



Q	Answer as per MS	Marks	NOTES
1	A substrate; B active site; C enzyme-substrate complex; D product(s);		A: Substrate B: Active site. C: Enzyme – substrate complex D: Product (Broken down substrate)
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2. i	kills (named) microorganisms / pathogens; prevents contamination (by bacteria / microorganisms); steam does not contaminant, product/ medicines (with chemicals); steam reaches all the crevices of fermented		Steam is ideal because it reaches all the crevices of the mentor. it prevents contamination by killing microorganism and at the same time does not contaminate the product.
ii	pH; temperature; oxygen; carbon dioxide; (named) nutrients; waste; turbidity; AVP; (gas) pressure / rate of stirring / amount of (named) product		1. pH. 2. Temperature 3. Oxygen.
iii	penicillin; AVP;		Penicillin

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3	correct ref to active site ; enzyme must be complementary shape to, substrate / alcohol ; to make enzyme – substrate complex / to allow substrate to bind to enzyme ; ref to only fits one substrate / specific to one substrate ;		Enzymes are specific to substrates in order to make the enzyme – substrate complex. Therefore each enzyme must be complementary in shape to the Substrate.
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4 i	increased kinetic energy ; molecules move faster ; increased frequency of collisions ; increased number of successful collisions ;		An increase in temperature causes an increases in kinetic energy of enzyme particles. The makes the enzyme particles move faster and hence produce move success full collisions.
ii	Ph		pH

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Enzyme	Substrate	Product	Location of enzyme production
Salivary amylase	starch	maltose	Salivary glands
Maltose	Maltose	Glucose	Small intensity Wall
Pepsin	Protein	Amino acid	Stomach

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6	1 temperature ; 2 surface area of substrate ; 3 concentration / volume / amount / number, of enzyme (solution) ; 4 concentration / volume / amount, of (named) substrate (solution) ; 5 type of enzyme ; 6 type of substrate ;		1. Temperature 2. Surface area of substrate.
ii	1 increases and decreases ; 2 peaks at / optimum, at pH 4.0 / 0.55 (au) ; 3 no activity beyond pH 6.5 ; 4 curve is symmetrical / AW ; 5 any data quote, e.g. activity is 0.55 (au) at pH 4.0 ;		Increases beyond pH 2.5 and peaks at a pH of 4. Thereafter it decreases , becoming inactive at a pH of 6.5
iii	1 pH 4 is the optimum (pH) ; 2 pH 7 enzyme is denatured ; 3 enzyme / protein / active site, has changed shape at pH 7; 4 shape of active site is complementary to substrate (4) / not (7) ; 5 enzyme-substrate complexes form (4) /not (7) 6 (most) effective collisions (between enzyme and substrate) (4) / none (7) ;		At pH 4 the activity is maximum whereas at a pH 7 , the enzyme is denatured and becomes inactive. This occurs because shape of the active site has changed at pH 7 and enzyme – substrate complex formation is no longer possible.



7 i	<p>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 ;</p>		<p>Stirrer: Keeps the mixture homogeneous and in a suspended state.</p> <p>Water – filled jacket: reduces heat energy and maintains a constant, suitable temperature.</p> <p>Probes: detect and measure temperature, pH, gas concentration and pressure of nutrients.</p>
ii	prevent contamination ;		Air and nutrients must be sterile to prevent contamination of product.



8 i	ref. to surface area; affecting enzyme / enzyme activity; allows comparison; make experiment valid; controlled variable;		Surface area affects enzyme activity . therefore , to ensure a fair experiment the surface area of all pieces was kept constant.
ii	water-bath / in a beaker of water / incubator; insulate test-tube; allow solutions to equilibrate to temperature (before experiment); use a thermometer to check the temperature (is constant);		Temperature can be controlled using a water both and allowing the solution, to equilibrium rate before experiment.
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9	(pH) 8 ...1;		pH 8.
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10	enzymes are protein; enzymes can be reused / are unchanged in the reaction; enzymes are specific; (enzymes are)catalysts / speeds up reaction; lowers the energy needed for the reaction; successful collisions / enzyme- substrate complex / ESC; active site; (enzyme and substrate) fit together; complementary shape; (digestive enzymes perform) chemical Digestion / hydrolysis / catabolic reactions; break down, large / insoluble, molecules into, small / soluble, molecules;		Enzymes are bio – catalyst . they break down the substrate into smaller particles without undergoing a change themselves hence are reusable thus they are ideal for digestive process which involves breakdown of food particles . each enzyme is specific to the substrate and is effected by changes in temperature , pH and concentration of substrate.



	amylase converts starch to sugars / maltose; lipase converts lipid / fats, to fatty acids and glycerol; maltase converts maltose to simple sugars / glucose; ref to pH; ref to denaturation;		
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11	<p>1 enzymes are, biological / protein, catalysts / speed up reactions;</p> <p>2 ref to specificity;</p> <p>3 active site;</p> <p>4 substrate / protein, fits into / AW, enzyme / active site;</p> <p>5 ref to, complementary shape of molecules;</p> <p>6 enzyme-substrate complex / ESC;</p> <p>7 enzymes, lower energy needed for reaction</p> <p>8 enzymes are, unchanged (at end of reaction) / reused;</p> <p>9 (enzymes) carry out, chemical digestion / hydrolysis / catabolic reactions;</p> <p>10 break down, large / insoluble, molecules into small(er) / soluble, molecules;</p> <p>11 protein broken down to, polypeptides / peptides / amino acids</p> <p>12 pepsin, active in stomach;</p> <p>13 trypsin, active in, small intestine / duodenum / ileum;</p> <p><i>ref. to conditions in alimentary canal</i></p> <p>14 low pH / pH 1–3 / (hydrochloric) acid, in stomach;</p>		<p>Enzyme are protein which are biological catalyst which remain unchanged at the end of reaction</p> <p>Protein digestion begin in the stomach where the enzyme pepsin breaks down protein to polypeptides. The pH required for pepsin is acidic. Next step in protein digestion occurs in duodenum where pancreatic juice containing the enzyme trypsin is released. trypsin requires alkaline medium which is supplied by sodium bicarbonate present in pancreatic juice. remaining digestion of proteins occurs in small intestine where protease enzyme break down polypeptides into peptides, and amino acids.</p>



	<p>15 high pH / alkaline / neutral / non-acidic / pH 7–9, in, small intestine / duodenum / ileum; 16 ref. to denaturation; 17 temperature is 37 °C; 18 ref. to successful collisions;</p>		
12	<p>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;</p>		<p>Enzyme are biocatalyst which act by locking on to the substrate and breaking it. thus, Pectin's an enzyme, locks on to the substance which causes plant cells to stick together. when the pectin is broken down extraction of fruit juice becomes easier. Thus, pectinase is commercially used in the extraction of fruit juice.</p>



13 i	19 ÷ 10 or 17.5 ÷ 10; 2 (cm ³ per min);		
ii	A / 0.5 (cm ³ cubes); large(st) surface area (to volume);		A the apple cubes are smallest in size, hence, the surface area exposed is the largest. The action of enzymes increases with increase in surface area.

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14	(fungus) grown / put, in fermenters; aerobic conditions / AW; (provide) sugars / nitrogen source nutrients; purification / filtration, of product / penicillin; batch culture / AW; sterile conditions; AVP;		The surface Penicillium grown in a fermenter in a culture of carbohydrates and amino acids. The growth stage takes about 15 – 24 hours and then secretion of penicillin begins. The secretion rate is controlled by adding small quantities of sugar. When secretion slows down, the liquid containing Penicillin is collected and treated to increase the concentration of Penicillin.
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