

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0654 CO-ORDINATED SCIENCES

0654/31

Paper 3 (Extended Theory), maximum raw mark 120

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) blast furnace ; [1]
- (b) iron oxide / iron(III) oxide / Fe_2O_3 ; [1]
- (c) magnesium loses electrons and sulfur gains electrons ;
reference to loss or gain of two electrons ;
reference to acquisition of complete outer shells ; [max 2]
- (d) $\text{Mg} + \text{S} \rightarrow \text{MgS}$; [1]
- (e) it is an ionic compound ;
strong attraction between ions / opposite charges attract (strongly) ;
much (thermal) energy needed to separate ions ; [max 2]
- [Total: 7]**

- 2 (a) diploid ; [1]

(b) (i)

parents

phenotypes

female

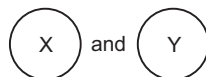
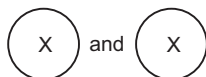
male

sex chromosomes

XX

XY

gametes



chromosomes and phenotypes of offspring

		male gametes	
		X	Y
female gametes	X	XX female	XY male
	X	XX female	XY male

ratio

.....1:1.....

gametes correctly shown: X, (X), X, Y ;
offspring chromosomes correctly shown ;
gametes shown correctly in punnet square ;
1:1 / 2:2 or 50/50 ;

[4]

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(ii) X sperm less viable / swim slower / AVP / random chance ; [1]

(c) (i) as temperature increases percentage of females increases ; [1]

(ii) 29 (°C) ; [1]

(iii) increased temperature activates, genes / enzymes, / kills males / AVP ; [1]

(iv) more females would hatch / ORA ;
reduced fertility of the population / owtte ; [2]

[Total: 11]

3 (a) (i) 8.8 (A) ; [1]

(ii) $R = \frac{V}{I}$;
 $= \frac{12}{4} = 3$;
 Ω / ohms ; [3]

(b) (P=) $V \times I$;
 $= 12 \times 4 = 48$ (W) ; [2]

(c) (as temperature increases) **kinetic** energy / velocity of molecules / particles / atoms increases ;
increased force / energy of collisions ;
increased frequency of collisions ;
(collisions with) walls / surface of tyre ; [max 3]

[Total: 9]

4 (a) (a) movement of sucrose / sugars / amino acids ;
in phloem ; [2]

(b) (i) arrow drawn going upwards, in xylem vessel ; [1]

(ii) X at / near the top of the diagram ; [1]

(c) transpiration / evaporation (from leaves) ;
causing a tension / 'pull' (in the xylem) ;
creates water potential gradient ;
and water molecules are cohesive ; [max 3]

(d) nitrate / magnesium / any correct named mineral ion ; [1]

[Total: 8]

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- 5 (a) (i) hydrogen ; [1]
- (ii) greater than 2 but less than 7 ;
some of the acid has reacted/been used up / acid concentration is lower /
lower concentration means higher pH ; [2]
- (b) (i) 18 (°C) ; [1]
- (ii) copper does not react with dilute acid / there is no reaction ; [1]
- (iii) E ;
thermal energy has been converted into chemical energy / reference to takes
in heat energy / thermal energy from the surroundings ;
shown by reaction being endothermic / temperature decrease ; [3]
- (c) *[answers must relate answers to the test-tubes or materials]*
in tube **A** the metal has 'different' surface area / greater degree of division ;
(metal in) tube **A** magnesium is more reactive than zinc / or metal in **A** more
reactive ;
reaction in **A** is more exothermic **OR** higher temperature produces higher rate ; [max 2]

[Total: 10]

- 6 (a) travel at same speed (3×10^8 m/s) ;
travel in a vacuum / OR A ;
transverse waves ; [2 max]
- (b) (i) reflection shown and angles approximately correct ; [1]
- (ii) e.g. (non-surgical) internal investigations / optical fibres passed into / inside
body ; [1]
- (c) (i) *lid* – prevent (heat loss) by convection / evaporation ;
cork mat – is an insulator / prevents conduction ; [2]
- (ii) can **B** / dull / black surfaces are better absorbers ;
OR
can **A** / shiny / silver surfaces are worse absorbers (reflect heat) ; [max 1]
- (d) (i) evaporation occurs at any temperature / boiling only occurs at the boiling
point of a liquid ;
evaporation – only most energetic particles can escape from surface / boiling
– all particles have enough energy to escape ; [2]
- (ii) (thermal energy transferred / heat) = $mc\Delta T$;
= $32000 \times 450 \times 1500$;
= 2.16×10^{10} J = 2.16×10^7 kJ ; [3]

[Total: 12]

Page 5	Mark Scheme	Syllabus	Paper
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- 7 (a) (i) anaerobic ;
respiration ; [2]
- (ii) glucose → lactic acid ; [1]
- (b) 32 (seconds) ; [1]
- (c) (i) lactic acid production is slower/ decreases ;
because blood supplies more oxygen/ less need for anaerobic respiration/
more aerobic respiration ; [2]
- (ii) lactic acid removed faster ;
because more oxygen to convert it to CO₂/ more (lactic acid) is
oxidised etc. ; [2]
- (d) to absorb more oxygen (into blood/ cells) ;
idea of oxygen debt ;
the extra oxygen is being used for breakdown of lactic acid/ oxidises the
lactic acid ; [max 2]
- (e) *produce less, (no mark)*
because better oxygen supply ; [1]
- [Total: 11]**
- 8 (a) (i) (ionising) radiation constantly present in the natural environment/
surroundings of the Earth (which is emitted by natural and artificial
sources) ; [1]
- (ii) 800 (cpm) ; [1]
- (iii) evidence of using background radiation 100, e.g. starting at 800
(*max 2 marks if this not shown*) ;
3 half-lives (or correct use of 3 in the calculation) ;
60 (days) ; [3]
- (iv) *number of protons:* 98
number of neutrons: 155
number of electrons: 98 ; [1]
- (v) α - loses 2 protons and 2 neutrons ;
β - proton gain, neutron loss ; [2]
- (b) (i) 25 000
230
step down
smaller (allow decreases)
decreases (allow smaller)
(*all five correct: 2 marks, four correct: 1 mark*) ;; [max 2]

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(ii) (efficiency =) $\frac{\text{energy output}}{\text{energy input}}$;
 $= 100 \times \frac{450}{500} = 90\%$; [2]

[Total: 12]

9 (a) (i) ethane and ethene ;
 contain only hydrogen and carbon ; [2]

(ii) (ethene)
 contains (C to C) double bond / does not contain maximum possible
 hydrogen ; [1]

(iii) orange / brown solution decolourised ; (reject red) [1]

(b) (i) *any two from:* solvent / fuel / in drinks / other correct ;; [max 2]

(ii) water ; (allow water vapour / steam) [1]

(iii) moderate / high temperature / 300–350 °C ;
 high pressure / 60–70 (atmospheres) ;
 catalyst / phosphoric(V) acid ; [max 2]

(iv) addition (reaction) ; [1]

(c) X, loses oxygen / gains hydrogen, (and so is reduced) ;
 ethanol gains oxygen / loses hydrogen, (and so is oxidised) ;
 idea of, if one reactant is oxidised the other must be reduced ; [max 2]

[Total: 12]

10 (a) (i) area under graph (triangle and rectangle) ;
 $(\frac{1}{2} \times 5 \times 10) + 10$;
 $= 35$ (m) ; [3]

(ii) (deceleration / acceleration =) change in speed / change in time (or working) ;
 $= 2$ (m/s²) ; [2]

(b) becomes louder – amplitude increases ;
 has a lower pitch – frequency decreases ; [2]

[Total: 7]

Page 7	Mark Scheme	Syllabus	Paper
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- 11 (a) (i) emulsifies ;
increases surface area ;
so, faster digestion ; [max 2]
- (ii) stores glycogen ;
controls blood glucose/sugar levels ;
breaks down poisons/alcohol ;
destroys hormones ;
produce urea/deamination ;
remove old red blood cells ;
AVP ; [max 2]
- (b) increased surface area ;
for uptake/absorb of substance(s) ; [2]
- (c) (i) absorption of water/mineral ions ; [1]
- (ii) oxygen transport ;
contains haemoglobin, to carry oxygen ;
no nucleus, so more room for haemoglobin/oxygen ;
biconcave shape, so flexible/large surface area ; [max 3]
- [Total: 10]**
- 12 (a) (i) number of protons in atom/nucleus ; [1]
- (ii) idea that **L** and **O** in same group/properties similar within groups ;
atoms of **L** and **O** have same number of outer electrons/**L** and **M** have
different numbers of outer electrons/or statement of number of electrons in
outer shells ;
chemical properties related to number of outer electrons ; [max 2]
- (b) symbols correct ;
have 8 electrons in all outer shells ;
two shared pairs in both bonds ; [3]
- (c) (i) 476.2 – 474.0 **or** 2.2 g (unit required) ; [1]
- (ii) $M_r \text{CO}_2 = 44$;
number of moles = $2.2 \div 44 = 0.05$; (*allow ecf from (i)*) ; [2]
- (iii) (express volume of drink in $\text{dm}^3 =$) 0.454 (dm^3) ;
concentration = $0.05 \div 0.454 = 0.11$ (mol/dm^3) ; (*allow ecf*) [2]
- [Total: 11]**