**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# MARK SCHEME for the May/June 2011 question paper

# for the guidance of teachers

## 0654 CO-ORDINATED SCIENCES

**0654/31** Paper 3 (Extended Theory), maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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**1** **(a)** **(i)** hot water rises / cold water sinks / hot water stays on top of cold water ;
ref. to convection ;
hot water less dense / cold water more dense ; [m

**(ii)** 5000 J / 5 kJ ; [1]

**(iii)** energy = shc × mass × temperature change (or rearranged) ;
mass = 280 kg or 280 000 g ***and*** temperature change = 30 ;
energy = 36 000 000 J **or** 2 × 5 × 60 × 60 ; (allow ecf from **(ii)**)
correct substitution into formula ; (allow ecf)
4286 J / kg °C ; (allow 4290 or 4300) (allow ecf) [max 4]

**(b)** (large current produces) stronger electromagnet ;
(strong enough to) attract iron (on pivot) ;
contacts break ; [3]

**[Total: 10]**

**2** **(a)** chlorine ;
glass ; [2]

**(b)** **(i)** *any two of:* copper, sodium chloride, glass ; [1]

**(ii)** argon **and** glass ; [1]

**(iii)** attractions between molecules, are weak / require little energy to break ;
bonds within molecules, are strong / require much energy to break ;

(energy from) heating sufficient to separate molecules ;
(energy from) heating insufficient to break chemical bonds ;

evaporation requires (only) weak forces between molecules to be overcome ;
appearance of, hydrogen / carbon, requires chemical bonds to be broken ; [max 3]

**(c)** **(i)** reaction is reversible ; (**not** 'the equation is reversible' or 'it is reversible') [1]

**(ii)** increases reaction rate ;
increases surface area (of catalyst) ;
greater collision frequency / less catalyst required / improves catalyst efficiency / avp ; [3]

**(iii)** nitrogen is, unreactive / stable / inert ;
nitrogen, is strongly bonded / has triple bond ;
much energy needed to break molecule / start reaction ;

link high temperature to kinetic energy of molecules ;
link, pressure / high temperature, to high collision frequency ; [max 3]

**[Total: 14]**

**3** **(a)** label to cell membrane ;
label to cytoplasm ;
label to nucleus ; [m

**(b)** testis ; [1]

**(c)** **(i)** single sperm quantities would be too small to measure ; [1]

**(ii)** respiration ;
oxygen combined with sugar to release energy ; [2]

**(iii)** (formula) (power = ) work ÷ time **or** energy ÷ time ;
(substitution) 164 / 60 × 60 ;
(answer + unit) 0.046 / 0.05, W **or** J $s^{-1}$ ; [3]

**(iv)** pointed (head) / small head / streamlined ;
reduces, friction / drag / resistance of the water ;
idea that less (forward-acting) force required ; [max 2]

**(d)** fertilisation ;
nuclei fuse ;
form a zygote ; [max 2]

**[Total: 13]**

**4** **(a)** **(i)** electrons ; [1]

**(ii)** negative ; [1]

**(iii)** electrons / charged particles, accumulate on screen ; (**not** protons or ions) [1]

**(iv)** *any two for 1 mark*:
length,
cross sectional area / diameter / thickness / width,
resistivity / conductivity / material,
temperature ; [max 1]

**(b)** a device that processes, information / electrical signals ; [1]

**(c)** **(i)** heat / thermal ; [1]

**(ii)** increase temperature / air is heated / air rises / convection current ; [1]

**(iii)** efficiency = useful energy output / energy input **or** = 100/300 ;
= 33 (%) ; [2]

**[Total: 9]**

**5** **(a)** in **B** / not in **A** or **C**, because air / oxygen and water are present **or** air and water are needed for rusting ;
no water in **A** **and** no air / oxygen in **C** ;

**(b)** **(i)** carbon ; [1]

**(ii)** regular structure (of iron) disrupted / atoms are of different sizes ;
(iron) atoms do not so easily slip past one another ; [2]

**(c)** **(i)** saturated – only single bonds **and** unsaturated – contain double / multiple bonds;
double bonds are between carbon atoms ; [2]

**(ii)** double bonds become single and monomers link together ;
to form chains ; [2]
(diagram showing at least three symbols linked by single bonds scores both marks)

**[Total: 9]**

**6** **(a)** **(i)** reflex (action) ; [1]

**(ii)** as electrical impulse ;
along, nerves / neurones / nerve cells ;
correct ref. to sensory / motor, neurone ;
correct ref. to central nervous system / brain ; [max 3]

**(b)** grinding / crushing ;
increase surface area of food ;
idea of easier access for enzymes ; [3]

**(c)** **(i)** catalyst ;
protein ;
speeds up / controls, (metabolic) reactions ; [max 2]

**(ii)** breaks down / digests, starch ;
to, sugar / maltose ;
so that it can be absorbed ; [max 2]

**(iii)** pancreas ;
duodenum / small intestine ; [2]

**[Total: 13]**

**7** **(a)** **(i)** ($\lambda$ =) v / f **or** v = f × $\lambda$ ;
300 000 000 / 10 000 000 000 = 0.03 m ;

**(ii)** (distance =) speed × time ;
= 300 000 000 × 0.000 027 = 8100 m so distance = 4050 m ; [2]

**(b)** (KE = ) ½ $mv^2$ ;
= ½ × 140000 × 100 × 100 = 7 × $10^8$ J ; [2]

**(c)** **(i)** (deceleration =) change in velocity / time ;
(= 85/40 =) 2.125 m / $s^2$ ; [2]

**(ii)** suitable axes and scales ;
straight line ;
from 85 m / s at **t** = 0 to 0 m / s at **t** = 40 ; [3]

**[Total: 11]**

**8** **(a)** lilac coloured flame shows potassium (feldspar) / yellow flame shows sodium (feldspar); [1]

**(b)** total charge of positive ions = total charge of negative / total negative needs to be 4 – ;
so each carbonate must be 2 – ; [2]

**(c)** **(i)** ($M_r$ dolomite is) 40 + 24 + (12 + 16 × 3) / 184 ;
moles = mass ÷ $M_r$ / moles = 1.84 ÷ 184 ; (allow ecf)
= 0.01 ; [3]

**(ii)** 0.02 ; (allow ecf from **(i)**) [1]

**(d)** **(i)** calcium chloride **and** magnesium chloride ; [1]

**(ii)** $MgO + 2HCl \longrightarrow MgCl_2 + H_2O$ ;;;
(one mark for each correct *product* formula and one mark for balancing) [3]

**[Total: 11]**

**9 (a) (i)** jointed legs ;

**(ii)** six legs / body in three parts / head, thorax and abdomen / one pair of antennae ;

**(b)** ref. to digestion / absorption (in dung beetle) ;
ref. to respiration (in dung beetle or in decomposers) ;
carbon dioxide, into air / breathed out ;
carbon dioxide absorbed by plant ;
carbon dioxide used in photosynthesis (in plant) ; [max 3]

**(c) (i)** nitrates absorbed by plant roots ;
used for making proteins ;
proteins used for making new, cells / tissues ; [max 2]

**(ii)** fewer, nitrates / fertilisers, to leach into waterways ;
less eutrophication ;
less growth of algae ;
fewer bacteria in waterways ;
more oxygen in the water ;
so organisms that need oxygen / fish, can survive ;
less artificial fertiliser manufactured so less energy used ; [max 3]

**[Total: 10]**