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**Answer ALL questions in the spaces provided.**

1. The table below compares the features of typical plant, animal and bacterial cells. Complete the table by placing a tick (✓) in the appropriate box if the feature is usually present or a cross (✗) if the feature is usually absent.  
**Do not leave any boxes empty.**

The first line has been done for you.

	<b>Plant (eukaryotic) cell</b>	<b>Animal (eukaryotic) cell</b>	<b>Bacterial (prokaryotic) cell</b>
Cell wall	✓	✗	✓
Chloroplasts			
Nuclear membrane			
Cell (unit) membrane			
Ribosomes			
Centrioles			

Q1

(Total 5 marks)



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2. The hormone insulin is a protein. It is produced in certain cells in the human pancreas. Once insulin molecules have been produced they are secreted through the cell membrane into the blood. Describe the sequence of events from when an insulin molecule has been formed until it passes through the cell membrane.

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(Total 5 marks)

Q2



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3. Cellulose and starch are both polysaccharides, made up of glucose molecules condensed together.

(a) Describe how the molecular structure of a cellulose molecule differs from that of a starch molecule.

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(3)

(b) In the cell walls of plants, the cellulose molecules are arranged so that they make up cellulose microfibrils. Explain how the arrangement of cellulose molecules in a microfibril give it great strength.

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(2)

(c) Xylem vessels are tubes formed when columns of cells die. Their walls are made of cellulose strengthened with other substances, such as lignin. In addition to providing support, xylem vessels also transport water from the roots to the leaves with the help of cohesion. Explain what is meant by cohesion.

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(2)

(Total 7 marks)

Q3



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4. (a) The pigment melanin provides protection against the harmful effects of sunlight. Human albinos produce no melanin. Suggest why human albinos have a very high risk of developing skin cancer.

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- (b) Describe the sequence of events leading to the formation of a tumour, such as a skin tumour.

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- (c) A patient who had a cancerous skin tumour removed later developed further tumours, despite taking great care to avoid further exposure to sunlight. Suggest how these further tumours might have occurred.

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(Total 7 marks)

Q4



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5. (a) Mammalian gametes are formed by meiosis and have the ability to fuse to form a zygote. Explain why it is important that gametes are produced by meiosis.

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- (b) Explain how the genetic material from a mammalian sperm cell is able to enter an ovum to bring about the process of fertilisation.

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(2)



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(c) (i) Calculate the number of cells that will be present in the embryo after the first four mitotic divisions of the zygote.

..... (1)

(ii) Suggest why, during the first four mitotic divisions, the embryo does not increase in volume even though the total number of cells increases.

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..... (1)

(iii) Outline the events that occur in mitosis from the start of prophase up to the end of metaphase.

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(Total 9 marks)

Q5



6. The photograph below shows brine shrimps.



A student carried out an investigation to determine the effect of temperature on the hatching success of brine shrimp eggs. The results are shown below.

<b>Temperature/ °C</b>	22	24	26	28	30	32
<b>% Eggs hatching</b>	36	40	42	44	42	41

(a) Describe the pattern shown by the data in this table.

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**(2)**

(b) Suggest why brine shrimps are affected by temperature in the way shown by the data.

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(c) Suggest how global warming, directly or indirectly, might alter brine shrimp populations.

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(3)

Q6

(Total 7 marks)



7. Pollen grains buried in peat can be used to deduce what the climate was like in the past.

(a) (i) State how the age of a peat layer can be estimated.

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**(1)**

(ii) The presence of a large amount of alder tree pollen in a layer of peat is taken to mean that there was high rainfall when the layer was formed. Suggest why it is thought that the presence of alder pollen in peat indicates high rainfall.

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**(1)**

(b) The exoskeletons of many insect species are also found in peat. Exoskeletons are resistant to decay. Suggest how insect exoskeletons from peat could be used to show that the climate became warmer over a period of years.

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**(2)**





(c) Certain arctic plants are adapted to growing in very cold conditions in the treeless tundra habitat of northern Norway, Sweden, Finland and Russia, near the coast of the Arctic Ocean.

(i) Suggest why the geographical location of arctic plants makes them especially vulnerable to extinction due to global warming.

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(1)

(ii) Increase in temperature increases the rate of respiration more than it increases the rate of photosynthesis. Suggest why this might be a problem for arctic plants affected by global warming.

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(Total 7 marks)

Q7



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8.



A crop of sunflowers

Biofuels can be used as an alternative to fossil fuels. Biofuels are produced from plants such as sunflower and sugar beet.

- (a) Vehicles running on sunflower oil give out a similar mass of carbon dioxide to that given out when they are running on petrol, or diesel, produced from fossil fuel. Explain why, despite this, the use of sunflower oil is considered to contribute much less to climate change than the use of fossil fuel.

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(2)



(b) Ethanol is an alternative type of biofuel produced from sugar beet.



A field of sugar beet

Turning raw sugar beet or sunflower seeds into a form that can be used as motor fuel is called down-stream processing. This processing requires energy. The table below compares the energy yield of biofuel from sugar beet and sunflowers.

Crop	Biofuel	Total energy yield in raw plant material	Energy required for down-stream processing	Net biofuel yield	Net energy in biofuel as % of total energy yield
Sugar beet	Ethanol	3.98	3.22	0.76	19
Sunflowers	Oil	1.06	0.29		

Energy units are given in tonnes of fossil fuel equivalent per hectare.

- (i) Calculate the net biofuel yield for sunflowers and then give it as a percentage of the total energy yield. Show your calculations below and put the answers in the empty spaces in the above table.

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(ii) Discuss, using information in the table, which of the two sources of biofuel is the more energy efficient.

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(iii) Suggest why the production of biofuel is unlikely to replace a country's need for fossil fuel in the near future.

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(c) (i) Genetic modification (GM) can be used to change crop plants to make them more useful and commercially valuable. Suggest **two** ways in which sunflower or sugar beet plants might, in future, be improved by GM to reduce the price of the biofuel.

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(ii) Suggest why some people might be opposed to the use of GM to improve biofuel production.

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(Total 12 marks)

Q8



9. (a) A single stem cell can give rise to many genetically identical cells of different types. There are, for example, adult stem cells in the human brain which are capable of producing the different types of brain cells including nerve cells (neurones).

Scientists are trying to find ways of growing such adult brain stem cells in the laboratory.

- (i) Name the type of cell division by which a stem cell can give rise to many genetically identical cells.

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**(1)**

- (ii) Explain how cells produced from stem cells can have the same genes yet be of different types.

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- (iii) Suggest why it might be useful to keep a supply of live stem cells from your brain in a laboratory.

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(b) Much research remains to be done and so it will be some time before adult stem cell treatments will be available to those who might benefit from them. However, research using embryonic stem cells is much further advanced.

(i) Suggest why research with embryonic stem cells is further advanced than research with adult stem cells.

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(2)

(ii) Some people hold the view that research into and the medical use of embryonic stem cells is unethical and that we should await the results of research on adult stem cells.

Are you for or against embryonic stem cell research? .....

Using your scientific knowledge and your understanding of the ethical issues associated with embryonic stem cell research, explain why you hold this view.

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**Q9**

**(Total 11 marks)**

**TOTAL FOR PAPER: 70 MARKS**

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