PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 6: MICROBIOLOGY AND PATHOGENS

MICROBIAL TECHNIQUES

SCORE	PERCENTAGE
/82	%

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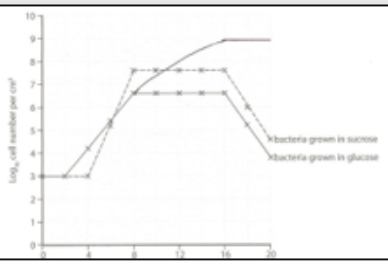
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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	• values read from graph per unit time and converted back from logs • subtraction of each pair and division done	(7.6=) 39 810 717 and (6.6=) 3 981 072 and (3.0=) 1000 or (4.2=) 15849 10 / 10.04 ACCEPT 1.9 / 1.92 / 2 / 82.5 / 82.54 / 83 for 1 mark	

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • (lag phase longer as) {sucrose has to be broken down / enzymes to breakdown sucrose had to be synthesised} (1) • (reproduction faster) because sucrose has more {sugar / monosaccharides / energy} (1)	ACCEPT converse for glucose ACCEPT sucrase ACCEPT sucrose made of glucose and fructose / sucrose is a disaccharide and glucose is a monosaccharide	

Question Number	Answer	Additional Guidance	Mark
(iii)	• a line that continues to go up after 8 hours and then levels off (around) 16 hours without dropping		

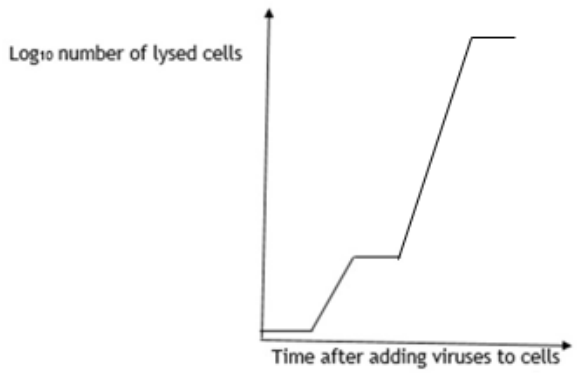
Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to five of the following: • disinfect surfaces / use benchcoat (1) • work near Bunsen flame / work in a sterile cabinet (1) • flame top of tube (1) • heat wire loop (1) • open lid of Petri dish to a small extent (1) • allow wire loop to cool (1)		**(5)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • virus to attach to host cells / {genetic material / DNA} to enter host cells (1) • synthesis of DNA (1) • {protein synthesis / transcription and translation} (1) • assembly of new viruses (1)	**ACCEPT** virus {enters / infects} **DO NOT ACCEPT** RNA **IGNORE** nucleic acid **DO NOT ACCEPT** RNA unless already penalised in mp 1 / in the context of {proviruses / latency} **ACCEPT** capsid / capsomeres / tail / base plate / tail (fibres) / collar / J protein / enzymes / protease / permease / other named proteins will need to be checked **DO NOT ACCEPT** reverse transcriptase / integrase **NB ACCEPT** (time for) {replication / multiplication} of the virus in correct context if no other marks awarded.	(3) EXP

Question Number	Answer	Additional Guidance	Mark
(ii)	• correct values read from graph and divided by the time (1) • mean rate calculated (1)	3.8 and 1.7 and a division by 40 / 0.0525 / 3.147 **IGNORE** ref to logs 156 ecf wrong time value but correct answer to whole number e.g.(30 mins) 209 Correct answer only = 2 marks	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iii)	• line going up and (generally) levelling off (1) • increase greater than the first increase (1)	**IGNORE** a third increase  	(2) EXP

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to four of the following: • sample taken from the female genital tract (1) • bacteria grown on {selective / indicator} media (1) • bacteria grown on media containing different types of antibiotics (1) • use of {antibodies / DNA profiling} (1) • using {Gram staining / cell shape / colony shape / colony colour} (1)		(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • because they grow on the skin cells preventing pathogenic bacteria from doing so (1) • because they use the glycogen so less {glucose / energy / glycogen} available for the pathogenic bacteria (1) • because they produce lactic acid which inhibits the growth of pathogenic bacteria (1) • because the low pH denatures the enzymes of the pathogenic bacteria (1)	. **ACCEPT** below optimum pH	(3)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	• glucose is a monosaccharide and maltose is {a disaccharide /made of two glucoses / made of two monosaccharides} (1)	**ACCEPT** maltose has a glycosidic bond and glucosedoes not glucose has 6 carbons and maltose has 12 glucose has the formula $C_6H_{12}O_6$ and maltose $C_{12}H_{22}O_{11}$ **ACCEPT** a labelled diagram	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • neither sugars respired immediately because the yeast need to {acclimatise / adjust to the conditions} (1) • delay is longer for maltose as {enzymes need to be synthesised / maltose needs to be broken down into glucose} (1) • respiration of maltose is faster (than glucose) as maltose has {twice the number of sugar units / more glucoses / more hydrogens} (1)	**ACCEPT** glycosidic bonds have to be broken **ACCEPT** because maltose contains more energy / maltose is a disaccharide and glucose is a monosaccharide	(2)

Q6.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • lactose is not {respired / used} as the yeast do not produce {theappropriate enzymes / lactase} (1) • sugars in the cytoplasm are {used / respired} (1)	**ACCEPT** yeast cannot break lactose down **NB** at least one reference to respiration for bothmarks to be awarded	(2)

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to three of the following: **Similarity** • both have peptidoglycan (1) **Two differences from:** • positive has {more / thicker layer of} peptidoglycan than negative / positive has a thicker cell wall than negative (1) • positive has teichoic acid, negative does not (1) • negative has outer membrane, positive does not (1) • negative (most) has periplasmic space, positive does not (1) • negative has {more lipid / lipopolysaccharide / porin proteins}, positive does not (1)	Accept periplasm	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• subtraction using values from graph (1) • calculation of percentage change (1)	$10^8 - 10^2 = 99\ 999\ 900$ $\div 10^8 \times 100 = \mathbf{99.9999}$ Correct answer gains full marks, with no working shown.	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • it is effective if irradiation longer than 3 hours (1) • it is effective against E. coli which infect the intestine (1) • not all species of {pathogenic bacteria / bacteria causing food poisoning} investigated / only three types of bacteria investigated (1) • toxins may remain in food (1)	Accept effectiveness depends on how long it is irradiated for	**(4)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to five of the following points: • same species of bacteria (1) • same {concentration / volume} of antibiotic (1) • use {agar / broth / culture medium} (1) • incubate between 20 °C and 25 °C for stated time (1) • measure {zone of inhibition / turbidity} (1) • use of described aseptic technique (1)	**DO NOT ACCEPT** less than 24 hours **e.g.** use of Bunsen burner / flame loop / swab bench	**(5)**

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • because the food poisoning was happening {after one hour /within a few hours} of the meal **(1)** • indicating that exotoxins caused the food poisoning **(1)** • because endotoxins are only present after {about 12 hours / several hours / when the bacterial cells are estroyed} **(1)** • *Staphylococcus* releases exotoxins / endotoxins come from *Salmonella* **(1)**	**Accept** soon after meal / quickly / by {12 / 1} o clock **Do not accept** *Staphylococcus* is an exotoxin / *Salmonella* is an endotoxin	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to any four of the following: • isolate the bacteria from the {food / patient / faeces / vomit} **(1)** • look at the colonies to see if they have a {characteristic / named characteristic} (of *Staphylococcus*) **(1)** • use Gram stain to show presence of Gram positive bacteria **(1)** • grow on selective media that identify {*Staphylococcus* / eliminates other bacteria} **(1)** • use antibodies against *Staphylococcus* **(1)**	**Accept** a description of how this is done e.g. streak plating from a faecal sample **Accept** *Staphylococci* will appear purple with Gram stain **Accept** differential media / selective agar / named example e.g. mannitol salt agar / with antibiotics	**(4)**

Q10.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	B		**(1)**

Question Number	Indicative content
***(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Dilution plating takes longer to obtain a result but optical methods are quicker • Because incubation period needed for dilution plating • Because need to do serial dilutions to find correct concentration for dilution plating • Dilution plating counts living cells but optical methods measure living and dead cells • Dilution plating gives direct count but optical methods give turbidity reading • To calculate original concentration of bacterial cells, the volume of diluted suspension added to each agar plate needs to be known / optical methods require use of calibration curves • Dilution plating requires easily available apparatus but optical methods require colorimeter / spectrophotometer • Dilution plating has risk of error if colonies run into each other but optical methods produce error if tube not shaken

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.
Level 3	5-6	A scientific judgement is made that is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	• $\log_{10} N_t = 8$ and $\log_{10} N_o = 2$ (1) • $\log_{10} N_t - \log_{10} N_o = 6$ (1) • t = 9 (1) • k =2.215 (1) [ecf applies for mps 2, 3 and 4]	Correct answer gains full marks with no working	**(4)**

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • medium allows only {*Salmonella* / certain bacteria} to grow (1) • {culture / colonies / bacteria} is spread out on the {agar / medium} (1) • because this separates out individual bacteria (1) • so that colonies are {discrete / separate / individual} (1) • so only one type of {bacteria / colony} can be picked up (1)	**ACCEPT** in context of {named media / antibiotic-containing media}	**(4)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• log of the values taken (1) • substitution of values into equation (and evaluating correctly) (1) • k given to an appropriate number of decimal places (1)	log 5 x 10^3 = 3.6989700043 and log 4 x 10^6 = 6.6020599913 (6.6020599913 - 3.6989700043) ÷ (0.301 × 10) = 0.9644817233 **ACCEPT** correct value for rounded up values substituted 0.964 / 0.96 **CE applies from mp 1 only**	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • the value for t used in the calculated value is greater than the actual value (1) • therefore the calculated value for k will be smaller (1) • because the *Salmonella* will not be replicating (in lag phase) (1)	**ACCEPT** converse for actual value **ACCEPT** converse for actual value **ACCEPT** dividing / growing	**(3)**

Q12.

Question Number	Acceptable Answer	Additional Guidance	Mark
	A explanation that makes reference to three of the following: • both plates prepared with nutrient agar of the same composition, to provide both bacterial populations with the same resources for growth (1) • both plates seeded with the same volume of the same culture of *Campylobacter*, so all antibiotics are acting on the same bacterial population (1) • use of aseptic technique such as 'flaming' instruments or working in { updraught of flame / flow hood } , to reduce risk of contamination of either plate with extraneous bacteria (1) • both plates should be incubated at the same temperature for the same length of time, to give equal opportunity for bacterial growth (1)		**(3)**

Q13.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • because public health workers could become infected with *Salmonella* (1) • because cross-contamination could lead to false identification of bacteria (1)		**(2)**

Q14.

Question Number	Answer	Additional Guidance	Mark
	A description that includes the following: Two relevant techniques to prevent bacterial growth described (2)	eg use of sterile / autoclaved equipment flaming neck of bottle / transfer loops working next to (lit) Bunsen burner disinfection of bench use of selective medium / antibiotics in medium Ignore partial removal of lid	**Exp (2)**

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	• Correct calculation of number of cells (1) • Conversion to standard form (1)	Example of calculation 7 divided by 0.004 = 1750 per mm^3 8 2000 per mm^3 $1.75 / 1.8 / 2 \times 10^3$ Correct answer with no working gets 2 marks	**Grad (2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that includes two of the following: • {yeast cells may not be evenly distributed / sample may not be representative} (1) • yeast cells may be {reproducing / budding / undergoing cell division} (so hard to know whether to count one or two) (1) • difficult to decide if they are touching the sides of the counting square (1)	Accept clumping / overlapping of cells may occur Accept this method counts dead cells (as well as live) Ignore human error / miscounting unqualified Ignore ref to air bubbles / artefacts / cells moving	**Exp (2)**