IGC HK EXAM - WJEC

WJEC & Eduqas - Biology

Mock 1 Practice Paper

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Please note that mark schemes are at the end of each section.
Page number of each section are shown in the index page.
Layout of each section page are shown as Title, Ranking of Relevant Level, and WJEC specification point covered.

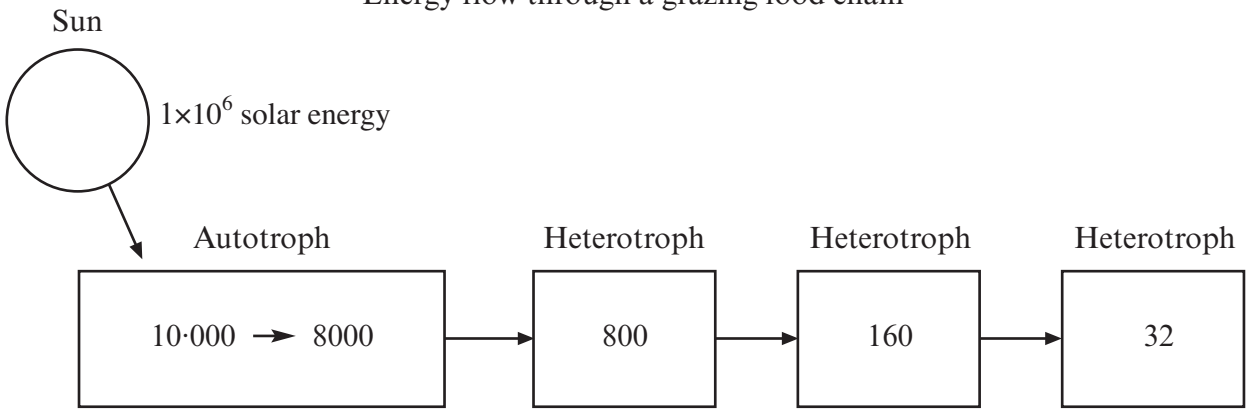
BY5 - WJEC
10/10
3.5 & 3.6

Examiner only

7. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Using the diagram below explain what is meant by the flow of energy through an ecosystem. Describe how energy is lost at each stage and comment on the efficiency of the transfer. Suggest reasons for any differences in efficiency which you may observe. [10]

Energy flow through a grazing food chain



Figures represent $kJm^{-2}yr^{-1}$

Examiner only

8. *(a)* Explain what is meant by the following terms:

(i) Succession [2]

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(ii) A climax community. [1]

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(b) Heather plants are small shrubs and are the dominant species in the climax community of some moorlands. The structure and shape of the heather plant changes as it ages. This results in changes in the species composition of the community. A large area of moorland was burnt leaving bare ground. The table shows four stages of succession in this area.

Time after burning/ years	Appearance of heather plant	Mean percentage cover of heather	Other plant species present
4		10	Many
12		90	Few
19		75	Several
24		30	Many

Explain why the number of other plant species decreases between 4 and 12 years after burning. [2]

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(c) The rate at which a heather plant produced new biomass was measured in g per kg of heather per year. As the plant aged the ratio of leaves to woody parts decreased. Use the information in the table to explain why. [3]

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(Total 8 marks)

Examiner only

9. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Define the terms conservation and extinction. Discuss the importance of the conservation of genetic sources. Describe steps conservationists have taken to prevent the extinction of endangered species. [10]

Examiner only

2. The Grand Banks is an area of sea off the coast of Newfoundland in Canada. It was once one of the most productive fishing grounds in the world for Atlantic cod.

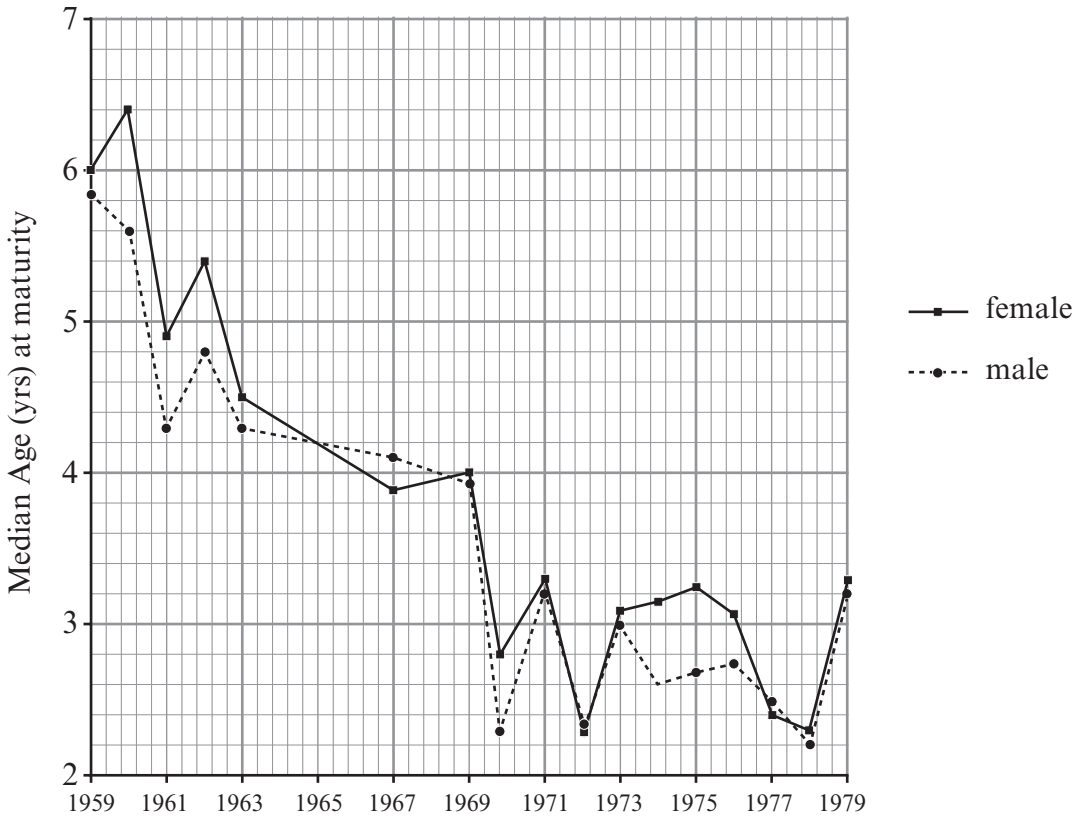
The cod was fished heavily for about 50 years.

About 60% of the total cod population of reproductive age was harvested annually.

Cod fishing in the Grand Banks was closed in 1992 but by then the population was less than 1% of what it had been.

Cod grow evenly throughout their life.

The cod that remained when fishing was finally closed were much smaller and grew more slowly than the cod that lived in the Grand Banks several decades previously.



Graph to show the median age of cod at sexual maturity in the same location during the time of heaviest fishing.

Examiner only

(a)

(ii) The cod fisheries have been closed for nearly 20 years but there has been little change in the phenotype and no population recovery. Suggest why there has been little change in the phenotype and no population recovery. [3]

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Turn over.

Examiner only

(b) Other than restricting the mesh size of nets, give **two** other methods which are used to prevent overfishing. [2]

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(c) (i) One solution to overfishing is aquaculture or fish farming.
Give **two** problems associated with producing fish in this way. [2]

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(ii) Wild trout are diploid **(2n)**. Some trout used in fish farming are triploid **(3n)**.
Suggest why triploid trout are infertile. [4]

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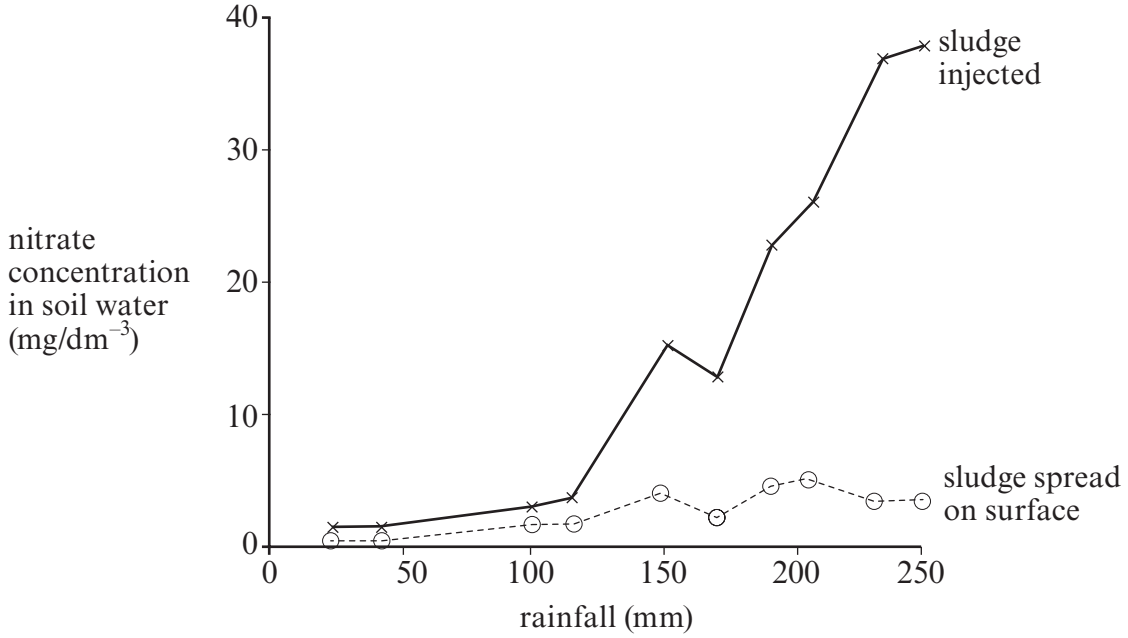
Examiner only

5. The treatment of sewage produces sludge as a product. This sludge contains high concentrations of nitrogen compounds such as nitrates and ammonia.

Experiments have been carried out into the leaching of nitrate from grassland to which sludge has been applied. The sludge was applied to two areas of grassland. On one area it was spread onto the surface whilst in the other it was injected at various points across the area.

The rate of leaching was measured by taking samples from the water flowing through the soil and measuring the concentration of nitrate in them after different volumes of rainfall had fallen.

The graph below shows the results obtained.



(a) (i) State **two** precautions that should be taken to ensure that the results are reliable. [2]

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(ii) Using the information in the graph describe fully the relationship between the leaching of nitrate and rainfall. [2]

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Examiner only

(iii) Using the data from the graph opposite, what advice would you give to a farmer as to the best time to apply sludge to the farmer's field for maximum benefit? [1]

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(b) The presence of high nitrate levels in rivers can lead to eutrophication. Briefly describe why eutrophication can result in the death of fish and many invertebrates in a river. [3]

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(c) Describe and explain what type of crops a farmer could grow to increase the nitrate level in the soil without using fertilisers, such as sludge. [3]

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Examiner only

6. *(a)* Explain what is meant by the term *gross primary productivity*. [1]

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(b) It has been found that an increase in temperature has a greater effect on the rate of respiration in a plant than on the rate of photosynthesis.
Using this information, explain what effect an increase in temperature has on the net primary productivity. [2]

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(c) (i) Give **two** ways by which energy is lost as it passes from one trophic level to the next. [2]

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(ii) Consumption efficiency is defined as the percentage of net production at one trophic level that is consumed by the next.
Suggest why the consumption efficiency of herbivores is much lower than that of carnivores. [2]

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(d) Tropical marine or tropical lake ecosystems generally have one or two more trophic levels than terrestrial ecosystems. Suggest **one** reason why this is the case. [1]

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Examiner only

6. *(a)* (i) Describe what is meant by the photosynthetic efficiency of a plant. [1]

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(ii) Distinguish between Gross Primary Production (GPP) and Net Primary Production (NPP). [1]

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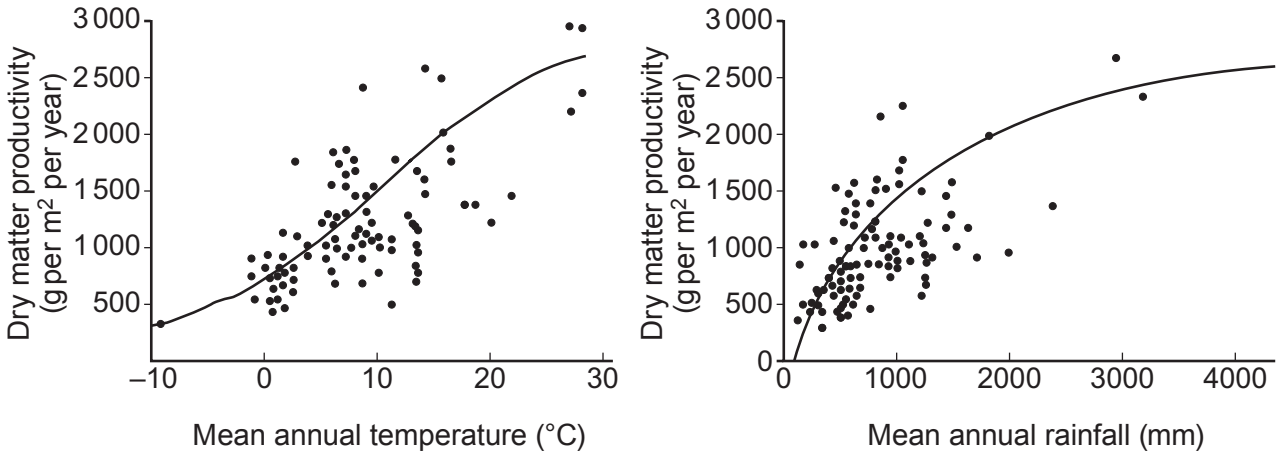
(b) The rate of Primary Production is called Primary Productivity. The graphs below show the effect of two environmental factors on Primary Productivity.



(i) Describe the relationship between productivity and the **two** abiotic factors shown. [1]

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(ii) Use this information to suggest why tropical rain forest is one of the most productive ecosystems in the world. [1]

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Examiner only

(c) Estimates of Net Primary Productivity for different types of ecosystem are given in the table below.

Type of Ecosystem	Average NPP (kJ/m^2/yr)
Tropical rain forest	35 280
Temperate forest	24 360
Northern coniferous forest	15 120
Woodland and shrubs	10 920
Lakes and streams	9 240
Agricultural crops	8 820
Desert	840

The average value for the solar energy striking the Earth's atmosphere is estimated at 4.41×10^7 kJ/m^2/yr.

The ecological efficiency of tropical rain forest is $(35\,280 \div 4.41 \times 10^7) \times 100 = 0.08$

(i) Calculate the ecological efficiency of agricultural crops. [2]

Answer .....

(ii) Calculate the loss in Net Production for one year, if an area of tropical rain forest the size of Wales (21 785 km^2) was cleared and used to grow sugar cane (an agricultural crop). [2]

Answer .....

Turn over.

Examiner only

(iii) Explain why keeping cattle on the cleared land would be less efficient than growing crops. [2]

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(iv) Suggest a negative impact on the Earth's atmosphere of keeping large numbers of cattle. [2]

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(v) Suggest why growing sugar cane for producing biofuels could be considered carbon neutral. [1]

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Examiner only

Answer **all** *questions.*

1. *(a)* Bananas are grown on large plantations in tropical regions such as South America, using monoculture production methods.

(i) Define the terms:

I. biodiversity; [1]

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II. monoculture. [1]

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(ii) Describe and explain the effects of banana production on biodiversity in South America. [2]

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(b) Multinational banana companies own plantations, sea transport, ripening facilities and distribution networks in countries where the bananas are consumed. The data below was published by one such company.

	Banana Carbon Footprint (Farm-to-Retail Distribution Centre) /kg	
	USA	Europe
Per box (18kg)	18	24

(i) Define the term *'carbon footprint'*. [1]

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(ii) Explain the difference in the values for USA and the values for Europe. [2]

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Examiner only

(c) In an attempt to reduce their carbon footprint for their USA operation, the company switched to transporting the bananas part of the way by rail, instead of taking them the whole way by truck.

(i) Explain why this would reduce the carbon footprint. [2]

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(ii) How would this change benefit the environment? [1]

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Turn over.

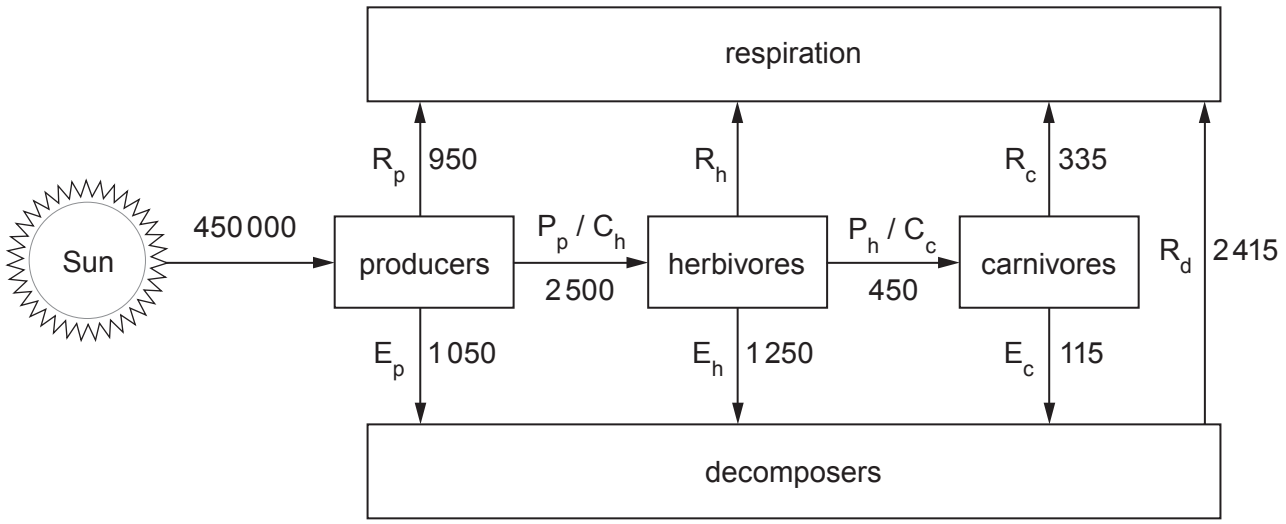
Examiner only

5. The diagram below shows energy transfer through a model ecosystem, where,

C = consumption, P = production, R = respiration, E = death, faeces or urine;

subscripts indicate the feeding group $_p$ = producers, $_h$ = herbivores, $_c$ = carnivores, $_d$ = decomposers,

e.g. C_h = consumption in herbivores.



(a) (i) Define the term *trophic level*. [1]

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(ii) Using appropriate letters from the diagram write an equation to represent energy transfer through the herbivores. [1]

(b) The numbers in the diagram represent energy transfer over a given area of ecosystem in a given time.

(i) Suggest suitable units for the values. [1]

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Examiner only

(ii) Calculate the following:

I. the photosynthetic efficiency of the producers. [2]

photosynthetic efficiency = ...

II. R_h [2]

R_h = ...

(c) The model assumes that **all** of the biomass produced by one group is transferred to the next group in the food chain. This might not be true in natural ecosystems.

(i) Suggest why this assumption is **not** likely to be true in a woodland ecosystem. [2]

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(ii) State the assumption the model makes about the dead organic material that the decomposers receive. [1]

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(iii) Conditions in peat bogs are acidic. Describe and explain how this will affect the rate of decomposition. [2]

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(iv) Explain whether the assumption the model makes about the dead organic material that the decomposers receive is likely to be true in peat bogs. [1]

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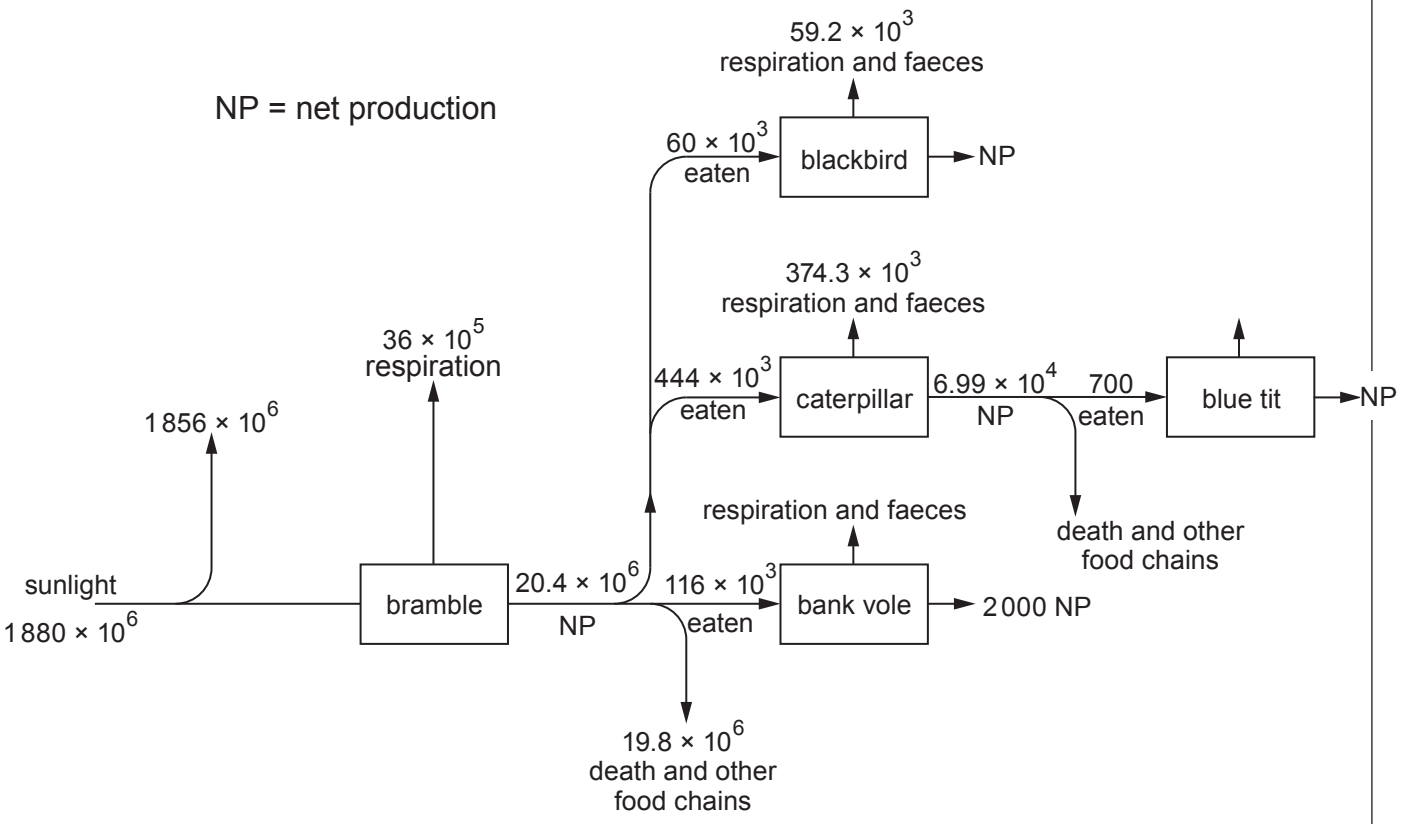
Examiner only

2. The diagram below shows the energy flow in a **small portion** of a woodland ecosystem. Figures are given in $kJ\,m^{-2}\,yr^{-1}$.



(a) Which of the organisms are:

(i) autotrophic; [1]

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(ii) secondary consumers? [1]

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Examiner only

(b) Calculate the following values:

(i) the gross primary production of brambles; [2]

gross primary production of brambles = ... $kJ\,m^{-2}\,yr^{-1}$

(ii) the net production of blackbirds; [2]

net production of blackbirds = ... $kJ\,m^{-2}\,yr^{-1}$

(iii) how much energy is lost via respiration and faeces by bank voles. [2]

energy lost = ... $kJ\,m^{-2}\,yr^{-1}$

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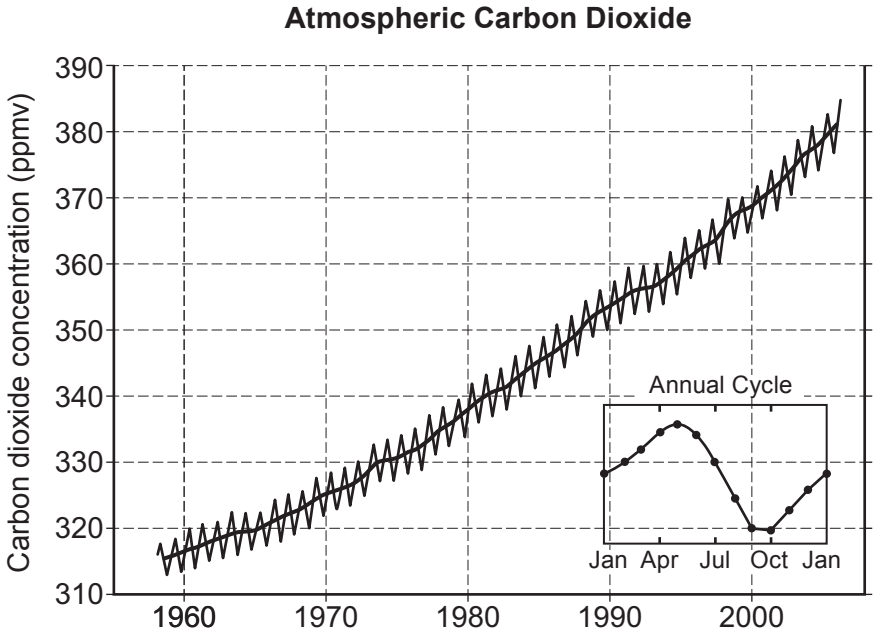
Turn over.

Examiner only

3. There is currently great concern about the concentration of carbon dioxide in the atmosphere. The graph below shows the results of measurements taken at one location in the USA.



(a) (i) Describe the trend over the years 1960 to 2000 shown in the graph. [1]

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(ii) The location is heavily forested. Explain how this might account for the annual cycle shown in the insert. [2]

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Most scientists agree that forest management can affect the atmospheric carbon dioxide level but there is disagreement about the best methods to manage forests in order to counteract the effects of climate change.

(b) Briefly explain the link between atmospheric carbon dioxide concentration and climate change. [2]

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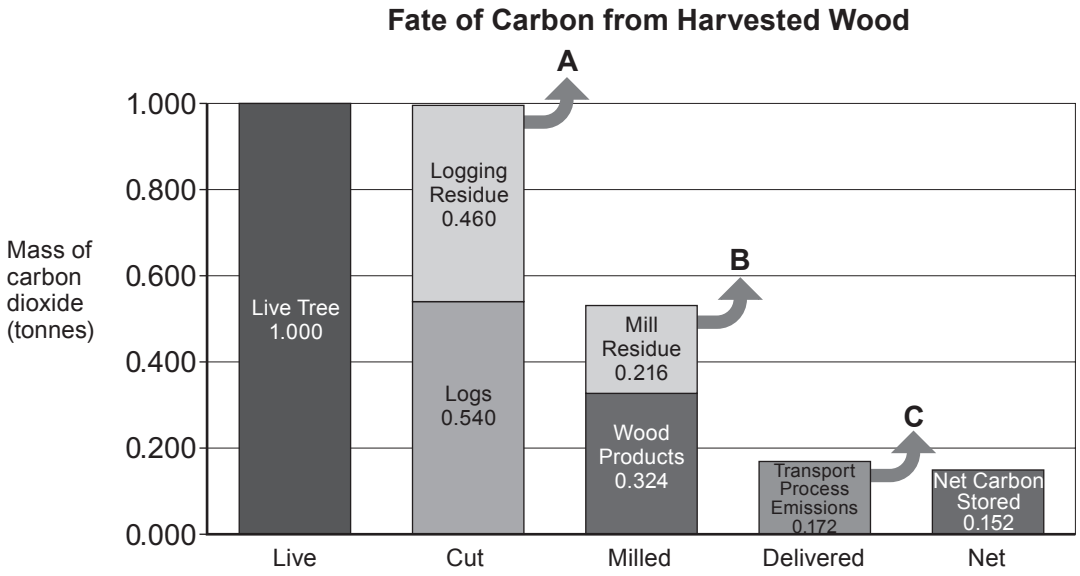
Examiner only

One group suggests that the best way to store the carbon fixed by forests is to harvest the trees and store it in wood products. The diagram below shows the fate of carbon atoms at each stage.



Data from Smith et al. 2006 and Gower et al. 2006.

Logging residue consists of stumps as well as thin branches and twigs at the tops of the trees. Mill residue consists of bark, shavings and strips of wood too thin to use.

(c) Calculate the percentage of carbon from a live tree which is stored in milled wood products. [2]

percentage of carbon = ... %

(d) Arrows **A**, **B** and **C** represent carbon returned to the atmosphere.

(i) Explain how the carbon would be returned to the atmosphere in **A** and **B**. [1]

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(ii) Explain why the net carbon stored is less than that stored in the milled wood products. [1]

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Turn over.

Examiner only

8.

Any diagrams included in your answer must be fully annotated.

(b) (i) Explain what is meant by primary and secondary succession and describe how succession affects communities. [7]

(ii) Explain how human activity can impact upon ecological succession. [3]

Question			Mark Scheme
7	(a)	A = Energy (in form of organic mols) passing from one trophic level to another. (not: through food chain/between consumers) B = Photosynthesis/light energy to chemical energy. C + D = Energy loss, not all wavelengths of light absorbed/some reflected/transmitted; Latent heat of evaporation; Loss as heat/ by radiation/convection. (Any 2 marks from 3 for C + D energy loss from plant) E = Loss of energy from plant by respiration. F = Ref NPP <u>and</u> GPP. G = Calc of efficiency = 1% or 0.8% H = some parts of plant not eaten / enter decomposition pathway. I = Respiratory loss by consumers/heterotrophs. J + K = Examples of what energy produced by respiration used for. 2 Examples from movement/anabolic / catabolic reactions/ maintaining temp/active transport. l = Consumers lose energy by egestion/ref. cellulose not digested. M = Consumers lose energy by excretion. O = Secondary and tertiary consumers more efficient than primary consumer/ Calc primary to secondary or secondary to tertiary (comparison 10% to 20%). P = reason for difference in efficiency – more egested waste in primary consumers	**10 MARKS**

Question			Marking details	Marks Available
8.	(a)	(i)	• Change in structure in a <u>community</u> over time; • Change in {composition of species / species present} (in a community) over time; • Either due to change in environmental / (named) abiotic factors;	2
		(ii)	A stable community which {undergoes no further change / reached equilibrium} / no further succession;	1
	(b)		• (Increased) interspecific competition / other plant species compete with heather / heather outcompetes other plant species; • For light / nutrients / minerals / named nutrient / water (linked to competition); Reject resources unqualified.	2
	(c)		• More energy used in respiration; • Higher respiration relative to {photosynthesis / GPP} / NPP decreases; • {Fewer leaves / less surface area} for photosynthesis; • Less energy / glucose to {produce new biomass / for growth / synthesis of protein or named compound}; • (Heather increases in size / ages / more competition from other species) soil fertility decreases / less minerals or nutrients available / greater competition for named resources; • Growth rate decreases / fewer leaves produced; • (As heather increases in size) less light penetrates the centre of the plant; • Loss of central leaves, (therefore woody parts increase); (Any 3 points)	3
			Question total	**8**

Question		Marking details		Marks Available
9	(a)	A	Extinction is the loss of species;	1
		B	Conservation is the <u>planned</u> preservation of wildlife / the {enhancement / maintenance} of biodiversity;	1
		C	To ensure the survival of the species;	1
		D	Conservation of existing <u>gene pools</u>;	1
		E	To conserve potentially useful {genes / genetic sources} (for future generations);	1
		F	Qualification / Example of E – resistance to disease or other;	1
		G	Use of plants / animals as a gene bank to cross with highly cultivated varieties;	1
		H	Conservation of <u>plants</u> with medicinal properties;	1
		I	(Planned) preservation of habitat, with example – wetlands, coral reef, sand dune;	1
		J	Seed / sperm banks;	1
		K	Re-introduction programmes, e.g. Red Kite;	1
		L	Protection / breeding of endangered species in specialised zoos / captive breeding programmes / rare breeds;	1
		M	Trade restrictions on endangered species / reference to CITES / ivory / whaling;	1
		N	Relevant reference to NGOs {e.g. WWFN / government agency / CCW / SSSI / National Parks / nature reserves} / ecotourism / education;	1
		O	Correct reference to relevant <u>legislation</u> e.g. to prevent over-grazing / over-fishing / hunting / poaching in context / collecting birds eggs / picking wild flowers / collecting plants;	1
			Question total	**10**

Question			Marking details	Marks Available
2.	(a)			
		(ii)	Very few large cod survived/ ORA; *reject none* reduced gene pool; {No/ little} mutation (to increase size) / insufficient time for genetic drift (to increase size) / No gene flow from another gene pool; Small fish produce less gametes/ difficulty in breeding/ few fish remain to reproduce/ reproductive isolation; Not enough food/ increased competition for food/ increased predation/ disease; Change in {temperature/ pH}/ pollution;	Max 3
	(b)		Restricted fishing times/ hours; Quotas/ licenses; Exclusion zones/ OWTTE; Limiting numbers of fishing vessels/ international agreements limiting catches; Limiting season; Restriction of <u>area</u> of nets; Closing spawning and/ or nursery areas; *REJECT any reference to mesh size*	2

Question			Marking details	Marks Available
	(c)	(i)	Eutrophication/ pollution; {Disease/ parasites} more likely (to spread) in {cultivated fish/ overcrowded conditions}/ disease may spread to wild fish; {Antibiotics/ pesticides} qualified e.g. can harm other marine organisms/ bioaccumulation of pesticides/ enters food chain/ high cost; Problems associated with flow of alleles into wild population; Higher level of dioxins/ PCBs in farmed fish;	2
		(ii)	Three of each type of chromosome / {odd/uneven} number of chromosomes/ unpaired chromosomes; No pairing of homologous chromosomes/ no bivalent formed; Prophase 1 meiosis; Meiosis does not take place; No gametes produced; **Question 2 total**	Max 4 **[16]**

Question			Marking details	Marks Available
5.	(a)	(i)	repeat experiments; Same area of grassland used for each test/ Same grass covering/ sludge injected to same depth/ Same {volume / mass/ concentration} of sludge/ same sludge applied/ Same soil {type/ gradient/ aspect/ exposure}/ same soil nitrate concentration/ same time of year; NOT temperature/ pH	2
		(ii)	increase in rainfall increases {leaching/ nitrate concentration in soil water}; greater effect on injected sludge with increased rainfall/ ORA; only a small effect at low rainfall;	2 max
		(iii)	apply (to surface) when {dry / little rainfall/ rainfall is less than [any figure less than 120]};	1
	(b)		Algal growth/ algal bloom/ overgrowth of plant; Less light, so {algae/ plants} die; {Bacteria/ saprobionts/ saprotrophs/ fungi} decompose {plants/ organic material} (and increase in number); (Reject decomposers) Using up oxygen in respiration;	3 max
	(c)		Leguminous plants/ any named leguminous plant; Rhizobium/ nitrogen fixing bacteria (in root nodules); *Reject nitrate fixing Azotobacter* Convert nitrogen (gas) into ammonium/ ammonia/ amino acids; Plants {left to decay/ ploughed in}; **Question 5 Total**	3 **[11]**

Question			Marking details	Marks Available
6.	(a)		Rate of Conversion of light energy into chemical energy (by producers /by photosynthesis); *Accept rate at which {products/ organic materials} are formed/ produced*	1
	(b)		(net primary production) decreases; More {carbohydrate/ glucose} is {broken down/ used by} respiration (than is produced by photosynthesis);	2
	(c)	(i)	(heat lost in) respiration; Excretion; egestion/not all parts of the material are digestible; not all parts eaten;	Max 2
		(ii)	Herbivores: {difficult to digest/ less efficient at digesting} cellulose/ have more {indigestible/ fibrous} material (in diet)/ ; *Reject cannot digest cellulose* Carnivores:{easily digest/ more efficient at digesting } {protein/ fat}; More {<u>egested</u> material/ faeces} (lost) by herbivores/ less {<u>egested</u> material/ faeces} lost by carnivores;	Max 2
	(d)		Productivity of producers higher/ primary productivity higher; Secondary productivity higher/ more energy stored in consumers; {Less energy {used/wasted} /respiratory rate is lower} + qualification eg.in cold blooded animals/ buoyancy; Higher {temperature/ light} higher rate of photosynthesis;	Max 1
			Question 6 Total	**[8]**

			Marking details	Marks Available
6	*(a)*	(i)	(Photosynthetic efficiency is a measure of) how well a plant is able to {capture/convert} light energy (and convert to biomass / chemical energy / product) / the percentage of light captured by the plant; NOT rate	1
		(ii)	Gross is the total {energy / CO_2} {transferred / fixed by plant}, net is total energy minus the energy lost in plant respiration / NPP=GPP-{Respiration / R};	1
	(b)	(i)	The higher the temperature the higher the {NPP / dry matter productivity} **and** The higher the rainfall the higher the {NPP / dry matter productivity};	1
		(ii)	Rainforest have high temperature and rainfall;	1
	(c)	(i)	(8820÷44100000)x100; = 0.02(%); Correct answer = 2 marks	2
		(ii)	(35280 – 8820) = 26460 = 2.6×10^4 [tropical – agricultural crops] $(2.6 \times 10^4) \times (2.1785 \times 10^4) = 5.8 \times 10^8$ [multiply by area of Wales (km^2)] $(5.8 \times 10^8) \times 10^6 = 5.8 \times 10^{14}$ [convert to m^2] Correct answer = 2 marks 57643110 / $5.8 \times 10^?$ = 1 mark	2
		(iii)	• Energy is lost in transfer to {next trophic level / description of e.g. plants to cow}; • to respiration of herbivores / movement / keeping warm / excretory products / not all plant {eaten / digested};	2
		(iv)	• (Cattle produce) {Methane / carbon dioxide} / deforestation occurs so less carbon dioxide absorbed in photosynthesis / the burning of the cut trees produces carbon dioxide; • reference to greenhouse {effect / gas}; NOT global warming	2
		(v)	Burning the biofuel increases carbon dioxide in the air **and** photosynthesis removes carbon dioxide (during growth);	1
			Question 6 total	**[13]**

GCE BIOLOGY - BY5

SUMMER 2016 MARK SCHEME

Question			Marking details	Marks Available
1	(a)	(i)	I (Biodiversity is) the {variety/ number of} <u>species</u> on {earth/in an ecosystem/ in an area}; NOT variation	1
			II (monoculture is) {growing/planting/producing} one {species/ plant/crop} (in large area);	1
		(ii)	reduces (bio)diversity; {destroys/takes up/reduces} habitat/deforestation or description of; Accept reference to interspecific competition/effect on food web	2
	(b)	(i)	the {mass/amount/volume/level} of carbon (dioxide) attributable to the actions of an {individual / product/ service} over a period of {time/ one year/lifetime}/ total CO_2 released in the production of bananas from field to shelf;	1
		(ii)	Greater distance to transport the bananas; ORA vehicles {burn/use} more fuel; ORA	2
	(c)	(i)	Any two from: • One train carries more bananas than a truck; • trains take a more direct route; • less fuel burnt; • trains could use renewable electricity;	2
		(ii)	Less Greenhouse {effect/gases} / less CO_2 / global warming / climate change; NOT ref to ozone/ prevent global warming	1
			Question 1 total	**[10]**

Question			Marking details	Marks Available
5				
	(a)	(i)	Position in a food chain; Accept feeding level	1
		(ii)	$C_h=R_h + E_h +P_h$ / $P_h= C_h- R_h - E_h$ / $P_h= C_h- (R_h + E_h)$; Accept P_p for C_h Accept C_c for P_h	1
	(b)	(i)	$kJ\,m^{-2}\,week^{-1}$/ $kJhectare^{-1}year^{-1}$ [any energy unit / area unit/time unit] (allow / or per or $^{-1}$)	1
		(ii)	I $\frac{(950+2500+1050)}{450000} \times 100 = 1.0$**%** 2 for correct answer 1 if correct workings wrong answer or no units	2
			II 2500-1250-450 = 800 2 for correct answer, 1 if correct workings wrong answer	2
	(c)	(i)	(Biomass of producers includes) {wood/ cellulose/ligno-cellulose}/biomass includes {bones/teeth/fur}; Which is inedible/ not {eaten/digested} by herbivores;	2
		(ii)	**All** (of the dead organic material) is {broken down/ digested/ used in respiration/ owtte}.	1
		(iii)	Rate of decomposition will be less/owtte; (Acidic conditions) {prevent/slow} growth of bacteria and fungi/ {inactivate/ denature/away from optimum pH} enzymes; Accept: rate of decomposition will increase because the enzymes have low optimum pH = 2 marks	2
		(iv)	**No,** because not all of the dead organic matter is {decomposed/ broken down} / owtte;	1
			Question 5 Total	**[13]**

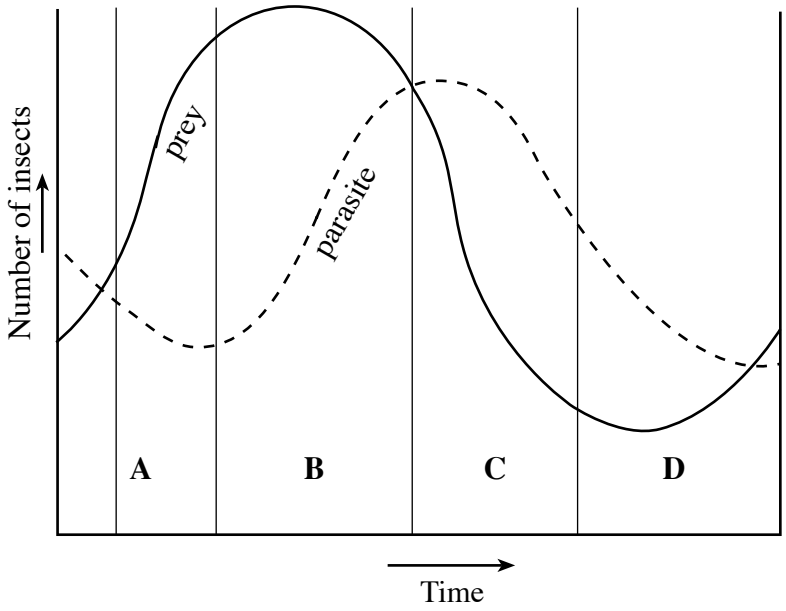
Question			Marking details	Marks Available
2	*(a)*	(i)	Brambles;	1
		(ii)	Blue tits;	1
	(b)	(i)	$20.4 \times 10^{6} + 36 \times 10^{5}$; 24×10^{6}/ 24 000 000;	2
		(ii)	$60 \times 10^{3} - 59.2 \times 10^{3}$; 800/ 8×10^{2};	2
		(iii)	116×10^{3} -2000; $=1.14 \times 10^{5}$/ 114×10^{3}/ 114 000/ 11.4×10^{4};	2
			Question 2 Total	**8**

Question			Marking details	Marks Available
3	*(a)*	(i)	CO_2 concentration increasing (with time);	1
		(ii)	Decreases Apr/ May trees photosynthesise; Increases Oct {trees lose leaves/ less growth}; NOT reference to cutting down trees/ trees dying	2
	(b)		CO_2 layer does not allow heat out/ correct reference to wavelengths of light; NOT absorbs more heat Leads {to increasing temperature/ global warming}; Not planet	2
	(c)		0.324/1 x 100; 32.4%; 2 for correct answer, 1 for correct workings wrong answer	2
	(d)	(i)	Decay/ combustion/ action of decomposers;	1
		(ii)	CO_2 is produced by burning (fossil) fuels in lorries/ trains etc/ carbon footprint qualified;	1
			Question 3 total	**9**

Question			Marking details	Marks Available
8	*(b)*			
		A	Succession is the change in structure and species composition of a community overtime;	
		B	The different stages in a succession when particular communities dominate are known as seres;	
		C	reaches a climax of succession known as the climax community;	
		D	{species diversity/ biodiversity} increases;	
		E	as does the stability of the community;	
		F	Primary succession refers to the introduction of plants/ animals into areas that have not previously been colonised;	
		G	Suitable example in general terms - bare rock to grassland to scrub to woodland /sand dune succession	
		H	secondary succession refers to the (reintroduction of organisms into) a bare habitat previously occupied by plant and animals	
		I	Suitable example e.g. following (forest) fire / logging	
		J	Specific reference to named plants in seres e.g. grasses/ shrubs/ trees. for either 1^{o} or 2^{o}	
		K	Human activities: {grazing /mowing} arrests succession at grassland (sere) NOT [deforestation/ habitat destruction} unqualified	
		L	Burning gorse/ heathland management arrests succession (at scrub (sere))	
		M	{Forest management / logging/ slash and burn/ coppicing} starts new secondary succession	
		N	Intensive agriculture/ monoculture prevents succession	
		O	Plagioclimax/ deflected succession/ AVP	
			Question 8 Total	**10**

BI5 - WJEC
4/10
3.5 & 3.6

8. The diagram shows the changes in the populations of two insects living on plants in the tropics. One of these insects is a wasp that parasitises the plant-feeding prey insect. Over time this cycle would be continuously repeated.
During each cycle both populations would be exposed to natural selection.



(a) Selection could favour genes which increase the reproductive rate of the prey. Suggest **one** advantage of this to

(i) the prey population as a whole; [1]

.....

.....

(ii) individual members of the prey population. [1]

.....

.....

(b) Selection for an increase in the reproductive rate of the parasite could be disadvantageous for the parasite population. Suggest an explanation. [2]

.....

.....

.....

(c) The level of intraspecific competition for food varies during the cycle. Using letters from the diagram, state in which region competition is greatest in

(i) the prey population; [1]

.....

(ii) the parasite population. [1]

.....

(d) Explain your answer to *(c)* (ii). [1]

.....

.....

(e) Using a letter from the diagram, state the region in which both populations are in the lag phase. [1]

.....

(f) Samples of both populations were taken during phase **C**. From the data a pyramid of numbers was plotted and gave an unexpected result. Explain why the pyramid appeared unusual. [2]

.....

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.....

(g) (i) The parasitic insect was *Encarsia formosa*. Name the prey. [1]

.....

(ii) In Britain, the parasite is introduced onto cucumber crops in glasshouses to attack the prey insect. What is the name given to this type of population regulation? [1]

.....

(iii) When this artificial method of population regulation is used, the population cycle shown in the diagram does not normally occur. Suggest **two** possible reasons for this. [2]

.....

.....

.....

(h) Natural selection is also taking place in the glasshouse populations. However this is unlikely to have any effect on the evolution of the two species. Suggest an explanation for this. [2]

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(Total 16 marks)

SECTION B

Answer **all** *questions.*

6. Read the passage below and use the information and your knowledge to answer the questions that follow.

The rainforests in the developing countries of Southeast Asia are being destroyed both by roaming farmers and large companies. The roaming farmers, known as "shifting cultivators", have been blamed for large-scale forest destruction, loss of species and uncontrolled burning.

In shifting cultivation a plot of forest is felled and burnt, providing fertile ash in which to grow food crops. After 1 to 3 years, as weeds flourish and fertility declines, the plot is abandoned for a fallow period of about 20 years.

In Sumatra this traditional method of cultivation has been adapted to make best use of the fallow period. Rubber seedlings are planted with food crops and the rubber trees allowed to mature during the fallow period, during which time other wild plant species will grow again. The rubber, a cash crop, can be harvested after 10 years and the land can be made available for felling again after a further 15 years.

Where the human population density is high, fallow periods have been reduced and food yields have dropped significantly. In some places the cultivation pattern has been replaced with permanent agriculture, such as rubber plantations.

Adapted from New Scientist, 15th November 1997

(a) State **two** possible reasons, other than agriculture, for the destruction of the rainforests. [2]

1 .....

2 .....

(b) What is the advantage to these farmers of burning felled trees to produce ash before cultivation? [2]

.....

.....

.....

.....

(c) 'Where the human population density is high, fallow periods have been reduced and food yields have dropped significantly.' (lines 12-13)

Explain why the food yields have decreased. [2]

.....

.....

.....

.....

(d) Give two reasons why the pattern of shifting cultivation practised in Sumatra (lines 7–11) is of benefit to the farmer. [2]

1 .....

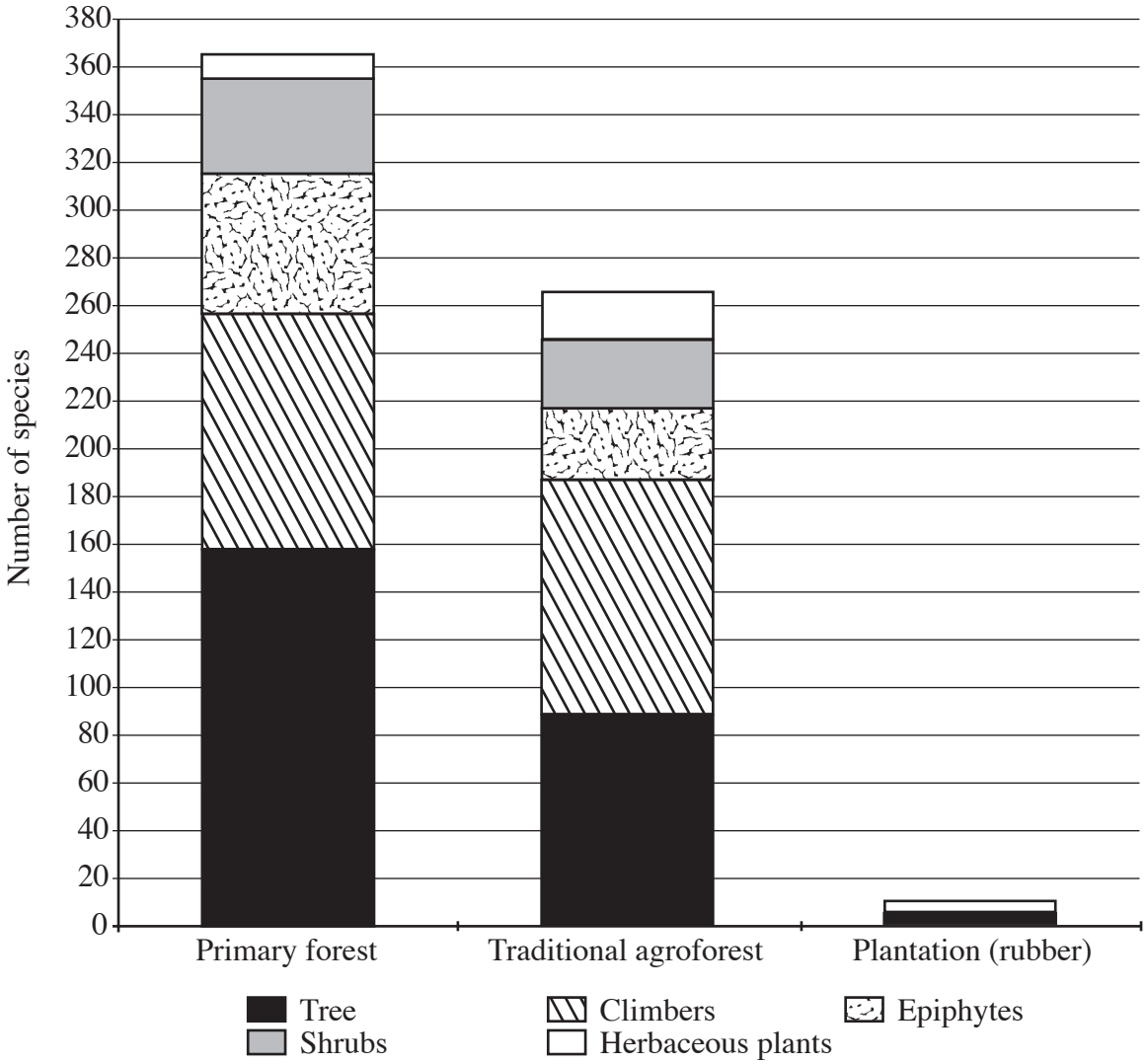
2 .....

(Question continued overleaf)

A study was carried out in three areas of forest that had different types of agriculture. The number of species of five types of plant (trees, climbers, epiphytes, shrubs and herbaceous plants) were counted in:

an area of undisturbed primary forest;
an area that was used for traditional agroforest (shifting cultivation, as in Sumatra);
a rubber plantation.

The results are shown below.



Adapted from New Scientist, 15th November 1997

(e) Comment on the species diversity of:

(i) the plantation compared with the primary forest; [2]

.....

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(ii) traditional agroforest compared with the primary forest. [3]

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(f) It is often stated that cultivation of the rainforest is totally destructive. Using the information given in the graph and your own knowledge, comment on the validity of this statement. [2]

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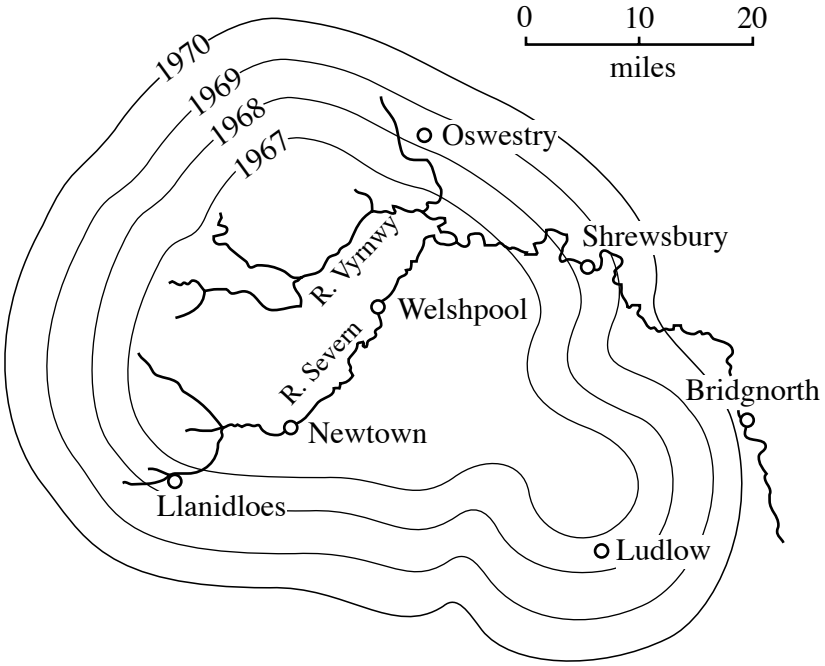
(Total 15 marks)

4. Warfarin is used as a rat poison. Resistance to this poison is thought to be controlled by a single dominant allele.



Data after Greaves, Mammal Review 3, 1973

Prior to 1967 Warfarin was used in all areas shown on the map. The first incidence of Warfarin resistance was recorded near Welshpool. The map shows the spread of the allele for Warfarin resistance.

(a) (i) Explain how the Warfarin resistant allele developed initially. [1]

.....

(ii) Explain how the allele became common in that population. [3]

.....

.....

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.....

(iii) State **two** ways in which alleles for the resistance spread through the rat population in the area shown on the map. [2]

1. .....

2. .....

(b) Animals with this allele for resistance need large quantities of vitamin K in their diet (which may not be available) without which they are unlikely to survive and breed.

Spread of the resistant population was dependent on the continued use of Warfarin. If its use is discontinued the frequency of the resistant allele in the population is likely to decrease. Explain this statement. [2]

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(Total 8 marks)

5. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the structure and mode of action of striated (skeletal) muscle. [10]

Or *(b)* Describe the process of fertilisation and seed development in flowering plants. [10]

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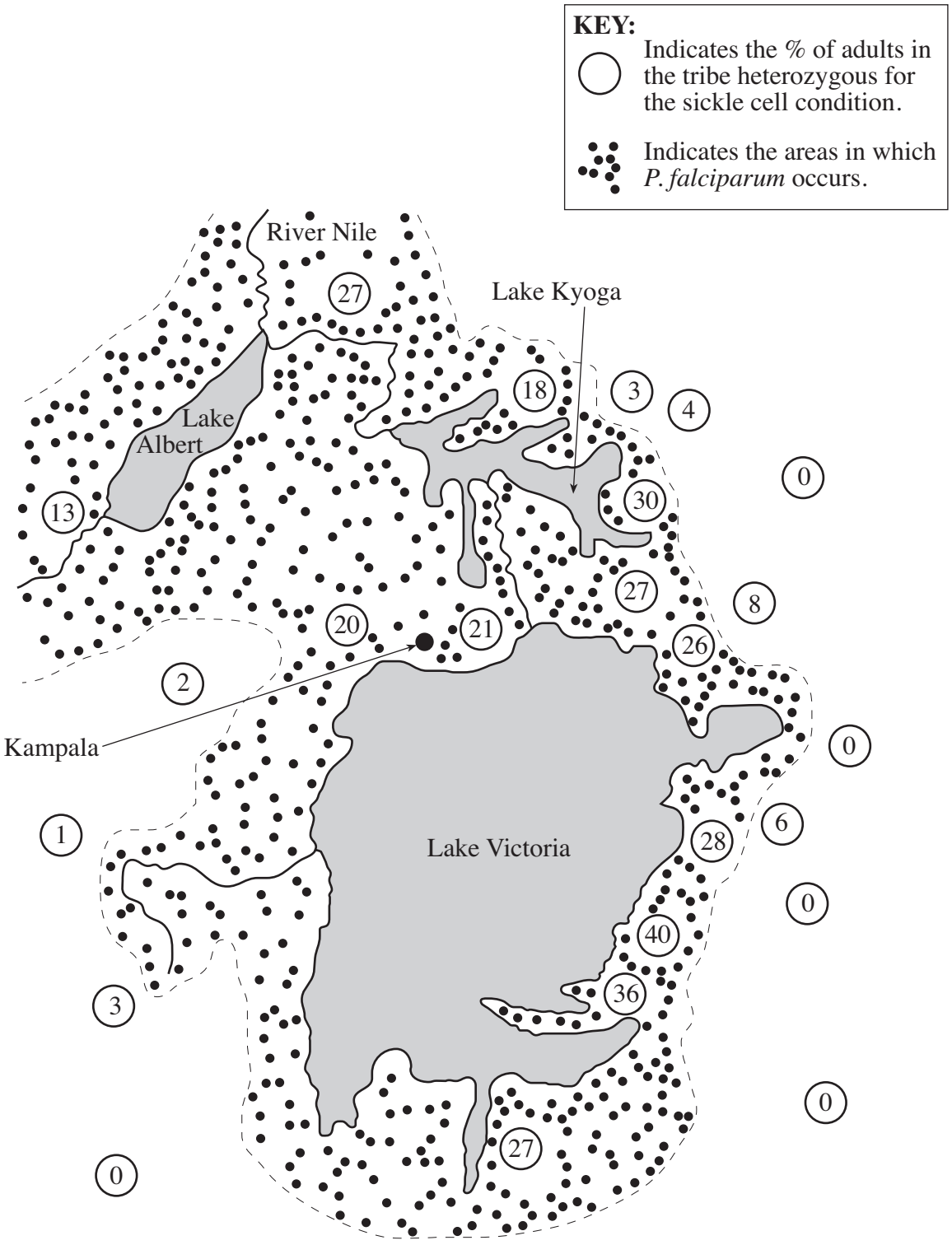
SECTION B

Answer **all** *questions*.

7. Malaria is a parasitic disease of humans which is endemic in parts of Africa. The map below shows the distribution of the malaria parasite *Plasmodium falciparum*, together with the percentages of heterozygote humans in different areas.



(a) Suggest an explanation for the distribution of *P. falciparum* as shown on the map. [2]

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(b) Explain the connection between the percentage of individuals heterozygous for sickle cell anaemia and the distribution of *P. falciparum*. [3]

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(c) The sickle cell gene has arisen by gene mutation.

(i) Explain precisely what is meant by *gene mutation*. [1]

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(ii) Explain the effect of the mutation on the protein for which this gene codes. [2]

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(d) Prevention of malaria relies on knowledge of the vector's life cycle. Chemical control methods have become almost useless in many areas and increasingly biological control methods of controlling the vector are being used. One method involves releasing sterile males into malaria infected areas.

(i) Explain the difference between biological and chemical control methods. [2]

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(ii) Explain why the chemical methods have become almost useless. [2]

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(iii) Suggest how the release of sterile males may reduce vector numbers. [2]

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8 **a** (i) increased population size relative to parasite improves chances of survival. (not: population would go up) 1

(ii) Greater production of an individual's genes gives advantage in intraspecific competition/ less likely to be predated so increases chances of survival. 1

b More parasites means more prey destruction/could reduce prey population to point where parasite crashes completely/greater or increased competition for food, parasite may become extinct. (ie increasing competition (1) consequence (1)) 2

c (i) B 1
(ii) C 1

d High parasite numbers and rapidly disappearing prey/prey harder to find (reference to both needed) 1

e D 1

f The pyramid is inverted 1
Normally it is expected that the number of primary consumers is greater than that of secondary consumers/more parasites than prey. 1

g (i) *Trialeurodes vaporarium* or white-fly. 1

(ii) Biological Control 1

(iii) The parasites are introduced in greater than natural numbers, to cause a permanent crash in the prey population.

The time span is very short compared to the field situation and the crop is harvested before cycles can be established. 2

h The glasshouse is a closed environment separated from the tropical populations so no gene flow (2)
At the end of the growing season the crop is harvested and residual populations are destroyed; any new genotypes then become extinct.(2)
Short term treatment so no time for changes to take place (2) 2
(ie cause (1) effect (1))

[16]

Question			Answer/Explanatory Notes	Marks Available
6	(a)		somewhere to live / housing; logging / wood products; development / industry / roads; fuel. mining / drilling (Any 2) (allow: construction once only)	2
	(b)		provides fertile, material / soil / acts as a fertiliser; good crop, growth / yield; no need to buy fertilisers; remove pests. (Any 2)	2
	(c)		less fertile soil; less material to burn; less (plant) has grown during fallow period; less (fertile) ash; less time for soil to regain fertility; crops remove nutrients. (Any 2)	2
	(d)		food crop and rubber crop / two crops; cash crop / income; land can be felled in (about) same time; sustainability. (Any 2)	2
	(e)	(i)	*assume candidate is referring to plantation, unless otherwise stated* far fewer species / very little diversity; only 2 plant types / trees and herbaceous plants; no (2 of) climbers, epiphytes, shrubs; ref. figures (comparative) / 360 vs 10 species. (Any 2)	2
		(ii)	*assume candidate is referring to agroforest, unless otherwise stated* all types represented in both fewer tree species; fewer epiphyte / shrub species; more herbaceous species; (approx.) same number of species of climbers; fewer species / less diversity; ref. figures (comparative) / 360 vs 260 species (Any 3)	3

Question	Answer/Explanatory Notes	Marks Available
(f)	depends upon agriculture; plantations seem to be destructive; reduced / do not permit species diversity / monoculture; agroforestry allows forest to regenerate; maintains a (fairly) high level of diversity; (Any 2)	2
		[15]

Question			Answers/Explanatory Notes	Marks Available
4.	(a)	(i)	Mutation;	[1]
		(ii)	Selective advantage (if Warfarin being used); (not: just ref. to natural selection and survival of the fittest) more resistant rats survived; formed breeding population; passed on beneficial allele to offspring/more resistant alleles in gene pool.	Max. 3
		(iii)	(Sexual) reproduction/interbreeding; migration.	[2]
	(b)		If Warfarin not used there is no selective advantage/ description; Disadvantage rats with allele need large amounts of vitamin K; therefore selected against/die out. 2 from 3 (not: more rats survive therefore greater selection pressure)	[2]

Question		Answers/Explanatory Notes	Marks Available
7.	(a)	One stage of the parasite occurs in mosquitoes/mosquito is vector; Which need water/swamps/lakes/rivers for breeding/egglaying;	[2]
	(b)	Heterozygotes have increased resistance to malaria; Mention of sickle cell trait/codominance of genes/ref. to haemoglobin structure; This gives them a selective advantage (or converse)/survival in context; Homozygotes die of malaria or sickle cell disease; Any 3	[3]
	(c)	(i) Changes in bases/base pairs in the gene (not: DNA)	[1]
		(ii) Change in the amino acid order/sequence/codes for different amino acids; Protein changes shape/becomes non-functional	[2]
	(d)	(i) Biological control involves the use of natural predators/parasites/pathogens to kill pest (not: sterile males); Chemical control involves the use of chemicals/pesticides to destroy pests.	[2]
		(ii) Chemicals(used over a long period) have selected for those who have resistant genes/mutations have brought about resistance; These survive and pass the genes to their offspring which (are also resistant).	[2]
		(iii) Males mate with females; They lay unfertilised eggs which will not hatch/no offspring produced.	[2]
	(e)	Many strains/species of *Plasmodium*/parasite; Different stages have different antigens; Ref. to protected when inside cells if immune system mentioned. Which are constantly mutating. (not: changing) Any 2	[2]
			[16]

BY4 Jan - WJEC

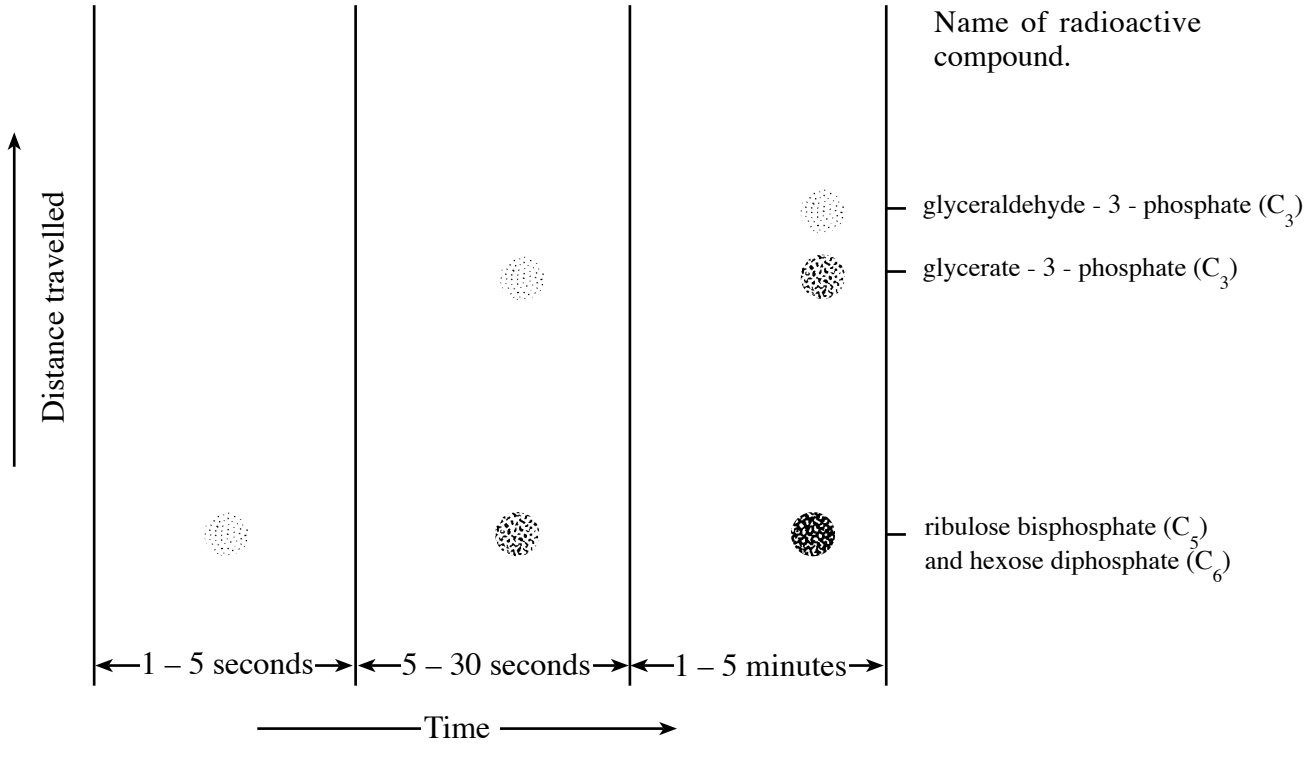
7/10

3.1-3.4

5. *(a)* The statements in the table refer to the light-dependent and light-independent reactions of photosynthesis.
If the statement is correct for the process, place a tick (✓) in the appropriate box. [5]

Statement	*Light-dependent reaction*	*Light-independent reaction*
oxygen produced		
carbon dioxide fixed		
produces ATP		
uses reduced NADP		
occurs in stroma		

(b) The individual steps in the path of carbon dioxide in photosynthesis were investigated by Calvin using the unicellular green alga, *Chlorella*.
He illuminated a suspension of the algal cells and allowed them to photosynthesise for a certain period of time in the presence of radioactive carbon dioxide, $^{14}CO_2$.
At various intervals, shown in the diagram below, a sample of the suspension of algae was run into hot ethanol and the radioactive compounds that had formed were extracted and separated by paper chromatography.
The diagram shows where the radioactive molecules had accumulated on the chromatograms.
High concentrations of radioactive molecules show darker areas than low concentrations.



(i) Suggest why the suspension was run into hot ethanol. [1]

.....

(ii) Suggest one **biologically** important similarity between $^{14}CO_2$ and $^{12}CO_2$. [1]

.....

(iii) With reference to the diagram state **three** conclusions that can be drawn from the appearance of the sequence of the compounds. [3]

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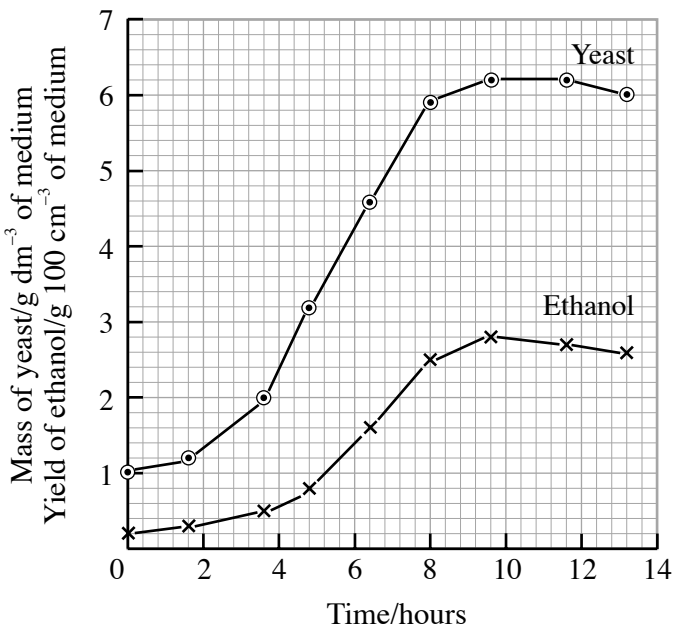
(Total 10 marks)

6. Graph A shows the growth of the yeast, *Saccharomyces,* and the yield of its product, ethanol.

Graph A



(a) (i) Calculate the mean production of yeast cells between 2 and 10 hours. Show your working and give your answer in g/dm^{-3} produced per hour. [2]

Answer ..... g/dm^{-3}

(ii) Give **two** possible reasons for the change in the multiplication of cells between 12-14 hours. [2]

.....

.....

(iii) Describe fully the relationship between the growth of the yeast and the yield of ethanol. [3]

.....

.....

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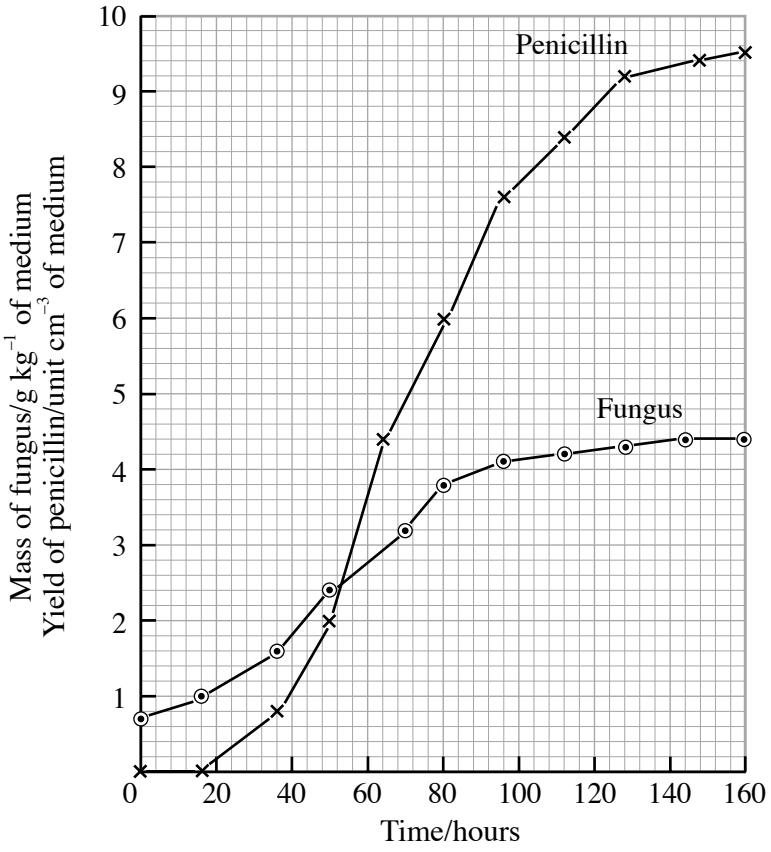
.....

(iv) What could be done at 10 hours to increase the growth rate? [1]

.....

Graph B shows the growth of the fungus, *Penicillium,* and the yield of its product, the antibiotic penicillin.

Graph B



(b) State **three** ways in which the pattern of accumulation of the fungus and penicillin in **Graph B** differs from the pattern of accumulation of yeast and ethanol in **Graph A**. [3]

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(c) Suggest how the differences in the pattern of accumulation of the two products may be related to their differing roles in the producer organism. [3]

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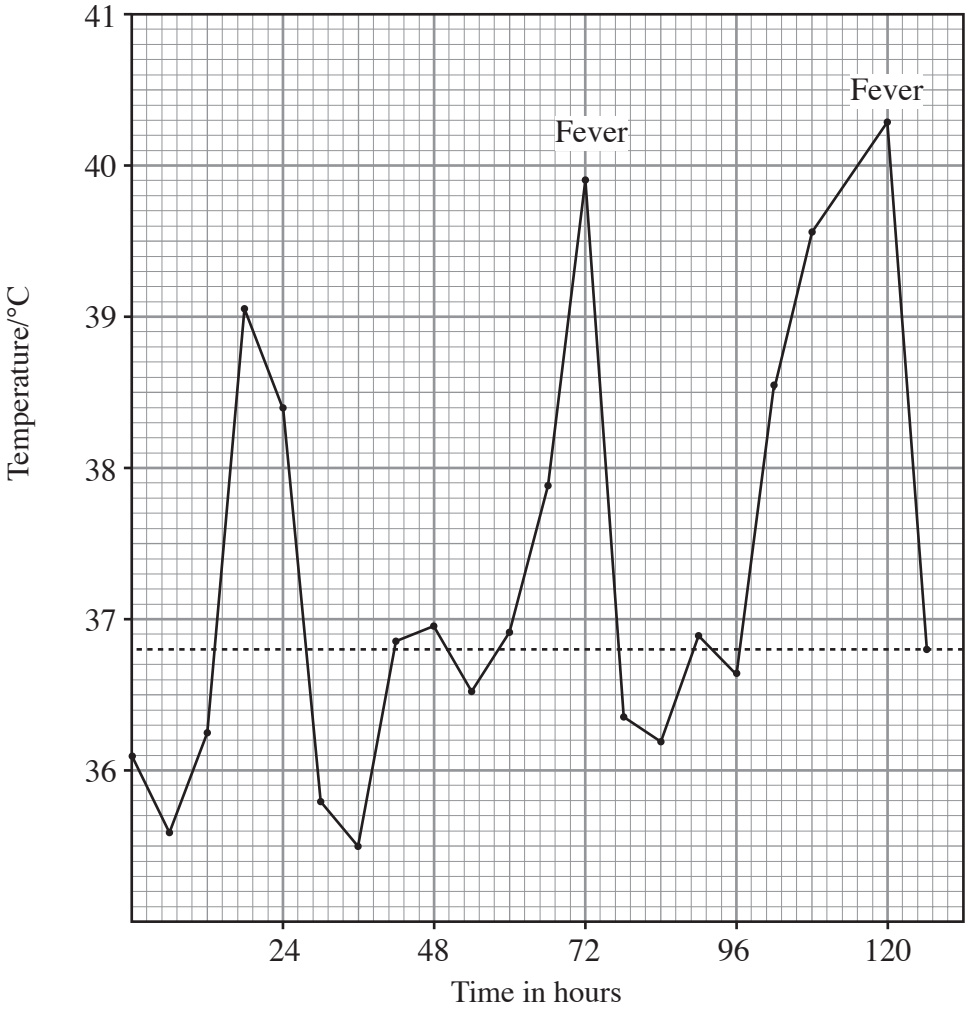
(Total 14 marks)

5. There are four parasitic species which can cause malaria in human beings.
Plasmodium vivax and *Plasmodium ovale* cause tertian fever, characterised by a sharp rise in temperature on alternate days. *Plasmodium malariae* causes a temperature rise every three days and *Plasmodium falciparum* produces irregular fevers, often on a daily basis.
The chart below shows the temperature fluctuation in a malaria patient.



(a) Name **two** species of *Plasmodium* which are unlikely to be responsible for the illness in this patient. [2]

.....

.....

(b) Explain the cause of the peaks on the graph. [2]

.....

.....

.....

.....

(c) Suggest an explanation for the temperature at 36 hours. [1]

.....

.....

(d) (i) What is the vector for the *Plasmodium* parasite? [1]

.....

(ii) Give **three** possible methods of preventing transmission of malaria by the vector. [3]

1. .....

.....

2. .....

.....

3. .....

.....

(e) After being introduced into the blood stream where in the body does *Plasmodium* first multiply? [1]

.....

(f) Give **two** disadvantages of controlling this infection with drugs. [2]

.....

.....

(g) Suggest why there are no really successful vaccines for malaria. [1]

.....

(Total 13 marks)

6. The rates of photosynthesis of two crop plants were compared under constant conditions at several different light levels. One of the plants was a tropical species, the other was a native of the temperate regions. The results of the experiments are given in the table below.

	Rates of photosynthesis ($\mu dm^3 CO_2/cm^{-2}/h^{-1}$)	
Light energy falling on leaf (arbitrary units)	*Plant* **A**	*Plant* **B**
100	45	27
200	85	68
300	99	108
400	115	144
500	135	172
600	142	200
700	145	230
800	148	234
900	150	238
1000	150	242

(a) What is the limiting factor on photosynthesis between 100 and 300 arbitrary units? [1]

.....

(b) Calculate the percentage increase in the rates of photosynthesis for the two plants between light energy levels of 100 and 300 arbitrary units. [2]

Plant **A** .....

Plant **B** .....

(c) (i) From your calculations, suggest which plant is probably the tropical species. [1]

.....

(ii) Give **two** reasons why the figures you have used support your conclusion. [2]

1. .....

.....

2. .....

.....

(iii) Give **one other** piece of information from the table which supports your conclusion. [1]

.....

.....

(d) (i) Above 500 arbitrary units, increased light energy appears to cause relatively little change in the rates of photosynthesis. Suggest **two** main factors which could limit photosynthesis in this region. [2]

1. .....

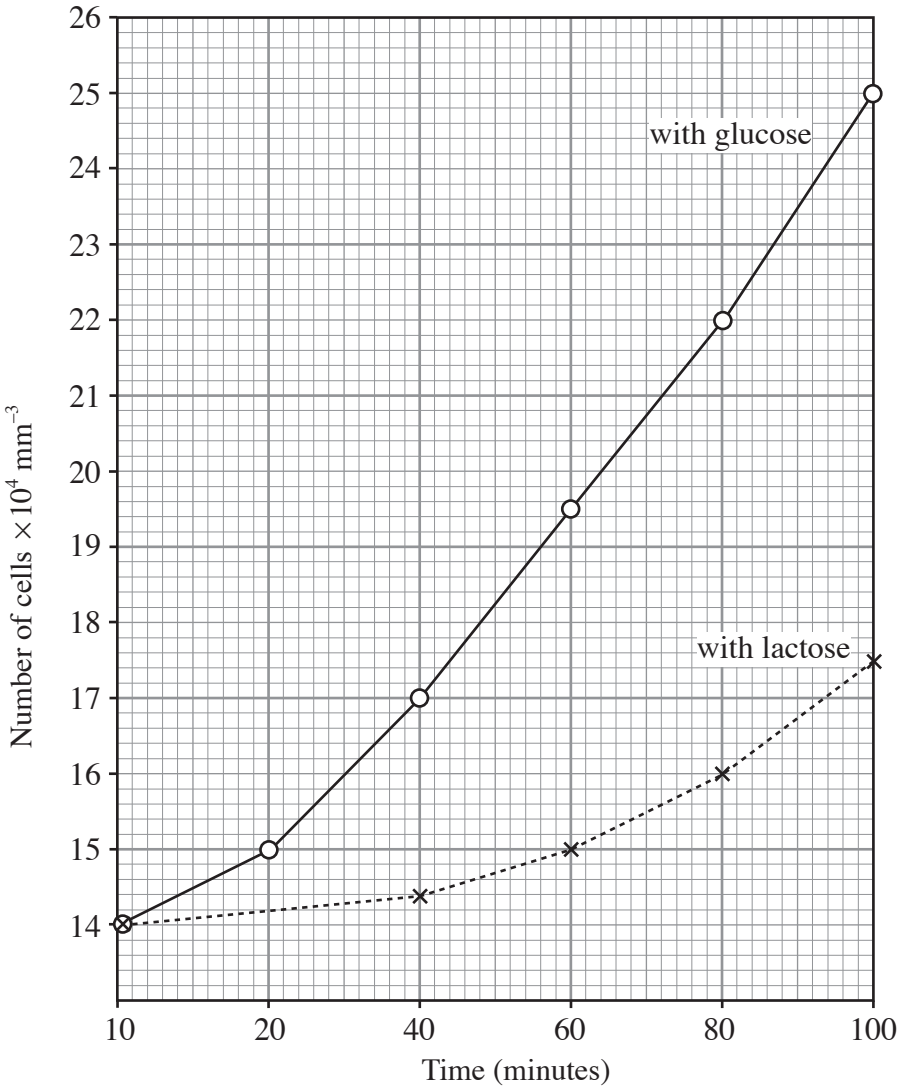
2. .....

(ii) An increase in which of these factors would produce the greatest difference in the tropical crop compared to the temperate crop? [1]

.....

(Total 10 marks)

7. The graph shows the growth of two colonies of the same bacterium. The nutrient medium includes a sugar as a source of carbon; glucose for one colony and lactose for the other.



(a) Estimate the rates of growth for the two colonies between 80 and 100 minutes. [2]

With glucose .....

With lactose .....

(b) Suggest an explanation for the difference between the two colonies. [1]

.....

.....

(c) Apart from the carbon source, name **two other** nutrients that are likely to have been included in the medium. [2]

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(d) The results were obtained using the viable counting technique. Explain briefly how this is carried out. [4]

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(e) Why is this procedure called 'viable counting'? [1]

.....

(f) In industrial processes, the growth of useful microorganisms is usually monitored by taking samples at intervals and measuring the density of the population using a colorimeter. Suggest **one** advantage of this industrial technique. [1]

.....

(Total 11 marks)

4. ATP is a compound that is described as *the universal energy currency in living organisms*.

(a) (i) Using the structure of ATP, explain what is meant by the phrase *energy currency.* [4]

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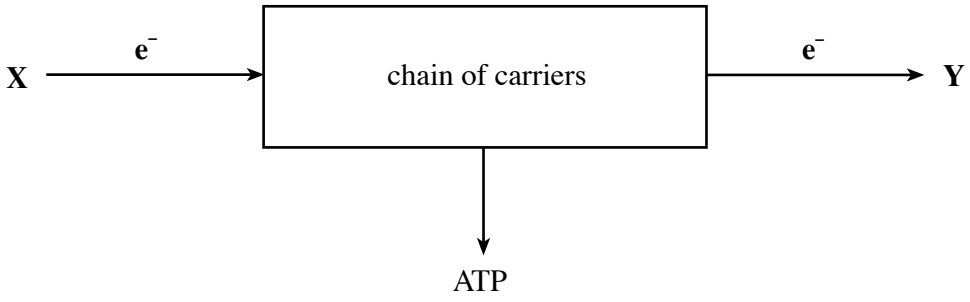
(ii) Give **two** examples of the use of ATP. [1]

.....

.....

(b) A diagram summarising the role of the electron transport system in ATP production is shown below.



This process takes place during both respiration and photosynthesis.

State the electron donor **(X)** and the final electron acceptor **(Y)** during

(i) respiration; [2]

X .....

Y .....

(ii) photosynthesis. [2]

X .....

Y .....

(c) As the electron is transferred along the electron transport chain, energy is made available for ATP formation.

Explain how this energy is used to produce ATP. [4]

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(Total 13 marks)

6. Three students were carrying out an experiment in which bacteria were cultured in a liquid. A sample of the bacteria was stained purple by the Gram stain.

(a) What does the staining indicate about the structure of the bacterial cell wall? [2]

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.....

(b) In order to monitor population growth, a number of different methods may be used.

One student suggested using a **viable** count.

(i) What assumption must be made when using this method? [1]

.....

.....

(ii) State **one** limitation of using this method. [1]

.....

.....

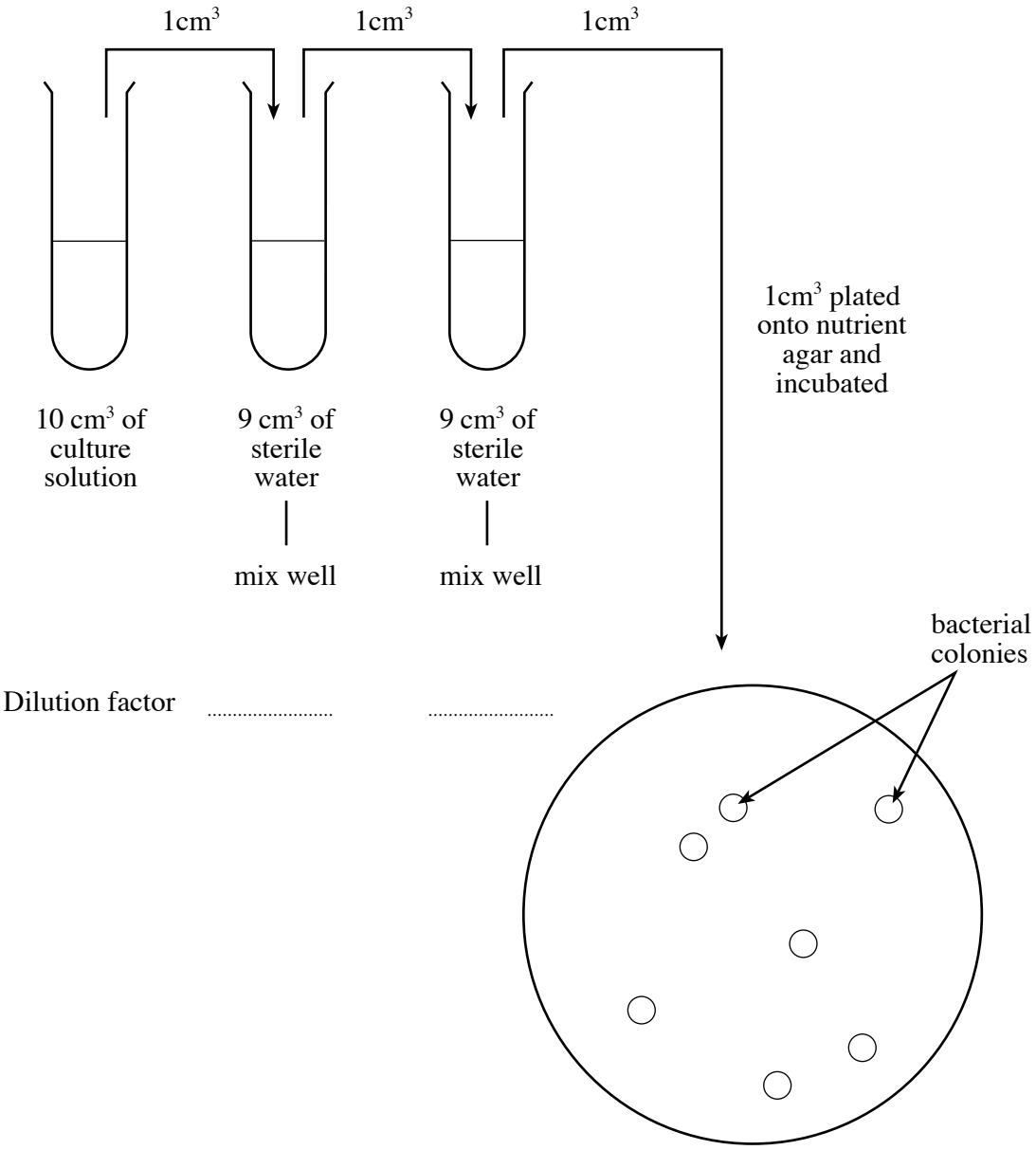
(c) Another student used a **total** count method. He counted all the bacteria in the field of view of the microscope.

Suggest why this method gave a higher estimate of the population than the viable count. [1]

.....

(d) In both methods the original culture must be diluted before a count can be made.

The diagrams below show how a dilution was carried out and the result of incubating 1cm^3 of the diluted sample on a nutrient agar plate for 24 hours.



Dilution factor ....

Using this information, complete the dilution factors and calculate the estimated total population in 1cm^3 of the original culture.
Show your working. [3]

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(Total 8 marks)

3. Malaria is a disease that is endemic in many tropical and subtropical regions of the world. It is particularly widespread in Africa and Asia.

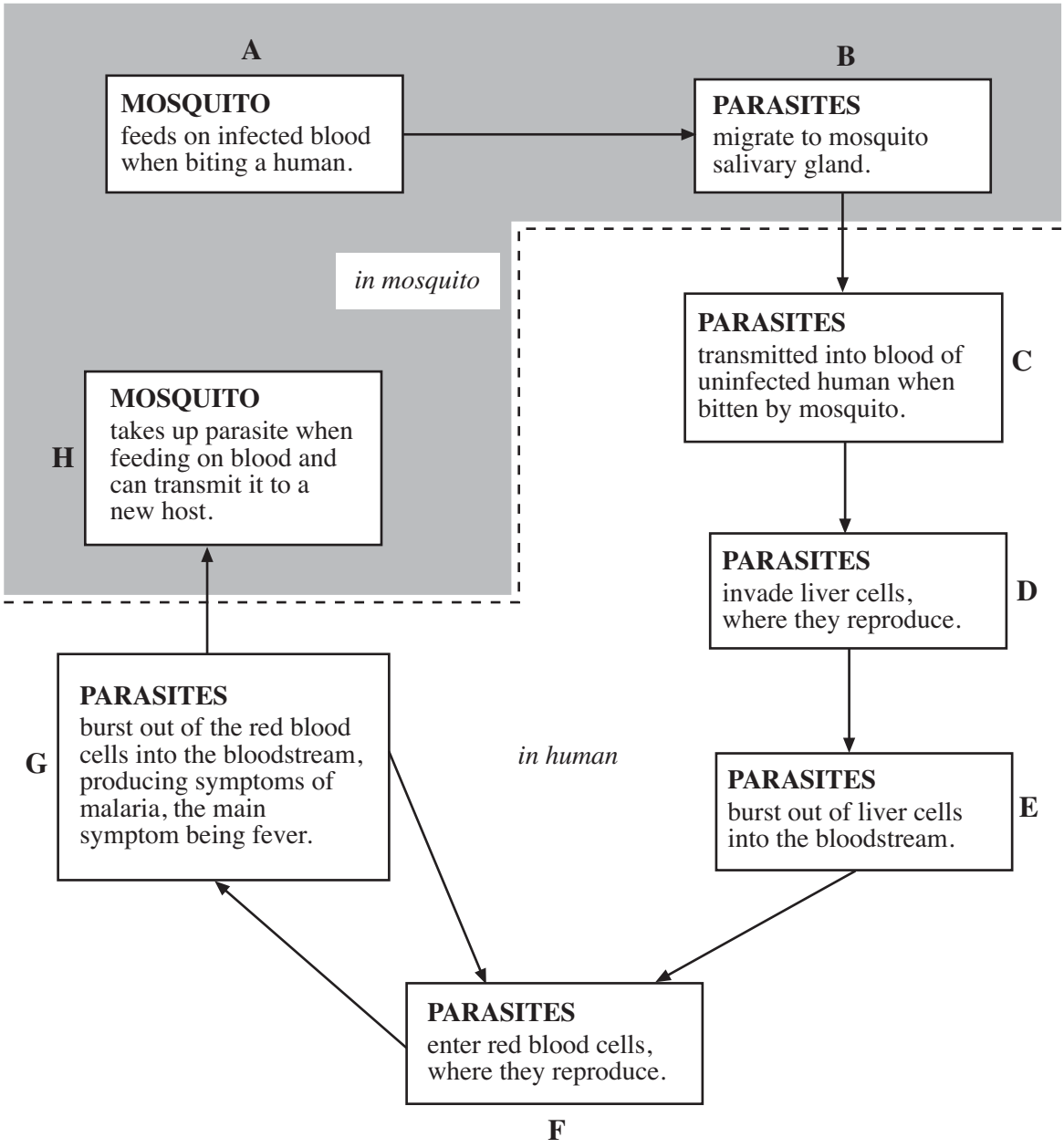
(a) Explain what is meant by the term *endemic*. [1]

.....

.....

.....

The diagram below outlines the life cycle of the malarial parasite.



(b) Explain why one of the symptoms of malaria is fever. [1]

.....

.....

(c) Giving a different reason each time, outline how each of the following methods prevents the transmission of malaria.

(i) Use of insect repellent spray. [1]

.....

(ii) Draining swamps. [1]

.....

(iii) Introduction of sterile male mosquitoes. [1]

.....

(iv) Stocking ponds with fish. [1]

.....

(v) Spraying oil on the surface of ponds. [1]

.....

(d) DDT reduces the risk of mosquitoes biting people. DDT acts in a number of ways when sprayed onto the walls and other surfaces of houses.

	Estimate of mosquito population affected/%
Repels entry,	90
of those that do not enter, are discouraged from biting,	50
of those that are discouraged from biting, prolonged contact kills the mosquito.	50

Assuming that the DDT was sprayed correctly and used over a period of time, calculate its effectiveness in preventing a sleeping child from being bitten by a mosquito.

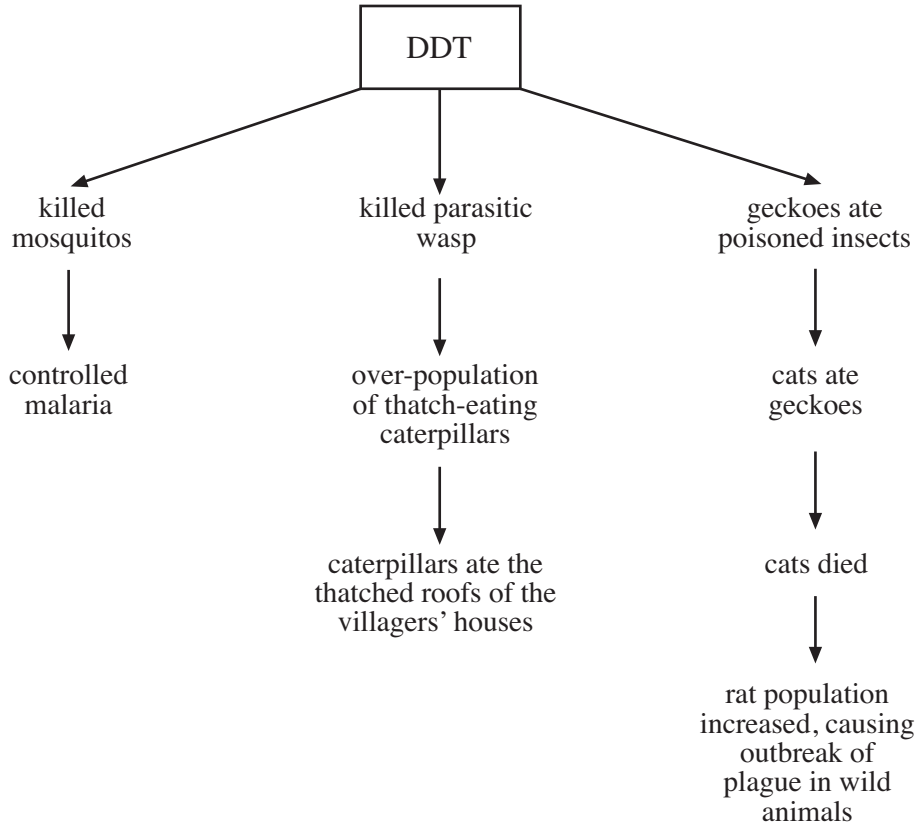
Show your working. [2]

.....

.....

.....

(e) In certain countries, DDT is no longer widely used. The diagram below outlines some of the consequences when DDT was used to control malaria in Borneo in the 1950s.



Suggest two **general** biological problems with using DDT, which results in damage to houses and an increased population of rats. [2]

1. .....

2. .....

(f) Certain human populations show a greater level of resistance to malaria.

Population I	In Africa and Papua New Guinea, some populations do not have a particular protein (antigen) on their red blood cells.

Population II	*Plasmodium falciparum* produces serious symptoms of malaria. However, in Vanuatu (a group of islands in the south-west Pacific), it has been noted that people who have been first infected with the less severe *Plasmodium vivax* do not seem to produce many of the more serious symptoms when subsequently infected by *Plasmodium falciparum*.

Suggest how the greater resistance is achieved in **each** of the above populations. [3]

I .....

.....

.....

II .....

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(g) When Cerys travelled to Kenya on holiday, she was advised to take antimalarial drugs.

(i) When is the parasite vulnerable to these drugs? [1]

.....

(ii) State **one** disadvantage of using these drugs. [1]

.....

(iii) Suggest why it is important for Cerys to continue taking these drugs for a period after returning home. [1]

.....

.....

(Total 17 marks)

4. Septicaemia is a condition in which bacteria move from a localised infection into the bloodstream where they multiply rapidly. Here their toxins accumulate, causing severe damage to vital organs. The bacterium *Listeria monocytogenes* is one of a large number of bacteria that are known to cause septicaemia. It is a Gram positive bacillus that is a facultative anaerobe.

(a) (i) State the shape of *Listeria monocytogenes*. [1]

.....

(ii) State what is meant by the term 'facultative anaerobe'. [1]

.....

(iii) Complete the following passage. [2]

The Gram staining technique distinguishes between Gram negative and Gram positive bacteria. Gram positive bacteria retain the stain of crystal violet and appear the colour ..... whilst Gram negative bacteria appear ..... due to the counterstain.

(b) Bacterial infections, such as septicaemia, are treated with antibiotics. Care needs to be taken to prescribe a suitable antibiotic as the effectiveness of an antibiotic in a given situation depends upon the type of bacterium involved and the mode of action of the antibiotic.

(i) Describe how penicillin is more effective against Gram positive rather than Gram negative bacteria. [5]

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(ii) Suggest why antibiotics that act on protein synthesis are described as 'broad spectrum'. [2]

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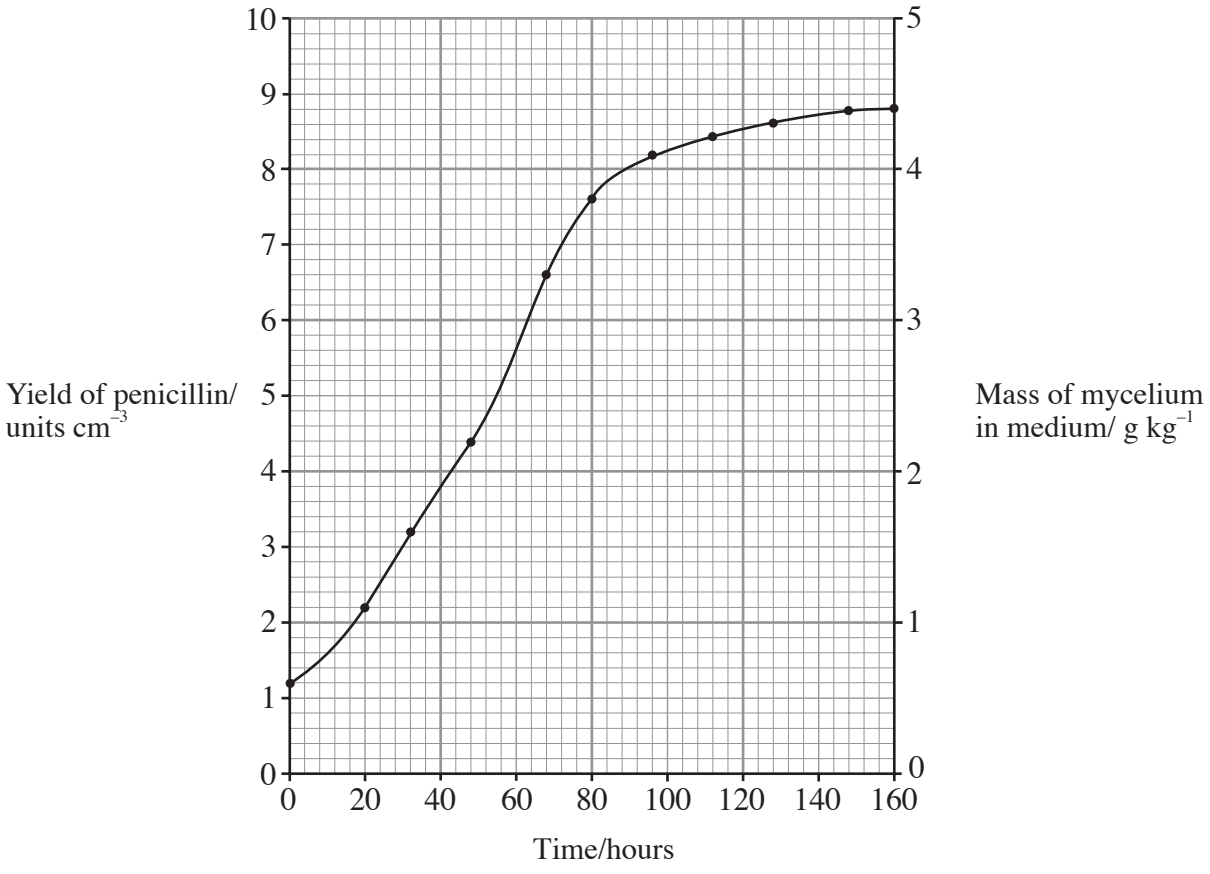
(c) Penicillin is produced by batch fermentation.
The graph below shows the mass of fungal mycelium in the fermenter during the process and the table shows the yield of penicillin at intervals during the process.

Time/hours	*Yield of penicillin/units cm^{-3}*
20	0
36	0.8
48	2.0
68	4.4
80	6.0
96	7.6
112	8.4
128	9.2
148	9.4
160	9.5

(i) Plot the information from the table on the graph. [2]



(ii) Explain why penicillin begins to be produced after 20 hours. [1]

.....

.....

(iii) How does this reflect the need of the organism when free-living? [1]

.....

.....

(iv) Give **two** reasons why sterile air is introduced into the fermenter. [2]

1. .....

2. .....

(v) State **two** factors that need to be monitored during the process. [2]

.....

.....

(Total 19 marks)

5. *(a)* The pigments for photosynthesis are held in chloroplasts. The pigments are chlorophyll a, chlorophyll b and accessory pigments, such as carotenoids.

(i) State precisely where in the chloroplast the pigments are found. [1]

.....

(ii) Name the specific pigment that loses an electron in the light dependent reaction. [1]

.....

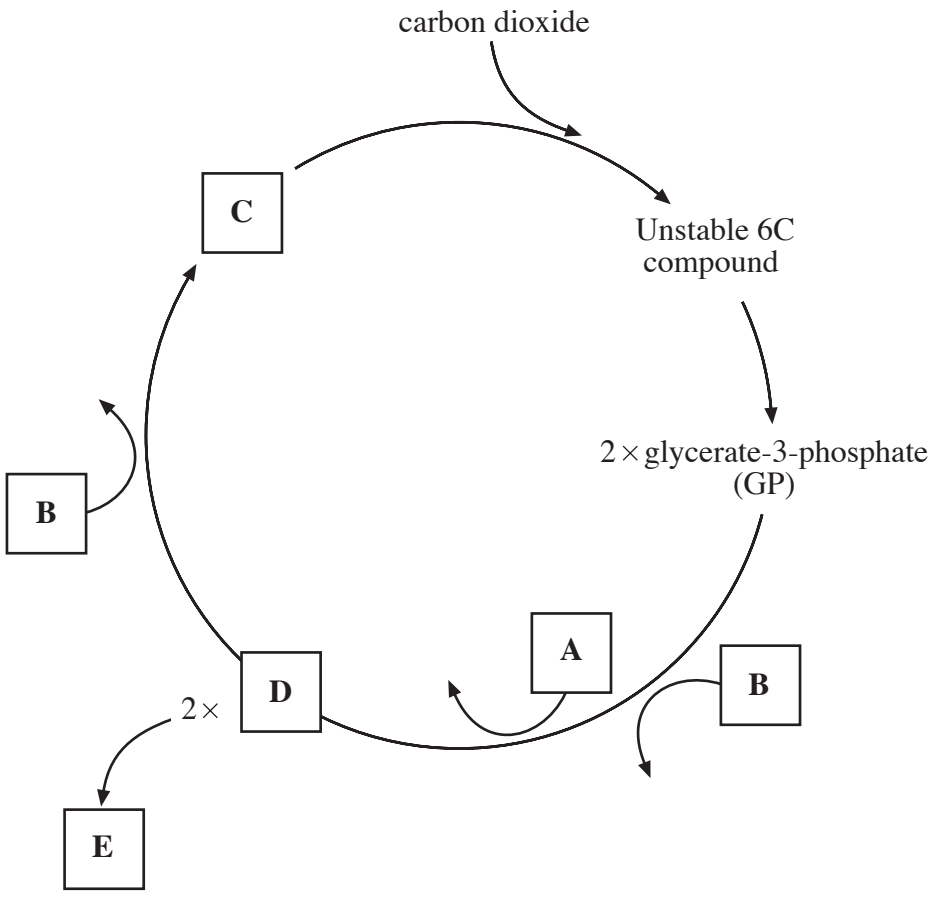
(iii) What is the function of the accessory pigments? [2]

.....

.....

.....

(b) The diagram below is an outline of some of the stages of the Calvin cycle.



(i) **A** and **B** are products of the light dependent reaction.
Identify compounds **A** and **B**. [2]

A .....

B .....

(ii) State **one other** product of the light dependent reaction. [1]

.....

(iii) Identify compounds **C** and **D**. [2]

C .....

D .....

(iv) Name **one** compound that could be formed at **E**. [1]

.....

(c) The rate of photosynthesis can be limited by a number of factors.

(i) State what is meant by a 'limiting factor'. [1]

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.....

(ii) Explain why temperature is an important limiting factor in photosynthesis. [2]

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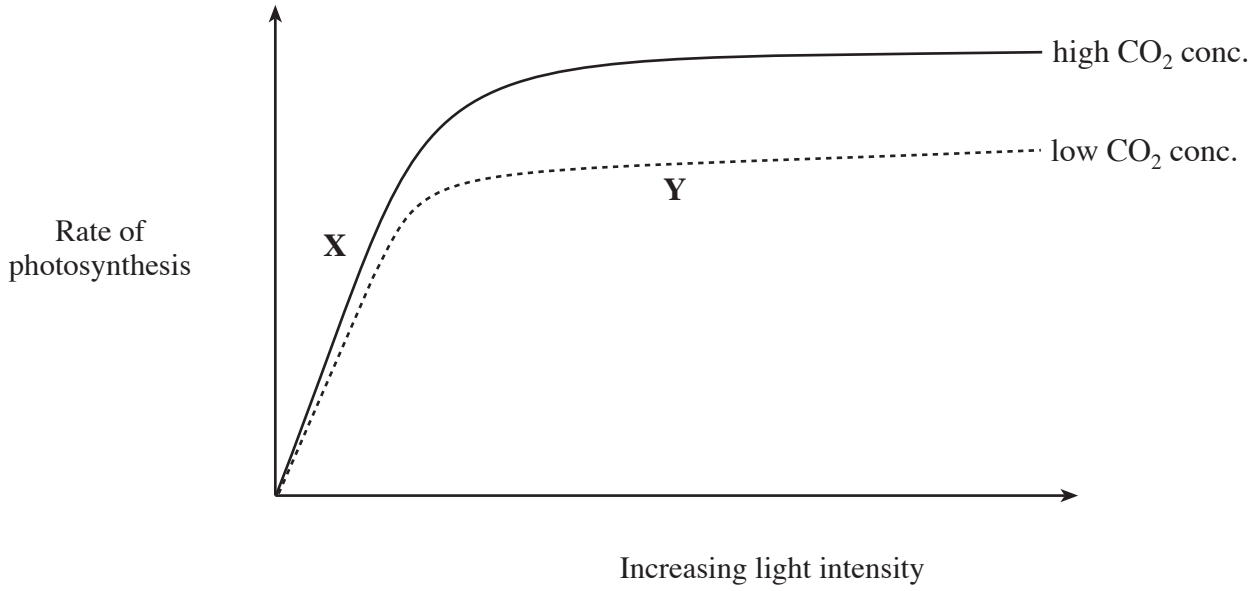
(iii) The graph below shows the effect of increasing light intensity on the rate of photosynthesis at low and high concentrations of carbon dioxide.



State which factors are limiting at **X** and **Y**. [2]

X .....

Y .....

(Total 15 marks)

2. Respiration is carried out as a number of stages.

Complete the table by stating the main products of each of the stages in respiration and where, precisely in the cell, each process takes place. [10]

Stage of respiration	*Main products*	*Where it takes place*
Glycolysis		
Krebs cycle		
Electron transport chain		

[Total 10 marks]

5 *(c)* The reactions in the Calvin cycle are controlled by enzymes.

In an investigation, the rate of photosynthesis was calculated for a species of plant at a number of different temperatures. The results are as follows.

Temperature / °C	*Rate of photosynthesis / arbitrary units*
5	1.8
10	3.4
15	4.0
20	3.8
25	2.1
30	0.0

A general statement made for reactions is that

'for every rise in temperature of 10°C, the rate of reaction will double'.

To what extent do these results confirm the statement?
Explain any differences observed. [3]

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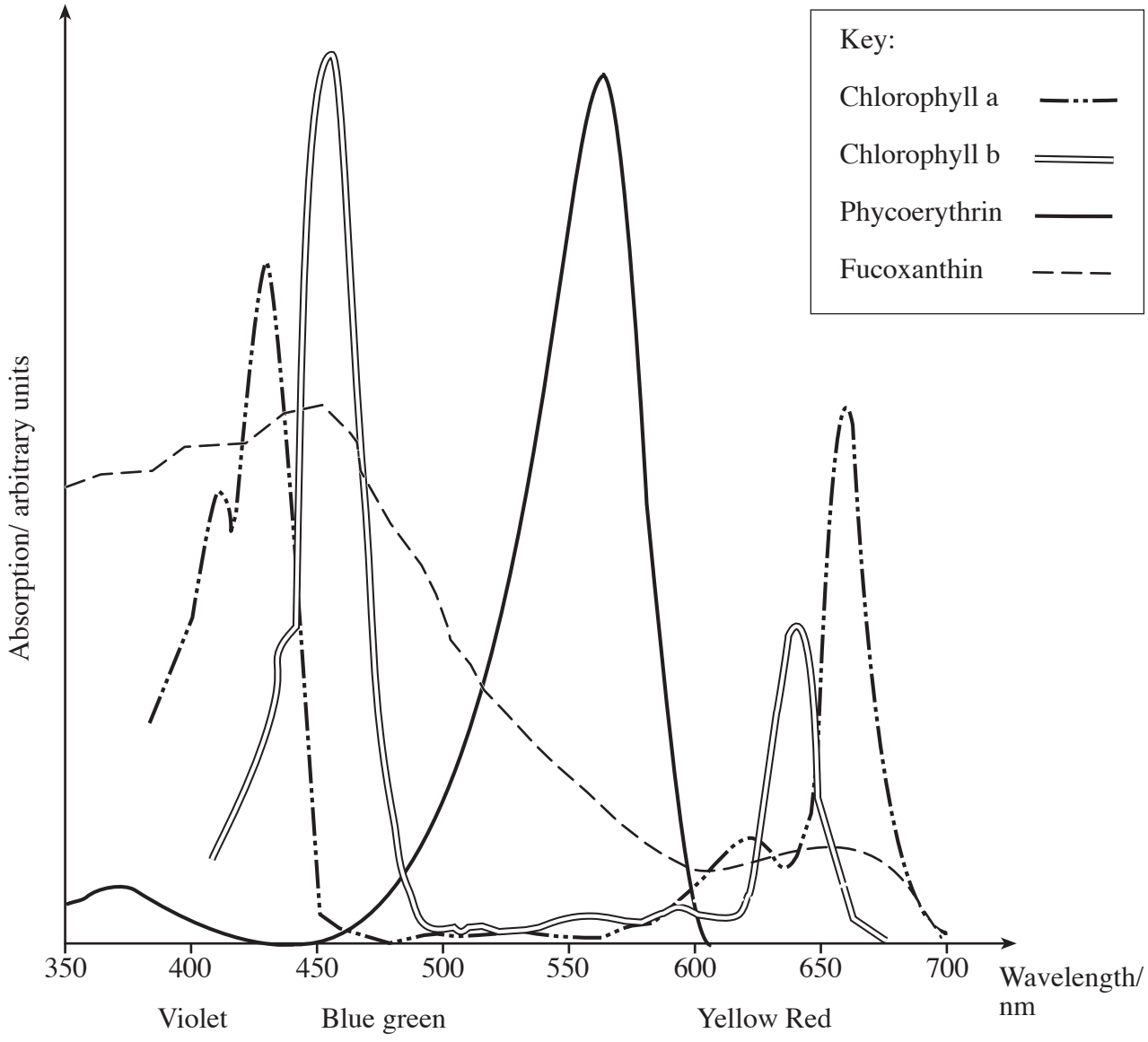
(d) Different types of seaweed possess different pigments.

The table below gives information about the pigments present in green, red and brown seaweeds.

Seaweed	*Main pigments*	
Green	chlorophyll a	chlorophyll b
Brown	chlorophyll a	fucoxanthin
Red	chlorophyll a	phycoerythrin

The graph shows the absorption spectrum for each of these pigments.



Green seaweeds are generally found at the surface of the water, while the brown and red are found in deeper water. The production of fucoxanthin and phycoeryrthrin increase as light intensity decreases.

What is the advantage to the brown and red seaweeds of having the pigments fucoxanthin and phycoerythrin? [2]

.....

.....

.....

.....

.....

[Total 10 marks]

[Total 5 marks]

Question	Answer / Explanatory Notes	Marks Available
5 (a)	**statement** **Light dependent** **light independent** O_2 / 1 CO_2 / 1 produces ATP / 1 uses NADPH2 / 1 in stroma / 1	
(b) (i)	enzymes denatured / stops chemical reactions instantly (not: kills cells/stops photosynthesis)	1
(ii)	the alga takes up both forms of CO_2 in the same way / it does not distinguish between the two forms of CO_2 / both can be used identically	1
(iii)	(Radioactivity first appears in RuBP and hexose) which suggests that the CO_2 combines with the 5C compound to form a 6C compound.	1
	(The formation of a 3C compound GP/PGA) implies a splitting of the 6C molecule	1
	(glyceraldehyde-3-phosphate/GALP is)formed from PGA/triose phosphate /eq.	1 [10]

Question			Answer / Explanatory Notes	Marks Available
6	(a)	(i)	1.3 or 1.35 from 6.2 = 4.9 or 4.85 ; 4.9/8 = 0.61 (g/dm^3/hour) (allow consequential error)	1 1
		(ii)	(limiting factors) eg nutrients used up; (death of cells) eg ethanol toxicity.	1 1
		(iii)	both have similar curves / rate of production follows growth; max. of both yeast and ethanol reached output of ethanol decreases (slightly) when yeast reaches max. growth/stationary phase. 3 · 1 mark	 3
		(iv)	add glucose(or sugar)/nutrients / dilute to reduce toxicity	1
	(b)		Ref. to time scale – Penicillium grows more slowly than the yeast. start – no penicillin produced at start / no penicillin produced until 16 hours. penicillin continues to accumulate at a fast rate during the stationary phase.	 3
	(c)		Ethanol is a by - product/toxic / **waste product** of the metabolism of yeast (when there is no glucose the rate of production declines); Penicillin is an **useful product** in the life of *penicillium* (when the organism has reached maximum growth it is already producing penicillin) / as it is used to **destroy** other organisms e.g. bacteria / which may be **competing** for the same food source. (2 from 3)	1 2 [14]

5. (a) *P. malariae* and *P. falciparum* (2)

(b) Parasite multiplies in blood corpuscle/development completed in 48 hours and parasites burst out/releasing toxins which cause raised temperature (2)

(c) Temperature below normal could be due to cooling effect of heavy sweating/excretion of toxin/sleep following fever/disturbance of normal regulatory mechanisms etc. (1)

(d) (i) (Anopheline) mosquito (1)

(ii) Nets/protective clothing to stop biting/repellents/oil to kill larvae/insecticides against adults/ fish to eat larvae/sterilise adult mosquitoes/drainage of swamps or oil on surface to kill larvae. (3)

(e) Liver (1)

(f) Human toxicity/side effects e.g. liver damage;
Development of resistance in parasite. (not: immunity)
(not: ref. to expense/not affected when inside cells) (2)

(g) Some reference to variation in antigenicity/mutagenicity in complex organisms (i.e. reference to parasite not disease)
(not: show variation) (1)

Total 13 marks

6. (a) Light (1)

(b) **A** 120% (1)

B 300% (1)

(c) (i) Plant B (1)

(ii) The starting figure (27 cf to 45) shows that B is less adapted to low light conditions (1)

The greater percentage increase shows that B is more responsive to increasing illumination (tropical dawn) (1)
(parts (i) and (ii) linked)

(iii) (400 and above) shows much more efficient photosynthesis by B in strong lighting (1)

(d) (i) Temperature and carbon dioxide concentration (2)

(ii) Temperature (1)

Total 10 marks

7. (a) With glucose 0.15 with lactose 0.075 (1)
(accept alternatives, e.g. 1.5 cells/10 minutes and 0.75 cells/10 minutes or 3 cells/20 minutes and 1.5 cells/20 minutes) (1)
Units = (cells) minute^{-1} or other correct expression of unit time.

(b) Lactose poorly absorbed by cell;
Lactose not used for respiration so energy production is poor;
Enzyme to break down lactose is synthesised slowly (or lactose gives rise to essential glucose very slowly).
(allow: lactose must be broken down first)

Any one (1)

(c) Nitrate (nitrogen source)/amino acids/ammonium ions. (2)
phosphate
vitamins/mineral salts
(not: ammonia/nitrogen/specific minerals)

(d) Use sterile conditions (equipment reagents etc.);
Known volume of culture serially diluted;
Using water, saline or buffer
at 1:9;
Known volume onto agar plates;
Incubate 25^{o}/24hr and
count colonies; Calculate original density of bacteria (allowing for dilution).

Any four (4)

(e) Ignores dead cells - counts only those able to reproduce (1)

(f) Requires less labour/less skill/is less costly/is much quicker (1)

Total 11 marks

Question			Answer/Explanatory Notes	Marks Available
4.	(a)	(i)	sugar + base + 3 phosphates or correct names; ATP to ADP + Pi releases energy/exergonic or description; ADP + Pi to ATP needs energy/endergonic or description; easily reversible; transfers energy from place of release/one molecule to energy-requiring reactions; provides energy in 'small packets'/figure e.g. 30.6 or 31. (Max 4)	4
		(ii)	***two of*** synthesis/muscle contraction/active transport/other e.g. nerve impulses/photosynthesis etc.; (not: movement/growth)	1
	(b)	(i)	**X** H (atom)/reduce NAD/reduced FAD;	1
			Y oxygen; (not water)	1
		(ii)	**X** chlorophyll/photosystem I or II;	1
			Y chlorophyll/NADP/photosystem I;	1
	(c)		(electron) fuels proton pump; across membrane/into intermembrane space; H^+/protons diffuse/flow down concentration gradient; Through ATP synthetase/stalked particles (not: ATPase); Chemiosmosis; Membrane impermeable to protons; (Max 4)	4
				[13]

Question		Answer/Explanatory Notes	Marks Available
6.	(a)	mostly peptidoglycan/thick murein layer; carbohydrate/polysaccharide with amino acid side chains; no lipoprotein/lipopolysaccharide;	2
	(b)	(i) each cell produces 1 colony/cells separate;	1
		(ii) underestimate/doesn't allow for clumping;	1
	(c)	include dead bacteria;	1
	(d)	calculation of dilution factor 10^{-2};	1
		counting of colonies 7;	1
		multiplication 700; (allow: consequential error)	1
			[8]

Question		Answer/Explanatory Notes	Marks Available
3.	(a)	disease always present (in the population); (not: low level)	1 mark
	(b)	parasite released into blood/parasite released from red blood cells/ toxins released into blood;	1 mark
	(c)	(i) prevents mosquito biting human; *Allow 'reduces mosquito population' once only in (ii) – (v)*	1 mark
		(ii) removing mosquito breeding grounds/killing larvae;	1 mark
		(iii) preventing (successful) reproduction of mosquito/fertilisation;	1 mark
		(iv) eat mosquito larvae;	1 mark
		(v) drown mosquito larvae;	1 mark
		(Due to error allow: 22.5%, 77.5% risk or 90% effective/10% risk – 1 mark or 50% with multiplication and 90% or 10% – 1 mark)	
	(d)	50% of 50% of 10%; 97.5% effective/2.5% risk;	2 marks
	(e)	kills non target species/kills useful species/not specific; disrupts food chains/webs; (ALLOW: DDT accumulates in the food chain/ stays in tissues)	2 marks
	(f)	parasite does not recognise red blood cells/uses antigen to enter cell; immune response/lymphocytes activated against *P. vivax*; (not: resistance caused) memory cells/lymphocytes/antibodies partially effective against/ triggered by *P.falciparum*; (ie triggered because similar)	3 marks
	(g)	(i) they act on the parasite when it is 'free' in the blood/ stages C + E + G;	1 mark
		(ii) side effects/expensive/region specific/different antigenic types/ excessive use leads to resistance in parasite/need to be taken regularly/ action limited to 1 stage of life cycle/temporary; (not: doesn't stop biting)	1 mark
		(iii) to deal with any parasites that may have been inside (liver/red blood) cell/to make sure that all are killed; (not: malaria remains dormant in liver)	1 mark
			Question Total: 17

Question			Answers/Explanatory Notes	Marks Available
4.	(a)	(i)	rod shaped;	1
		(ii)	grows/survives/respires in the presence or absence of oxygen/can survive without oxygen (not : can survive in presence of oxygen/ref. to anaerobe/aerobe);	1
		(iii)	purple/blue/violet; Red/pink.	2
	(b)	(i)	inhibits formation of cross linkages in (positive) cell wall; (not : affects/weakens/breaks) peptidoglycan/murein affected; wall is weakened; (not : broken down) osmotic uptake/water taken up; lysis/cell walls break; bacteriocidal/kills bacteria; Gram negative walls protected by layer of lipoprotein/ lipopolysaccharide.	Max. 5
		(ii)	act on (wide) range/types of bacteria; interferes with protein synthesis carried out by all bacteria; acts on common metabolic process; success not dependent on feature only possessed by some bacteria.	Max. 2
	(c)	(i)	all correct = 2, 1 error = 1, 2 or more errors = 0; (no tolerance)	2
		(ii)	once the nutrients/glucose begins to run out; (not : in short supply)	1
		(iii)	reduces competition (in crowded conditions/when food is scarce);	1
		(iv)	prevent entry of micro-organisms/contaminants/maintain aseptic conditions; provides oxygen for respiration/mixing;	2
		(v)	pH; temperature.	2
			Total	**[19]**

Question			Answers/Explanatory Notes	Marks Available
5.	(a)	(i)	thylakoid/granum/lamellae/antenna complex/ light harvesting units; (not : reaction centre/photosystems)	1
		(ii)	chlorophyll a;	1
		(iii)	absorb light energy/photon; pass (energy) onto primary pigment/reaction centre/chlorophyll a; increase range of wavelength absorbed.	Max. 2
	(b)	(i)	A reduced NADP; B ATP;	2
		(ii)	oxygen;	1
		(iii)	C ribulose bisphosphate; D triose phosphate/GALP;	2
		(iv)	glucose/amino acids/lipids or other correct.	1
	(c)	(i)	the factor in the shortest supply/nearest to its minimum value (and therefore the most likely to determine the rate of photosynthesis);	1
		(ii)	photosynthesis/Calvin cycle uses enzymes; enzyme action is affected by temperature/ref. to enzyme kinetics; high temperature denatures enzymes/low temperature slows enzyme action;	Max. 2
		(iii)	X light; (intensity) Y carbon dioxide (concentration).	2
			Total	**[14]**

Q.2

stage of respiration	main products	where it takes place
Glycolysis	pyruvate ; reduced NAD ; ATP ; **2 max**	cytoplasm ;
Krebs cycle	carbon dioxide ; reduced NAD ; reduced FAD ; ATP ; **3 max**	matrix (of mitochondrion) ;
Electron transport chain	ATP ; water ; NAD / FAD ; **2 max**	inner mitochondrial membrane / crista ;

Incorrect answer negates correct answer.

10 max

[Total : 10]

Q.5

(c) statement applies / rate (just about) doubles for increase from 5°C to 15°C ;

more energy for more collisions ;

comment on only small increase from 10°C to 20°C / decreases from 15° to 25° / 20° to 30°;

optimum (appears to be 15°C) ;

so would not expect increase above it or expect a decrease ;

30° / higher temperatures denature enzymes ; **3 max**

(d) can absorb other / wider range of wavelengths /different colours;

less light penetrates into / intensity in deeper water ;

different wavelengths penetrate to different depths;

allows more / sufficient / maximum photosynthesis ; **2 max**

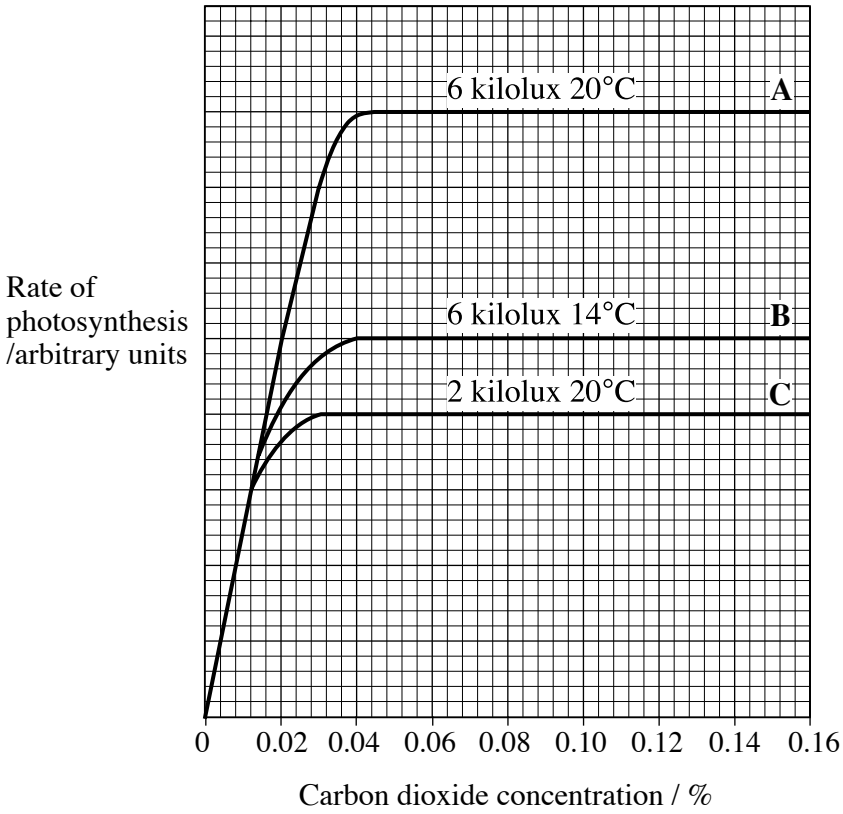
[Total : 10]

BY4 June - WJEC

7/10

3.1-3.4

4. The graph shows the relationship between the rate of photosynthesis and carbon dioxide concentration in the green plant *Hormidium* at different light intensities and temperatures.



(a) (i) Explain the shape of the curve **A**. [2]

.....

.....

.....

.....

(ii) Explain why there is a difference between graphs [2]

A and **B** .....

.....

.....

A and **C** .....

.....

.....

(iii) Draw a line on the graph to indicate the rate of photosynthesis at 2 kilolux and 14°C. [1]

(b) What would be the effect of depriving the plant of nitrogen and magnesium? [3]

.....

.....

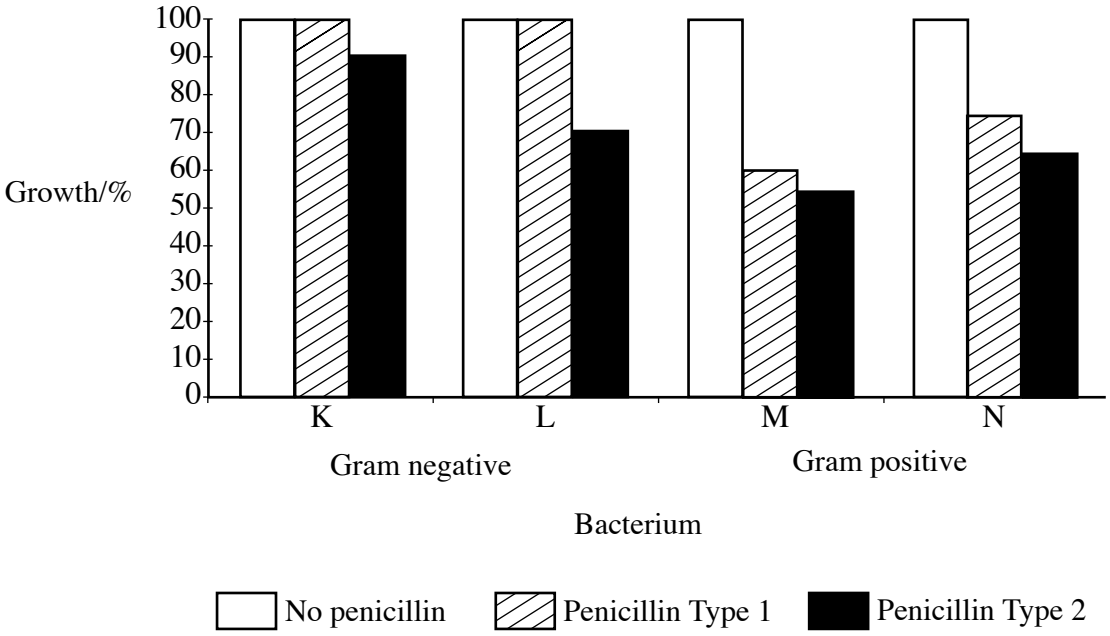
.....

.....

(Total 8 marks)

6. Penicillin and closely related biochemicals are widely used as antibiotics. Antibiotics vary in their effectiveness depending upon the mode of action of the antibiotic and the organism that is being targeted.

Drug companies conduct research to find the most effective antibiotic for use with particular pathogens. In an investigation, the growth of four species of bacterium (K, L, M and N) was observed without penicillin and with two different types of penicillin. Bacteria K and L are Gram negative bacteria and M and N are Gram positive. Penicillin antibiotics act by inhibiting the formation of crosslinks between certain molecules during cell wall synthesis. The results of such an investigation are shown in the graph.



(a) (i) What was the purpose of growing bacteria in the absence of penicillin? [1]

.....

(ii) Suggest which penicillin type should be prescribed for general use in patients infected with any of these bacteria. [1]

.....

(iii) Which **two** species of bacteria are most affected by penicillin? [1]

.....

(iv) Using the information given and your own knowledge, suggest why the various species of bacteria respond differently to penicillin. [2]

.....

.....

.....

.....

(b) The bacteria infecting humans will be found in the blood or tissue fluid.

(i) Using the information given and your knowledge, explain the mechanism by which penicillin brings about the destruction of bacterial cells. [3]

.....

.....

.....

.....

.....

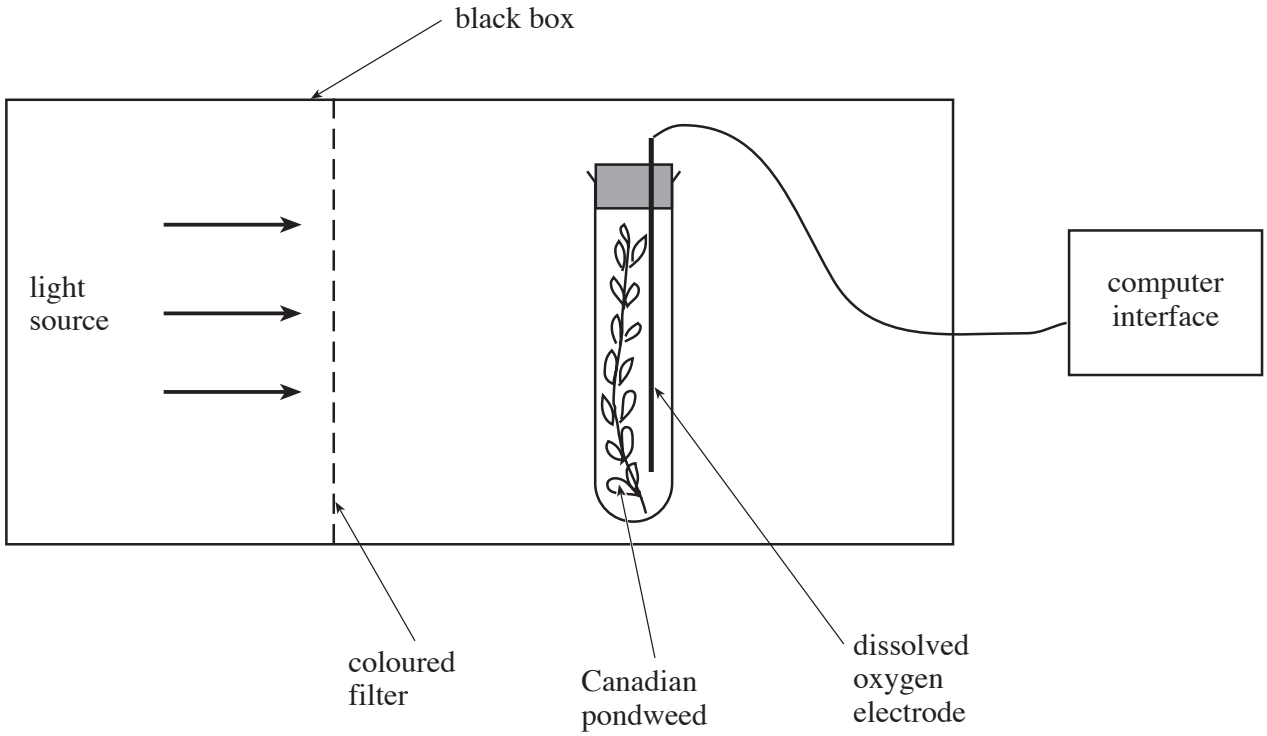
.....

(ii) When might the bacteria be most susceptible to the action of penicillin? [1]

.....

(Total 9 marks)

(b) The following apparatus was assembled, using different coloured filters, to investigate the effect of light wavelength on the rate of photosynthesis. The dissolved oxygen electrode measures the concentration of oxygen in the solution around the Canadian pondweed. The experiment was repeated a number of times.



(i) Explain how the use of the dissolved oxygen electrode allowed the rate of photosynthesis to be determined. [2]

.....

.....

(ii) Give **two** sources of inaccuracy with **this** experimental set up and explain how it could be corrected. [2]

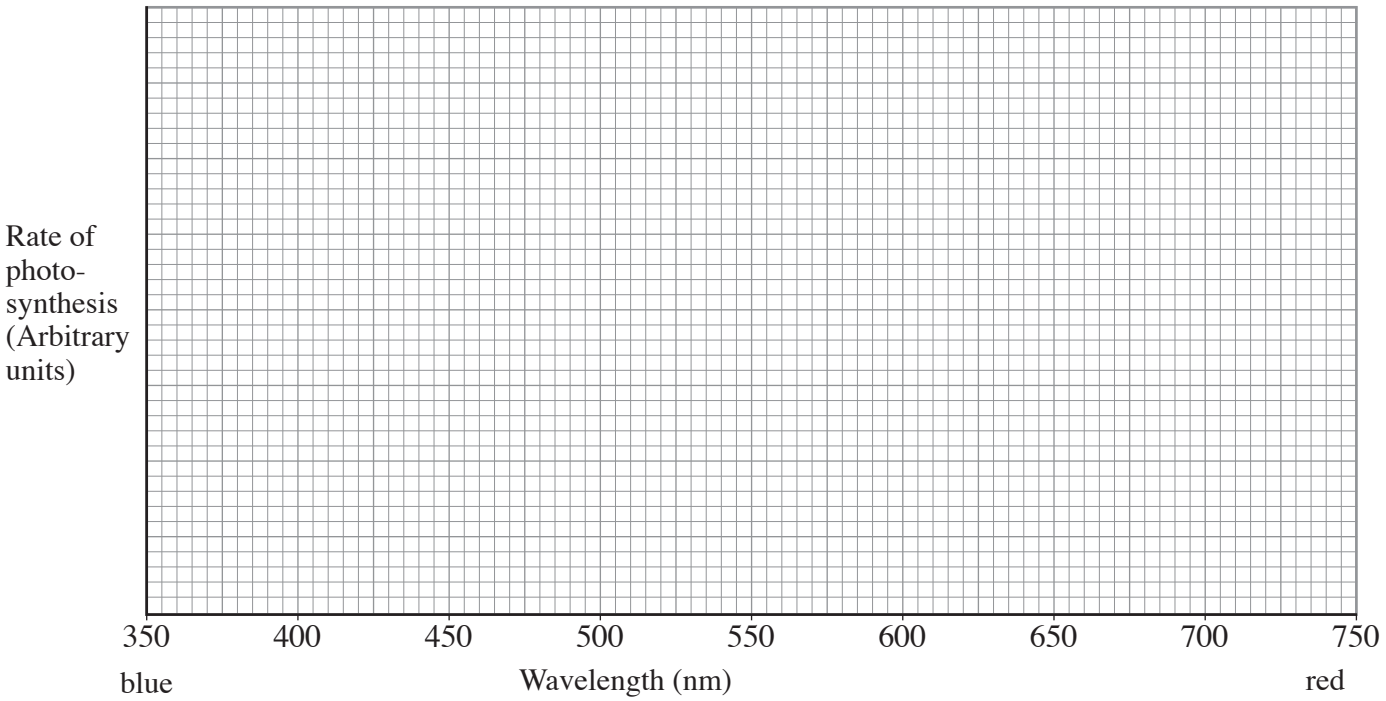
1. Inaccuracy .....

Correction .....

2. Inaccuracy .....

Correction .....

(iii) Draw the results you would expect to obtain for this experiment, using a series of coloured filters, on the graph below. [2]



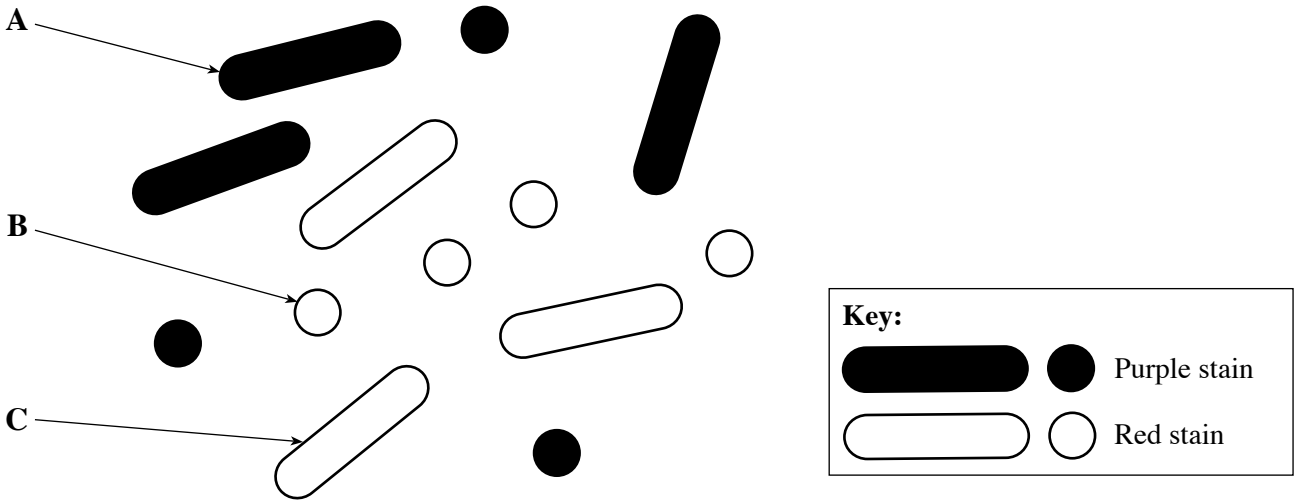
(iv) What is the name given to this graph? [1]

.....

(Total 13 marks)

Turn over.

4. When swabs of infected tissue are taken to the microbiology laboratories, they are first stained to allow initial identification of the bacterial type(s) present.
A sample of bacteria was stained and the results shown below.



(a) Using the diagram identify the types of bacteria labelled **A** and **B**.

A (i) .....

(ii) .....

[2]

B (i) .....

(ii) .....

[2]

(b) (i) Explain the reason for the differences in the staining between the bacteria labelled **A** and **C**. [3]

.....

.....

.....

.....

(ii) What advantage might bacteria stained with the red stain have over those stained purple? Explain your answer. [2]

.....

.....

.....

[Total 9 marks]

8. A potted plant was watered using water containing the radioactive isotope of oxygen ^{18}O. It was placed in suitable conditions in a growth room and subjected to light which was moved different distances from the plant. The mean volumes of oxygen released from the plant were recorded in the table below.

Distance of plant from light bulb (cm)	*Mean volume of oxygen evolved ($cm^3 hour^{-1}$)*
80	0.5
60	0.5
40	1.0
20	2.5
10	5.0
5	55.0

(a) Plot a graph of these results. [3]

(b) (i) Describe the pattern of results from the graph and table. [2]

.....

.....

.....

.....

(ii) Explain these results using your knowledge of photosynthesis. [2]

.....

.....

.....

.....

(iii) How could you improve this experiment? [1]

.....

.....

(c) What would you conclude from the fact that the oxygen evolved was found to be radioactive? [1]

.....

(d) A further experiment was performed to investigate the conditions required for photosynthesis. Chloroplasts of nettle leaves were extracted and suspended in buffer solution containing methylene blue. This was divided into four equal parts and treated as shown in the table of results below. The methylene blue is acting as an artificial hydrogen acceptor.

Experiment	*Conditions*	*Colour of solution*	
		After 5 minutes	*After 45 minutes*
1	Darkness at 5°C	Blue-green	Blue-green
2	Darkness at 25°C	Blue-green	Blue-green
3	Light at 5°C	Blue-green	Pale green
4	Light at 25°C	Pale green	Pale green

(i) Explain how the hydrogen is being formed during photosynthesis? [1]

.....

.....

(ii) What would be the normal hydrogen acceptor in the chloroplast? [1]

.....

(iii) What conclusions may be drawn from the results shown in the table? [2]

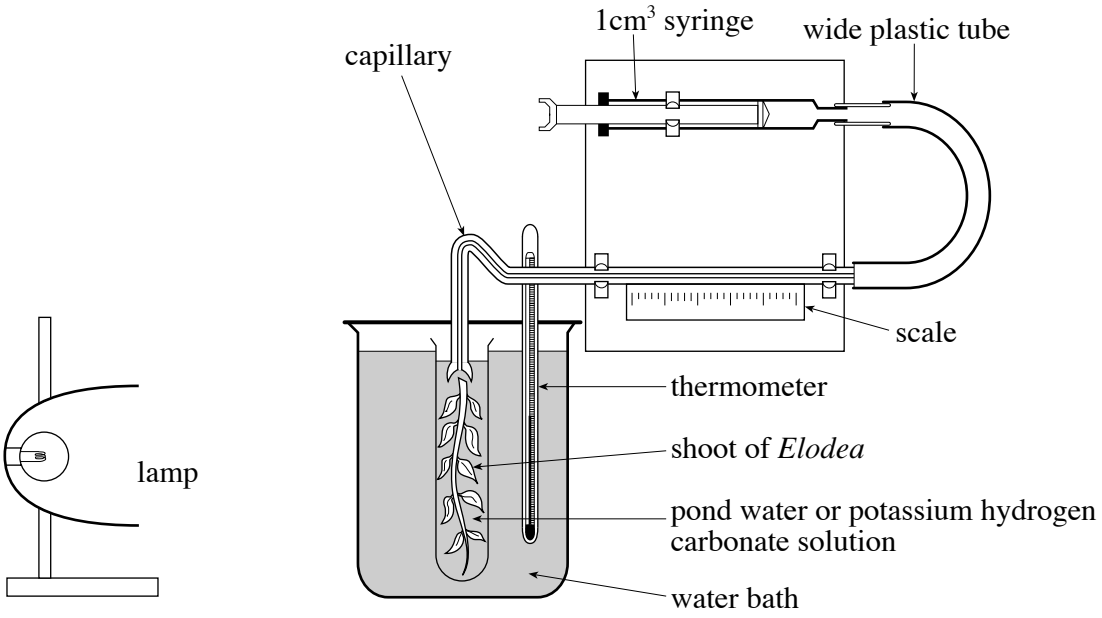
.....

.....

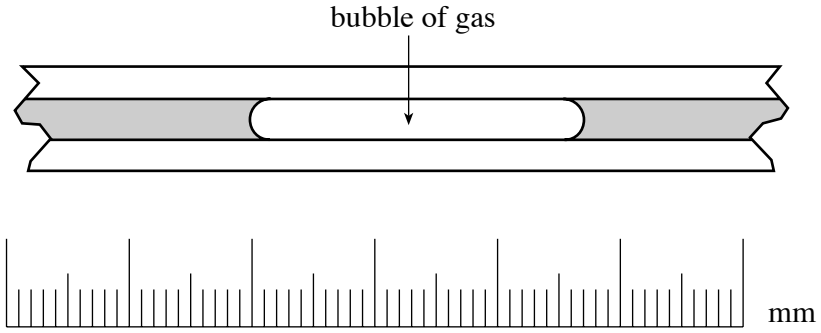
.....

[Total 13 marks]

5. The apparatus shown below can be used to investigate the rate of photosynthesis.



(a) The drawing below shows part of the capillary tube after 5 minutes.



(i) Name the gas produced. [1]

.....

(ii) According to the scale drawn, what was the length of gas bubble produced? [1]

.....

(iii) Calculate the volume of gas produced in **1 hour**, if the internal diameter of the capillary tube is 0.4 mm and π is 3.14. Use the formula: Volume = $2 \pi r^2$ x length. [2]

.....

.....

.....

.....

(b) Describe how you would use the apparatus to investigate the effect of the wavelength of light on the rate of photosynthesis. [3]

.....

.....

.....

.....

.....

(c) The table shows the results of two experiments conducted with the apparatus, in order to investigate the effect of light intensity.

Distance (d) from lamp (m)	*light intensity ($1/d^2$)*	*Volume of gas produced per hour (mm^3)*	
		experiment ***A***	*experiment* ***B***
0.9	1.23	10	12
0.8	1.56	16	25
0.7	2.04	25	35
0.6	2.78	35	45
0.5	4.00	46	56
0.4	6.25	51	65
0.3	11.11	50	70
0.2	25.00	52	69
0.1	100.00	51	71

(i) Describe effect of increasing light intensity in experiment **A**. [2]

.....

.....

.....

.....

(ii) In experiment **A**, over what distance from the lamp is light intensity the limiting factor? [1]

.....

(iii) Suggest **one other** factor that was changed in experiment **B** in order to produce these results. [1]

.....

.....

(iv) State the *Law of Limiting Factors* that applies to these experiments. [2]

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[Total 13 marks]

3. *(a)* What is meant by the term *Law of limiting factors*? [2]

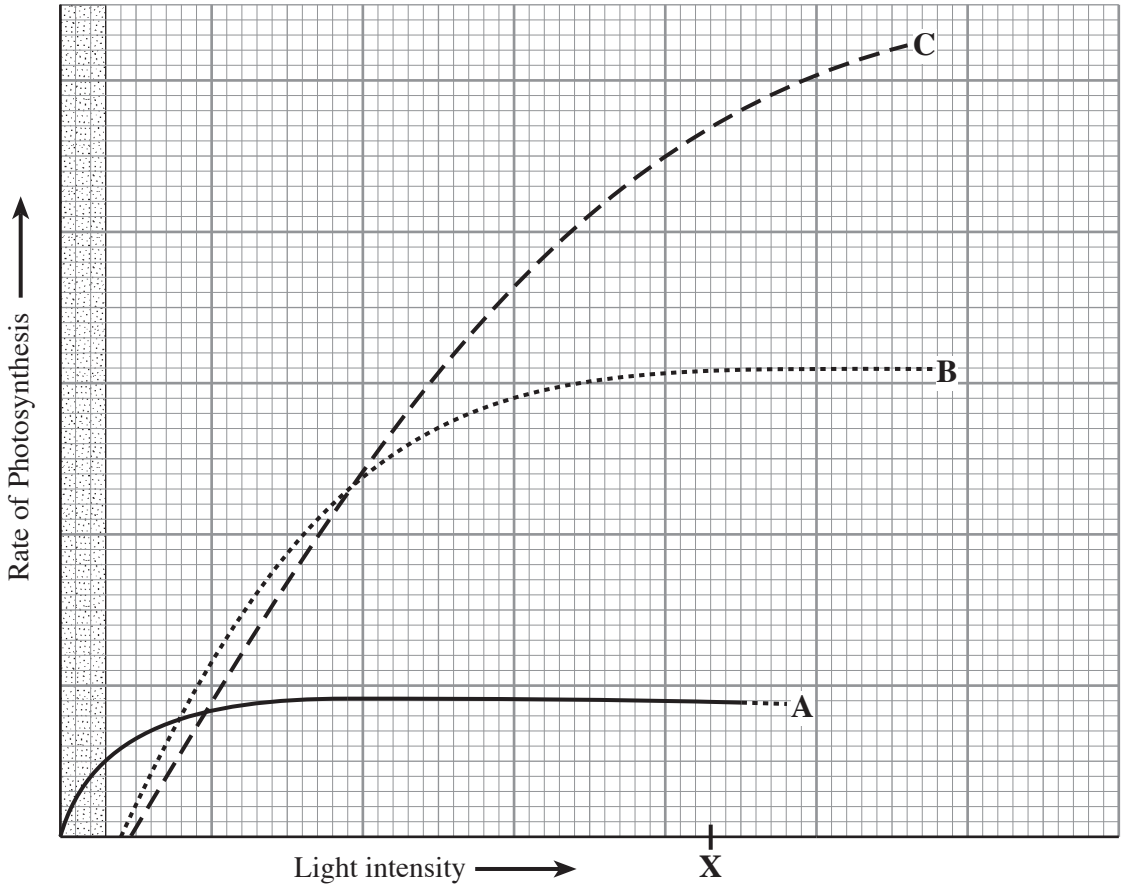
.....

.....

.....

.....

(b) The graph below shows the effect of different light intensities on the rate of photosynthesis in three species of plants.



Key

Normal light intensity inside building

(i) Suggest **two** reasons why the rate of photosynthesis of plant **B** slows down after light intensity **X** is reached. [2]

1. .....

.....

2. .....

.....

(ii) Suggest which of these species of plant is adapted to living in high light intensities. [1]

.....

(iii) Using information from the graph, suggest why species **A** is likely to make the best indoor house plant. [1]

.....

.....

(c) There is a certain light intensity at which the rate of photosynthesis just balances the rate of respiration (net carbon dioxide exchange is zero) and this is called the light compensation point.

(i) Explain why the rate of photosynthesis of a plant is not accurately given by the volume of carbon dioxide taken in. [1]

.....

.....

(ii) What do you predict would happen to the **dry mass** of a plant which is kept in a light intensity below the light compensation point? [1]

.....

.....

(Total 8 marks)

5. Bacteria can be cultured in the laboratory on agar plates.

(a) State **three** conditions which are necessary for growth of bacterial colonies on these plates. [3]

1. .....

2. .....

3. .....

(b) Suggest how you could ensure that aseptic and sterile conditions are present during the preparation of agar plates and the transfer of the bacteria from the culture medium to the plates. [2]

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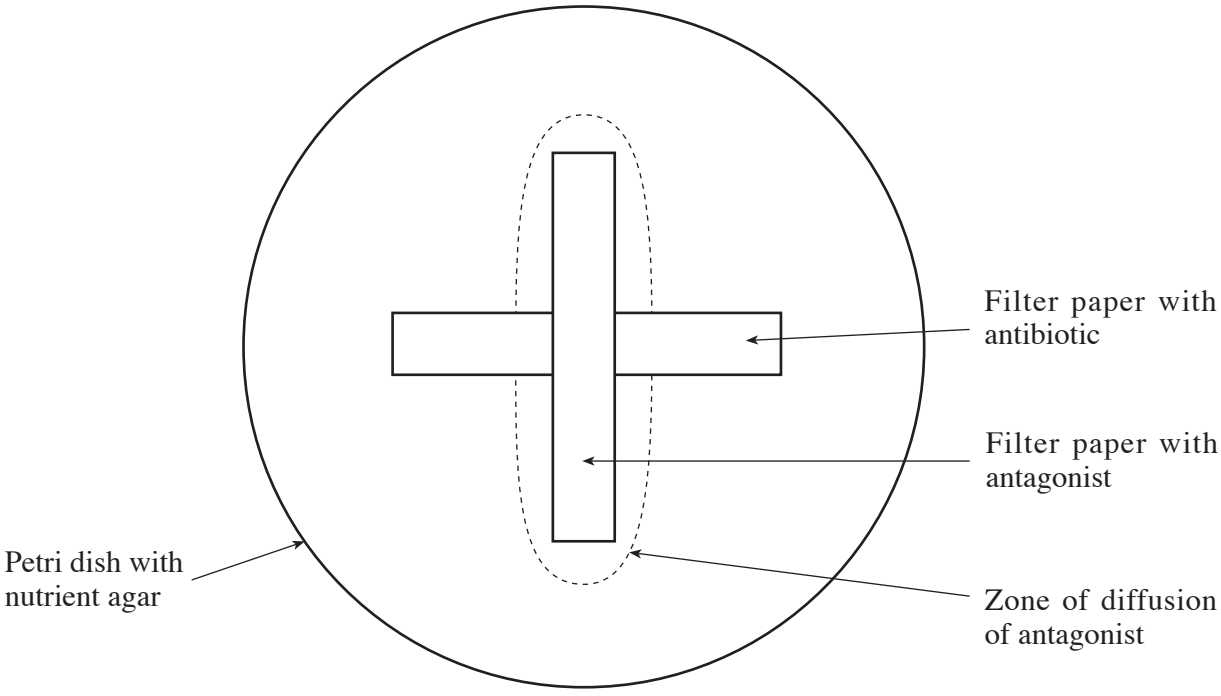
(c) Some substances are known to interfere with the action of antibiotics and are called antagonist. Two strips of filter paper, one soaked with the antibiotic and the other soaked with a suspected antagonist, are placed so that they cross at right angles on a Petri dish. The Petri dish contains nutrient agar inoculated with a microorganism sensitive to the antibiotic. Draw and label on the diagram the pattern of bacterial growth you would expect to see after 48 hours incubation. [2]



(d) Antibiotics can be described as being bactericidal or bacteriostatic. State what is meant by **each** of these terms. [2]

Bactericidal .....

.....

Bacteriostatic .....

.....

(e) Certain bacteria are resistant to antibiotics.

(i) Suggest **two cellular** features which enable a bacterium to be resistant to antibiotics. [2]

1. .....

.....

2. .....

.....

(ii) Explain how mutation and natural selection are involved in the development of resistance by certain bacteria to antibiotics. [3]

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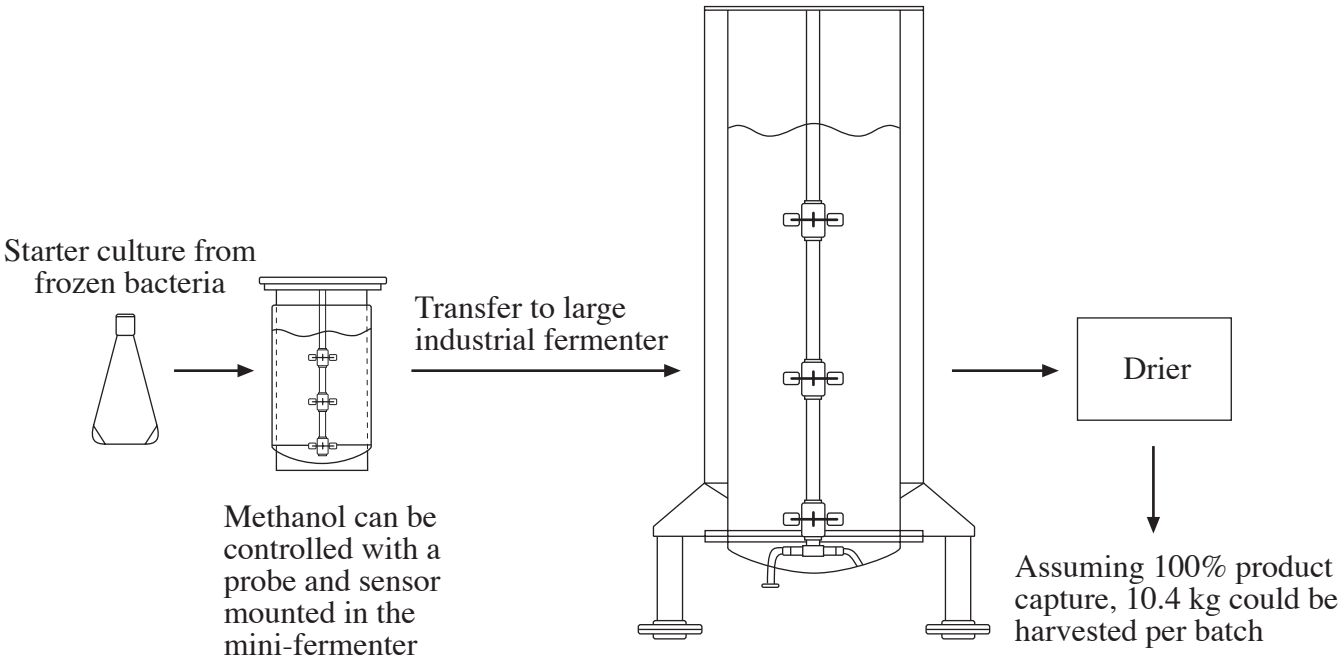
(Total 14 marks)

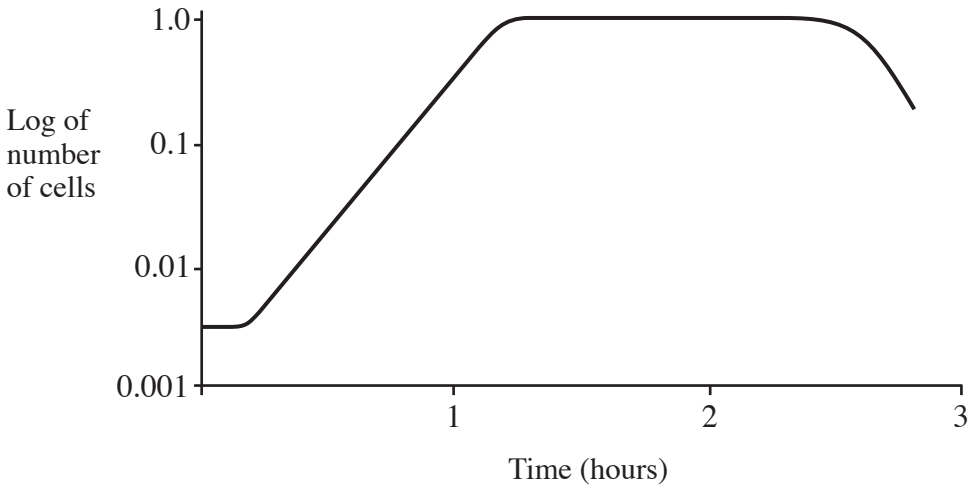
3. Below is a flow diagram showing batch fermentation for the production of animal feed supplement from methanol, using *Bacillus methanolicus*. A 300-litre fermenter is used for the final fermentation production stage. This runs for a number of hours, after which the bacteria are dried ready for addition to animal feed.



(a) State **three** factors which would need to be controlled in the fermenter and state how they would be controlled. [3]

Factor	*Means of control*

The graph below shows the type of growth curve shown by the bacteria.



(b) Draw an arrow on the graph to show the point at which the bacteria should be harvested.

Explain why you have chosen that point. [2]

.....

.....

.....

(c) State **three** advantages of using industrial fermenters. [3]

.....

.....

.....

(d) Suggest **one** reason why the bacteria are initially grown in a mini fermenter prior to adding the culture to the industrial fermenter. [1]

.....

.....

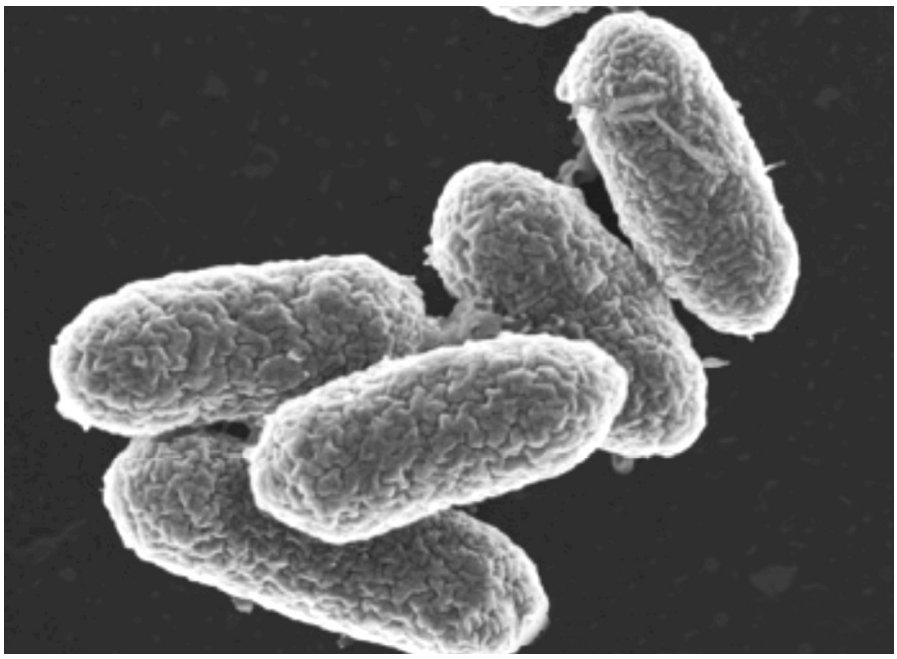
(e) Name **one** *other* product which is produced in an industrial fermenter. [1]

.....

(Total 10 marks)

2. The photograph below shows a species of *Salmonella* bacteria.

These are Gram negative bacteria and are the most common cause of food poisoning (salmonellosis) in humans.



DR GARY GAUGLER / SCIENCE PHOTO LIBRARY

(a) (i) What colour would Gram negative bacteria stain with the Gram stain? [1]

.....

(ii) Give **two** features of a Gram negative, bacterial cell wall. [2]

.....

.....

.....

(iii) Give **one** advantage to the bacteria of having this cell wall structure. [1]

.....

(b) What is the term used for the shape of this bacterium, as shown above? [1]

.....

(c) What are the symptoms of *Salmonella* food poisoning and what causes these symptoms? [2]

.....

.....

.....

(Total 7 marks)

4. To investigate the relationship between photosynthesis and respiration, unicellular algae were encapsulated in alginate balls. These were then suspended in hydrogen carbonate indicator which can be used to indicate the concentration of dissolved CO_2.

A number of small glass tubes were prepared each containing 30 algal balls and the same volume of indicator was added to each.
The tubes were each exposed to light of a different intensity. All other conditions were kept constant.
After 1 hour a sample of the indicator was taken and placed in a colorimeter. The results are shown in the table below.
The colorimeter was set at zero with pH 7.0. In acid conditions the solution turned lighter giving lower (negative) figures and in alkaline conditions the solution turned darker giving higher (positive) figures.

Light intensity (arbitrary units)	100.0	71.0	50.0	25.0	12.5	0.0
Colorimeter reading (arbitrary units)	0.34	0.30	0.17	–0.03	–0.10	–0.15

(a) Plot a graph on the paper opposite. [4]

(b) Describe the results from the graph. [2]

.....

.....

.....

(c) What name is given to the point where your line crosses the X axis? [1]

.....

(d) What precisely is happening at this point? [1]

.....

(e) Explain the results using your knowledge of photosynthesis and respiration. [4]

.....

.....

.....

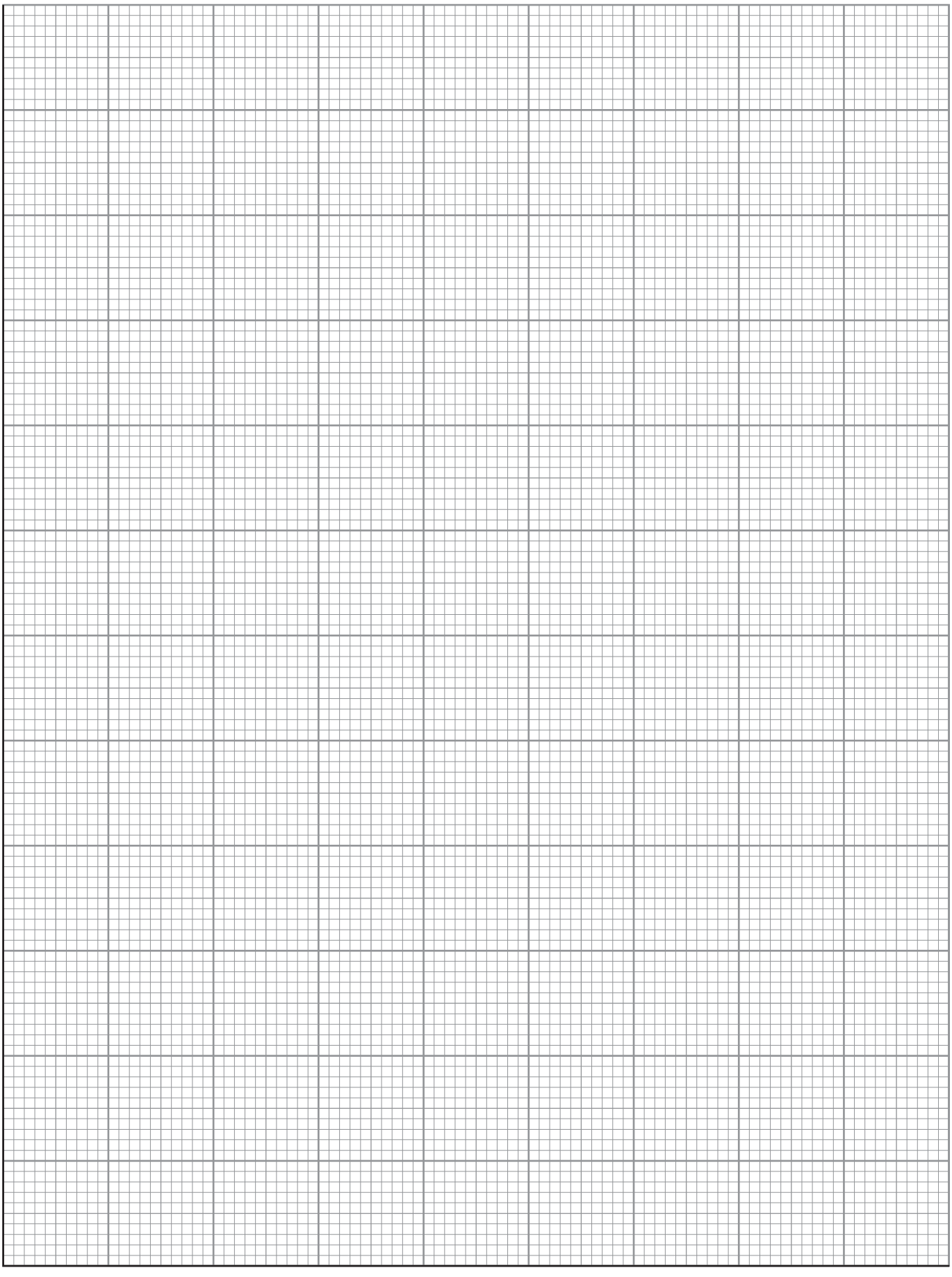
.....

.....

.....

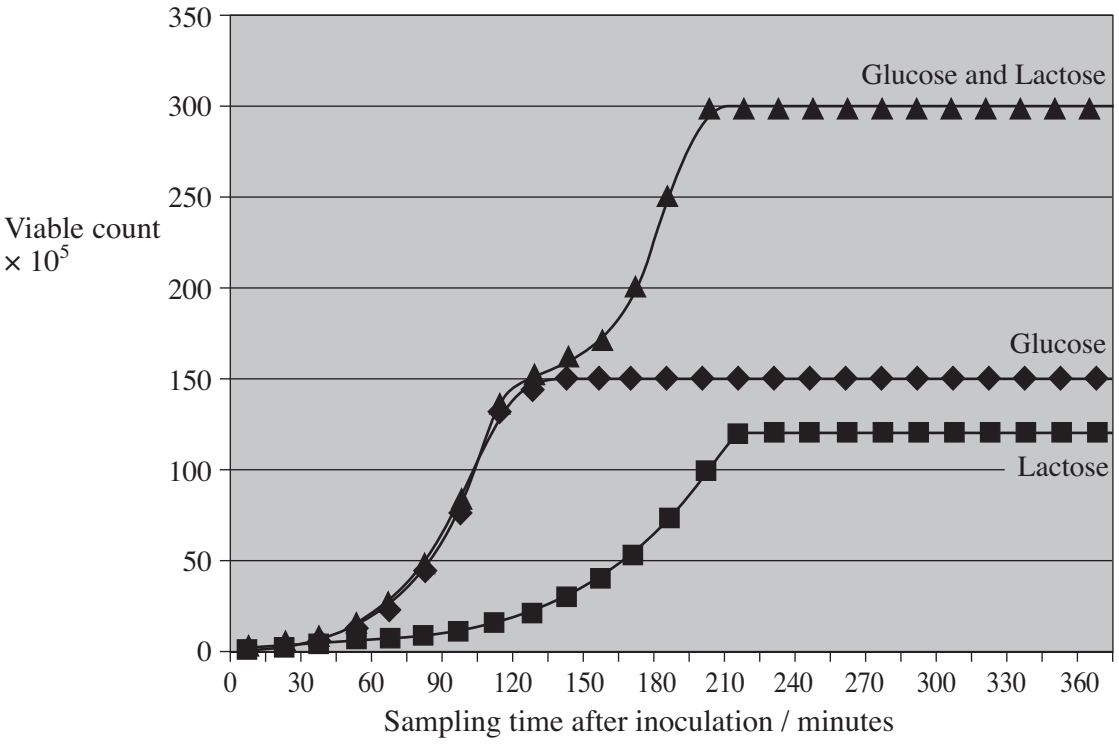
(Total 12 marks)

Examiner only



Turn over.

5. Three fermenters were set up in order to study the population growth of *E coli* in different sugar solutions, 0.001M glucose, 0.001M lactose and a mixture of glucose and lactose both at 0.001M. Samples were removed from the fermenter at timed intervals. Using serial dilution and the viable count method, the population size in each fermenter was estimated. The results are shown in the graph below.



(a) Explain what is meant by *serial dilution*. [2]

.....

(b) Explain what is meant by the *viable count* method. [2]

.....

.....

(c) Explain why there is a difference in population growth between the glucose and lactose. [3]

.....

.....

.....

.....

(d) Describe and explain the shape of the curve when the bacteria are grown in lactose and glucose together. [4]

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.....

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.....

.....

.....

(Total 11 marks)

MARK SCHEME

BI4 - June 2002

4. (a) (i) initial slope shows CO_2 is limiting (at this stage);
flattening shows CO_2 no longer limiting/another factor limiting; (2)

(ii) (comparing A and B) [same light intensity] shows temperature limiting;
(comparing A and C) [same temperature] shows light intensity limiting; (2)

(iii) curve of same shape drawn below C; (1)

(b) (*nitrogen)*
stunted/reduced growth;
needed for formation of amino acids/protein;
needed for formation of nucleic acids;

(*magnesium)*
chlorosis; (not: yellowing of leaves unqualified)
(rate of) photosynthesis reduced;

(One reference to chlorosis only) (3)

Total 8 marks

Total 11 marks

6. (a) (i) control/indication of 'normal' growth/to compare effect of penicillin;(1)

(ii) type 2; (1)

(iii) M and N/Gram positive; (1)

(iv) some difference in composition of cell wall;
Gram negative walls have fewer of the relevant crosslinks/thinner peptidoglycan layer;
Gram negative walls more complex/have extra layers;
Any two (2)

(b) (i) wall is weakened;
bacteria takes in water (by osmosis);
wall breaks/lysis; (3)

(ii) at/during reproduction/growth; (1)
(allow: (cell) division)

Total 9 marks

Question	Answer/Explanatory Notes	Marks Available
7		
(b)	X = cilia/brush border Y = basement membrane (not: cell/plasma membrane)	2

Question		Answer/Explanatory Notes	Marks Available
	(c)	Cilia move/beat/wave (allow consequential error for 'villi') Mucus carried along/moved/removed (not: ref. to goblet cells)	2
	(d)	Distance allowed 34-36mm	
		$\frac{35}{1000}$	1
		$35 \cdot 10^{-3}$mm/35μm or eq. in nm.	1
	(e)	Collection/many/(large) number of cells/group (not: layer) Similar structure Carrying out a particular function/working together Any 2/3.	2
			[9]

Question		Answer/Explanatory Notes		Marks Available
4.	(a)	A	Gram positive bacillus/rod	
		B	Gram negative Coccus	4
	(b)	Gram +ve have a thicker cell wall (not: larger) made of murein/peptidoglycan (not: lipopolysaccharide) which retains the crystal violet/purple stain *or converse*		3
	(c)	Red stained/Gram negative bacteria have extra layers in the/ more complex cell wall which protect/give resistance to lysozyme/penicillin/antibiotics (not: prevents osmotic lysis)		2
				[9]

Question			Answer/Explanatory Notes	Marks Available
8.	(a)		Axis - correct way round and scale over half grid	1
			Axis labels plus units	1
			Correct plot with line, no extrapolation	1
	(b)	(i)	At the closest distance/5cm the rate of photosynthesis/O_2 evolved is at its highest At 10cm the rate of P/S or O_2 evolved falls rapidly from 5cm to 10cm/correct ref. to figures and pattern At distances of 20cm and greater the rate of P/S is very low/ no change over 60cm (Any 2)	2
		(ii)	At the closest distance/5cm there are (maximum)/more (photons of) light falling on the leaf/chloroplast/photosystems; more electrons emitted from photosystems causing photolysis/splitting of water; (not: hydrolysis) which includes oxygen as a by-product (linked to points 1 or 2) (Any 2)	2
		(iii)	there are insufficient readings to enable the relationship between light intensity/distance from plant and evolution of oxygen to be plotted accurately; additional readings at high light intensity are required measure light intensity e.g. luxmeter rather than distance use heat shield to prevent temperature increase due to lamp (not: take more readings or wider range of readings unqualified)	1
	(c)		the oxygen given off/evolved must have come from the water.	1
	(d)	(i)	It is formed by the photolysis/splitting of water (in the thylakoid cavity)	1
		(ii)	NADP	1
		(iii)	Photolysis/Photosynthesis does not occur in the dark/without light/needs light Photolysis/Photosynthesis only occurs very slowly at 5°C Photolysis/Photosynthesis proceeds more quickly at a temperature of 25°C (not: ref. to limiting factors/high temperatures/ photosynthesis affected by light) (Any 2)	2
				[13]

Question			Answers/Explanatory Notes	Marks Available
5.	(a)	(i)	oxygen	1
		(ii)	27 mm / 2.7 cm (allow: consequential error)	1
		(iii)	40.69 mm^3 – no units 1 mark only (allow: 40.5 to 40.7) 81.3 to 81.5	2
	(b)	(i)	collect bubbles of gas (over a fixed time period) (use syringe to move bubble) and measure its length / volume;	1
			insert coloured filters (between lamp and pondweed) and repeat (not: different colours)	1
			steps to avoid stray light / temperature change; max 3	
	(c)	(i)	(at low light intensities) increasing light intensity increases rate / volume of gas produced;	1
			at higher light intensities / quoting values increasing light intensity does not affect rate. (not: ref. to time/levels off)	1
		(ii)	0.9 to 0.4m	1
		(iii)	the temperature / carbon dioxide level / volume $NaHCO_3$	1
		(iv)	when a process is affected by more than one factor or description	1
			the overall rate is limited by that factor which is closet to its minimum value. (not: factor in least supply) (i.e. within not between factors)	1
				[13]

Question		Answers/Explanatory Notes	Marks Available
3.	(a)	Process controlled by more than one factor; final rate controlled by the factor closest to its minimum value.	[2]
	(b)	(i) Carbon dioxide is limiting; Temperature not high enough/limiting; Rate of photosynthesis has reached maximum for the plant/ Not enough chlorophyll / enzymes/ owwte (not: ref. to area/water)	2 Max
		(ii) C	[1]
		(iii) Reaches maximum rate of photosynthesis at low light intensities/normal light inside building	[1]
	(c)	(i) (Carbon dioxide) produced by respiration.	[1]
		(ii) Fall / drop owtte.	[1]
			[8]

Question		Answers/Explanatory Notes	Marks Available
5.	(a)	Suitable temperature/warm (between 25-40); Nutrients; Correct pH (6-8); Oxygen; Water (not: moisture); (not: ref. aseptic/sterile)	[3]
	(b)	Autoclave / High temperatures and pressure/AVP; Sterilise glass rod/loop etc by flaming; Flame top of culture tube after removing lid; Lift Petri dish lid at angle/short time open; Bunsen to cause air flow. (not: ref. to disinfect benches)	[2]
	(c)	1 mark for clear zone around antibiotic clearly labelled; 1 mark for shape (horizontal 'bow-tie').	[1] [1]
	(d)	Bacteriocidal, kills; (not: destroys cell wall) Bacteriostatic, inhibits cell division/growth.	[1] [1]
	(e)	(i) This is a suggest question and any valid points are acceptable e.g. Different enzymes used not affected by antibiotic; Cell wall impermeable/ref. structure; No receptors; Capsule / slime layer does not allow entry; Antibiotic broken down/changed; Antibiotic pumped out of cell Plasmid qualified	2 Max
		(ii) Mutation causes a change in DNA; causes a different protein to be made; Bacteria with advantageous alleles; survive; pass on allele to daughter cells. (Mutation plus 2 others)	[3]
			[14]

Question	Answers/Explanatory Notes	Marks Available

3.(a)

Factor	*Control*
pH	Addition of acid / alkali/base
Temperature	Use of cooling jacket
Oxygen levels	Addition of air/oxygen through spargers / eg

(not: use buffer/insulate/control contamination or nutrients)

[3]

(b) Arrow at top of Log phase on curve [1]

because product / bacteria can be harvested in minimum time;

no build up of toxins / does not run out of methanol or nutrients;

bacteria do not start dying. [1]

Question	Answers/Explanatory Notes	Marks Available
(c)	More efficient due to high yield Very rapid rate of growth; Grown continuously on a large scale; Can be carried out at physiological / lower temps / press; Can use waste products (not: yield unqual/ref. to cost)	[3]
(d)	To minimise the lag phase /allow bacteria to adapt to conditions/reduce contamination.	[1]
(e)	Penicillin / mycoprotein / beer / wine / quorn/vinegar	[1]
		Total 10 marks

Question	Answers/Explanatory Notes	Marks Available
2. (a) (i)	red / pink	[1]
(ii)	**1** has a thin murein / peptidoglycan cell wall;	[1]
	2 has an (additional) lipopolysaccharide / lipoprotein layer (outside) the cell wall;	[1]
(iii)	resistant to penicillin / lysozyme (spelling)(example needed, not:antibiotics)	[1]
(b)	bacillus (not: rod shaped)	[1]
(c)	causing abdominal pain/ vomiting/ diarrhoea (2 symptoms) (not: dehydration)	[1]
	produce (entero)toxins (which act on the small intestine)	[1]

[Total 7 marks]

Question		Answers/Explanatory Notes	Marks Available
4.	(a)	axes correct - colorimeter readings vertical, axis at 0, -ve below, +ve above	[1]
		axes **both** labelled, including units, over half page	[1]
		scale correct and same on **both** axes	[1]
		all plots correct, no tolerance	[1]
	(b)	As light intensity increases the reading increases / eq (or converse)	[1]
		Some ref to slowing of rate of increase at high LI / correct use of figs	[1]
	(c)	Compensation (point)	[1]
	(d)	Rate of respiration = Rate of photosynthesis	[1]
	(e)	<u>Low Light Intensity</u>	
		More CO_2 is produced / CO_2 is produced in respiration;	
		More respiration (than PS);	
		<u>High Light Intensity</u>	
		Less CO_2 is present / CO_2 is used up in PS;	
		More PS (than respiration);	
		Any correct use of data;	
		CO_2 or Temp are limiting factors at high LI;	
		Any 4 points	[4]
			[Total 12 marks]

Question	Answers/Explanatory Notes	Marks Available
5. (a)	A sequence of dilutions; 10 fold or 100 fold Any correct description / diagram of how this is carried out eg 9+1 Any 2	[2]
(b)	a single living bacterium will reproduce/divide (asexually) to form a visible colony; colonies can then be counted to give an initial number of living bacteria. Any 2	[2]
(c)	Glucose is a monosaccharide; (and so) can be used instantly for respiration/directly into glycolysis; Lactose is a disaccharide; And so needs hydrolysis into monosaccharides / eq; Which requires synthesis of lactase; Any 3	[3]
(d)	At start rapid increase in population; as there is plenty of glucose; Levels off when glucose runs out; then synthesis of enzymes / lactase to hydrolyse lactose; Rapid rise when lactose is hydrolysed; To glucose and galactose; Then levels off / stationary phase; Correct use of figures; Any 4	[4]
		[Total 11 marks]