Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced Subsidiary

Unit 3B: Practical Biology and Research Skills

Monday 7 January 2013 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI07/01

You must have:
Ruler, Calculator, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P39882A

1/1/1/1/

P 3 9 8 8 2 A 0 1 1 6

PEARSON

BLANK PAGE

Answer ALL questions.

1 In a class practical, a student had used tissue culture techniques.

He decided to investigate the conditions needed for the growth of plant cells. Plant cells can grow to form a callus, a mass of undifferentiated cells.

The main ingredients needed for the growth of calluses are:

- mineral salts
- auxin (IAA)
- cytokinin
- sugar, such as sucrose or glucose.

The student decided to investigate the effect of glucose concentration on the growth of calluses from pieces of cotton plant tissue.

He mixed the ingredients listed above with an agar solution to make a gel on which he could grow the calluses. Working in sterile conditions, he removed small pieces of tissue, known as explants, from one cotton plant. The explants were placed on this gel.

This procedure was repeated using agar gel containing different concentrations of glucose.

After two weeks, he recorded the percentage of explants that had formed calluses and the dry mass of the callus.

(a) (i) Name **one** of the dependent variables in this investigation.

(1)

.....

(ii) Name the independent variable in this investigation.

(1)

.....

(iii) Give **one** growth condition that should be controlled in this investigation and explain how you would control it.

(3)

Growth condition .....

How this growth condition can be controlled .....

.....

.....

.....

.....

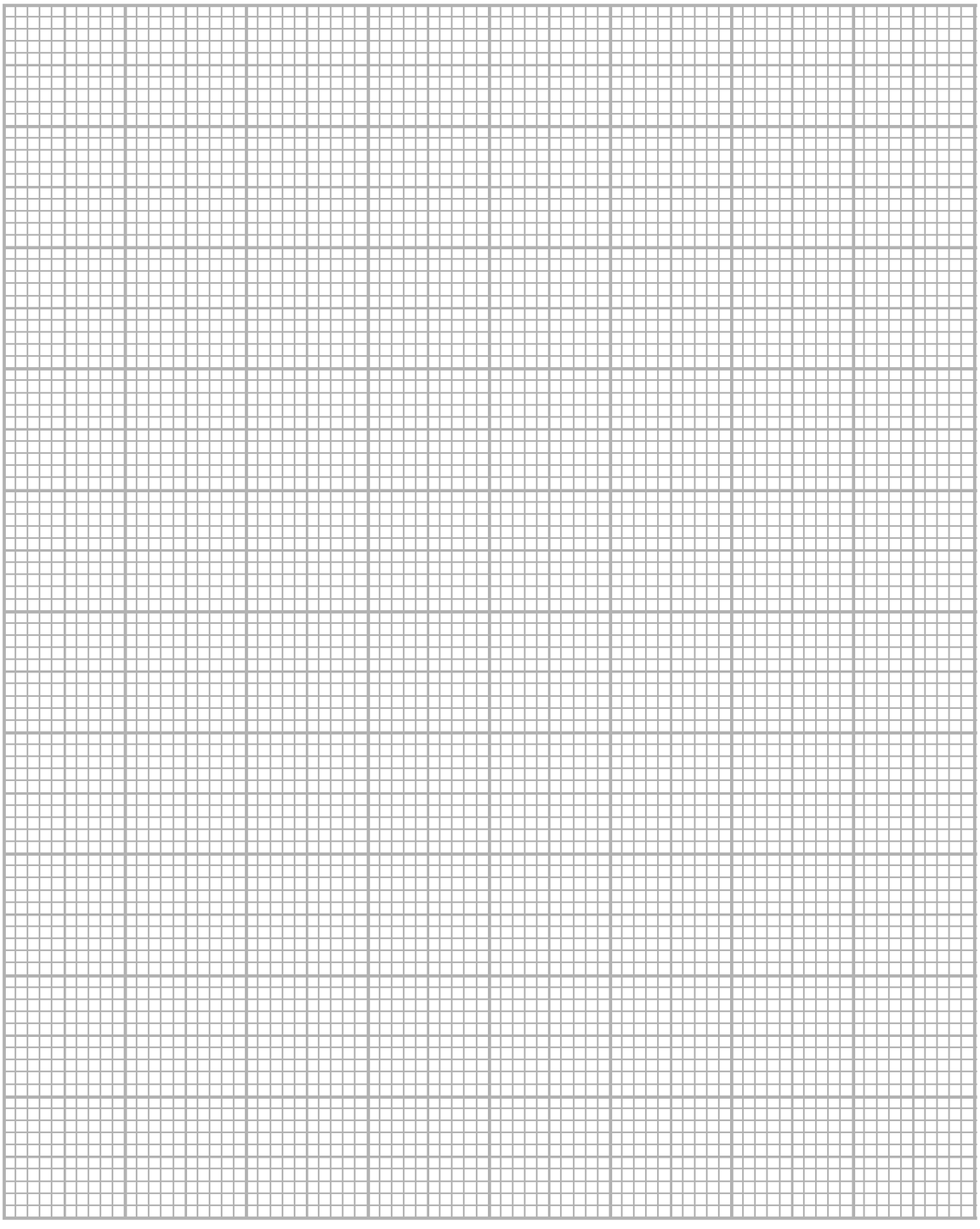
.....

(b) The results of his investigation are shown in the table below.

Glucose concentration (%)	Mean percentage of explants forming a callus (%)	Mean dry mass of callus / mg	Standard deviation (SD) of dry mass of callus
1	37	22	0.7
2	51	64	1.7
3	99	156	3.8
4	95	175	4.2
5	86	134	2.9
6	79	102	2.9

(i) Plot the glucose concentration and the mean dry mass of callus, in a suitable graphical form.

(5)



(ii) Describe the effect of glucose concentration on the mean dry mass of callus.

(3)

(iii) Comment on the reliability of the data for the mean dry mass of callus.

(3)

(iv) Using the data in the table, describe the effect of glucose concentration on the mean percentage of explants forming a callus.

(2)

(v) Using the results of this investigation, suggest the optimum glucose concentration for both the formation and growth of calluses from explants. Explain your answer.

(2)

(Total for Question 1 = 20 marks)

BLANK PAGE

2 Read the following extract from a student's **unfinished** draft report on the topic of farming with genetically modified crops.

1 Farming is the main source of food for society. From the mid-1940s, yields have been increased by the use of pesticides and fertilisers, enhancing growth and minimising loss of produce. Genetically modified crops (GM crops) may change the way we farm and have the potential to increase productivity, at the same time as reducing the use of agro-chemicals.

2 With conventional crops, inherited traits carried in the genes can be passed only between individuals of the same or closely related species. Genetic modification allows the transfer of genes across unrelated species, potentially between animals, plants and microbes.

3 Genes are transferred by vector and vectorless techniques. Vector transmission usually requires a virus (the vector) carrying the genetic material from one species to another.

4 Vectorless transmission is much simpler. There are three types of vectorless transmission:

- The gene gun in which DNA is fired into the target organism in the hope of combining the donor genes with the DNA of the GM organism.
- Cells of the recipient are placed in a solution of the foreign DNA and an electric field is applied. This disrupts the cell membranes and leads to the DNA being inserted into the cell's DNA. The process is called electroporation.
- Tiny crystals of silicon carbide are placed in a solution in water, the plant cells and the foreign DNA. The solution is shaken and the silicon carbide punches small holes in the cell membranes through which the foreign DNA enters the cell.

5 Crops can be made disease-resistant, given improved nutritional value and an ability to survive adverse weather conditions such as floods, droughts and frosts.

6 Bt maize is an example of a GM crop that has been modified to secrete a toxin, from the bacterium *Bacillus thuringiensis*. The toxin, a protein, kills the corn borer insect *(Ostrinia nubilalis)* which causes major damage to the maize crop. The corn borer would conventionally require up to 6 sprays of chemicals. However, Bt maize growers don't use insecticides against the corn borer as the plant is totally resistant to this insect. Only one application of another insecticide is required to control other pests. Spain is currently commercially farming Bt maize on approximately 25000 hectares of farmland. In 1997 a trial was carried out across a number of regions in Spain. Improvements in yield using Bt maize were shown.

7 Another GM crop is glyphosate-tolerant soya. Glyphosate is a herbicide which kills a large variety of weeds, but it will also kill soya. Using glyphosate-tolerant soya allows just one herbicide to control all of its weeds, saving a lot of money. One or two applications of the glyphosate will do, whereas non-GM crops would require repeated applications of a range of narrow spectrum herbicides for the same effect.

8 So, growing GM crops means that fewer agro-chemicals, which can have serious impacts on the environment, are needed.

9 If GM crop technology is widely used around the globe, it will have major impacts on many less economically developed countries (LEDCs). Both their economic and social stability will improve, making them self sufficient in food and earning revenue from exports. Eight hundred million people do not have sufficient food to maintain their health. This leads to malnutrition which accounts for about half of the 12 million deaths per year of children under the age of five. However, it must be noted that GM seeds can be very expensive.

10 Finally, with non-GM crops, soil erosion is a common problem because the soil has to be cleansed before planting. As GM soya has a resistance to glyphosate, soil cleansing can be done later. This conserves soil moisture, fauna and flora, as well as reducing water and wind erosion and thus the risk of desertification is reduced.

11 However, there are risks from the use of GM crop technology. The genetically modified genes may escape through cross-pollination leading to hybridisation between GM and non-GM plants. If a weed were to inherit a tolerance to a specific herbicide, another herbicide would have to be used to control the weed, negating the whole purpose of using GM crops. GM technology could also lead to the loss of beneficial insects like lacewings and ladybirds which feed on the aphids that damage crops. For example the Bt toxin from the maize could travel along food chains to these predators. This might lead to a reduction in populations of native birds. The use of the very powerful glyphosate herbicide might increase with GM crops and this may damage habitats within farmland.

12 Campaigners against GM crops believe that the research and funding going into the technology would be better placed elsewhere. It is suggested, for example, that an advance in irrigation systems would lead to less soil erosion, without the need for GM crops. A decrease in soil erosion would help farmers maintain a healthy soil capable of producing high non-GM crop yields. Methods of crop protection could lead to a less extensive use of pesticides by reducing the infestation of unwanted plants. These improvements would reduce the need for GM technology and its associated risks and costs. Avoiding monoculture also offers protection from the entire crop being wiped out by a single strain of disease, again without the need for GM.

(a) The student's tutor said that he needed to add some visuals to his report, as well as some data.

(i) He found the picture shown below in a magazine.
He decided to add some information to this picture and use it in his report on GM crops.

Advantages

Disadvantages

Using the information in the extract, complete the boxes below to show the advantages and disadvantages of growing GM crops.

(4)

Advantages	**Disadvantages**

(ii) Suggest where in the extract the student should place this completed visual.

(1)

.....

(iii) The student found the following data related to the study mentioned in paragraph 6.

Region in Spain	Mean yield / tonnes ha^{-1}	
	Conventional maize	**Bt maize**
Albacete	13.34	14.20
Girona	12.07	13.63
Huesca	12.54	13.35
Lleida	13.13	13.72
Madrid	14.28	14.70
Zaragoza	11.32	12.01
All regions		13.60

Using the information in the table, calculate the mean yield for conventional maize crops from all regions. Show your working.

(2)

Mean yield = ... tonnes ha^{-1}

(iv) The student decided to draw a graph to compare the data for the two types of maize grown in the six regions of Spain.
Make a sketch to show the appearance of this graph and suggest a title.

(4)

Title .....

.....

(b) A report is expected to address the implications of the applied biology involved.

Explain **two** environmental implications from this extract.

(4)

1 .....

.....

.....

.....

.....

2 .....

.....

.....

.....

.....

(c) Throughout the report, the student included references.

The following shows an extract from the list of references he provided.

1. Ethics, Morality, and Crop Biotechnology written by Roger Straughan and Michael Reiss. Published by Cambridge University Press in 1996 that is located at University Printing House, Shaftesbury Road, Cambridge, CB2 8BS.
2. 'GM Crops and the Environment-Benefits and Risks' written by the Food and Drink Federation (FDF). Produced by the FDF located at 6 Catherine Street, London, WC2B 5JJ.
3. Mehier-Humbert, S and Guy, R.H. (2005) Physical Methods for Gene Transfer. *Drug Delivery Reviews*. 57(5), 733-753.

(i) Give a paragraph number in which you think he might have referred to reference number 3.
Explain your choice.

(3)

Paragraph number .....

.....

.....

.....

.....

(ii) Reference number 3 is complete and written in a suitable format.

Rewrite reference number 1 in a suitable format.

(2)

.....

.....

.....

.....

(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

BLANK PAGE