CHEMISTRY ONLINE TUITION

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BIOLOGY

THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	CANCER
PAPER TYPE:	QUESTION PAPER - 3
TOTAL QUESTIONS	7
TOTAL MARKS	47

Cancer - 3

1. The enzyme aromatase produces a chemical known as estrogen. The ovaries are the primary source of oestrogen in females, although many other organs in the body, including the lungs, also generate aromatase. Certain lung tumors may form more quickly when estrogen is present. Cell division in these tumors is stimulated by the binding of oestrogen to cell-surface receptors.

Researchers looked into the possibility of two medications preventing lung tumors in female mice. These mice had first had their ovaries removed. After that, for four weeks, they gave the mice two daily injections of a tobacco-derived substance that causes tumors. Next, the mice were divided into four groups at random. Ten mice were in each group.

• A placebo was administered to Group Q. Neither medication was present in this placebo.

• Anastrozole was administered to Group R. The aromatase enzyme is inhibited by this.

Group S received fulvestrant as a medication. This binds to receptors for estrogen.

• Both fulvestrant and anastrozole were administered to Group T.

Throughout weeks five through fifteen of the study, the mice received these medications once a week.

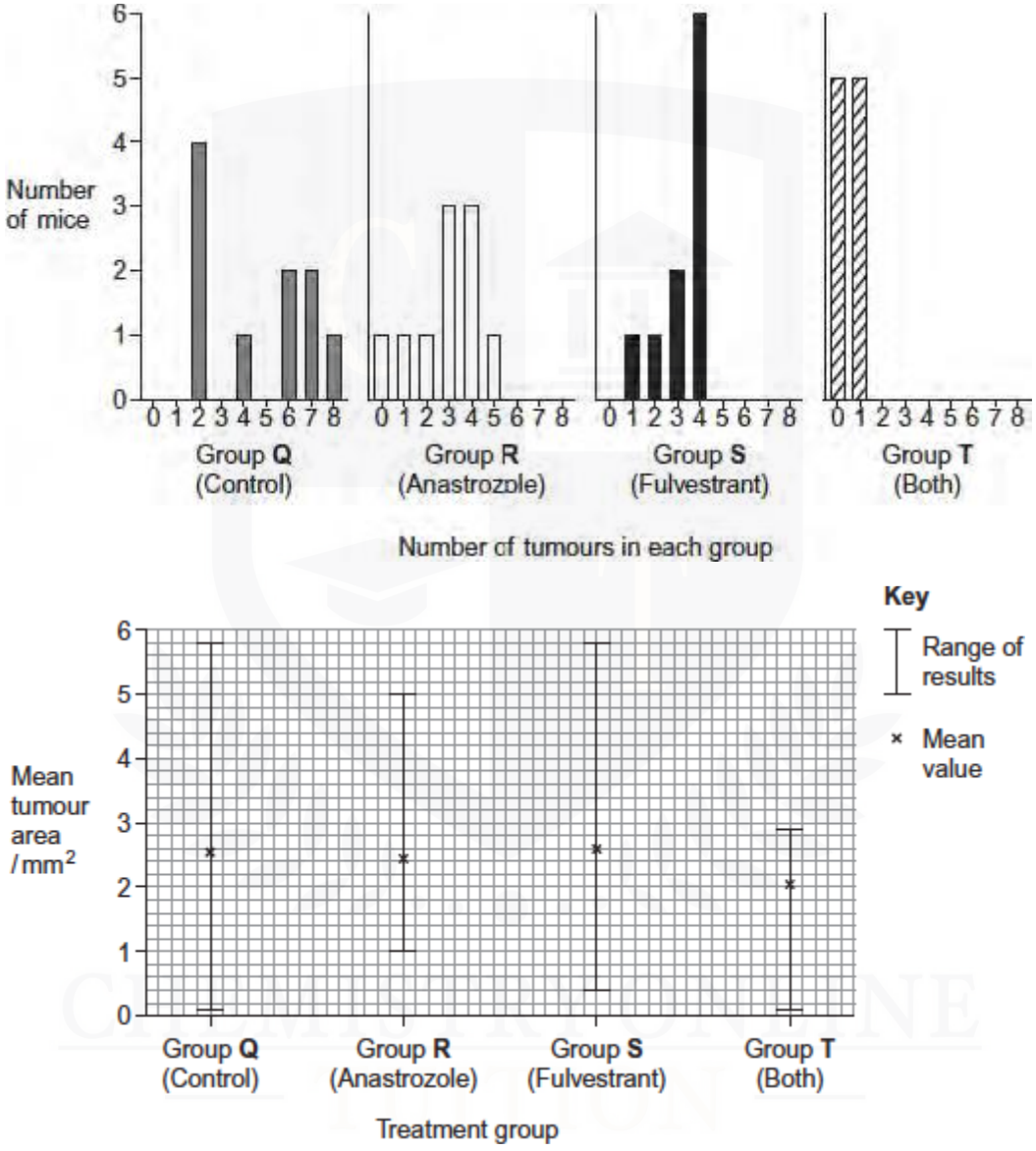
(a) In order to conduct the experiment, the scientists removed the mice's ovaries. Daily injections of the aromatase substrate were also administered to the animals.

Justify the need for these actions. **(2)**

(b) The researchers hypothesized that fulvestrant plus anastrozole would have a greater therapeutic impact than fulvestrant alone. Provide a rationale for their prediction based on the available data. (2)

The mice's lungs were taken out and evaluated at week fifteen. The researchers next calculated the average tumor size and the total number of tumors in each group.

Figures 1 and 2 present the findings of the scientists.



(c) The researchers came to the conclusion that combining the two medications would lower the risk of lung cancer in female smokers.

Do you concur? Give an explanation for your response. **(5)**

(d) The researchers employed the tumor's area as a proxy for its size.

Describe why tumor area might not be the most accurate measure of tumor size and offer a more dependable one. **(2)**

(e) These medications are presently being tested on humans by a different team of experts. A placebo, however, is not being administered to the control group.

Explain why this group is receiving something other than a placebo and why that is the case. **(2)**

2.

(a) A tumor may develop as a result of a mutation in a tumour suppressor gene. **(2)**

Describe how.

(b) Not every mutation modifies the encoded polypeptide's amino acid sequence.

Describe your reasoning. **(2)**

3.

(a) The cell-surface membrane of some cancer cells contains a receptor protein that binds to the hormone known as growth factor. This promotes the division of cancer cells.

A monoclonal antibody that blocks this activation has been created by scientists.

Make a suggestion for how this antibody prevents a tumor from growing using your understanding of monoclonal antibodies. **(3)**

4.

(a) Describe how cancer can result from the methylation of tumour suppressor genes. **(3)**

Researchers looked into potential connections between women's death rates from breast cancer in ten different countries and the quantity of fat in their diets.

The table below displays their data.

Percentage of fat in diet of population	**Death rate of women from breast cancer per 100 000 women**
9.5	1.5
15.0	7.0
20.0	12.

25.0	9.0
32.0	15.
35.0	8.0
35.0	20.
40.5	18.
43.0	24.
45.0	26.

(b) Explain how you would arrange these data on a suitable graph. Justify the graph type you choose. **(3)**

(c) From these data, what conclusions can you draw? **(2)**

5.

One kind of skin cancer is called metastatic melanoma (MM). A malfunctioning receptor protein in cell-surface membranes is the root cause of it. For this malignancy, there aren't many highly successful treatments available.

A medication called dacarbazine has been used to treat multiple sclerosis (MM) because it seems to lengthen the survival period of certain MM patients.

Physicians looked into treating multiple myeloma (MM) with ipilimumab, a novel medication. The researchers examined the median survival time (ST) of two patient groups receiving treatment for multiple myeloma (MM): one group had dacarbazine-only treatment, and the other group received dacarbazine + ipilimumab treatment.

The ST is the duration of a patient's life following diagnosis.

The percentage of patients whose tumors significantly shrank after each treatment was also noted by the physicians.

There were 502 patients in total who were part of the study.

The doctors' findings are displayed in the table below.

Treatment	Median survival time (ST) / months	Percentage of patients showing significant
Dacarbazine	9.1	10.3
Dacarbazine and	11.2	15.2

(a) The physicians contrasted the patients' median survival periods within each category.

How would you go about determining a group of patients' median survival time? **(2)**

I am Sorry !!!!!

(b) A placebo, or inert substance, is administered to a control group of patients in numerous clinical studies for novel medications.

In this experiment, dacarbazine had been administered to the control group. Explain why a placebo was not administered to them. **(2)**

(c) A reporter who reviewed this study came to the conclusion that ipilimumab enhanced MM treatment.

Does this conclusion hold up to the data in the table? Provide justification for your response. **(4)**

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(d) A malfunctioning receptor protein in cell-surface membranes is the cause of MM. The immune system has the power to eradicate cells seen in MM tumors.

Explain how the immune system might be able to eliminate them**. (3)**

6.

One medication used to treat a malignancy that targets white blood cells is imatinib. The pace at which white blood cells absorbed imatinib was studied by scientists. At 4°C and 37°C, they examined the rate of absorption. The table displays their outcomes.

	Mean rate of uptake of imatinib into cells / µg per	
Concentration of imatinib outside	**4°C**	**37°C**
0.5	4.	10.5
1.0	10.7	32.5
5.0	40.4	420.5
10.0	51.9	794.6
50.0	249.9	3156.
100.	606.9	3173.

(a) The rate of imatinib uptake was assessed by the scientists and expressed in µg per million cells per hour. Describe the benefits of this rate unit's use in this study. **(2)**

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(b) Determine the percentage increase in the mean rate of imatinib uptake during a temperature rise of 4°C to 37°C at a 1.0 μmol dm^{-3} imatinib concentration outside the cells.

Extend your response to a single decimal place. **(2)**

7.

Imatinib is actively transported into blood cells.

(a) Describe how this assertion is supported by the data for the two distinct temperatures. **(2)**

(b) Describe how the findings supporting the idea that imatinib is taken up by active transport at concentrations outside of blood cells at 50 and 100 μmol dm^{-3} at 37°C are supported. **(2)**

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