

**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

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- 1 (a) blast furnace ; [1]
- (b) iron oxide / iron(III) oxide /  $\text{Fe}_2\text{O}_3$  ; [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

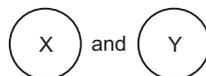
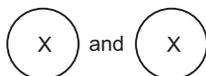
male

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)  $R = \frac{V}{I}$  ;  
 $= \frac{12}{4} = 3$  ;  
 $\Omega$  / 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) 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 ( $3 \times 10^8$  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) =  $mc\Delta T$  ;  
=  $32000 \times 450 \times 1500$  ;  
=  $2.16 \times 10^{10}$  J =  $2.16 \times 10^7$  kJ ; [3]

[Total: 12]

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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 CO<sub>2</sub>/ 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/s<sup>2</sup>) ; [2]

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

[Total: 7]

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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 ( $\text{dm}^3$ ) ;  
concentration =  $0.05 \div 0.454 = 0.11$  ( $\text{mol}/\text{dm}^3$ ) ; (*allow ecf*) [2]
- [Total: 11]**