Winchester College Election

SCIENCE

Theory Section

Tuesday 3rd May 2005

Time allowed: 45 minutes. Attempt BOTH questions.

Begin each question on a new sheet of ruled paper.

Spend equal times on each question.
Question 1

Begin a new sheet of ruled paper

Explain and discuss, using examples where possible, **FOUR** of the following points.

(a) It is possible to predict many chemical and physical characteristics of an element from its position in the periodic table alone.

(b) Many chemical reactions are associated with a perceived change in mass - indeed much early chemistry was elucidated in this way - yet mass is also known to be conserved in chemical reactions.

(c) Carbon monoxide and carbon dioxide can both be produced in the combustion of hydrocarbon fuels; one is largely non-toxic and the other highly toxic.

(d) Changes of state (i.e. gas, liquid, solid) can be explained in terms of the behaviour of the most simple particles that make up the substance.

(e) Aluminium is a more reactive metal than iron, yet iron is observed to corrode more quickly in air.

(f) When elements combine to form compounds they tend to react in well-defined and predictable proportions.

(g) Oxides can be classified as acidic, basic or neutral (or amphoteric).

(h) Carbon dioxide is blamed for warming the planet (via the greenhouse effect), yet it does not participate in any highly exothermic chemical reactions in the atmosphere.

(i) The electric current produced by batteries is the result of a chemical reaction.

(j) Carbon is considered to be a uniquely special element.

End of Question 1
Question 2

Begin a new sheet of ruled paper

Lactation is the secretion of breast milk for feeding newly born babies. It represents an additional energy burden for the mother. The following figures are derived from a report published by the Department of Health.

*Additional energy requirements for lactation*

<table>
<thead>
<tr>
<th>Month</th>
<th>Milk volume ml/d</th>
<th>Energy cost MJ/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>680</td>
<td>2.38</td>
</tr>
<tr>
<td>1-2</td>
<td>780</td>
<td>2.73</td>
</tr>
<tr>
<td>2-3</td>
<td>820</td>
<td>2.87</td>
</tr>
<tr>
<td>3-6</td>
<td>700</td>
<td>2.45</td>
</tr>
<tr>
<td>6 onwards</td>
<td>300</td>
<td>1.05</td>
</tr>
</tbody>
</table>

*(Dietary Reference Values for Food Energy and Nutrients for the United Kingdom, 1991)*

(a) Explain the units given by the Department of Health for ‘milk volume’ and ‘energy cost’. [2]

(b) Represent graphically the way in which milk volume changes with time. [4]

(c) Explain the pattern of data. [3]

(d) Describe how the energy needs of the foetus are met whilst it is in the uterus. [2]

(e) Suggest the dietary components present in breast milk and explain how the growing baby uses each of these components. [4]

(f) Suggest benefits of breast milk over commercially available substitutes. [3]

(g) Research suggests that, for a healthy expectant mother, very few changes need to be made to her diet. Suggest how the increased energy requirements during pregnancy could be met if the mother does not increase her energy intake. [2]

(h) Using the potato plant (*Solanum tuberosum*) and humans (*Homo sapiens*) as examples, suggest how the reproductive strategies of flowering plants differ from those of mammals. [5]

End of Theory Paper