

Name:

School:



TONBRIDGE SCHOOL

Scholarship Examination 2016

Science II – Physics, Chemistry and Biology

Wednesday, 27th April 2016

9.30 am

Time allowed: 1 hour 15 minutes

Answer all the Questions

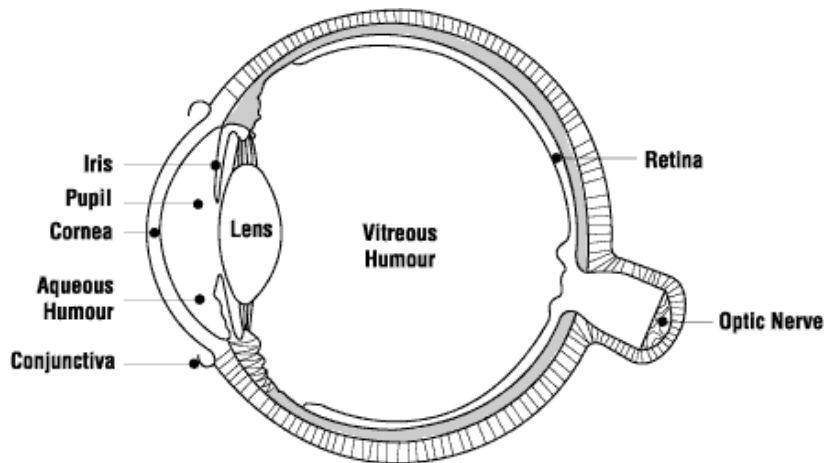
You may use a calculator

The entire paper is worth 60 marks and the number of marks for each question is shown in brackets.

Biology Section

1. All living organisms are made up of cells and many of these cells are specialised for particular functions.
 - a. In the space below draw a diagram of a specialised cell you have studied, label **three** parts and state how it is specialised to carry out its function. (4)

This diagram shows a cross section of the eye. The eye has many different layers and each layer contains different specialised cells.



- b. What evidence in the picture is there that the eye is an **organ**? (2)

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The iris at the front of the eye contains two sets of muscles, one set makes the pupil larger and another makes the pupil smaller.

c. What name is given to a set of muscles that work against each other in this way? (1)

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The cells in the cornea, at the front of the eye, need oxygen, but they get it in an odd way.

d. Name the process the cells need oxygen for. (1)

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e. How do cells in your body usually get oxygen? (1)

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f. Suggest why the cells at the front of the eye cannot get oxygen in the usual way and what the alternative method they actually use is. (3)

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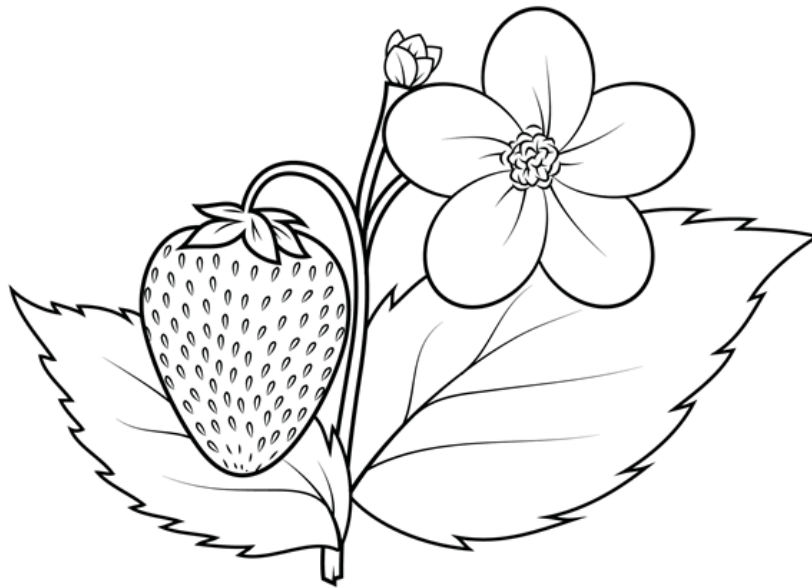
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[Total 12 marks]

2. Plants are often found at the bottom of food chains. They can create carbohydrates from simple compounds and then store this carbohydrate as starch.



- a. Write a **word** equation for the process plants use to make food (2)

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The plant in the picture (above) is a strawberry. Wild strawberries have much smaller fruits.

- b. State the name of the process farmers can use to create large strawberries from wild strawberries. (1)

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- c. Suggest **another** feature farmers might find advantageous in strawberries other than large fruit. (1)

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When farming it is important to stop other plants growing near your crops, so farmers will pull out weeds and might spray the crops with insecticide.

- d. Suggest **two** reasons that allowing weeds to grow could reduce the quality of a farmer's crop. (2)

First reason:

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Second reason:

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- e. If a farmer kills **all** the insects on a farm they may find that their crop of strawberries disappears completely. Suggest why, and refer to the picture in your answer. (2)

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[Total 8 marks]

End of Biology Section

Chemistry Section

3. This question is about diesel and petrol.

Diesel is mainly made up of a compound called dodecane.

Petrol is mainly made up of a compound called octane.



Diesel and petrol are both fossil fuels. Their combustion is well known to cause environmental pollution.

a. Name the two products of complete combustion of petrol. (2)

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b. State an environmental issue associated with the release of these products into the atmosphere. (1)

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c. Give one reason is it important that petrol is completely combusted in a car engine. (1)

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The main compound in diesel, dodecane, can be converted into octane using a reaction called cracking. In cracking, dodecane is passed over a heated catalyst. It breaks down into octane and butene.



Dodecane and octane are liquids at room temperature, butene is a gas.

d. In the list below, circle the type of change that best describes the conversion of dodecane into octane and butene: (1)

displacement; decomposition; reduction; neutralisation; evaporation;

- e. What is the expected mass of butene gas, assuming complete reaction and collection, if 10g of dodecane produces 8.5g of octane? (1)

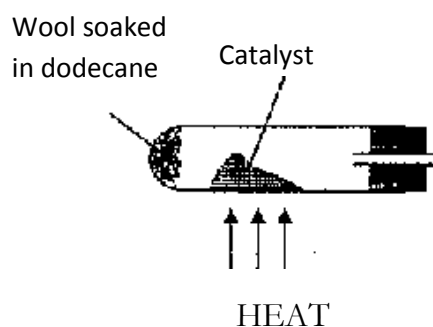
Answer: g

- f. Complete the diagram below, which shows how cracking could be performed in a school laboratory. (You will probably not have done this – have a go!)

Your answer should show:

- the hot gaseous products passing through a boiling tube surrounded by ice to collect the octane as a liquid
- the remaining butene passing out of the boiling tube and being collected by displacement of water in a test tube.

(3)



- g. What term is given to turning a gas into a liquid? (1)

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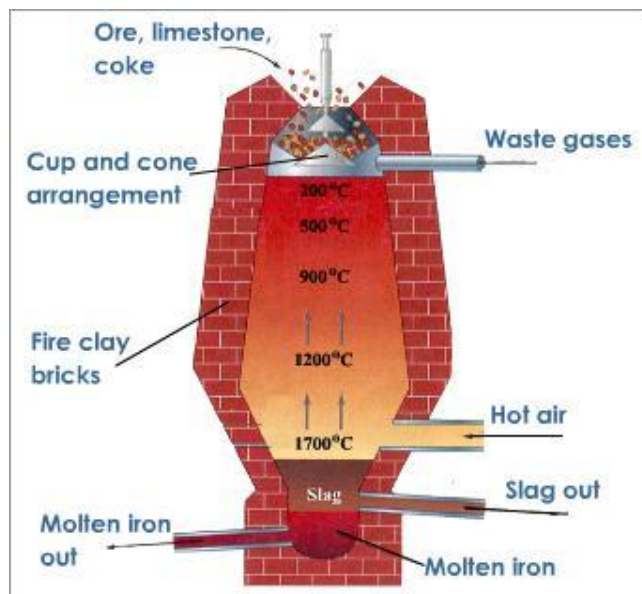
Dodecane and octane are members of the same chemical family, the alkanes. The chemical formula of dodecane is $C_{12}H_{26}$ and of octane is C_8H_{18} .

- h. Deduce the formula of the alkane containing 10 carbons in its formula. (1)

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[Total 11 marks]

4. This question is about the production of iron, which takes place in a blast furnace.



Read the information below, which gives details of the production of iron from its ore.

- The industrial production of iron requires four raw materials: iron ore, air, coke and limestone (a source of calcium carbonate).
- In the Blast Furnace the raw materials are heated and a sequence of reactions takes place to produce iron.
 - Reaction 1; Carbon + oxygen \rightarrow carbon monoxide.
 - Reaction 2; Iron ore + carbon monoxide \rightarrow Compound X
- At the same time, impurities in the ore, such as quartz sand, react with limestone to form a substance called slag.
 - Reaction 3; Quartz + Limestone \rightarrow Slag
- In the heat of the furnace the slag melts and floats on top of the molten iron. The molten iron has a density of around 7 g per cm³ and a melting point of 1540°C.

a. What is the chemical symbol for iron? (1)

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b. Deduce which of the raw materials the carbon in Reaction 1 comes from. (1)

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- c. Given that iron ore consists mainly of iron oxide, write a word equation to represent the reaction between iron ore and carbon monoxide. Include the real name of compound X. (2)

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- d. Calculate the volume occupied by 105 g of molten iron. (2)

Answer:

- e. Explain what happens to the volume of 105 g of molten iron when it cools down to room temperature. (2)

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- f. What can you say about the density of molten slag? (1)

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[Total 9 marks]

End of Chemistry Section

Physics Section

5. This question is about the motion of objects.

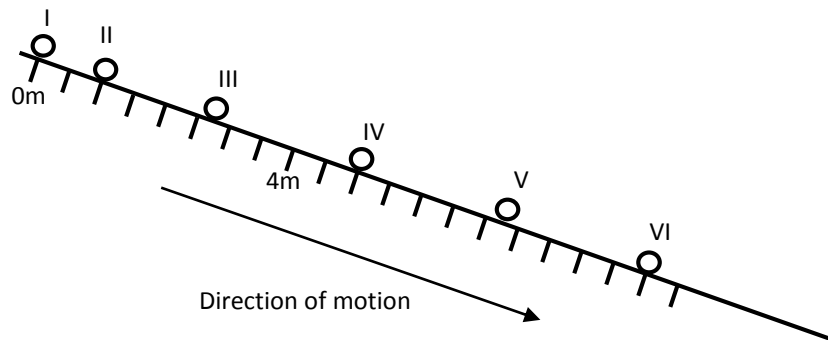
a. Write down **in words** the equation connecting speed, distance, and time. (1)

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b. A motorbike travels a steady speed of 15.3 m/s. Calculate the distance travelled by the vehicle in 15.4 s and give your answer to the nearest metre. (2)

Answer: m

The diagram below shows the position of a rolling ball as it travels down a slope. The ball took 0.5 s to travel from one position to the next.



c. How far did the ball travel from position I to position V? (1)

Answer: m

d. How long did the ball take to reach position V? (1)

Answer: s

e. Calculate the average speed of the ball as it rolls from position II to position IV. (2)

Answer: m/s

f. Describe and explain the changes in the motion of the ball between positions I and V. (3)

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g. After leaving the ramp the ball rolls across a horizontal but bumpy surface. With time the ball slows down. Suggest why this occurs. (2)

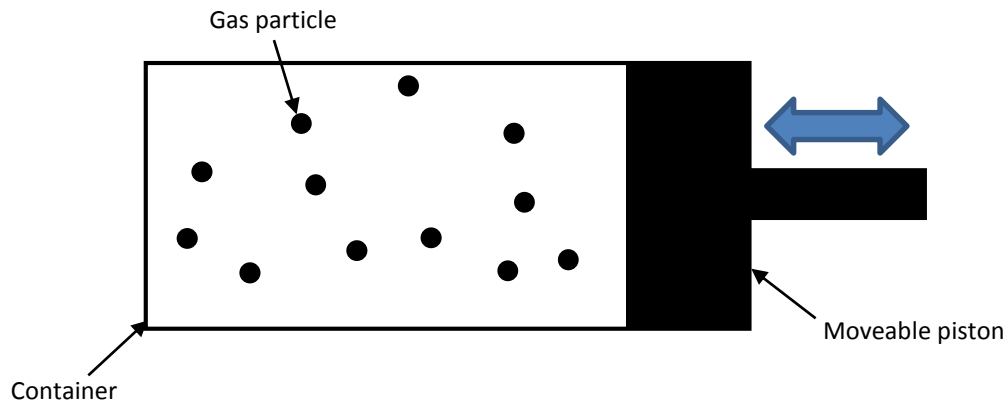
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[Total 12 marks]

6. When gas is put into a metal container as shown below, the particles that it consists of spread out throughout the volume available to it. The container has a piston that can move in or out and change the volume of the container.



a. Describe the motion of the particles in the gas. (1)

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b. Why do the gas molecules exert a force on the container walls? (2)

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c. If the piston was pushed into the container, what would happen to the force exerted by the gas on the container walls? Explain why. (2)

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- d. If the cylinder is now placed in an ice-filled coolbag, the piston moves inwards by itself. Explain the effect of temperature on the gas particles and, hence, the movement of the piston. (3)

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[Total 8 marks]

End of Physics Section

Now go back and check your answers!

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