

ENGINEERING SCIENCE 3
7100

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2015

ADVANCED LEVEL

Subject Title	ENGINEERING SCIENCE
Paper No.	3
Subject Code No.	7100

ONE AND A HALF HOURS

Answer ALL the questions.

You are reminded of the necessity for good English and orderly presentation in your answers.

All rough work should be done in your answer booklet.

You are allowed to use drawing instruments and scientific electronic calculators.

You will be supplied with a graph sheet.

Where necessary use the following data:

Speed of light in air, c	=	$3.0 \times 10^8 \text{ m s}^{-1}$
Acceleration due to gravity, g	=	9.8 m s^{-2}
Density of water, ρ_w	=	1000 kg m^{-3}
Density of mercury, ρ_{Hg}	=	13600 kg m^{-3}
Gas constant, R	=	$8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Planck's constant, h	=	$6.63 \times 10^{-34} \text{ J s}$
Stefan-Boltzmann's constant, σ	=	$5.7 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Relative atomic masses:		

$$C = 12; O = 16; N = 14; Ar = 40$$

Turn Over

SECTION A

Read the following passage and then answer the questions that follow:

An extract on the environment – “The Greenhouse Effect”

Source: General Chemistry Fifth Edition by Kenneth , W Whitten, pages 392, 393

During the last century, the increase in our use of fossil fuels has caused a significant rise in the concentration of carbon dioxide, CO_2 , in the atmosphere. Scientists believe that the concentration of atmospheric CO_2 could double by early in the 21st century, compared with its level just before the Industrial Revolution. During the last 200 years, the CO_2 concentration has increased by 25%.

Energy from the sun reaches the earth in the form of light. Neither CO_2 nor water vapor H_2O absorbs the visible light in sun light, so they do not prevent it from reaching the surface of the earth. However, the energy given off by the earth in the form of lower-energy infrared (heat) radiation is really absorbed by both CO_2 and H_2O (as it is by the glass or the plastic of the greenhouses). Thus, some of the heat the earth must lose to stay in thermal equilibrium can become trapped in the atmosphere, causing the temperature to rise. This phenomenon is called the greenhouse effect. The anticipated rise in average global temperature by the year 2050 due to increase CO_2 concentration is predicted to be 2 °C to 5°C.

An increase of 2 °C to 5°C may not seem like much. However, this is thought to be enough to cause a dramatic change in climate, transforming now productive land into desert and altering the habitats of many animals and plants beyond their ability to adapt. Another drastic consequence of even this small temperature rise would be the partial melting of the polar ice caps. The resulting rise in sea level, though only a few feet, would mean that water would inundate coastal cities. The earth's forest and jungles play a crucial role in maintaining the balance of gases in the atmosphere, removing CO_2 and supplying O_2 . The massive distribution for economic activities in heavily forested areas such as the Amazon rain forest in South America is cited as another long-term contributor to global environmental problems. World wide, more than three million square miles of once-forested land are now barren for some reason. Environmental scientists estimate that if even one quarter of this land could be reforested the vegetation would absorb 1.1 billion tons of CO_2 annually.

Even the most skeptical observers seem to agree that responsible stewardship of the planet requires that we do some things in a reasoned fashion to reduce production of greenhouse gases, primarily CO_2 and that this will involve decreasing our dependence on energy from fossil fuels.

Answer the following Questions

1. (a) What are fossil fuels? (2 marks)
 (b) Name two examples of fossil fuels. (2 marks)
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2. Suppose the C_nH_{2n} is the general formula of one of the components in a fossil fuel. Write the balanced equation for the combustion of C_nH_{2n} . (2 marks)
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3. If the CO_2 concentration today is 4 mg/m^3 , find its concentration 200 years ago. (3 marks)
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4. (a) What is the greenhouse effect? (2 marks)
 (b) Name three consequences of the greenhouse effect. (3 marks)
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5. Name three activities carried out by man using fossil fuels that increases the concentration of CO_2 in the environment. (3 marks)
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6. Explain how deforestation leads to the global environmental problem. (4 marks)
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7. Name three alternative sources of energy that will not produce greenhouse gases. (3 marks)
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SECTION B

8. Two engineering science students, A and B were determining the depth of an inaccessible chasm. They had at their disposal some stones, a rule and a stop watch.

Student A started by doing his measurements in air. He measured the time t for a stone to fall through a distance s .

He recorded the following data in Table 1 below.

Table 1

Distance, s/m						
Time, t/s	0.5	1.0	1.5	2.0	2.5	3.0

Table 1

- (a) (i) Show that the motion of the stone follows the equation

$$s = \frac{1}{2} g t^2$$
 (3 marks)
- (ii) Compute the values of s , in the Table 1 above. (2 marks)
- (iii) Use your values in the table to plot the distance fallen against time. (5 marks)
- (b) Student B used the results of student A to determine the depth of the chasm. He dropped a stone into the chasm and noted the time it took for him to hear the sound of the stone hitting the floor. He did six trials, and recorded the following times:
 3.71 s, 2.81 s, 2.71 s, 2.70 s, 2.80 s, 2.75 s.
- (i) Use the results of student B and your graph in Q 8 (a) to determine the depth of the chasm (4 marks)
- (ii) Suggest a reason why this value may be wrong. (2 marks)