QUESTIONSHEET 1

(a) (i) A and C;
clear zones/no bacterial growth next to the test fungus; **2**

(ii) the distance/length of the clear/no growth section; **1**

(b) Any two of : may be toxic/ have side effects/cause allergies/
existing antibiotic may be more effective/
uneconomic/too expensive to produce/unstable when extracted;; **2**

(c) polymers still split but inhibited enzyme unable to add new units;
wall weakens (not holes appear);
water entering by osmosis splits wall/internal pressure in cell too great (for wall); **3**

TOTAL 8

QUESTIONSHEET 2

(a) (i) ethanol is toxic/yeast killed by the alcohol/(reject 'limiting carbon/nitrogen source'); **1**

(ii) 4/5 days;
there would be little increase in alcohol concentration if kept longer; **2**

(b) (i) maltose/malt sugar; **1**

(ii) can be used for production of higher ethanol concentration/give a higher yield of ethanol/carries on producing ethanol when other strains would be killed; **1**

(c) mutants grown on a medium containing high ethanol/concentration;
those which form colonies transferred to even higher ethanol concentration medium;
continue until have only colonies able to grow on very high ethanol concentration; **3**

TOTAL 8

QUESTIONSHEET 3

(a) supplies (sterile) air containing oxygen;
used for respiration of microorganisms; **2**

(b) B absorbs/takes up heat and carries it away from the fermenter;
C spreads out/distributes heat (so reaches B more efficiently); **2**

(c) (i) substrate for respiration/ATP synthesis/polysaccharide synthesis; **1**

(ii) nitrogen source for amino acid synthesis; **1**

(d) (i) produced early in growth cycle/ throughout growth cycle; **1**

(ii) primary metabolite essential for growth/cell metabolism;
secondary metabolite may give advantage in environment; **2**

TOTAL 9

QUESTIONSHEET 4

(a) (i) stir the culture to ensure mixing of oxygen/nutrients;
(ii) cooling jacket/remove heat/maintain temperature (25-28^{0}C); **2**

(b) Any three of: strain used/
composition of medium/availability of C or N/
aeration/
pH control/
temperature control/25-28^{o}C
recovery efficiency;;; **3**

(c) substances produced by organisms after main growth phase/exponential phase has stopped/after 20 hours;
not essential for normal cellular physiology; **2**

(d) fungi would use nutrients for their own growth/not for penicillin production; **1**

TOTAL 8

QUESTIONSHEET 5

(a) Advantage: yields more product;
Disadvantage: need to aerate/stir; **2**

(b) Any three of: glue manufacture/
meat tenderiser/
detergent/
starch hydrolysis/
production of fruit syrups/any other valid example;;; **3**

(c) Any two of: cross linked to another chemical eg. to cellulose using gluteraldehyde/
entrapment in gel/silica gel/
adsorption in glass bead/alginate beads/any other valid example;; **2**

(d) Any two of: easier to obtain pure product/
can be re-used/
increased stability/
allows continuous production;; **2**

TOTAL 9

QUESTIONSHEET 6

(a) (i) provides glucose supply for respiration (when starch is digested by fungus); **1**

(ii) provides a nitrogen source for amino acid/protein synthesis; **1**

(iii) rapidly dividing cells contain high levels of RNA;
may be harmful to health if consumed; **2**

(b) greater production/fewer shut downs/can be automated/continual harvesting possible; **1**

(c) contains less fat/more fibre/more minerals; **1**

TOTAL 6

QUESTIONSHEET 7

(a) Lactobacillus acidophilus/Streptococcus lactis; **1**

(b) bacteria feed on/digest lactose/milk sugar;
produce lactic acid; **2**

(c) coagulates milk protein/caseinogen;
makes it precipitate as curds;
separating from the whey/liquid; **max 2**

(d) extract DNA from calf stomachs and DNA from yeast cells;
treat both DNA samples with the same restriction endonuclease enzyme;
mix treated DNA samples together and allow them to join together by their complementary sticky ends;
treat with DNA ligase to make permanent/produce recombinant DNA;
mix with yeast cells and calcium ions and give heat shock to make yeast cells take up rDNA/microinject yeast cells with rDNA;
culture yeast cells on large scale to enable harvesting of chymosin when released into culture medium;
max 4

TOTAL 9

QUESTIONSHEET 8

(a) ref to lock and key hypothesis/shape of active site fits glucose molecule;
ref to induced fit hypothesis/glucose induces change in shape of active site;
glucose is the only substrate that can fit the active site;
glucose and active site have complementary shapes/structures;
fructose does not fit the active site/diffuses away; **max 3**

(b) (i) rapid growth (so fast enzyme production);
easy/convenient to culture/can be cultured on large scale;
extracellular enzymes are easy to collect/separate; **max** 2

(ii) they show specificity;
act quickly in moderate/low temperatures;
safe/sterile conditions not required;
can be used in the reverse processes;
can be immobilised enabling reuse/easy product collection; **max 3**

TOTAL 8

QUESTIONSHEET 9

(a) immobilisation; **1**

(b) Advantages (any two of)
easier to separate enzyme and products;
allows catalysis in unfavourable media/increases stability;
allows continuous production;
enzyme can be recovered/reused; **max 2**

Disadvantages (any two of)
immobilisation may alter shape of enzyme/catalytic ability;
enzyme may become detached/rate may fall;
expensive; **max 2**

(c) continuous production of ethanol using yeast/zymase;
production of vinegar using Acetobacter;
use of glucose isomerase to convert glucose to fructose (when making fructose syrups); **max 2**

TOTAL 7

QUESTIONSHEET 10

(a) (i) respiratory substrate/use in respiration;
energy source for A. niger; **2**

(ii) stimulates production of pectinase by A. niger;
induces action of gene for pectinase synthesis; **2**

(b) extraction of enzyme from culture medium;
may involve filtering/centrifuging/chromatography;
precipitation;
concentration/drying; **max 2**

(c) digests pectin in cell walls;
thus clarifies/clears fruit juice;
increases the volume of juice extracted; **max 2**

TOTAL 8

QUESTIONSHEET 11

(a) (i) substrates/essential metabolites added to fermenter continuously;
growth rate of organism is kept in exponential stage/allows maximum formation of product;
products released continuously;
product is a primary metabolite/will not produce secondary metabolites effeciently; **max 3**

(ii) an organism/living cells/enzymes;
which are used to speed up/bring about a chemical reaction; **2**

(b) (i) ensures even mixing of nutrients/oxygen/ensures even temperatures; **1**

(ii) insulate/cool/contents of fermenter/heat exchanger; **1**

(iii) enable aeration/oxygen supply for respiration; **1**

(c) production of mycoprotein/single cell protein;
production of amino acids;
vinegar production (Orleans process); **max 1**

TOTAL 9

QUESTIONSHEET 12

(a) yeast does not have an enzyme to digest/breakdown starch;
yeast cannot respire starch;
maltose (produced during germination) can be respired/used by yeast;
yeast contains maltase to digest/breakdown maltose to glucose; **max 3**

(b) (i) to prevent contamination/keep the strain pure;
to have a concentrated enough inoculum to add to the beer fermenter; **2**

(ii) the fermentation is anaerobic;
the yeast cells are killed by the alcohol; **2**

(c) yeast extract for food/vitamin supplements/marmite;
single cell protein for animal feed; **max 1**

TOTAL 8

QUESTIONSHEET 13

(a) ref to use of reverse transcriptase;
mix (extracted) RNA, enzyme and (dexoxyribo)nucleotide triphosphates/ATP, GTP, CTP and TTP together;
single stranded DNA made into double stranded DNA using DNA polymerase; **max 3**

(b) endonuclease cuts the DNA at specific points to give sticky ends;
same endonuclease used for cDNA and plasmid DNA;
complementary sticky ends join DNAs by hydrogen bonds;
ligase seals the different DNAs together (by covalent bonds); **max 3**

(c) reproduce rapidly to give a large amount of product in a short time;
product can be extracted easily from the culture medium; **2**

TOTAL 8

QUESTIONSHEET 14

(a) allows fabrics to be washed at different temperatures effectively; **1**

(b) (i) culture medium containing nutrients added to fermenter;
inoculum of bacteria added;
ref to incubation at optimum temperature/pH;
left for specific period/until all reactions have proceeded far enough;
no further nutrients added;
fermenter emptied and product extracted;
ref to use of aseptic technique (give at any stage in answer); **max 5**

(ii) filter/centrifuge medium to separate the cells;
pass liquid through a column containing bound/immobilised substrate;
enzymes bind to column/substrate; **3**

TOTAL 9

QUESTIONSHEET 15

(a) (<u>method</u> must be correctly linked to an appropriate material)

<u>adsorption</u>;
onto matrix/glass beads/dextran/DEAE-cellulose/collagen;
<u>encapsulating/entrapment;</u>
into polymer/lattice/sodium alginate/polyacrylamide/collagen/silica gel;
<u>covalent bonding/cross linking;</u>
to a supporting material/carboxymethyl-cellulose/gluteraldehyde; **max 4**

(b) (i) enzyme is more stable;
enzymes reusable/extracted after use;
enzyme does not contaminate the product;
no purification process required;
enzyme can be used for a longer period/ref to reduction in costs; **max 4**

(ii) enzymes more stable at high temperatures;
enables fermentation at high temperatures;
pathogens cannot survive high temperatures/reduces risk of contamination; **max 2**

TOTAL 10