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Topic 2: Genes and Health (Teacher 2)

Task 1

Links to the A level Biology syllabus:

2.1 i) Know the properties of gas exchange surfaces in living organisms (large surface area to volume ratio, thickness of surface, difference in concentration).

ii) Understand how the rate of diffusion is dependent on these properties and can be calculated using Fick's Law of Diffusion.

iii) Understand how the structure of the mammalian lung is adapted for rapid gaseous exchange.

2.3 Understand what is meant by osmosis in terms of the movement of free water molecules through a partially permeable membrane (consideration of water potential is not required).

2.4 i) Understand what is meant by passive transport (diffusion, facilitated diffusion), active transport (including the role of ATP as an immediate source of energy), endocytosis and exocytosis.

ii) Understand the involvement of carrier and channel proteins in membrane transport.

2.5 i) Know the basic structure of mononucleotides (deoxyribose or ribose linked to a phosphate and a base, including thymine, uracil, cytosine, adenine or guanine) and the structures of DNA and RNA (polynucleotides composed of mononucleotides linked through condensation reactions).

ii) Know how complementary base pairing and the hydrogen bonding between two complementary strands are involved in the formation of the DNA double helix.

2.12 i) Understand how errors in DNA replication can give rise to mutations.

ii) Understand how cystic fibrosis results from one of a number of possible gene mutations.

The second topic in Biology looks at cellular processes and also at genes and how changes in genes can affect health. The following questions will cover some of the key points needed to understand the topic.

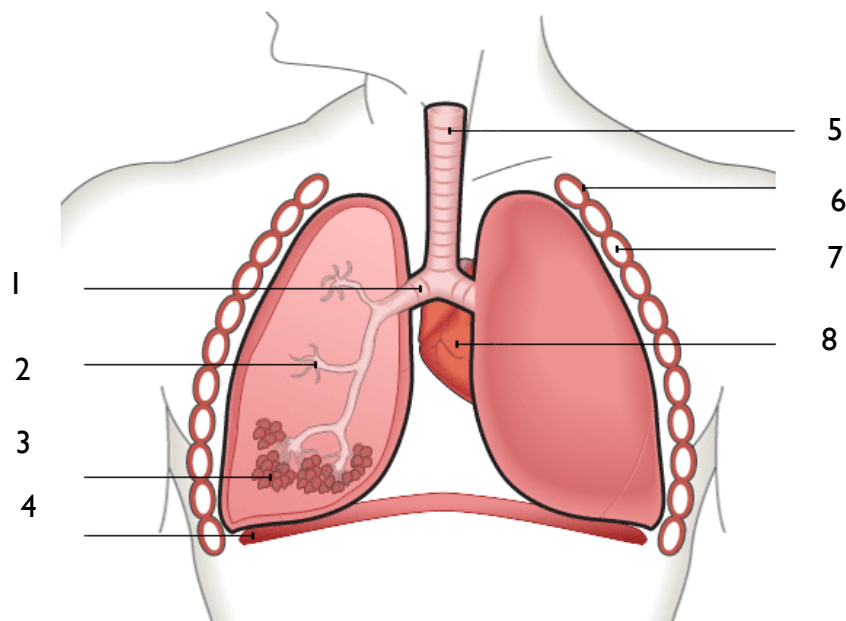
- I. Complete the table below to describe the three main methods of transport in a cell and add a diagram to illustrate your description.(9 marks)

Type of transport	Description of process with examples	Diagram
Diffusion		
Osmosis		
Active transport		

2. You will also study the structure of DNA in detail. In the space below summarise what you can remember about the structure of DNA using a diagram. (5 marks)

3. In discussing how genes affect health we look at cystic fibrosis in particular. One part of the body that is affected by cystic fibrosis is the lungs.

Label the diagram below to show the key structures found in the lungs. (8 marks).



State the function of each labelled part. (8 marks)

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Task 2 Research

You will also study the science behind the inherited disease cystic fibrosis.

Produce a summary page on cystic fibrosis, this could be handwritten on file paper or typed and printed out. You should include the following and use them as subtitles.

- **Cause of the disease**
- **Genetic basis**
Is the disease caused by a recessive or dominant gene? Explain these key words and use a Punnett square to illustrate your ideas.
- **The symptoms**
- **Treatments**
(include physical therapies, medications and potential future genetic advances)
- **Figures**
Current % or numbers of the UK population who are thought to suffer with the disease (and if this trend has changed over the last 10 years)

Keep your work concise and follow the order suggested above. Ensure the work is written in your **own words** (no copy & paste of text) and you include **diagrams and graphs** to support your research.

Task 3 Maths skills

All Biology exams include questions that target mathematics at Level 2 **or above**. Overall, a minimum of 10% of the marks across the three exams you sit will be awarded for mathematics at Level 2 **or above**.

Q1. The diagram shows a shrew, a small mammal.



Source: <http://museum2.utep.edu/archive/mammals/DDshrew.htm>

Different species of shrew have different mean body masses. An investigation was carried out to find the relationship between mean body mass and oxygen consumption during respiration.

The table below gives the results for five species of shrew.

Species of shrew	Mean body mass / g	Oxygen consumed during respiration / $\text{cm}^3 \text{g}^{-1} \text{h}^{-1}$
<i>Sorex cinereus</i>	2.5	10.8
<i>Sorex vagrans</i>	4.5	8.6
<i>Sorex montereyensis</i>	6.5	7.2
<i>Sorex sonomae</i>	11.5	5.2
<i>Blarina brevicauda</i>	20.0	4.0

(i) Calculate the oxygen consumed in one day by one *Sorex cinereus* shrew.

(2)

Answer cm^3

(ii) Explain why the oxygen consumption was measured per gram per hour.

(2)

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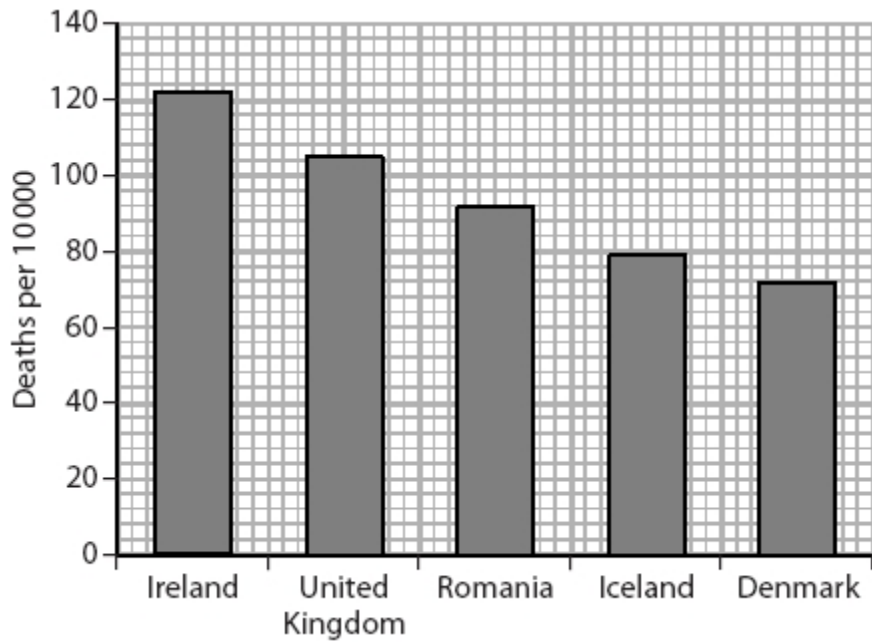
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(Total for question = 4 marks)

Q2. All organisms exchange gases with their environment.

The graph shows the death rates due to diseases of the respiratory system in some countries.



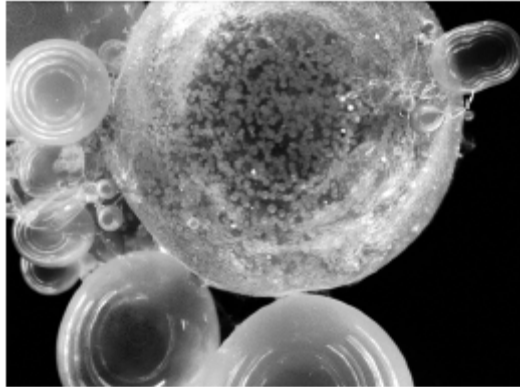
Calculate the probability of dying from a disease of the respiratory system in the United Kingdom.

(2)

Answer

(Total for question = 2 marks)

Q3. All organisms exchange gases with their environment. Sailor's eyeball (*Valonia ventricosa*) is a single-celled, spherical organism. One of these organisms can have a diameter of 1 cm to 4 cm.



The table shows the diameter, surface area and volume of different *Valonia ventricosa* cells.

Diameter / cm	1	2	4
Surface area / cm²	3.14	12.57	50.27
Volume / cm³	0.52	4.19	

(i) The volume of a sphere can be calculated using the following equation.

$$V = \frac{4\pi r^3}{3}$$

What is the volume of a cell with a diameter of 4 cm?

(1)

- A** 33.51 cm²
- B** 33.51 cm³
- C** 268.08 cm²
- D** 268.08 cm³

(Total for question = 1 mark)