Food production

Crop plants

Growing crops in greenhouses and polythene tunnels will increase ...MICRO... This is because the solar radiation entering the greenhouse becomes trapped and therefore the ...TEMP...will go up. Because the process of photosynthesis in plants is controlled by ...ENZYMES... which work at slightly higher temperatures this causes the growth of the plants to increase. The temperature must not, however, become too high as this may cause the ...ENZYMES... to ...DENATURE... (stop working). Like wise because ...CO_2... gas is needed by plant the concentration of this can also be artificially increased to improve yield.

Farmers will also apply fertiliser to their fields; this contains the following three main nutrients:

1. ...N : NITRATE...
2. ...P : PHOSPHATE...
3. ...K : POTASSIUM...

These are essential for growth. For example the ...NITRATE... is needed to produce amino acids used to make ...PROTEINS...for growth.

Another way of maximising yield is to reduce damage by ...PESTS... Chemical PESTICIDES... can be added or biological pest control can be used. This is where ...NATURAL PREDATORS ARE INTRODUCED TO DECREASE PEST POPULATIONS...

An example of this is:

...USE OF LADYBIRDS TO REDUCE NUMBER OF APHIDS...

Briefly describe the advantages and disadvantages of both techniques below:

...BIOLOGICAL: CAN BE CHEAP & EFFECTIVE NO CHEMICALS BUT CAN GET WRONG e.g. CANE TOAD IN AUSTRALIA...
...CHEMICAL: EASY / EFFECTIVE BUT USES CHEMICALS, PESTS CAN DEVELOP RESISTANCE & DISRUPT ECOSYSTEM.

Micro-organisms.

The single celled fungus ...YEAST... is used in the production of beer as the waste product of its anaerobic respiration (AKA ...FERMENTATION... is ...ETHANOL... (as well as carbon dioxide)

Draw a flow chart below to show the production of beer:

GERMINATE BARLEY SEEDS (AMYLASE DIGESTS STARCH)
↓
SEEDS DRIED → MALT
↓
MALT + WATER IN A MASH TUN
↓
MASH BOILED / FILTERED
↓
ADD HOPS (FLAVOUR) + YEAST TO FERMENT SUGARS
↓
FILTER / PASTEURISE (?) BEER.

The yeast will also produce carbon dioxide gas. To test for this being produced by a sample of yeast must first be made to respire anaerobically. To do this to the sample of yeast in a boiling tube add a small amount of Diazin green indicator which will turn PINK *when no oxygen is available and then add a thin layer of paraffin oil to stop oxygen entering. The yeast will use up the oxygen in the tube and then start to respire anaerobically. Once the indicator has changed colour attach a delivery tube to the boiling tube and pass any gas given off into either lime water (turns* CLOUDY *with CO_2) or hydrogen carbonate indicator (turns from red to yellow with CO_2). The rate at which the colour changes indicates the rate of fermentation. Conditions can easily be changed, for example altering the temperature by placing in a* WATER BATH

As you have for beer, draw another flow chart to show the production of yoghurt using the bacterium *Lactobacillus:*

PASTEURIZE (90°C @ 30 MINS) + HOMOGENISE MILK

↓

COOL TO 35°C : ADD LACTOBACILLUS BULGARICUM

↓

INCUBATE : BACTERIA PRODUCE LACTIC ACID

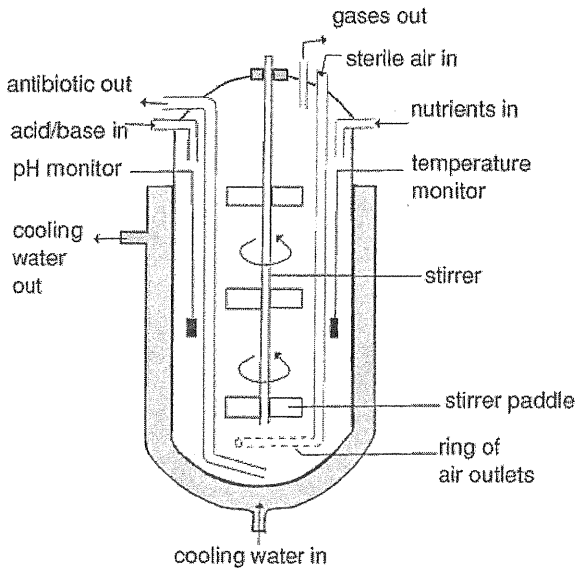
↓

AT PH 4.2 YOGHURT PRODUCED : COOL / STIR

↓

ADD FLAVOURINGS / COLOURANTS.

Industrial fermenter (to make Penicillin):



Explain the need for: Temperature and pH probe, cooling water jacket, oxygenation, stirring and the sterile air (aseptic):

TEMP/PH : TO ENSURE THESE ARE KEPT OPTIMAL FOR ENZYME ACTIVITY.

COOLING JACKET : RESPIRATION RELEASES HEAT : THIS WILL HELP COUNTERACT THIS

OXYGEN - RESPIRATION CAN OCCUR

STIRRER - MIX UP NUTRIENTS etc

STERILE AIR - ENSURE NO OTHER BACTERIA ENTER.

Fish farming.

Why is fish farming useful?

- REDUCES DEMAND ON NATURAL STOCKS
- CHEAP PRODUCTION

List and describe 4 controls or checks that need to be made when farming fish:

1. WATER QUALITY: TEMP, O_2 etc
2. FEEDING: QUALITY + QUANTITY. FEEDING SCHEDULE
3. PESTICIDE USE TO KILL OFF PESTS
4. SELECTIVE BREEDING - INCREASE GROWTH RATE.

Selective breeding.

Selective breeding is where desirable characteristics in either plants or animals are increased by only breeding with organisms which show those traits. Examples include:

Plants (give one):

INCREASE IN WHEAT SEED HEAD → MORE GRAIN.

Animals (give one):

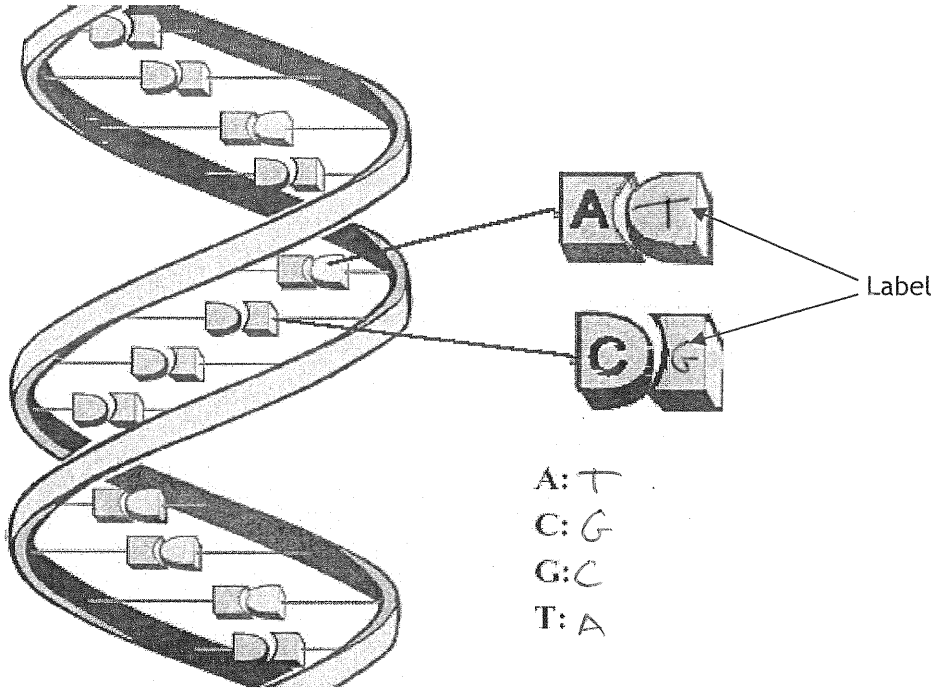
INCREASE IN MILK YIELD

Genetic Modification

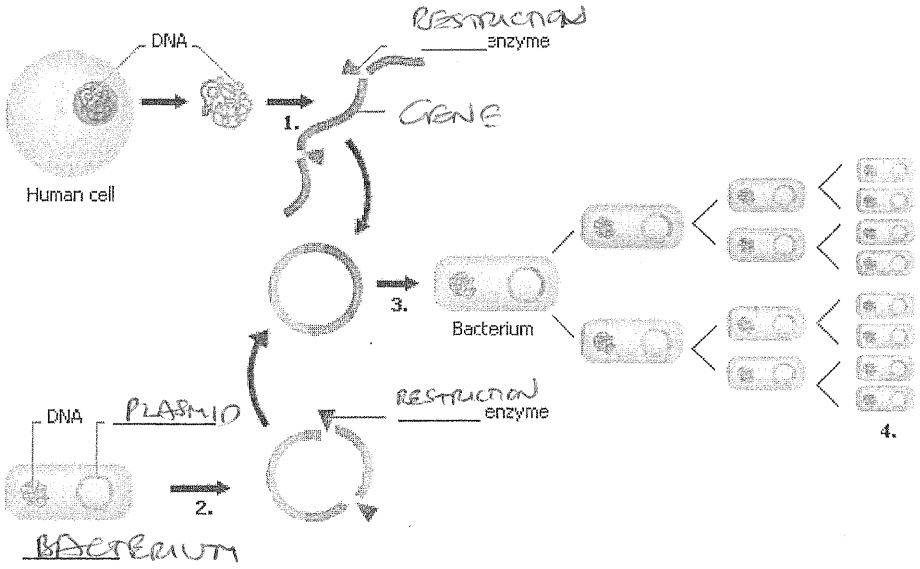
A DNA molecule consists of two strands coiled to form a double HELIX. The strands are held together by complementary paired BASES: ADENINE (A), CYTOSINE (C), THYMINE (T), GUANINE (G)

Complete the following diagrams:

DNA molecule:



Gene transfer:



In this diagram a ..RESTRUCTION..... enzyme cuts the DNA and another enzyme, known as ..LIGASE..... joins pieces back together. Other than plasmids, VIRUSES..... can also be used to transfer the gene.

The bacterium with the gene from another organism is now known as ..TRANSGENIC.....

An example of the use of this technology is in the production of ..INSULIN.....for use by people who have .....DIABETES..... Advantages of this include:

.....PRODUCE EXACT COPY OF HUMAN INSULIN ⇒ .....

.....VERY EFFECTIVE.....

Plants can be modified, for example the bacterium *Agrobacterium* can be used to insert genes, which might improve:

1. DISEASE RESISTANCE
2. SALT TOLERANCE
3. PEST RESISTANCE

This could be very useful to improve crop yield but does have several dangers / downsides:

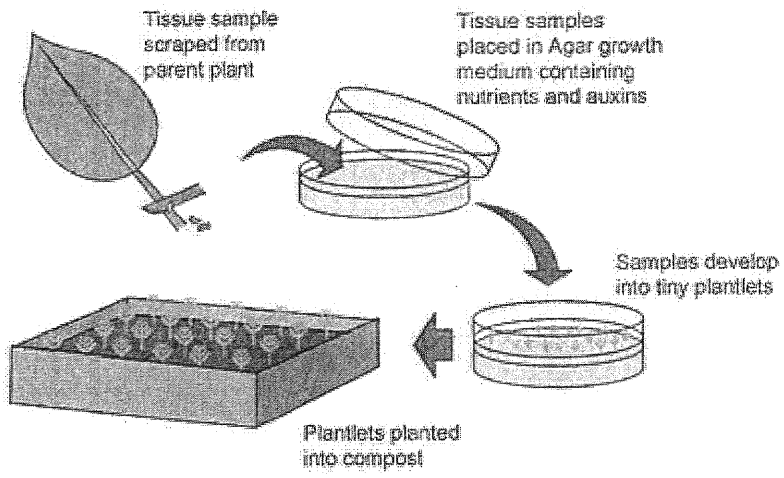
1. GENE MOVE INTO WILD TYPE SPECIES
2. POTENTIAL HEALTH EFFECTS???

Organisms with DNA from more than one species are said to be ...TRANSGENIC

Cloning

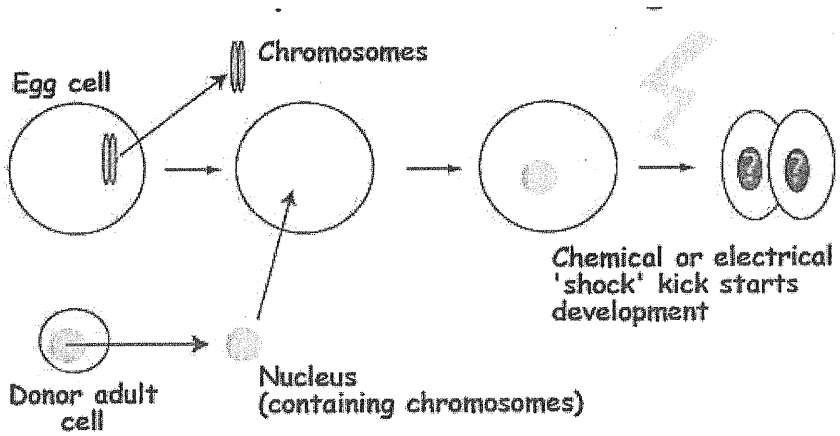
Micropropagation (...EXPLANT CLONING...**)**

Small pieces of desirable plants are grown on a nutrient medium (e.g. agar), producing identical plantlets. This can be used on a large scale and is particularly useful, for example, when a new plant has been genetically modified.



Mammal cloning.

The following very simple diagram shows the basics of this process. It can be seen that the chromosomes are removed from an egg cell (this cell is called ...ENUCLEATED) and replaced by the ...DONOR...nucleus from a cell taken from the organism to be cloned. They are fused together and forced to start to divide. At this stage the cells will be implanted into a surrogate mother. An example of this is with ...DOLLY..... the sheep.



The potential for this technology includes (discuss the idea of producing human antibodies or organs):

STEM CELL WORK ; THERAPEUTIC CLONING

AS OPPOSED SIMPLY TO REPRODUCTIVE CLONING

INSERTING HUMAN GENES INTO COWS → PROTEIN (e.g. ANTIBODY, CLOTTING FACTOR) PRODUCED (IN MILK).

IGCSE Questions

1.

> Chemical fertilisers are used to increase crop yields. As an alternative to using chemicals seeds can be treated with "biofertiliser".
>
> This biofertiliser provides a way of coating seeds with nitrogen fixing bacteria before they are sown. Biofertiliser is, for example, used in parts of India to improve crop yield.

A comparison was made of the yield of a crop grown using three different treatments. The table shows the results.

Treatment used	Crop yield in tonnes per hectare
no fertiliser	4.0
chemical fertiliser	4.4
biofertiliser	5.6

(a) (i) When compared with using no fertiliser, what is the increase in crop yield using chemical fertiliser?

..... tonnes per hectare **(1)**

(ii) When compared with using no fertiliser, the percentage increase in crop yield when using chemical fertiliser is 10%. Calculate the percentage increase in crop yield when using biofertiliser compared with using no fertiliser. Show your working.

Answer .....% **(2)**

(b) Explain how nitrogen fixing bacteria help the crop to grow.

.....

.....

.....

.....

.....

.....(4)

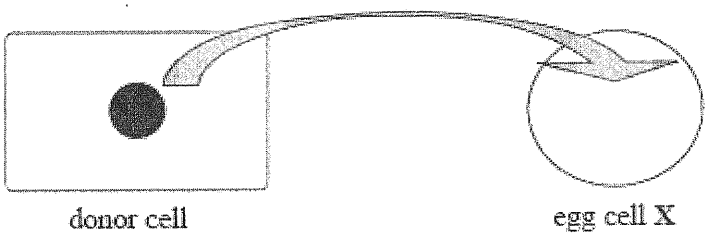
(c) One disadvantage of chemical fertilisers is that they may need to be applied several times during the growth of the crop. Give **one** reason for this.

.....

.....(1)

Total 8 Marks

2. (a) The diagram shows a stage in the cloning of animals. The nucleus of an egg cell is removed and replaced with the nucleus from a body cell called the donor cell. This modified cell is shown as egg cell **X**.



In the table, tick the row with the correct description of the nucleus that was removed from the original egg cell and the nucleus in egg cell **X** that came from the donor cell.

Nucleus in original egg cell	Nucleus in egg cell X	Tick
haploid	haploid	
haploid	diploid	
diploid	haploid	
diploid	diploid	

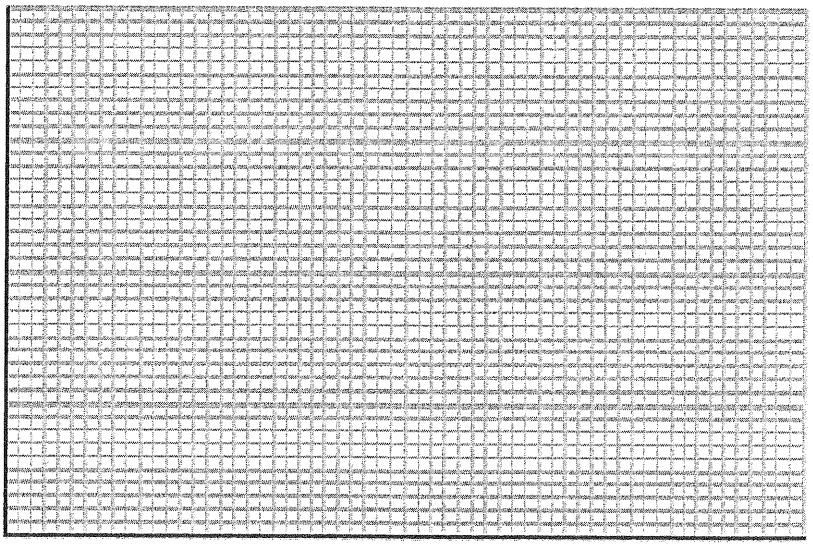
(1)

(b) Cloning experiments have been carried out with frogs at early stages of development. These experiments showed that the age of the donor cells used to provide the nuclei had an effect on the number of offspring that survived. The results of one experiment are shown in the table.

Age of donor cells in hours	Percentage of offspring that survived
6	80
12	76
24	52
38	40
58	28
120	15

(i) Plot the data in the table on the grid below. Join the points with straight lines.

Percentage of offspring that survived



Age of donor cells in hours

(3)

(ii) At what age did the donor cells produce 50% of offspring that survived?

.....(1)

(iii) Describe the relationship between the age of donor cells and the percentage of offspring that survive.

.....

.....(1)

(c) The process described in (a) can be used to make clones of transgenic animals.

What is meant by the term **transgenic**?

.....

.....(2)

Total 8 marks

3. DNA is a double helix with each strand linked by a series of paired bases. There are four bases in DNA. The table below shows the percentage of each base found in a sample of DNA taken from a mammal. Only two of the bases have been named in the table.

(a) Complete the table to give the names of the other two bases.

Percentage of base in DNA sample	Name of base
30	thymine (T)
20	guanine (G)
30	
20	

(2)

(b) The sample of DNA contained 2000 bases. How many thymine bases would the DNA sample contain?

.....**(1)**

(c) Human DNA contains the gene to make insulin. Bacteria can be modified to contain this gene. Describe the steps used to do this.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....**(5)**

Total 8 marks

4. Etoposide is a drug that can be used against cancer. The drug is made by a rare plant. Scientists are using micropropagation to produce clones of this plant.

(a) The passage below describes the process of micropropagation. Write on the dotted lines the most suitable word or words to complete the passage.

Small pieces (called explants) are ..... from the parent plant. The small pieces of plant are dipped into dilute bleach to ..... their surfaces. They are then grown *in vitro* by placing them into test tubes containing ....., in conditions free from microorganisms. Each piece of plant develops into a ball of cells called a callus. Growth regulators are then added to encourage each callus to grow shoots and ..... . In this way large quantities of the rare plant can be produced. **(4)**

(b) Why are the plants produced by micropropagation called clones?

.....

.....(2)

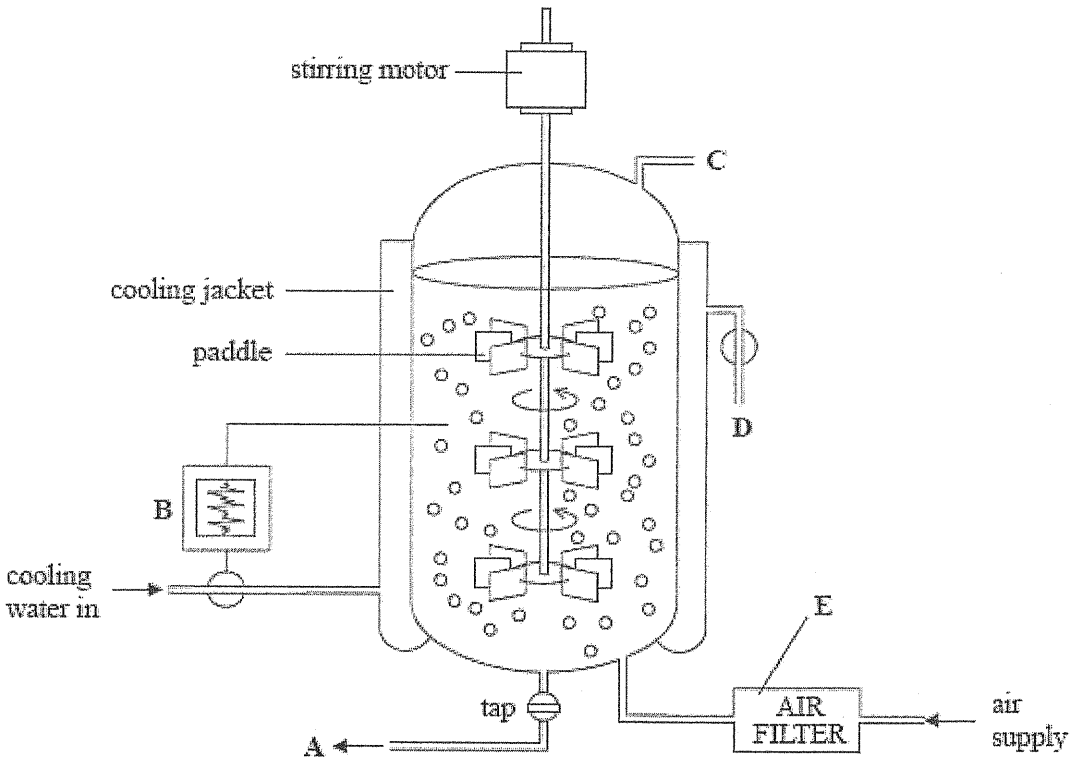
(c) Suggest **one** reason for using micropropagation to produce these plants rather than natural reproduction.

.....

.....(1)

Total 7 marks

5. The diagram shows a fermenter used to grow bacteria that have been genetically modified so that they produce large amounts of human insulin.



The table lists problems that occurred when parts of the fermenter did not work properly.

(a) Complete the table by giving the letter of the part that did not work properly.

Problem	Part that did not work properly
Other bacteria got into the fermenter	
The liquid food got too hot	

(2)

(b) Bacteria can be genetically modified so that they produce human insulin.

Describe this process.

.....

.....

.....

.....

.....

.....

.....

.....(5)

(c) The human insulin produced in the fermenter is used by people who cannot make their own insulin. In these people, the organ that produces insulin is damaged.

(i) Name the organ that produces insulin.

.....(1)

(ii) Explain what insulin does in the human body.

.....

.....

.....

.....

.....

.....(3)

Total 11 marks

6. The technique of selective breeding can be used to produce a crop of tomato plants that flower early.

The table shows the steps taken to breed early-flowering tomato plants.

Complete the table by using numbers to show the correct order of the steps.

Step	Order of step
select early-flowering offspring plants	
allow seeds from early-flowering plants to grow	
select early-flowering plants	1
grow early-flowering offspring plants	5
repeat the process for several generations	
collect seeds from early-flowering plants	

Total 4 marks

REVISION BOOKLET 6 ANSWERS.

1.

(a) (i) 0.4; **(1)**

(ii) 4.0 - 5.6 or 1.6 / 4.0;
40; **(2)**

(b) nitrogen;
gas / from air;
to ammonium / nitrate;
amino acid(s);
protein;
maximum of 4 **(4)**

(c) used up / leached / washed / eq; **(1)**

Total 8 marks

2.

(a)

Nucleus in original egg cell	Nucleus in egg cell X	Tick
haploid	haploid	
haploid	diploid	3;
diploid	haploid	
diploid	diploid	

(1)

(b) (i) scales linear + scales over half the axes;
points plotted correctly;
tidy line through points; **(3)**

(ii) 26 / read from graph; **(1)**

(iii) increase in age has decrease in survival / eq; **(1)**

(c) transfer of gene/allele/DNA/genetic material;
from an organism to different organism / eq; **(2)**

Total 8 marks

3.

(a) adenine / A;
cytosine / C; **(2)**

(b) 600; **(1)**

(c) restriction enzyme / endonuclease;
cut DNA / gene;
ligase;
join/insert/stick/put into DNA / eq;
plasmid(s);
vector;
recombinant DNA / recombinant bacteria;
maximum of 5 **(5)**

Total 8 marks

4.

(a) cut / eq;
sterilise / disinfect;
nutrient / agar / food / medium / growth substance / glucose / minerals;
roots / leaves; IGNORE water **(4)**

(b) genetically / alleles / genes / DNA;
identical / same; **(2)**

(c) quicker;
all plants produce drug / less variation idea / identical; max
lots made / commercial idea; **(1)**

Total 7 marks

5.

(a) E or C;
B or D; (2)

(b) (human) gene / DNA (for insulin);
plasmid / vector;
restriction enzyme;
same restriction enzyme;
cuts / eq;
ligase; max
sticks / eq; (5)

(c) (i) pancreas / Islets of Langerhans; (1)

(ii) controls/regulates sugar/glucose levels;
reduces glucose;
converts to glycogen; max
in liver; (3)

Total 11 marks

6.

Question Number	Question		
6	**(a)**		
	Acceptable Answers	Reject	Mark
	Three from: kill; pests / insects / organisms; less damage / less crop eaten; better yield / eq;		(3)

Question Number	Question		
6	**(b)**		
	Acceptable Answers	Reject	Mark
	(i) suitable example; target organism; **(ii) Two** from: specific / does not affect other organisms / eq.; does not need to be reapplied; does not pollute / not poisonous;		2 2 (4)

Question Number	Question		
6	**(c)**		
	Acceptable Answers	Reject	Mark
	resistance to pests / eq.;		(1)

Total 8 marks