CANDIDATE NAME


## CO-ORDINATED SCIENCES

0654/03
Paper 3 (Extended)
October/November 2008
2 hours
Candidates answer on the Question Paper.
No Additional Materials are required.

## READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES

Answer all questions.
A copy of the Periodic Table is printed on page 28.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use |  |
| :---: | :--- |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| Total |  |

This document consists of $\mathbf{2 5}$ printed pages and $\mathbf{3}$ blank pages.

1 Fig. 1.1 shows a blood capillary between alveoli in the lungs. The alveoli provide the gas exchange surface.


Fig. 1.1
(a) Describe what happens in the red blood cells as they pass through the capillaries in the lungs.
$\qquad$
$\qquad$
(b) White blood cells are able to move out of blood capillaries through tiny gaps in their walls. Suggest the function of the white blood cell in the alveolus.
$\qquad$
(c) (i) Describe how air is made to move into the lungs during inhalation.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(ii) Suggest why there are elastic fibres around the alveoli.
$\qquad$
$\qquad$
(d) Explain how the structures shown in Fig. 1.1 make the alveoli an efficient surface for gaseous exchange.
$\qquad$
$\qquad$
$\qquad$
(e) Describe how gas exchange takes place in the leaf of a plant.
$\qquad$
$\qquad$
$\qquad$

2 (a) A student is given the apparatus shown in Fig. 2.1.


Fig. 2.1
Describe as fully as you can, how the student would select from the apparatus provided, and use it to produce an electric current.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(b) Electric power is produced at power stations using generators.

A simple generator is shown in Fig. 2.2.


Fig. 2.2
(i) Explain why a current is induced in the coil when it rotates.
$\qquad$
$\qquad$
(ii) Explain why the current is at a maximum when the coil is horizontal, and at a minimum when the coil is vertical.

3 A student investigates the reaction between magnesium and dilute acid $\mathbf{Y}$.
Fig. 3.1 shows the metal being added to the acid contained in a test-tube, and also the same tube some time later.


Fig. 3.1
(a) (i) Name acid $\mathbf{Y}$.
$\qquad$
(ii) Describe and explain one observation which the student would have made during the reaction.
$\qquad$
(iii) The student noticed that, within a short time, the piece of magnesium completely reacted.

Predict and explain what would be observed if another small piece of magnesium were added to the solution in the tube shown on the right of Fig. 3.1.
$\qquad$
$\qquad$
$\qquad$
(b) Explain why a metal such as magnesium is a good conductor of electricity. You should draw a labelled diagram to help your explanation.
(c) Magnesium alloys are widely used in making parts for aircraft and racing car engines.

Table 3.1 shows some incomplete data about one type of magnesium alloy.

Table 3.1

| element | moles in 100 g of alloy | mass in 100 g of alloy $/ \mathrm{g}$ |
| :--- | :---: | :---: |
| magnesium |  |  |
| zinc | 0.055 | 3.575 |
| zirconium | 0.011 |  |

(i) Calculate the mass of zirconium in 100 g of the alloy. Zirconium is in Period 5 of the Periodic Table.

Show your working.
(ii) Calculate the mass and hence the number of moles of magnesium in 100 g of the alloy.

Show your working.

4 In the 1930s, farmers growing sugar cane in tropical parts of Australia had problems with insect pests, such as lacebugs, that ate the crop. Cane toads, Bufo marinus, were introduced from central America to try to solve the problem. Cane toads kill and eat insects and other small animals.

Fig. 4.1 shows a cane toad.


Fig. 4.1
(a) State one feature of a cane toad, visible in Fig. 4.1, which shows that it is an amphibian.
(b) Name the genus to which cane toads belong.
$\qquad$
(c) Use the information above to write a food chain involving cane toads. For each organism, state whether it is a producer or a consumer.
(d) The cane toads did help to control the insect population. However, they also ate many other small animals, including species of rare and endangered mammals. The cane toads have spread rapidly from the place to which they were introduced, into other areas of Australia. Cane toads have become a serious pest.

Biologists noticed that the cane toads that first arrived in a new area tended to have longer legs than the original cane toads that were introduced into Queensland. They thought that perhaps this happened because toads with longer legs could travel faster than other toads. They collected toads with different leg lengths, and measured the distance the toads travelled in 24 hours. The results are shown in Fig. 4.2.


Fig. 4.2
(i) Calculate the speed at which a toad with normal leg length travelled. Show your working.
(ii) Suggest why it could be an advantage to a cane toad to move into a new area where there are no other cane toads present.
$\qquad$
(iii) The researchers suggested that cane toads might be evolving into toads with longer legs. Using all the information provided, outline how this might happen.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

5 (a) Some countries use nuclear fission reactors to generate electricity.
(i) What is meant by the term nuclear fission?
$\qquad$
$\qquad$
(ii) State one advantage and one disadvantage of generating electricity using nuclear
advantage $\qquad$
$\qquad$
disadvantage $\qquad$
$\qquad$
(b) When nuclear fuel is used in a power station, ionising radiation is released.

Table 5.1 shows some information about three types of ionising radiation.
Table 5.1

| radiation | ionising power | deflection by electric field |
| :---: | :---: | :---: |
| alpha | very strong | small |
| beta | moderate | large |
| gamma | weak | none |

(i) Explain how alpha, beta and gamma radiations can be separated from each other by passing them across an electric field.

## reactors.

(ii) Explain why alpha radiation is the most ionising.
$\qquad$
$\qquad$
(iii) Describe the effect of ionising radiation on living things.
$\qquad$
$\qquad$
(iv) Why are radioactive sources stored in lead containers?

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6 Fig. 6.1 shows crude oil (petroleum) being extracted from sedimentary rock under the sea.


Fig. 6.1
(a) The oil shown in Fig. 6.1 is found only in rock layer $\mathbf{B}$ and not in layers $\mathbf{A}$ or $\mathbf{C}$.

Suggest the property of rock $\mathbf{B}$ which is different from rocks $\mathbf{A}$ and $\mathbf{C}$, and which allows it to contain oil.
$\qquad$
$\qquad$
(b) Crude oil is a mixture of different hydrocarbon molecules. A typical hydrocarbon molecule is shown in Fig. 6.2.
hydrocarbon molecule


Fig. 6.2
Write the graphical (displayed) formula of the hydrocarbon shown in Fig. 6.2, and explain whether it is an alkane or an alkene.
$\qquad$
(c) Fig. 6.3 shows a simplified diagram of an important industrial process involving hydrocarbons.


Fig. 6.3
(i) Name the process shown in Fig. 6.3.
$\qquad$
(ii) Suggest a process which could be used to separate the mixture of alkanes and alkenes.
(iii) A research chemist is investigating two catalysts, $\mathbf{P}$ and $\mathbf{Q}$, for use in the process shown in Fig. 6.3.

Describe a simple chemical test for alkenes. Suggest how the chemist could use this test to discover which catalyst, $\mathbf{P}$ or $\mathbf{Q}$, produces a mixture containing the larger amount of alkenes.
$\qquad$
$\qquad$
$\qquad$
$\qquad$

7 Fig. 7.1 shows the female reproductive system.


Fig. 7.1
(a) Name the structures labelled A, B, C and D.

A $\qquad$
B $\qquad$
C $\qquad$
D
(b) Fig. 7.2 shows how the thickness of the uterus lining changes during the menstrual cycle.


Fig. 7.2
(i) Suggest the date on which menstruation began.
(ii) Suggest the date on which ovulation (the release of an egg from an ovary) occurred.
(c) AIDS can be transmitted from one person to another during sexual intercourse. Explain how this transmission can take place.
$\qquad$
$\qquad$
(d) Humans, like all mammals, use internal fertilisation, whereas fish use external fertilisation.
(i) Explain what is meant by external fertilisation.
$\qquad$
$\qquad$
$\qquad$
(ii) Explain why external fertilisation is used only by animals that reproduce in water.
$\qquad$
$\qquad$
(iii) Mammals produce only a few eggs at a time, whereas fish produce thousands. Suggest why.
$\qquad$
$\qquad$
$\qquad$

8 An airline passenger enters an airport.
(a) He buys some hot food at the restaurant and carries it away in a polystyrene container.

Explain why a polystyrene container is used to keep food hot.
$\qquad$
(b) He then moves up an escalator (moving staircase) as shown in Fig. 8.1.


Fig. 8.1
(i) The passenger weighs 900 N . Calculate the work done lifting the passenger a vertical distance of 6 m up the escalator.

State the formula that you use and show your working.
formula
working
(ii) State the potential energy the passenger has gained when he reaches the top of the escalator.
(c) The passenger places three pieces of luggage onto a conveyor belt as shown in Fig. 8.2.


Fig. 8.2

Each piece of luggage has a different mass.
mass of $\mathbf{A}=12 \mathrm{~kg}$
mass of $\mathbf{B}=15 \mathrm{~kg}$
mass of $\mathbf{C}=22 \mathrm{~kg}$
(i) What is the momentum of the luggage before the conveyor belt starts to move?

Explain your answer.
$\qquad$
$\qquad$
(ii) When the conveyor belt is switched on, the luggage moves at a constant speed of $0.5 \mathrm{~m} / \mathrm{s}$.

Which piece of luggage $\mathbf{A}, \mathbf{B}$ or $\mathbf{C}$ has the most momentum?
Explain your answer.
$\qquad$
$\qquad$
(iii) At one point the conveyor belt turns left. The luggage on the belt continues to move at a constant speed.

Does the momentum of the luggage change as it turns left on the conveyor belt?
Explain your answer.
$\qquad$
$\qquad$
(d) Radar uses microwaves with a frequency of about $10000 \mathrm{MHz}\left(10^{10} \mathrm{~Hz}\right)$. A short pulse is sent from a transmitter, reflected by an aircraft and picked up by a receiver next to the transmitter.
(i) Explain the meaning of the term frequency.
$\qquad$
$\qquad$
(ii) Microwaves travel at $300000000 \mathrm{~m} / \mathrm{s}\left(3 \times 10^{8} \mathrm{~m} / \mathrm{s}\right)$. Calculate the wavelength of the microwaves.

State the formula that you use and show your working.
formula
working
(iii) Radio signals are electromagnetic waves. They can be either digital or analogue. State the difference between these two terms.
$\qquad$
$\qquad$
$\qquad$
(e) A large crane is being used to build a new terminal building at the airport. The crane in Fig. 8.3 is balanced.


Fig. 8.3
(i) Calculate the moment of the load about the supporting tower of the crane.

State the formula that you use and show your working.
formula
working
(ii) Calculate the distance of the crane's counterbalance from the crane's supporting tower.

Show your working.

9 Fig. 9.1 shows the apparatus and substances used by a student to make an electrical cell.


Fig. 9.1
(a) Suggest a compound which the student could dissolve in water to make the electrolyte. Explain your answer briefly.
$\qquad$
$\qquad$
(b) The student knows that the electrode made from the more reactive metal is the negative electrode of the cell.

The student has three other electrodes made of unknown metals $\mathbf{X}, \mathbf{Y}$ and $\mathbf{Z}$. The results of experiments involving all five metals are shown in Table 9.1.

Table 9.1

| experiment | negative electrode | positive electrode | cell voltage / volts |
| :---: | :---: | :---: | :---: |
| 1 | zinc | copper | 1.1 |
| 2 | $\mathbf{X}$ | copper | 2.7 |
| 3 | $\mathbf{Y}$ | copper | 1.5 |
| 4 | $\mathbf{X}$ | $\mathbf{Z}$ | 3.2 |

(i) Use the results shown in Table 9.1 to place the metals in order of reactivity. Copper has already been placed in position.
$\qquad$ (most reactive)
$\qquad$
$\qquad$
copper
............................................................................ (least reactive)
(ii) State and explain briefly which one of the metals above has atoms which change into ions most easily.
$\qquad$
$\qquad$
(c) Copper is a transition metal which forms two oxides. The chemical formulae of these oxides are:

$$
\begin{array}{ll}
\mathrm{Cu}_{2} \mathrm{O} & \text { copper(I) oxide } \\
\mathrm{CuO} & \text { copper(II) oxide }
\end{array}
$$

The formula and electrical charge of an oxide ion is $\mathrm{O}^{2-}$.
Deduce the difference between the copper ion in copper(I) oxide and that in copper(II) oxide. Show how you obtained your answer.
$\qquad$
$\qquad$
$\qquad$
(d) Zinc can be obtained industrially by the electrolysis of concentrated zinc sulphate solution which contains zinc ions, $\mathrm{Zn}^{2+}$.

Describe and explain what happens to zinc ions in the solution in order to convert them into zinc atoms.
$\qquad$
$\qquad$
$\qquad$

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DATA SHEET
The Periodic Table of the Elements


The volume of one mole of any gas is $24 \mathrm{dm}^{3}$ at room temperature and pressure (r.t.p.). publisher will be pleased to make amends at the earliest possible opportunity.

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