PHYSICS 3
780

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2009

ADVANCED LEVEL

Subject Title	Physics
Paper No.	Paper 3
Subject Code No.	780

Two and a half hours

Answer all questions.

Section I of the paper is designed to be answered in one hour and Section II is designed to be answered in one and a half hours. You are advised to divide your time accordingly, and the invigilators should announce when one hour has elapsed.

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

In calculations you are advised to show all the steps in your working, giving your answers at each stage.

Non programmable calculators and formulae book may be used.

SECTION ONE

(One hour)

Read the following questions and answer the questions that follow

The energy crisis has been and would always be a topic for debate amongst scientists Bob H. an energy researcher in Mexico is currently working on a more benevolent source of energy which promises to be a great break through in portable electronics. When fully developed, the microfuel cells shall keep the mobile phone, laptops and other devices up for weeks at a time. Their goal in the coming years would be to build phone fuel cells that last for one month before a change can take place.

The reason for this dream is that the standard power sources used in today's portable devices have irritating limitations. Microfuel cells seem to be the best bet to the solution of the problem. It operates through the extraction of electrical energy from the reaction of hydrogen with oxygen to form water. Hydrogen is however cumbersome to store and carry around. This makes it awkward and totally impracticable in devices such as the mobile phone, where space is a necessary consideration. The standard solution has been to use a liquid fuel such as methanol and extract the hydrogen from it. But there are difficulties with this too. The "reforming" reaction that converts methanol and water into hydrogen and waste carbon dioxide requires a separate, bulky reaction vessel and works best at 250 ^{0}C

In recent years, researchers have developed a class of fuel cells known as "Direct Methanol fuels" DiviFC, which are now regarded as the breakthrough that will make miniaturisation possible. When tested, DMFC produces an output of about 40 watts for 8 hours on a single 125 millilitre ampoule of methanol.

It is believed that when economics of scale comes into play the price of cells would almost be as low as that of a Lithium ion battery of the same size.

Microfuel cells still have a long way to go. Distribution is a real hurdle. One of the most serious challenges is power density, which is essentially the output obtained per unit mass or volume. It is largely important in mobile devices because it determines the overall size and weight of the thing. The higher the power density, the smaller and lighter you can make your devices.

A typical Lithium -ion battery would produce about 150 watts hours per kilogram. So far fuel cells are of the size of an MTN credit card; Bob argues that when using an ampoule design, the methanol would diffuse into the cell through a porous surface. In this way, the waste water would then be drawn away by capillary effect. Putting fuel cells in Laptops is quite attractive. Laptops are usually notorious for their short battery life and the latest models incorporate power hungry features as the wireless internet access and brighter displays which are a serious power drain.

The challenges are enormous but there are plenty of incentives to overcome them, particularly with the invention of the third generation, 3a phones. Sceptics are still wondering whether the use of fuel cell portables electronics would be cost effective.

All major Japanese manufacturers including NEC, SONY, TOSHIBA are developing fuel cells for 3a phones which carry large amounts of data up to 10 times as fast as today mobiles, through high frequency signals. The changes in applications and the dangers, the cells phones would offer the society, can only be imagined and ever so with some amount of do not.

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1.   Explain the meaning of the following terms or phrase as used in the passage
   - (a)   portable electronics
   - (b)   irritating limitations
   - (c)   miniaturisation
   - (d)   cost effective   **(10 marks)**

2.   (i)   Why is hydrogen already posing a problem in portable electronics?
       (ii)   Show how the problem can be handled.   **(5 marks)**

3.   (i)   State three advantages of the fuel cells over the Lithium –ion batteries
       (ii)   Give four reasons why despite these advantages the fuel cells would still not completely replace the standard, or conventional source.   **(7 marks)**

4.   (i)   Why is power density a challenge that has to be taken seriously in the design of the fuel cells.
       • (ii)   Calculate the energy liberated by a 50 g fuel, if the fuel cell performance is 10 % that of Lithium –ion cell.   **(5 marks)**

5.   Name and explain one societal problem that has been caused by the proliferation of mobile phones in Cameroon.   **(3 marks)**

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SECTION TWO

(ONE AND A HALF HOURS)

READ THE FOLLOWING ACCOUNT OF AN EXPERIMENTAL INVESTIGATION AND ANSWER THE QUESTIONS THAT FOLLOW.

Atmospheric pressure P, varies with height, h, above sea level according to the equation.

$P = P_0 (1 - Kh)^n$ where $K = 2.26 \times 10^{-5}$ m^{-1}, P_0 and N are constants

The table below shows how the pressure P varies with h.

h/km	P/ kPa
2.0	78.5
3.0	69.3
4.0	60.9
5.0	53.4
6.0	46.7
7.0	40.6
8.0	35.2
9.0	30.4
10.0	26.2
11.0	22.4
12.0	19.1
13.0	16.2
14.0	13.7
15.0	11.5

6. a) Plot a graph of P on the vertical axis against h on the horizontal axis.

   b) Given that the gradient of the graph at any point is
       $S = -nKP_0 (1 - Kh)^{n-1}$
       Determine a value for n and P_0.   (16 marks)

7. Plot a suitable graph to obtain other values of n and P_0.

   Determine another value of n and P_0.   (11 marks)

8. Comment on the values of n and P_0 obtained in 6 and 7 above.   (3 marks)

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