoglobin.

[1]

(iv) Explain the biological significance of the different oxygen dissociation curves of myoglobin and adult haemoglobin.

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…….. **[2]**

3 Thirty-three human blood group systems are known to exist. Two of these are the ABO blood group system and the Hh blood group system.

(a) Explain why a person whose blood group is AB expresses both A and B antigens on the surface of their red blood cells.

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…… **[2]**

(b) The Hh blood group system is controlled by one gene locus with two alleles.

The homozygous recessive genotype produces the Bombay phenotype, resulting in a very rare blood group, in which no antigen is expressed.

The Bombay phenotype is very rare. One person in 250 000 of the world's population is estimated to have the Bombay phenotype.

(i) Using the Hardy-Weinberg equations, calculate the **percentage** of the world's population who carry one copy of the recessive allele.

$$p + q = 1 \qquad p^2 + 2pq + q^2 = 1$$

Show each step in your working. Give your answer to **one significant figure**.

percentage …… **[4]**

(ii) The Bombay phenotype is more common in some regions of India, where it can occur in one in 10 000 people.

Researchers have suggested that the Bombay phenotype is more common in these regions because of the practice of endogamy, in which marriage occurs only between people within the same tribe or small social group.

Suggest why endogamy has increased the frequency of the Bombay phenotype.

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..... **[2]**

(c) A research team planned to compare the genetic diversity of the populations of three towns.

An overview of their methodology is provided below.

- Genetic analysis will be conducted on 20 people from town A, 50 people from town B and 155 people from town C.
- 100 gene loci will be analysed.

What additional information would need to be considered to improve this methodology?

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..... **[3]**

4 **(a)** Bacteria represent one of two prokaryotic domains.

The Gram staining method allows bacteria to be classified based on the thickness of the peptidoglycan layer in their cell wall.

Outline **one** risk involved in using the Gram staining method.

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…… **[1]**

(b) Like bacterial cells, palisade mesophyll cells have cell walls.

Complete **Table 4.1** to give **two** similarities and **two** differences between the structure of bacterial cells and palisade mesophyll cells **other than** the presence of a cell wall.

	Bacterial cells	**Palisade mesophyll cells**
Differences		
Similarities		

Table 4.1 **[4]**

(c) Some bacterial species aid digestion in ruminants.

Describe the role of bacteria in ruminant digestion.

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…… **[2]**

(d)* A student wrote the following statement:

> *Bacteria can be harmful and cause disease, but some bacteria can play important roles in the environment, for example, recycling nutrients. In recent years, scientists have developed techniques to genetically alter bacteria. These genetically modified bacteria have allowed us to produce useful substances.*

Using the ideas in the student's statement, outline the relationship between humans and bacteria. **[6]**

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Additional answer space if required.

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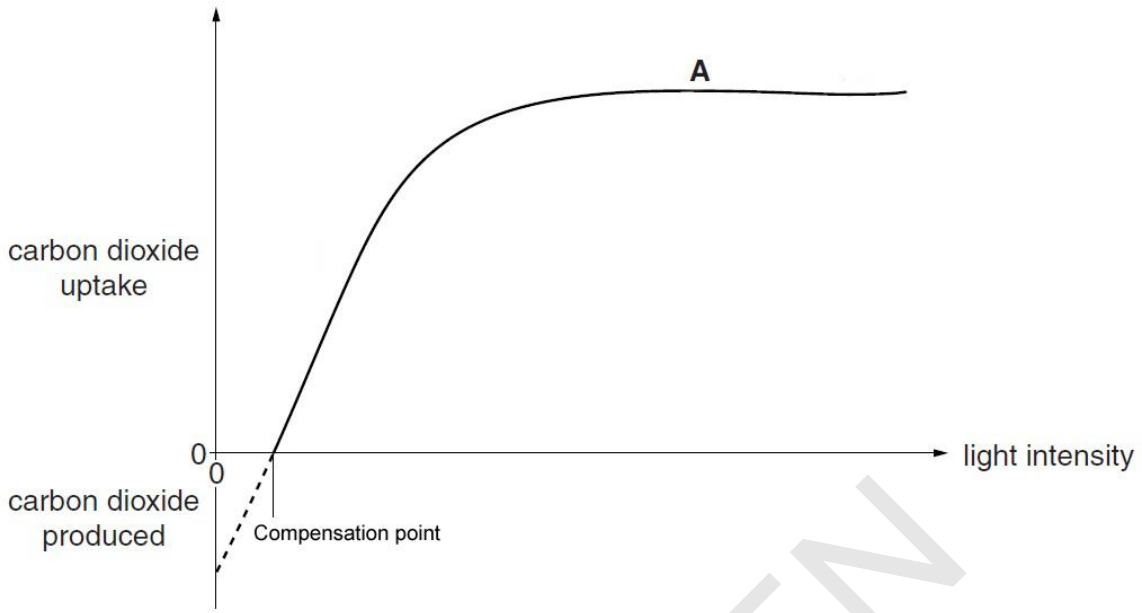

Plants experience two compensation points each day, one in the early morning and one in the evening. A compensation point is shown in **Fig. 5.1**, which illustrates the effect of light intensity on the carbon dioxide exchanged by the plant.

Fig. 5.1

(a) **(i)** Compare the rates of respiration and photosynthesis between 0 and the compensation point shown in **Fig. 5.1** above.

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…… **[1]**

(ii) Explain why the carbon dioxide uptake forms a plateau at **A** in **Fig. 5.1**.

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…… **[1]**

(b) **(i)** A student planned to compare the compensation points of two plant species.

Describe how the student could use hydrogencarbonate indicator solution to investigate the compensation points of the two species.

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…… **[3]**

(ii) The student conducted another experiment using a photosynthometer to investigate the effect of light intensity on the rate of photosynthesis.

When the light source was 0.50 m from the plant, an oxygen bubble 6.00 cm long was collected in the photosynthometer during a 2 minute period.

The diameter of the photosynthometer tube was 0.12 cm.

$$Volume\ of\ cylinder = \pi r^2 l$$

$$where\ r\ is\ radius, l\ is\ length$$

Calculate the rate of photosynthesis under these conditions.

rate of photosynthesis = …… $cm^3\ min^{-1}$ **[2]**

(c) The atmospheric carbon dioxide taken up by plants is used as a reactant in the Calvin cycle.

(i) Name **one** product of the light-dependent reactions of photosynthesis that is used as a reactant in the Calvin cycle **and** describe its role in the cycle.

Product ……

Role ……

[2]

Fig. 5.2 shows the molecular structure of the amino acid cysteine, which can be synthesised from products of the Calvin cycle.

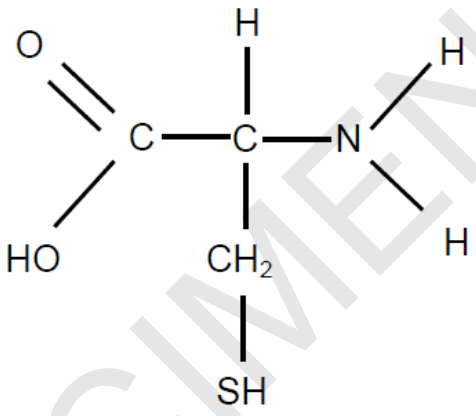

Fig. 5.2

(ii) In addition to the products of the Calvin cycle, suggest **two** mineral ions that plants would need to absorb through their roots in order to synthesise cysteine.

1 ……

2 ……

[2]

6 Plants begin flowering in response to changes in day length. This is known as photoperiodism. Some plants, such as cocklebur, are "short-day" plants. They will only begin flowering when they have experienced a relatively long period in the dark.

Table 6.1 shows the results of experiments with cocklebur plants that were kept in darkness for different lengths of time. Some of the plants were exposed to particular wavelengths of light during the experiment.

	Period in darkness (hours)	**Light exposure during the dark period**	**Result**
A	8.5	None	Flowers
B	6.0	None	No flowers
C	12.0	Flash of red light (660 nm) after 6 hours	No flowers
D	12.0	Flash of red light followed by flash of far red light after 6 hours	Flowers
E	6.5	Intense exposure to far red light (730 nm) at the beginning of the 6.5 hours	Flowers

Table 6.1

(a) (i) A student examined the data in **Table 6.1** and made the following statement:

Plants will not flower without being kept in the dark for a minimum of 8.5 hours.

Using your knowledge of the control of flowering in plants and the information in **Table 6.1**, evaluate the validity of the student's conclusion.

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…… **[3]**

(ii) With reference to **C, D** and **E** in **Table 6.1**, what conclusions can you draw about the role of phytochrome in the control of flowering in plants?

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……**[4]**

(b) The ability of cocklebur plants to time their flowering to coincide with changes in day length maximises the chances of pollination.

Flowers also show features that are adapted for particular methods of pollination.

Describe **two** ways in which flowers are adapted for wind pollination.

1 ……

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2 ……

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[2]

7 Ocular melanoma is the most common form of cancer to affect the eye. More than 400 new cases are diagnosed each year in the UK.

Fig. 7.1 shows the structure of a human eye.

Ocular melanoma can develop in the choroid, ciliary body or at **A** in **Fig. 7.1**. Diagnosis is usually made earlier for melanomas that have developed at **A**.

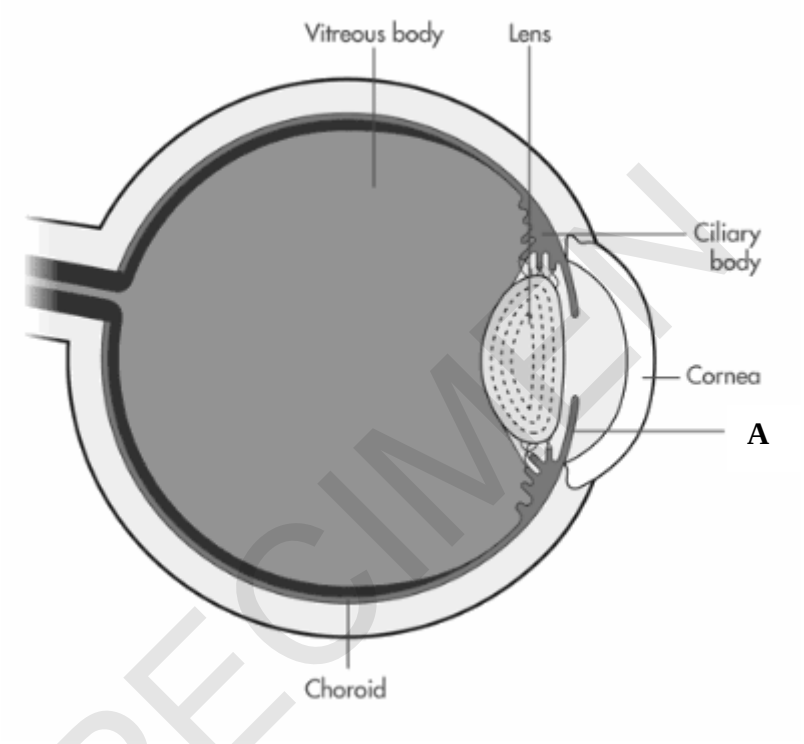

Fig. 7.1

(a) **(i)** Name the part of the eye labelled **A** in **Fig. 7.1**.

……... **[1]**

(ii) Suggest why melanomas at **A** are diagnosed earlier than other ocular melanomas.

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…… **[1]**

(iii) Cells in the choroid and **A** in **Fig. 7.1** produce a pigment called melanin.

Suggest and explain **two** functions of melanin.

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2 ……

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[2]

(b) The GNA11 gene codes for a protein that is involved in cell signalling.

(i) Outline the changes in DNA which would lead to a faulty version of the GNA11 gene.

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…… **[1]**

(ii) Suggest how the faulty version of the GNA11 gene is formed and suggest how the faulty GNA11 causes the development of ocular melanoma.

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…… **[3]**

8 Parkinson's is a neurological disorder that affects one in 500 people in the UK. **Table 8.1** lists some of the drugs available to treat Parkinson's.

Drug	Short-term effectiveness	Long-term effectiveness	Short-term side effects	Long-term side effects
Levodopa	Controls symptoms, especially late-stage symptoms	Can become less effective	Nausea, joint stiffness	Can cause a serious movement disorder called dyskinesia
Procyclidine	Relatively effective at improving early, mild symptoms such as tremors	Ineffective for symptoms such as slowness and stiffness	Possible confusion and blurred vision	Possible memory loss in older patients; can reduce the effectiveness of levodopa
Dopamine agonists	Delays and manages symptoms but less effective than levodopa	Relatively ineffective at controlling late-stage symptoms	Drowsiness, nausea	Drowsiness, nausea
Entacapone	Improves the effectiveness of levodopa	Improves the effectiveness of levodopa	Can worsen the effects of dyskinesia	Worsens dyskinesia, but this effect reduces over time

Table 8.1

(a) (i) A doctor will often decide on a 10-year treatment plan for a person who has been diagnosed with early-stage Parkinson's.

Suggest the best drugs to include in a long-term, 10-year plan, based on the evidence in **Table 8.1**.

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…… **[3]**

(ii) People with Parkinson's produce lower levels of the neurotransmitter dopamine.

Dopamine can act as either an excitatory or an inhibitory neurotransmitter.

Describe how dopamine can produce an excitatory post-synaptic potential.

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..... **[2]**

(b) Alzheimer's is another neurological disorder. A potential new drug treatment for Alzheimer's has entered clinical trials. The drug has passed the phase 2 trial in which it was tested on 50 patients.

A brief summary of the plan for phase 3 of the trial is as follows:
- The new drug is compared to the best treatment currently available.
- 70 patients receive the new drug in total, 35 from hospital A and 35 from hospital B.
- A placebo is not used.
- Blind trials are used.

(i) Discuss aspects of the planned phase 3 clinical trial and explain how each aspect is likely to affect the validity of the results.

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(ii) State **two** possible causes of Alzheimer's.

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2 ..... **[2]**

END OF QUESTION PAPER

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A Level Biology B (Advancing Biology)
H422/02 Scientific literacy in biology
Sample Advance Notice Article

For issue on or after: Date/Year

NOTES FOR GUIDANCE (CANDIDATES)

1. This leaflet contains an article which is needed in preparation for a question in the externally assessed examination H422/02 Scientific literacy in biology.
2. You will need to read the article carefully and also have covered the learning outcomes for A Level in Biology B (Advancing Biology). The examination paper will contain questions on the article. You will be expected to apply your knowledge and understanding of the work covered in A Level in Biology B (Advancing Biology) to answer this question. There are 20–25 marks available on the question paper for this question.
3. You can seek advice from your teacher about the content of the article and you can discuss it with others in your class. You may also investigate the topic yourself using any resources available to you.
4. You will not be able to bring your copy of the article, or other materials, into the examination. The examination paper will contain a fresh copy of the article as an insert.
5. You will not have time to read this article for the first time in the examination if you are to complete the examination paper within the specified time. However, you should refer to the article when answering the questions.

This document consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Insert for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

MYOKINES

Cytokines are proteins that send signals between cells. One of their principal functions is cell-signalling within the immune system. Scientists have discovered that some cytokines are produced by muscle fibres. These proteins have been named myokines. The myokine that has been studied the most is interleukin-6 (IL-6). Recent research has demonstrated that physical exercise stimulates the production of IL-6, which is a molecule that has been linked with changes in metabolism.

The effect of exercise on IL-6 production

Exercise can significantly increase IL-6 concentrations in blood plasma. Runners in a 246 km "Spartathlon" race showed an 8 000-fold increase in IL-6 levels. Few of us would attempt an extreme event like the Spartathlon, but milder exercise can also raise IL-6 levels. Many different studies have indicated that relatively short bouts of running or cycling will change the blood plasma concentrations of IL-6. Table 1.1 shows the results of some of these studies.

Cycling			Running		
Duration of exercise in each study (hr)	**IL-6 increase (fold change)**	**Number of participants in each study**	**Duration of exercise in each study (hr)**	**IL-6 increase (fold change)**	**Number of participants in each study**
0.3	2	7	0.2	1	12
0.3	1	9	0.9	9	12
0.3	2	7	1.0	4	7
0.4	1	9	1.0	9	7
0.4	2	8	1.5	4	8
0.5	2	9	1.5	8	8
0.7	1	16	1.5	20	10
0.8	3	6	1.6	10	10
1.0	2	7	2.5	8	30
1.0	2	17	2.5	25	10
1.0	5	8	2.5	29	7
1.0	5	7	2.5	30	9
1.0	5	9	2.5	52	10
1.0	9	8	2.5	109	16
1.5	2	9	3.0	10	16
1.5	2	8	3.0	50	6
1.5	3	11	3.3	63	16
1.5	6	7	3.5	88	18
2.0	2	6	3.5	92	10
2.0	3	6	3.5	128	10
2.0	4	8	3.7	43	18
2.0	8	6	4.5	42	50
2.0	11	8	6.0	4	19
2.0	20	6	9.1	6	6
2.0	38	8	9.8	28	13
2.5	16	15	9.9	29	7
2.5	24	10	26.3	126	60
3.0	8	18			
3.0	13	8			
3.0	26	6			

Table 1.1 Changes in IL-6 concentrations in the blood immediately after exercise

The use of PCR has revealed that exercise increases the transcription rate of the IL-6 gene. Within 30 minutes of exercise, IL-6 mRNA concentrations increase in skeletal muscle. Although it is clear that IL-6 levels increase during and immediately after exercise, the story is different in the long-term. Several studies have shown that regular physical activity decreases baseline concentrations of IL-6 in the blood plasma when the people being studied are at rest.

Short-term effects of IL-6 on carbohydrate metabolism

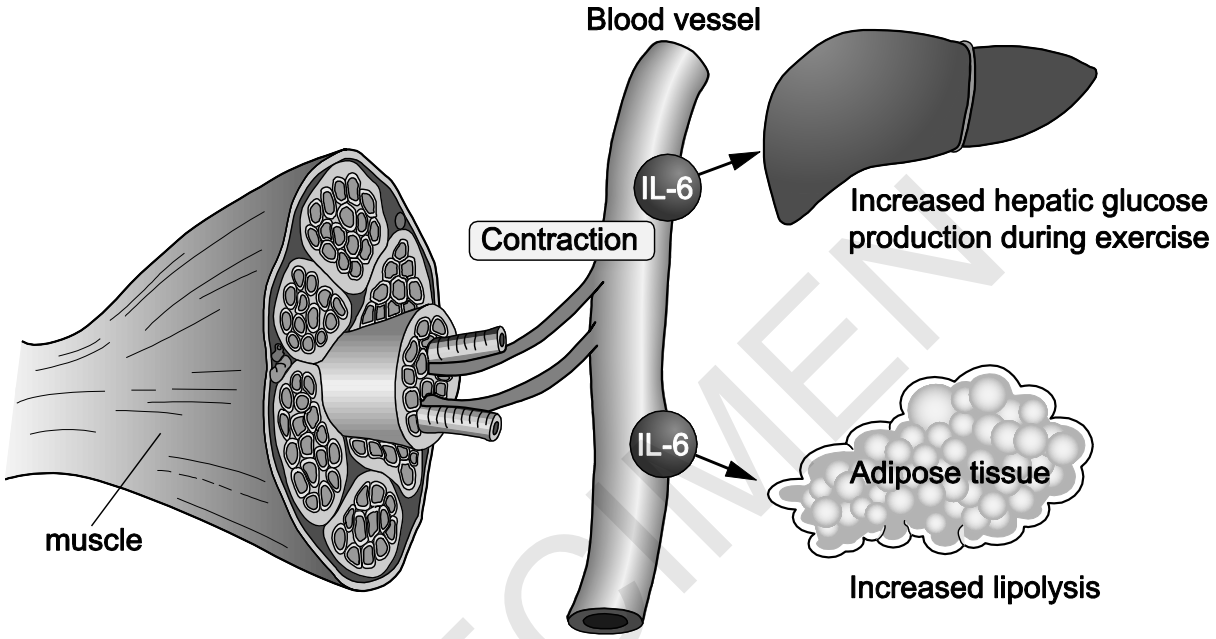

Fig. 1.1

Fig. 1.1 illustrates some of the effects of IL-6 when it is produced by muscles during exercise. IL-6 causes skeletal muscle cells to take up more glucose from the blood and to use more of their lipid reserves in respiration. IL-6 can also act like a hormone by travelling through the blood to produce effects in other tissues (e.g. adipose tissue and the liver).

Long-term effects of IL-6 on carbohydrate metabolism

The immediate effects on glucose metabolism of IL-6 produced during exercise are clear, but the long-term effects of this myokine are less certain. Whether IL-6 has a positive or negative effect on metabolism in the long-term is a controversial issue.

Table 1.2 lists various studies that have examined the effect of IL-6 on glucose metabolism and diseases such as diabetes.

Study	Type of study	Method	Results
A	In vitro experiment	Cultures of human muscle cells treated with insulin and IL-6.	The presence of IL-6 increased the uptake of glucose into muscle cells.
B	In vivo experiment	Mice were injected with high concentrations of IL-6.	Mice injected with IL-6 showed a reduced ability to take up glucose into muscle cells. The ability of insulin to stimulate glucose uptake from the blood was reduced.
C	Clinical observations	Blood analysis of patients with obesity and angina.	Concentrations of IL-6 in the blood of patients with obesity and angina were higher than concentrations in healthy people.
D	Clinical observations	Blood analysis.	As the blood concentration of IL-6 increases, the risk of developing type 2 diabetes increases.
E	In vivo experiment	A comparison of two groups: one that exercised regularly and one that did not, followed by an analysis of blood glucose concentration.	People who exercised regularly became more sensitive to insulin.
F	Gene knockout	Inactivation of the IL-6 gene in mice, and a comparison to a control group that was able to produce IL-6.	Mice that were unable to produce IL-6 were more likely to develop obesity and glucose intolerance.
G	In vitro experiment	Fat-storing cells from mice were exposed to another cytokine called TNF-alpha.	TNF-alpha decreased the ability of insulin to stimulate glucose uptake in the cells. TNF-alpha reduced the number of insulin receptors produced by the cells.
H	Gene knockout	Inactivation of the IL-6 gene in mice, and a comparison to a control group that was able to produce IL-6.	Mice that were unable to produce IL-6 exhibited increased concentrations of TNF-alpha in their blood.
I	Clinical trials	Patients with rheumatoid arthritis were given a monoclonal antibody that blocked the IL-6 receptor. This stopped IL-6 from producing any effects.	Cholesterol and glucose concentrations in the blood increased in patients with blocked IL-6 receptors.

Table 1.2

END OF ADVANCE NOTICE ARTICLE

OCR
Oxford Cambridge and RSA

A Level Biology B (Advancing Biology)
H422/02 Scientific literacy in biology
Sample Advance Notice – Teacher Instructions

To be read on receipt

To prepare candidates for the examination taken on Date/Year

This document consists of **2** pages.

NOTES FOR GUIDANCE

1. The Advance Notice material should be issued to candidates on or after the date shown on the front cover of the candidate instructions sheet at the discretion and convenience of the centre. Candidates can be given the material at any point, but it is suggested that this should be at least four weeks before the examination date.
2. Candidates will need to read the article carefully. Time can be built into the teaching programme to introduce the article content. Candidates should be able to discuss the article freely and be given support and advice in the interpretation of the content so that they are able to answer the questions based on the article in the externally assessed examination. Candidates should also be encouraged to investigate the topics covered in the article for themselves.
3. Candidates will be expected to apply their knowledge and understanding of the content in A Level in Biology B (Advancing Biology) to questions based on the article. There are 20–25 marks available on the paper for this question.
4. The Advance Notice material must not be taken into the examination. The examination paper H422/02 will contain a fresh copy of the article, as an insert. Candidates should be reminded that they do not have sufficient time during the examination to read the article for the first time. They should, however, refer to the article printed in the insert in the examination paper to help them to answer the questions.

[601/4720/9] DC (…)

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OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

A Level Biology B (Advancing Biology)

H422/02 Scientific literacy in biology

SAMPLE MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 100

This document consists of 20 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

- Read through the whole answer from start to finish.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:
  Higher mark: A good match to main point, including communication statement (in italics), award the higher mark in the level
  Lower mark: Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

Level of response questions on this paper are **1(b)(ii)** and **4(d)**.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)	(i)	mode = 2 ✓ mean = 3.11 ✓✓	3	 (2x9)+(2x8)+(3x11)+(6x7) / 35 = 3.11 **Award one mark** if a candidate has clearly taken the number of participants into account but has made an error in the calculation
		(ii)	*General points* *Idea of* valid conclusions would require information about the intensity of exercise ✓ *Idea that* (named) statistical test would confirm conclusion ✓ *Duration (up to a maximum of 2 marks)* positive correlation (suggests the conclusion is valid) ✓ many studies / repeats / AW, improves validity ✓ *idea of* relationship / correlation, clearer for cycling (than running) ✓ *Running vs cycling (up to a maximum of 2 marks)* *idea that* (conclusion is valid because) for a given duration, IL-6 increases more with running (than cycling) ✓ the number of participants varies, which makes comparison difficult ✓	4	**The general point marks can be scored for either section, but can only be scored once** **ALLOW** 'meta-analysis' for 'many studies' **ALLOW** calculated example
	(b)	(i)	**Any 3 from:** *Glucose uptake* (IL-6) increases / AW, insulin production ✓ (IL-6) increases / AW, insulin receptor sensitivity (on muscle cells) ✓ *Glucose production* (IL-6) increases / AW, glucagon production ✓ glycogen converted to glucose (in liver cells) ✓	3	 **ALLOW** acts like a hormone **ALLOW** glycogenolysis

Question			Answer	Marks	Guidance
		(ii)*	**Level 3 (5–6 marks)** Candidate's evaluation demonstrates excellent judgement of the data, providing conclusions that address all the significant issues. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Judgement is made on a range of aspects of the data, but conclusions are not comprehensive. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Simple conclusions are made, drawing on limited aspects of the data. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.	**6**	**Examples of relevant scientific points at L3 (in addition to points at L1 and L2)** *experimental & epidemiological evidence* • discussion of *in vitro* v *in vivo* experiments (e.g. the conflicting results in A and B; *in vitro* experiments might lack important factors, for example, found in *in vivo*) • discussion of the link between TNF and IL-6 (e.g. G and H. IL-6 could, for example, be high in certain cases because it has a defensive role against TNF) i.e. detailed links made between studies in Table 1.2 and impact on diabetes risk • in depth discussion of correlation v causation (e.g. C and D show correlation but not causation). *biological knowledge* • detailed understanding of the causes and symptoms of type 2 diabetes. **Examples of relevant scientific points at L2 (in addition to points at L1)** *experimental & epidemiological evidence* • discussion of correlation v causation • linking exercise, low baseline IL-6 and possible effects on diabetes risk • quite detailed links made, some in detail, between studies in Table 1.2 and the impact on diabetes risk. *biological knowledge* • good understanding of the causes and symptoms of type 2 diabetes.

Question			Answer	Marks	Guidance
					Examples of relevant scientific points at L1 *experimental & epidemiological evidence* • basic links made between studies in Table 1.2 and the impact on diabetes risk. *biological knowledge* • some understanding of the causes and symptoms of type 2 diabetes.
	(c)	**(i)**	*idea that* (gene is) replaced / disrupted / AW, with, artificial / synthetic / AW, DNA ✓	**1**	
		(ii)	**Any 1 from:** (mice have) similar, genome / DNA sequences, to humans ✓ (mice have) similar, metabolism / physiology, to humans ✓ (mice are) easy / cheap, to, house / manipulate / breed ✓	**1**	
	(d)		chemotaxis ✓ attraction of neutrophils (to site of infection) ✓ **OR** cause / stimulate, B cells / T cells, to, differentiate / proliferate ✓ cause / stimulate, B cells to release antibodies ✓ **OR** inhibit virus replication ✓ activation / AW, of T killer cells ✓	**2**	**ALLOW** (undergo) clonal expansion
			Total	**20**	

Question			Answer	Marks	Guidance
2	(a)		error = coenzyme, correction = prosthetic group ✓ error = tertiary, correction = quaternary ✓	2	**ALLOW** 'cofactor' for 'prosthetic group' **ALLOW** '3°' for 'tertiary' and '4º' for 'quaternary'
	(b)	(i)	selection pressure, (is) high altitude / risk of altitude sickness ✓ *idea of* individuals with, mutated gene / allele / Tibetan variant, will survive better at high altitude / have selective advantage ✓ *idea that* allele frequency for Tibetan EPAS1 increases over many generations ✓ natural selection ✓	4	
		(ii)	physiological ✓	1	**ALLOW** biochemical
		(iii)	**Any 2 from:** *idea of* less oxygen able to be transported in their blood ✓ (the potential for) less / reduced / AW, respiration ✓ partial pressure / concentration, of oxygen is lower at high altitude ✓	2	
		(iv)	(erythrocyte cell count using) haemocytometer ✓ measures / AW, concentration of (red blood) cells ✓ **OR** flow cytometry ✓ measures / AW, volume / morphology / concentration, of (red blood) cells ✓	2	**ALLOW** numbers of / types of protein in / amount of protein in, (red blood) cells

Question			Answer	Marks	Guidance
	(c)	(i)	Answer (in a range between) = 20 - 22 ✓✓ Units = % kPa^{-1} ✓	3	**1 mark can be awarded** if there is evidence that the candidate has identified the steepest part of the slope as (any value between) 3.6 - 4.6 kPa **ALLOW** % per kPa
		(ii)	lungs / alveoli ✓	1	
		(iii)	curve placed anywhere between the myoglobin and haemoglobin curves ✓	1	The fetal haemoglobin curve can merge with either of the other two lines after 10 kPa
		(iv)	myoglobin has, greater affinity / AW, for oxygen (at the same kPa) ✓ *idea that* oxygen will be transferred to myoglobin / muscle, from (adult) haemoglobin ✓	2	
			Total	18	

Question			Answer	Marks	Guidance
3	(a)		**Any 2 from:** (A and B are) codominant ✓ *idea that* both genes are transcribed ✓ *idea that* both antigen proteins are produced ✓	2	
	(b)	(i)	q = √ 0.000004 = 0.002 ✓ p = 1 – 0.002 = 0.998 ✓ 2pq = 2 x 0.998 x 0.002 = 0.003992 ✓ % to 1 significant figure = 0.003992 x 100 = 0.4 % ✓	4	**Correct answer of 0.4% scores all 4 marks** **ALLOW ecf** for MP 2-4
		(ii)	**Any 2 from:** small / decreased, gene pool ✓ inbreeding ✓ genetic drift ✓ population / genetic, bottleneck ✓	2	**ALLOW** decreased genetic variation **IGNORE** interbreeding **IGNORE** references to (increased) homozygous recessive genotypes because this is implied by information provided earlier in the question
	(c)		**Any 2 from:** *idea that* ideally sample sizes from each town should be, the same / more similar ✓ *idea of* avoiding bias / random selection ✓ *idea of* using the same, sampling method / approach, for each town ✓ calculation method described or named ✓ what gene loci will be analysed ✓	3	e.g. heterozygosity , proportion of polymorphic loci
			Total	11	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>Any 1 from:
crystal violet / methylene blue / iodine / potassium iodide / ethanol, is an irritant ✓
crystal violet is toxic / carcinogenic ✓
risk of burns when using heat source ✓
idea that bacterial species must be identified correctly to ensure they are not pathogenic ✓</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th></th><th>Bacterial cells</th><th>Palisade mesophyll cells</th><th></th></tr>
<tr><td rowspan="7">Differences</td><td>Smaller ribosomes</td><td>Larger ribosomes</td><td>✓</td></tr>
<tr><td>No membrane-bound organelles</td><td>Membrane-bound organelles</td><td>✓</td></tr>
<tr><td>No chloroplasts</td><td>Chloroplasts</td><td>✓</td></tr>
<tr><td>Circular DNA</td><td>DNA in chromosomes</td><td>✓</td></tr>
<tr><td>Cell wall contains peptidoglycan</td><td>Cell wall contains cellulose</td><td>✓</td></tr>
<tr><td colspan="2">Pili</td><td>No pili ✓</td></tr>
<tr><td rowspan="3">Similarities</td><td colspan="2">Cytoplasm / cytosol</td><td>✓</td></tr>
<tr><td colspan="2">Ribosomes</td><td>✓</td></tr>
<tr><td colspan="2">Plasma / cell surface, membrane</td><td>✓</td></tr>
</table>
</td><td>4</td><td>2 marks maximum for differences
2 marks maximum for similarities
1 mark maximum per row

ALLOW 70S ribosomes (bacterial) and 80S ribosomes (palisade mesophyll)</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Any 2 from:
(bacteria) hydrolyse / digest, cellulose ✓
(bacteria have) cellulase ✓
(bacteria found) in rumen ecosystem ✓
symbiosis / symbiotic relationship ✓</td><td>2</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
(d)*	**Level 3 (5–6 marks)** Candidate addresses all the ideas in the student's statement making clear connections between humans and bacteria and using examples to illustrate their answers. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Candidate addresses some of the ideas in the student's statement making some connections between humans and bacteria and using at least one example to illustrate their answers. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Simple comments about humans and bacteria made with connections not always made. Little exemplification. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.	6	**Examples of relevant scientific points:** **Benefits from the use of bacteria** • nitrogen cycling – including the role of putrefying, denitrifying, nitrogen-fixing and nitrifying bacteria. All benefitting food production • biotechnology – including genetic modification techniques that lead to benefits due to the production of drugs, insulin, the broadening of scientific research. Ideas might include the palindromic nature of recognition sequences for restriction enzymes and the need for reporter genes on plasmids. **Challenges from interactions with bacteria** • communicable diseases – including general mechanisms of pathogenicity of bacteria, causes, transmission, mode of infection, symptoms, treatment e.g. TB • the use of antibiotics and antibiotic resistance, including reference to TB and MRSA. **Examples of technical terms that could be used in answers:** Mycobacterium, communicable disease, prevalence, incidence, denitrification, saprotrophs, nitrification, named bacterial taxa, restriction enzymes, palindromic sequence, plasmid.
	Total	**13**	

Question			Answer	Marks	Guidance
5	(a)	(i)	(rate of) respiration , greater than / higher than , (rate of) photosynthesis ✓	1	**ALLOW** reverse argument
		(ii)	*Idea that* named factor is limiting (rate of) photosynthesis / light intensity is no longer limiting (rate of) photosynthesis ✓	1	**ALLOW** carbon dioxide and temperature as named limiting factors
	(b)	(i)	**Any 3 from:** *idea of* varying light intensity ✓ named control variable ✓ *idea that* hydrogencarbonate changes colour as , pH / CO_2 concentration , changes ✓ (hydrogencarbonate indicator is) yellow at , low pH / high CO_2 concentration ✓ (hydrogencarbonate indicator is) purple at , high pH / low CO_2 concentration ✓ AVP ✓	3	 e.g. same temperature / volume of hydrogencarbonate indicator solution / mass of plant e.g. use of colorimeter
		(ii)	0.03 (cm^3 min^{-1}) ✓✓	2	**ALLOW** correct calculator value or answer rounded correctly to any number of significant figures **AWARD 1 mark** for initial correct calculation (6 x (π x 0.06^2)) if the answer has not been divided by 2 to give a rate per minute.
	(c)	(i)	(product) ATP ✓ (role) provides / AW , energy ✓ **OR** (product) reduced NADP ✓ (role) donates hydrogen / provides reducing power / converts GP to TP ✓	2	**DO NOT CREDIT** produces energy **ALLOW** NADPH
		(ii)	sulphate / SO_4^{2-} ✓	2	

Question			Answer	Marks	Guidance
			nitrate / NO_3^- / ammonium / NH_4^+ ✓		
			Total	**11**	

Question			Answer	Marks	Guidance
6	(a)	(i)	(*lacks validity because*) *idea of* different plant species require different periods of darkness ✓ *idea of* no evidence that periods between 6.5 and 8.5 hours have been tested ✓ *idea that* exposure to far red light reduces the minimum darkness period ✓	3	**ALLOW** "conclusions can only apply to cocklebur"
		(ii)	**Any 4 from:** (high concentration of) P_R is required for flowering ✓ darkness , converts / AW , P_{FR} to P_R ✓ **C** red light , produces / AW . P_{FR} **AND** no flowers ✓ **D** *idea of* far red light , reverses / cancels , effect of red light ✓ **E** *idea of* far red light , produces / AW , P_R **AND** reduces critical period / length of darkness required ✓	4	**ALLOW** description of P_R as "the phytochrome produced by far red light / darkness" and a description of P_{FR} as "the phytochrome produced by red light."
	(b)		**Any 2 from:** *Idea of* stigmas , large and feathery / outside the flower ✓ dry / light, pollen grains ✓ large anthers / large amount of pollen produced ✓	2	
			Total	9	

Question			Answer	Marks	Guidance
7	(a)	(i)	iris ✓	1	
		(ii)	visible externally / AW ✓	1	
		(iii)	**Any 2 from:** (choroid), absorbs light, (giving) clearer image / AW ✓ (iris), absorbs light, (allowing) amount of light entering the eyeball to be controlled / AW ✓ protection from, UV / dangerous, radiation ✓	2	**ALLOW** choroid reduces light reflection (within eyeball)
	(b)	(i)	*idea of* changes in, base / nucleotide / triplet, sequence ✓	1	
		(ii)	mutation / AW, to proto-oncogene ✓ (leads to) faulty, receptor / growth factor ✓ (leads to) uncontrolled cell division ✓	3	**ALLOW** forms oncogene **DO NOT ALLOW** (cell) signalling molecule because this is referenced in the stem
			Total	8	

Question			Answer	Marks	Guidance
8	(a)	(i)	**Any 3 from:** *Idea that* levodopa is used, late in treatment plan / when symptoms become worse **OR** dosage of levodopa increased over time ✓ to delay / AW, onset of dyskinesia ✓ procyclidine / dopamine agonists, given in early stages ✓ *idea of* use of entacapone in late stages (with levodopa) needs to be monitored (to avoid worsening dyskinesia) ✓	3	
		(ii)	**Any 2 from:** binds / attaches, to receptor on postsynaptic, membrane / neurone ✓ sodium channels open ✓ sodium, moves / diffuses, into postsynaptic neurone ✓	2	
	(b)	(i)	**Any 3 from:** *idea that* 70 people is too low for a phase 3 trial (therefore reducing validity) / phase 3 trial should involve, hundreds / thousands, of people ✓ *idea that* (sample size of 70 people is) unlikely to differentiate new drug's performance from current drug (therefore reducing validity) ✓ blind trials (improve validity by), reducing / removing, bias (of patients) ✓ double blind trials (would be), improvement / AW, by removing bias of scientists ✓ *idea that* placebo cannot be used because it would be unethical in a phase 3 trial ✓	3	
		(ii)	**Any 2 from:** genetics ✓ head injuries ✓ age ✓ smoking ✓	2	
			Total	**10**	

Summary of updates

Date	Version	Change
January 2019	2.0	Minor accessibility changes to the paper: i) Additional answer lines linked to Level of Response questions ii) One addition to the rubric clarifying the general rule that working should be shown for any calculation questions