**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# MARK SCHEME for the October/November 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.

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**1 (a) (i)** arrow going from right to left ; [1]

**(ii)** central nervous system / spinal cord / brain ; [1]

**(iii)** (**A**)
carries / transmits, impulses / electrical signals / action potentials ;
(very) long ;
idea of connecting central nervous system with distant part of body ;
myelin speeds up (impulse / transmission) ; [max 2]

(**B**)
connect to, another cell / organ ;
e.g. muscle / gland / effector ;
passes on, impulse / electrical signal / action potentials ;
idea that branches make many contact points ; [max 2]

**(b) (i)** stores / contains, information / instructions ;
on making proteins ;
idea of hereditary material ; [max 2]

**(ii)** twice as much (in motor neurone) ; [1]

**[Total: 9]**

**2 (a) (i)** 0.5 waves per second / 0.5 Hz ; [1]

**(ii)** longitudinal – wave motion is in same direction as disturbance of medium ;
transverse – wave motion at right angles to disturbance of medium ; [2]

**(b)** (KE =) ½ $mv^2$ ;
= ½ × 50 × 12 × 12 = 3600 J ; [2]

**(c) (i)** no – weight is determined by gravitational attraction of a mass / gravity is the same at both points ;
**OR**
yes – weight is determined by gravitational attraction of a mass but this depends on height / distance between mass and centre of gravitational force ; [max 1]

**(ii)** KE will be greater because, more potential energy converted into KE / has been accelerating for longer / his speed is greater ; [max 1]

**(d)** energy = mass × shc × change in temperature ;
= 50 000 × 4 200 × 5 ;
= 1 050 000 000 J ; [3]

**[Total: 10]**

**3** **(a)** **(i)** speeds up reactions / provides lower activation energy route ; [1]

**(ii)** reaction (to make gases) is reversible ;
so reactants can never be fully used up / some product changes back to reactants / some gases pass through without reacting ; [2]

**(iii)** $2\ SO_2 + O_2 \rightleftharpoons 2\ SO_3$ ; (or correct multiple) [1]

**(iv)** sulfur dioxide ; [1]

**(b)** symbols shown in correct atoms ;
three bond pairs around central atom ;
lone pair correctly shown and no others ; [3]

**(c)** **(i)** calculate $M_r$ of ammonium nitrate = (14 × 2) + (1 × 4) + (16 × 3) / 80 ;
calculate mass of 0.1 moles = 0.1 × 80 = 8 g ; [2]

**(ii)** $NO_3^-$ ;
reference to charge balance given 1:1 ratio of ions ; [2]

**[Total: 12]**

**4** **(a)** conduction from filament to filament support / gas ;
radiation from filament (to the materials of the lamp) ;
convection of the (noble) gas ; [3]

**(b)** (60 – 54) ÷ 60 ;
= 10 % ; [2]

**(c)** **(i)** decreases ;
to constant (minimum) value ; [2]

**(ii)** 0.2(0) A ; [1]

**(iii)** power = voltage × current ;
230 × 0.20 = 46 W ; [2]

**(d)** 1/R = 1/R1 + 1/R2 ;
= 1/1000 + 1/2000 ;
R = 2000/3 = 666.7 Ω ; [3]

**[Total: 13]**

**5 (a) (i)** carbon ;
elements contain one type of atom / carbon is listed in the Periodic Table ;
compounds contain more than one, type of atom / element (bonded) ; (reject 'mixed') [3]

**(ii)** (both have a) giant structure / or good attempt to describe ;
so large numbers of bonds to break (which needs energy) ;
(all these) bonds are strong ; [max 2]

**(iii)** diamond is harder / has stronger bonds, than sapphires / rubies ; [1]

**(b) (i)** the idea of attraction between opposite charges ; [1]

**(ii)** $Al^{3+}$ gain and $O^{2-}$ lose electrons;
$Al^{3+}$ gains three and $O^{2-}$ loses two electrons ;
some relevant maths ; [3]
(e.g. so if six electrons then number of Al atoms is 6 ÷ 3 = 2)

**[Total: 10]**

**6 (a)**

| enzyme | one site of production | substrate | product |
|---|---|---|---|
| **amylase** | salivary glands | **starch** | **maltose** |
| **protease / trypsin / pepsin** | **stomach / pancreas** *(see note below)* | **proteins** | amino acids |
| **lipase** | pancreas | **fats / lipids** | fatty acids and glycerol |

*note: if protease given, allow **either** stomach or pancreas*
*if trypsin, **must** be pancreas*
*if pepsin, **must** be stomach*
one mark for any two correct ;;;; [4]

**(b)** villi ;
very long / coiled ;
increased surface area ;
good blood supply / good capillary system ;
has thin wall ; [max 2]

**(c) (i)** hepatic portal vein ; [1]

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

**(iii)** kidneys ; [1]

**(d) (i)** if glucose, cells would take up water by osmosis ;
may burst ; [2]

**(ii)** for energy ;
respiration ;
glucose oxidised / glucose combined with oxygen ;
for movement / other named use of energy ; [max 3]

**[Total: 14]**

**7 (a)** working may be shown on graph / idea of area under graph ;
(½ × 5 × 8) + (15 × 8) + (½ × 5 × 8) ;
= 160 m ; [3]

**(b)** force = mass × acceleration ;
= 70 × 1.5 = 105 N ; [2]

**(c)** work = power × time ;
= 600 × 5 = 3000 J ; [2]

**(d)** heat transferred into (water) particles (from surroundings) ;
(water) changes from liquid to gas ;
ref. attraction between particles in the liquid ;
fastest moving / more energetic, particles escape ;
(escape) at surface / ref. to process happening at temperature below boiling point ;
average energy of rest of particles reduced / heat removed from liquid ; [max 3]

**[Total: 10]**

**8 (a)** (**C**) high density and (high) electrical conductivity ; [1]

**(b) (i)** delocalised electrons / sea of electrons / the outer shell electrons ; [1]

**(ii)** diagram shows atoms of two different sizes ;
words or diagram imply layer structure disrupted ;
atoms of different size prevent layers of the other atoms from sliding ;
the idea that more force needed to move layers / atoms ; [max 3]

**(c)** (**X**) the idea that cell voltage is related to relative metal reactivity ;
the idea that the greater the difference in reactivity the greater the voltage / the reactivity difference between Cu and Zn is greater than between Cu and Sn ; [2]

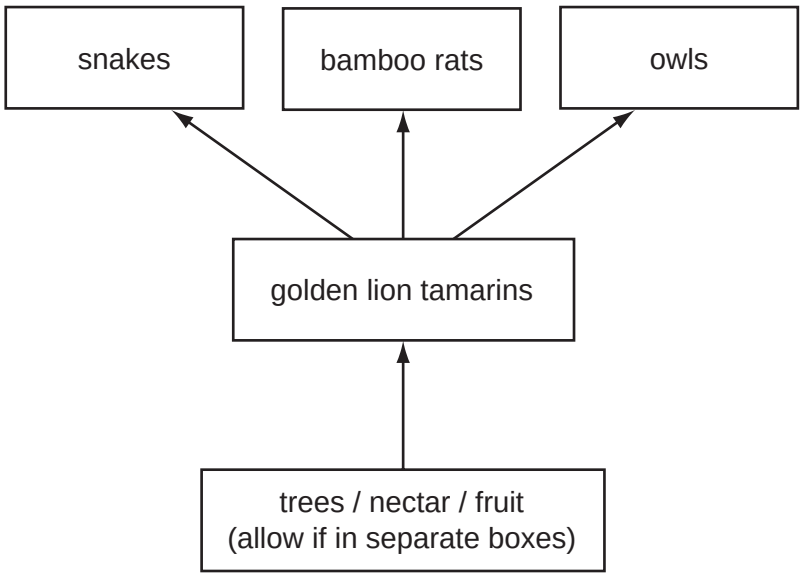
**(d) (i)** $2CO + 2NO \longrightarrow 2CO_2 + N_2$ (formulae + balanced) ;; [2]
(allow one mark for $CO + NO \rightarrow CO_2 + N$)

**(ii)** reference to increased rate of reaction ; [1]

**(iii)** greenhouse effect / global warming / climate change ;
much carbon dioxide (in exhausts) / carbon dioxide not reduced by converters / carbon dioxide made in converter ; [2]

**[Total: 12]**

**9 (a) (i)**




plants and tamarins connections correct ;
all three predators in separate boxes and with connections to tamarins correct ;
all arrows in right direction ; [3]

**(ii)** energy is lost along the food chain ;
ref. to one way in which energy is lost ;
idea that there is less energy for, top predators / at end of food chain ; [2]

**(b) (i)** fewer faeces further from tree / v.v. ;
furthest distance from tree is 400 m ;
figures quoted, e.g. 31% of faeces deposited within 50 m of tree ; [max 2]

**(ii)** faeces provide nutrients for, young plants / seedlings (**not** seeds) ;
less competition (for seedlings) away from parent tree ;
example of factor competed for (e.g. light, water, soil nutrients) ;
help to colonise new areas ; [max 3]

**[Total: 10]**