01. 0610_p20_MS_40 Q: 5

(a) *water jacket*

Any four from:

maintain optimum / constant temperature;

allow: prevent overheating

to prevent enzymes denaturing;

(because as) fungus respires;

releases heat so temperature in the fermenter increases;

which would kill fungus;

(therefore) no product / no penicillin / owtte;

addition of acids and alkalis

Any two from:

maintains pH / keeps pH constant;

enzymes need optimum pH;

to give maximum enzyme activity / rate of reaction at its fastest;

to give maximum yield / owtte;

allow: stop enzymes denaturing

[max 6]

(b) **(i)** 40–50; [1]

(ii) mitosis; [1]

(iii) Any three from:

nutrients are used up;

limiting (factors);

explanation of limiting factor;

allow: factor in shortest supply / owtte

waste products accumulate;

wastes are toxic;

penicillin could inhibit growth;

population reaches carrying capacity;

avp; [max 3]

(c) **(i)** fungus grows when no penicillin produced;

during first 20 hours; [2]

(ii) Any one from:

no more growth of fungus / fungus is dead;

no further production of penicillin / no advantage in continuing; [max 1]

(d) Any three from:

purifying or separating penicillin;

from waste or toxins / owtte;

concentration;

making into pills / owtte;

avp; e.g. colour / taste [max 3]

(e) Any two from:

viruses have no metabolism;

allow: viruses do not have ribosomes

idea that viruses have no target for antibiotics / owtte;

antibiotics stop cell wall growth;

viruses have no cell wall;

antibiotics stop enzymes working; [max 2]

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02. 0610_s20_MS_41 Q: 2

(a)	*one mark per row:* substance / enzyme / product(s) starch / amylase / maltose / glucose / (simple) sugar(s) fat / lipase / fatty acid(s) and glycerol protein / protease / pepsin / trypsin / amino acids ;;;	3
(b)	*any four from:* biological washing powder is more effective, at lower temperatures / between 10 °C and 40 °C / 10 °C and 43 °C ; comparative data quote for the difference at a stated temperature ; biological washing powder removes all stain between 30 °C and 40 °C ; non-biological removes all stain only at 60 °C ; effectiveness is similar, at high temperatures / between 50 and 60 °C ; same trend, below 30 °C / at low temperatures / from 50 °C ; *idea of* effectiveness of biological washing powder decreases between 40 °C and 44 °C, no such decrease for non-biological washing powder ;	4
(c)	*any two from:* active site changes shape ; substrate no longer fits into, enzyme / active site ; no enzyme-substrate complex / no successful collisions ;	2
(d)	*any two from:* individual people have, different / unique, DNA ; DNA has genes *or* alleles have, sequences of bases ; AVP ;	2

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03. 0610_s20_MS_41 Q: 3

(a)(i)	*any three from:* blue at time 0 indicates no glucose present ; ensures that no glucose on outer surface of dialysis tubing / in water, as a result of an error ; green / yellow / red, indicates presence of glucose ; glucose, diffuses / moves, out of dialysis tubing / into water ; (movement is) down the concentration gradient / high to low concentration ; dialysis tubing is permeable to glucose ; AVP ;	**3**
(a)(ii)	*idea that* (Benedict's solution) changes colour quicker / gives more intense colour / AW ;	**1**
(b)	**A** are microvilli ; *function:* allow movement of substances into the cell / increase surface area for absorption by diffusion OR active transport / have proteins in the membrane for active transport ; **B** is the (rough) endoplasmic reticulum / (R)ER ; *function:* site of protein synthesis / modify proteins / assemble amino acids in a specific sequence to make (named) protein ; **C** is a mitochondrion ; *function:* aerobic respiration / provides energy for (named) cell process(es) ;	**6**
(c)(i)	chloride ;	**1**
(c)(ii)	*any four from:* loss of water ; by osmosis / down water potential gradient ; diarrhoea ; dehydration ; loss of other, (named) ions / salt(s) ; AVP ;	**4**

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04. 0610_s19_MS_42 Q: 1

	Answer	Mark	Partial Marks
(a)	yeast ;	1	
(b)(i)	flour / starch / sugar / glucose / sucrose / carbohydrate ;	1	
(b)(ii)	respiration ;	1	
(b)(iii)	carbon dioxide ;	1	
(c)	*step 3 / 35 °C / low(er) temperature:* optimum / best / suitable / AW, temperature for, respiration / enzymes / gas production ; to allow the dough to, rise / expand / AW ; *step 5 / 200 °C / high(er) temperature* organism **A** / microorganisms / yeast, killed / enzymes denature ; to cook the dough ; to allow ethanol to evaporate ;	2	
(d)	biofuels ; wine / beer, making ; penicillin / antibiotic (production) ; AVP ;;	2	

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05. 0610_s19_MS_43 Q: 1

	Answer	Mark	Partial Marks
(a)	nucleus ; mitochondria ; (rough) endoplasmic reticulum ; AVP ;	2	
(b)(i)	*nitrogen* for making, amino acids / proteins ; *glucose* for respiration / source of energy ;	2	
(b)(ii)	for even / uniform, distribution / concentration, of contents / AW ; ensure more access of bacteria with, medium / AW ; prevent settling / clumping of, contents / AW ; so oxygen / glucose / nutrients, dissolves ; so that growth is not limited ; so bacteria can absorb substances (more easily) ; bacteria need oxygen for respiration ;	3	
(c)	*description:* at least two correctly named phases ; any two phases described correctly ; i.e. **A**: level, **B**: increasing, **C**: level, **D:** decreasing (numbers of live bacteria) correct relevant data quote for any phase ;; ***A** is the lag, phase / stage:* bacteria, growing / dividing, slowly ; bacteria adjusting to conditions / absorbing resources ; ***B** is the exponential / log, phase / stage:* resources are, not limiting / AW ; bacteria, growing / dividing, rapidly ; growth / birth, rate greater than death rate ; ***C** is the stationary, phase / stage:* growth / birth, rate equal to death rate ; ***D** is the death, phase / stage:* death rate greater than growth, birth / rate ; ***C** or **D**:* many bacteria are dying ; concentration of resources decreasing / resources become limiting ; space becomes limiting / AW ; (named) toxins building up ;	6	

06. 0610_w18_MS_41 Q: 2

	Answer	Mark	Partial Marks
(a)	fungus ;	1	
(b)	small / no, clear area / AW ; ora (antibiotic in disc), not killing bacteria / (continued) reproduction ; ora	2	**A** more bacteria growing
(c)(i)	**1** correct ref. to mutation (of bacteria) / have resistance gene ; **2** mutation is a change in the DNA / base sequence ; **3** mutations can be caused by, (ionising) radiation / (named) chemicals ; **4** variation (in ability of bacteria to survive antibiotic treatment) ; **5** ref. to (natural) selection / evolution ; **6** bacteria with resistance (survive and) reproduce / breed / multiply / produce offspring ; **7** bacteria with, no / little, resistance, die / do not reproduce ; **8** (bacteria that survive) pass on the resistance, allele / gene, to more bacteria ; **9** bacteria reproduce quickly ; **10** exposure to antibiotics acts as a selection pressure ; **11** only use antibiotics when essential ; **12** complete the full course of prescribed antibiotics ; **13** isolation of patients with infections ; **14** improved, healthcare / sanitation / nutrition / good diet / hygiene / cleanliness / screening / AW ; **15** and **16** AVP ;;	6	
(c)(ii)	viruses, are not alive / not made of cells / AW ; ora viruses do not have, a cell wall / named cell component ;	1	
(d)	small / take up little space ; reproduce rapidly / easy to grow ; contain plasmids ; transformation described / genetic modification / inserting genes ; no ethical concerns ; same genetic code as other organisms ; same DNA ; can make complex molecules / AW ; AVP ;	3	

07. 0610_w17_MS_43 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	respiration ; aerobic (respiration) ; release energy / make ATP ;	2	**A** respiration using oxygen **A** provide energy **R** produce / generate, energy
(a)(ii)	different composition of cell wall ; no, chlorophyll / chloroplasts / heterotrophic ; extracellular digestion / saprophytic / decomposer / AW ; hyphae / mycelium ; no (central) vacuole ; AVP ;	2	**A** not, autotrophic / photosynthetic / AW **A** enzymes secreted from cells to digest food **I** spores e.g. multinucleate / reproduction by budding
(b)	respiration / fermentation ; carbon dioxide released ; (bubbles / carbon dioxide) causes, dough / bread, to rise ; (yeast produces) enzymes ; enzymes / amylase, digest starch ; AVP ;	3	e.g. yeast, are not toxic / does not produce toxins / reproduce rapidly / can be stored dry / are single celled / cheap
(c)(i)	(fungus) grown / put, in fermenters ; aerobic conditions / AW ; (provide) sugars / nitrogen source / nutrients ; purification / filtration, of product / penicillin ; batch culture / AW ; sterile conditions ; AVP ;	3	**A** bioreactors **A** bubble air through e.g. ammonia / amino acids / protein e.g. described maintenance of culture / penicillin produced, when sugar source decreases / in stationary phase **A** fermentation conditions such as stirring / use of water jacket / controlling temp / pH etc.
(c)(ii)	bacteria are made of cells ; **ora**	1	**A** viruses are not alive / do not have a cell wall
(d)	mechanical barriers ; example of mechanical barriers ;; chemical barriers ; example of chemical barriers ;; blood clotting ;	max 3	**A** physical barriers / dead layer of cells for skin e.g. skin / hairs in nose / ear wax **A** mucus as mechanical or chemical e.g. mucus / stomach acid / vaginal acid / tears / lysozymes **A** scab

	Answer	Mark	Partial Marks
(a)	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$;;	[2]	1 mark for correct equation 1 mark for correct balancing
(b) (i)	4.1 (cm^3 per min) ;	[1]	
(ii)	a single line below the original curve on the graph and following the same shape ; line starts at origin ;	[2]	tolerance of ½ small square **mpt 1**: • no touching / crossing, lines • if line continues past beyond 6.0, must not drop or go above 4.1 cm^3 per min • no feathery line
(iii)	enzymes denatured / yeast died ;	[max 1]	**R** enzyme killed / yeast denatured
(c)	(named) alcohol production ; producing biofuels / ethanol ; production of yeast extract ; GM yeast ;	[max 1]	**I** fermentation / baking
(d) (i)	*stirrer* keeps microorganism suspended / prevent it from sinking ; enables microorganisms to always have access to nutrients ; maintain even temperature ; to create uniform / even / homogenous mixture ; to form pellets of fungus / avoid mat formation ; *water-filled jacket* reduces heat energy / temperature ; maintains, a constant / suitable / optimum, temperature ; *probes* monitor / detect / measure, temperature / pH / gas concentration / pressure / nutrients ;	[1+1+1] [3]	max 1 from each part *stirrer* **I** mixing unqualified **I** providing microorganisms with nutrients *water-filled jacket* **A** regulates temperature **I** cooling *probes* **I** controls / ensures
(ii)	prevent contamination ;	[1]	**I** ref to purity / impurities
		[Total: 11]	

09. 0610_p16_MS_40 Q: 5

(a) *water jacket*

Any four from:

maintain optimum / constant temperature;

allow: prevent overheating

to prevent enzymes denaturing;

(because as) fungus respires;

releases heat so temperature in the fermenter increases;

which would kill fungus;

(therefore) no product / no penicillin / owtte;

addition of acids and alkalis

Any two from:

maintains pH / keeps pH constant;

enzymes need optimum pH;

to give maximum enzyme activity / rate of reaction at its fastest;

to give maximum yield / owtte;

allow: stop enzymes denaturing

[max 6]

(b) **(i)** 40–50; [1]

(ii) mitosis; [1]

(iii) Any three from:

nutrients are used up;

limiting (factors);

explanation of limiting factor;

allow: factor in shortest supply / owtte

waste products accumulate;

wastes are toxic;

penicillin could inhibit growth;

population reaches carrying capacity;

avp; [max 3]

(c) **(i)** fungus grows when no penicillin produced;

during first 20 hours; [2]

(ii) Any one from:

no more growth of fungus / fungus is dead;

no further production of penicillin / no advantage in continuing; [max 1]

(d) Any three from:

purifying or separating penicillin;

from waste or toxins / owtte;

concentration;

making into pills / owtte;

avp; e.g. colour / taste [max 3]

(e) Any two from:

viruses have no metabolism;

allow: viruses do not have ribosomes

idea that viruses have no target for antibiotics / owtte;

antibiotics stop cell wall growth;

viruses have no cell wall;

antibiotics stop enzymes working; [max 2]

10. 0610_w16_MS_41 Q: 1

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(a)(i)</td><td>(antibiotics) kill / damage / destroy / eliminate,
pathogens / bacteria / fungi;
Bacteria / fungi / pathogen can cause
illness / disease / infections;
(antibiotics),prevent growth / reproduction of,
bacteria / fungi / pathogen;
AVP ref. to how antibiotics kill bacteria; e.g. ref. to cell
wall / production of proteins / inhibition metabolism;</td><td>2</td><td>I virus</td></tr>
<tr><td>(a)(ii)</td><td>1 all (bacteria / pathogens) need to be killed / destroyed;
2 any remaining (bacteria) will reproduce / multiply;
3 illness / disease would continue;
4 ref to problem of antibiotic resistance;
5 antibiotics no longer effective;
6 new antibiotics have to be developed;</td><td>3</td><td>A prevents growth I virus

I any reference to immunity</td></tr>
<tr><td>(b)</td><td>fungus / mould;</td><td>1</td><td>A Penicillium (notatum)</td></tr>
<tr><td>(c)(i)</td><td>steam;
autoclave / high temperature and high pressure;
UV / gamma, radiation / X rays;
bleach;
AVP; e.g. sterilise nutrients / air supply / items, entering fermenter</td><td>2</td><td>

A any reference to sterilizing substances that are added to the fermenter.</td></tr>
<tr><td>(c)(ii)</td><td><table><tr><th>letter from Fig. 1.1</th><th>name</th><th>function</th></tr><tr><td>P</td><td>water jacket</td><td>Maintain / control, temperature;</td></tr><tr><td>S</td><td>paddles / stirrers / mixers / vanes</td><td>mixes / stirs / maintains a suspension / stops solids settling / keeps nutrients moving / gives uniform mixture;</td></tr><tr><td>Q</td><td>nutrient inlet</td><td>supplies glucose / ammonia / amino acids / nutrients for growth / nutrients for respiration / energy;</td></tr><tr><td>R</td><td>Probe / sensor / data logger</td><td>monitors, temperature / pH;</td></tr><tr><td>U</td><td>air supply</td><td>supplies oxygen for respiration;</td></tr><tr><td>T</td><td>outlet</td><td>allows collection of the liquid containing penicillin after fermentation</td></tr></table></td><td>5</td><td>one mark for each correct row</td></tr>
<tr><td>(d)</td><td>penicillin is,
separated / extracted / filtered / centrifuged / evaporated / purified / crystalised / precipitated / dried / impurities removed;</td><td>1</td><td>A downstream processing</td></tr>
<tr><td></td><td></td><td>Total: 14</td><td></td></tr>
</table>

11. 0610_w16_MS_43 Q: 2

	Answer	Mark	Partial Marks
(a)	1 enzymes are proteins; 2 enzymes can be reused / are unchanged in a reaction; 3 enzymes are specific; 4 (enzymes are) catalyst / speeds up reaction; 5 lowers (activation) energy needed for the reaction; 6 successful collisions; 7 enzyme-substrate complex / ESC; 8 active site; 9 (enzyme and substrate) complementary shape / AW; 10 ref. to optimum, temperature / pH; 11 too much heat results in denatured enzymes; 12 too little kinetic energy / heat, less (successful) reactions; 13 incorrect pH results in denatured enzymes; 14 (substrate) is pectin / cell wall; 15 results / product, is clear juice; 16 mass / cheaper / more (volume) / yield, juice production;	6	**R** cellulose
(b)	read at eye level / avoid error of parallax; read bottom of meniscus; place measuring cylinder on a level / flat, surface; remove funnel / ensure all drops have fallen to the bottom;	2	**A** parallel / horizontal to meniscus
(c)(i)	19 ÷ 10 **or** 17.5 ÷ 10; 2 (cm^3 per min);	2	
(c)(ii)	**A** / 0.5 (cm^3 cubes); large(st) surface area (to volume);	2	**A** smallest cubes
		Total: 12	

12. 0610_s20_MS_43 Q: 2

(a)(i)	population in 1940 = 20 million, population in 2018 = 136 million ; 580% ;;	3
(a)(ii)	*any three from:* increase in birth rate / decrease death rate ; immigration ; increased food supply ; reduced poverty ; **ora** better housing / sanitation / health care / vaccination / AW ; AVP ;	3
(b)(i)	by yeast ; (using) anaerobic respiration ;	2
(b)(ii)	*any four from:* deforestation ; loss in (variety) of, habitat / places where organisms live / described ; disruption to food chains / described ; loss of (bio)diversity / (local) extinction of species / species become endangered / AW ; soil erosion / increased risk of landslides / flooding ; disrupted nutrient cycling ; decrease in (soil) water / desertification ; outbreaks / spreading, of crop diseases ; outbreaks / spreading, of (named) pests ; overuse of herbicides ; overuse of, pesticides / insecticides / AW ; killing of non-target species ; pollution of waterways by, plant nutrients / fertilisers ; pollution of the atmosphere by NOx from fertilisers ; pollution by use of fossil fuels in machinery ; AVP ;	4

13. 0610_s19_MS_41 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	liquid / fluid / watery, part of blood ;	1	
(a)(ii)	amino acid(s) ;	1	
(b)(i)	plasmid ;	1	
(b)(ii)	restriction (enzyme) ;	1	
(b)(iii)	cutting / opening, **A** / the plasmid, with same (restriction) enzyme(s) ; forming, sticky ends ; *idea that* (sticky) ends of human DNA and plasmid DNA are complementary ; reference to, bases / base sequences (of sticky ends) ; correct reference to (DNA) ligase ; e.g. inserting gene / sticky ends joining / splicing AVP ; e.g. **B** is a recombinant (plasmid / DNA)	3	
(b)(iv)	reliable / constant, supply ; produce, large(er) quantities / in a fermenter / bacteria reproduce quickly (to make more genetically engineered bacteria) ; not dependent on blood donations ; idea that no (named) health risk(s) ; higher quality of product ; AVP ;	1	
(b)(v)	mRNA moves through the cytoplasm ; mRNA molecules, move to / through, ribosomes ; sequence of bases in mRNA determines order of amino acids (in TPA) ; for protein synthesis / to make proteins ; AVP ;	2	
(a)(i)	cell wall ; cells are a regular shape / described ; vacuole(s) ; AVP ;	1	

14. 0610_s19_MS_43 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	restriction (enzyme) ;	1	
(a)(ii)	sticky ends ;	1	
(a)(iii)	plasmid is cut with the same (restriction) enzyme (as DNA) ; to form, sticky ends / region **A**, that are complementary to sticky ends of, gene / *cry* ; *reference to* base sequences (being complementary / AW) ; (DNA) ligase used to join plasmid and, *cry* / gene ; AVP ; e.g. formation of recombinant DNA / plasmid	3	
(b)	gene / *cry*, codes for the sequence of amino acids in, (toxic) protein ; DNA / gene / *cry*, is copied / transcribed, to form mRNA ; *cry* / gene / DNA, remains in nucleus ; mRNA moves from nucleus to, cytoplasm / ribosome ; mRNA passes through ribosomes / AW ; ribosomes assemble amino acids (into protein molecules) ; ribosomes make proteins ; AVP ; e.g. order of amino acids determined by base sequence of, mRNA / DNA / gene	4	
(c)	to kill / harm / deter, caterpillars / insects / pests ; higher yield / reduce losses due to, (certain) caterpillars / insects / pests ; higher quality of cotton ; use less insecticide ; (so) less pollution ; (so) less money spent on, insecticides / spraying ; (so) less risk to workers' health (from using insecticides) ; (so) less chance of insecticide resistance ; AVP ;	3	

15. 0610_w19_MS_41 Q: 2

	Answer	Mark	Partial Marks
(a)	*carbohydrates* cellulose ; for cell walls ; starch ; for energy/respiration ; to attract insects to flowers / nectar / fruits ; *amino acids* to make (named) proteins ; for enzymes ; for growth ; AVP ;	4	
(b)	correct position labelled on the leaf ; correct position labelled on the stem ; correct position labelled on the root ;	3	
(c)(i)	higher concentration in the stem / aphid **D** is nearer the root / is before the branching of the plant ; (sucrose moves by) translocation ; sucrose moves up the plant ; root / tuber, is a source ; (leaves / stems / AW) are a sink ; no photosynthesis (in the dark) ; no / less, glucose/sucrose (made in the leaves) ; plant uses stored starch (from root) / AW ;	3	
(c)(ii)	insert gene / ref. to genetic engineering / ref. to genetic modification ; gene, for insect / aphid resistance ; ref. to insecticide / described ; AVP ; description of how insecticide applied / biological control / grow in glasshouses / netting	3	
(c)(iii)	pollination ; AVP ; e.g. biological control described / insect products e.g. honey	1	

16. 0610_w19_MS_43 Q: 5

	Answer	Mark	Partial Marks
(a)	**1** nucleus / chromosome(s) ; **2** bases ; **3** protein ; **4** genes / alleles ; **5** same ; **6** sticky ; **7** recombinant ; **8** bacteria / vectors / viruses / yeast / (prokaryotic / host) cells ; **9** insulin ;	9	
(b)	washing powders ; (pectinase) for (fruit) juice production ; (lactase) for lactose-free milk ; AVP ;	2	

17. 0610_s18_MS_42 Q: 6

	Answer	Mark	Partial Marks
(a)	(asexual) reproduction ;	1	**R** sexual reproduction
(b)(i)	image size ÷ magnification ;	1	
(b)(ii)	0.8 (µm) ;	1	
(c)(i)	(Type 1) diabetes ;	1	**A** Type 2 diabetes
(c)(ii)	*ref.* to (human) gene / DNA that codes for (human) protein ; (human) DNA / gene, is, identified / isolated ; DNA / gene / plasmid, cut (out) using restriction enzymes ; forming, complementary / sticky, ends ; DNA / gene / plasmid, cut with the same restriction enzymes ; formation of recombinant, DNA / plasmid ; into plasmid (DNA) ligase used to join plasmid and, gene / DNA ; plasmids (with gene) inserted into bacteria ; bacteria (with the plasmid), replicate / reproduce / multiply ; AVP ; e.g. purification / identification of transformed bacteria /	5	*procedures must be in the correct sequence*
(d)(i)	kills (named) microorganisms / pathogens ; prevents contamination (by bacteria / microorganisms) ; steam does not contaminant, product / medicines (with chemicals) ; steam reaches all the crevices of fermenter ;	2	
(d)(ii)	pH ; temperature ; oxygen ; carbon dioxide ; (named) nutrients ; waste ; turbidity ; AVP ; (gas) pressure / rate of stirring / amount of (named) product	3	
(d)(iii)	penicillin ; AVP ;	1	
(e)	disease resistance ; large(r) / fast(er), yield ; drought resistance ; salt resistance ; frost resistance ; (named) nutritional enrichment ; pest / insect, resistance ; herbicide resistance ; vaccine production ; *ref to* benefits to, environment ; *ref to* more desirable, product / increased income / AW ; *ref to a* qualified benefit to humans ; e.g. food shortage / described health benefit AVP ; growth modification e.g. short stems / adaptations to extreme environments / rapid improvement to crop / improvements using characteristic that are not present in natural population	4	