

MARK SCHEME for the May/June 2013 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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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- 1 (a) (i) (A)
sum of protons and neutrons is greatest/nucleon number is sum of protons and neutrons/most protons and neutrons ;
- (ii) **A and D** ;
proton number 2 shows helium ;
(isotopes) have same number of protons but different, numbers of neutrons/(atomic) mass ; [max 2]
- (b) (i) atoms share electrons ;
electron pair (is shared) ;
electron pair lies between nuclei/shields nuclear repulsion ; [max 2]
- (ii) helium (atoms) inert/stable/unreactive/do not (need to) bond ;
reference to complete (outer) shell ; [max 1]
- (c) pop (test) indicates hydrogen (given off)/hydrogen is given off ;
zinc displaces hydrogen/reacts with HCl/ to produce hydrogen/silver does not react with HCl/ to produce hydrogen ;
zinc more reactive than hydrogen ;
silver less reactive than hydrogen (so no reaction) ; [max 3]

[Total: 9]

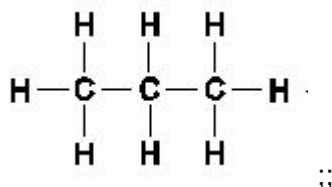
- 2 (a) (i) (distance =) speed × time ;
= 1600 × 0.2/2 = 160 m ; [2]
- (ii) (frequency =) velocity/wavelength, or velocity = frequency × wavelength ;
frequency = 1600/0.25 = 6400 Hz ; [2]
- (b) less fossil fuels used up/fossil fuels are conserved ;
no emissions causing acid rain ;
no CO₂ emissions/greenhouse gases ;
(reduced) greenhouse effect/global warming/consequences e.g. climate change/changed weather patterns etc.; [max 2]
- (c) (i) sea water ; [1]
- (ii) evaporation ; [1]

[Total: 8]

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- 3 (a) (i) anther, filament ;
- (ii) ovary wall, ovule, stigma ;
- (iii) insect gets nectar (from nectary)/insect goes to nectary ;
 anthers/stigma, inside petals ;
 insect has to brush against them ;
 pollen picked up from anthers ;
 pollen deposited on stigma ; [max 3]
- (b) (i) 'named' fruit drawn with feature to allow wind dispersal (e.g. wings, parachute) ;
 annotation comments on this feature ; [2]
- (ii) spread to, new/larger, areas/reduce competition ; [1]
- [Total: 8]**

- 4 (a) chain of three carbon atoms joined by single bonds ;
 eight hydrogen atoms correctly bonded to carbon ;
 i.e.



[max 2]

- (b) (i) decreases (from **D** to **A**) ; [1]
- (ii) (boiling range)/boiling point, is lower at **B** than **C** ;
 (average) molecular size is lower at **B**/the smaller the molecular size the lower the boiling point.;
 (mean) intermolecular attraction lower at **B**/the lower the intermolecular force the lower the boiling point.;
 so less (heat) energy needed to separate molecules/boil the mixture ;
 intermolecular attraction is lower for smaller molecules ; [max 3]
- (c) (i) too reactive/elements unstable/they would react/compounds (much) more stable ; [1]
- (ii) sodium atoms lose one electron/outer shell electron/become 2.8 ;
 chlorine atoms gain one electron/complete their outer shell/become 2.8.8 ; [2]
- (iii) particles shown as positively and negatively charged ;
 ions shown alternating in ratio 1:1 ;
 shape shown as square/cube ; [3]

[Total: 12]

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- 5 (a) (i) calcium ;
- (ii) water/H₂O ;
- (iii) has more calcium ;
for, teeth/bones ;
OR
has more protein ;
for making new, proteins/cells/enzymes/growth/repair of tissue ;
OR
if specifically in the context of famine conditions or nutrition of infants
has more fat ;
for survival of adults in famine conditions/ for infant growth ; [max 2]
- (iv) has less fat/ use of data ;
reference to risk of, obesity/ heart disease ; [2]
- (v) can be absorbed as it is/idea that it consists of particles small enough (to be absorbed) ; [1]
- (b) (i) to speed up the process ;
reference to enzymes ;
idea of enzymes working faster at this temperature ; [max 2]
- (ii) slows/stops enzymes working/to keep it fresh/the idea that enzymes stop working (so well) ; [1]
- (iii) acid produced ; [1]
- [Total: 11]

Page 5	Mark Scheme	Syllabus	
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- 6 (a) (i) (work =) force \times distance ;
X's work is 120 J and **Y**'s work is 100 J (so **X** does more work) ;
- (ii) worker **X** (no mark)
power = work \div time, or power \propto 1 \div time, or power is, rate of doing work \div work done per second, or how quickly work is done, so worker **X** uses more power ; [1]
- (iii) (density =) mass/volume ;
= 5000/5500 = 0.91 (g/cm³) ; [2]
- (b) resistance of thermistor goes down ;
current goes up ;
reference to $V = IR$;
(supply) voltage is constant ; [max 3]
- (c) (i) 1.2 \times 240 (with or without units)/use of (distance =) speed \times time, or area under graph ;
288 m ; [2]
- (ii) 240 (s) ; [1]
- (iii) boy **C** (no mark)
(line on) graph goes down (so speed was changing) / owtte / use of data ; [1]
- [Total: 12]**
- 7 (a) (i) vanadium oxide + magnesium \rightarrow vanadium + magnesium oxide ; [1]
- (ii) vanadium has higher density ;
vanadium has higher melting point ;
vanadium can act as catalyst ;
vanadium forms coloured compounds ; [max 2]
- (b) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$;
vanadium oxide is a catalyst/is not (permanently) changed ; [2]
- (c) M_r of $\text{H}_2\text{SO}_4 = 98$;
98% of 1 kg = 0.98 (kg) = 980 (g) ;
number of moles = mass \div molar mass 980 \div 98 = 10 (moles) ; [3]
- [Total: 8]**

Page 6	Mark Scheme	Syllabus	
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8 (a) combustion/burning, of (fossil) fuels ;
sulfur dioxide produced ;
(sulfur dioxide), reacts with/dissolves in/mixes with, water (in atmosphere) ; [max 1]

(b) eutrophication ;
increased growth of algae/surface plants ;
blocks light to plants (deeper down) ;
algae/plants die ;
bacteria feed on them/population increases ;
bacteria etc. use oxygen ;
removal of oxygen kills fish ; [max 4]

(c) less photosynthesis ;
so less carbon dioxide removed ;
OR
trees burned ;
producing carbon dioxide ; [max 2]

[Total: 8]

9 (a) (i) $V_1/V_2 = N_1/N_2$;
 $N_1 = 220 \times 40/5 = 1760$ (turns) ; [2]

(b) transformers increase voltage at power station ;
to reduce current in cables ;
to reduce energy losses ;
transformers decrease voltage at point of use ;
correct voltage for safe use in domestic appliances/owtte ; [max 3]

[Total: 5]

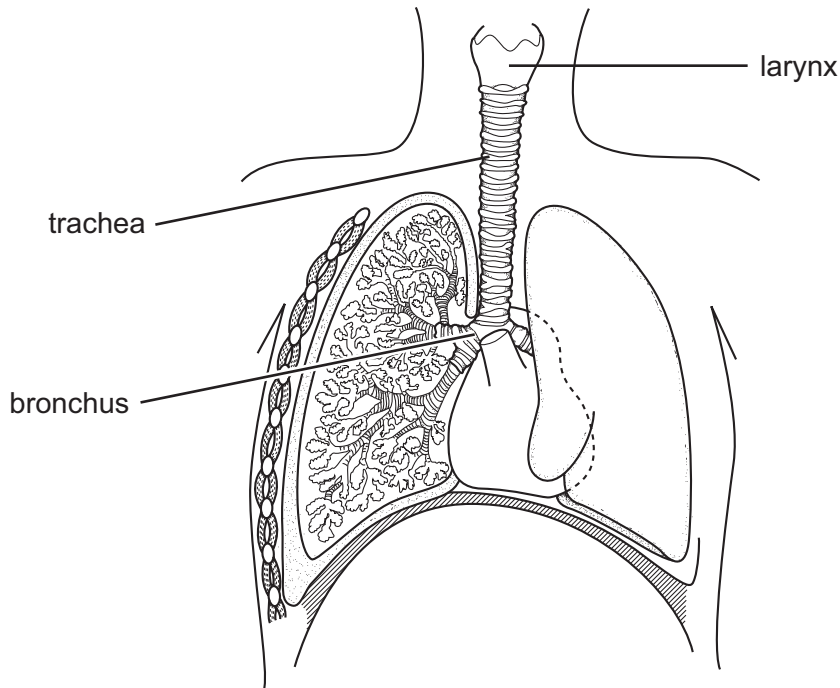
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- 10 (a) carbon dioxide/CO₂;
limewater turns cloudy etc.(with carbon dioxide) /limewater reacts with carbon dioxide/limewater is the test reagent for CO₂ ;
- (b) (i) X shown clearly on graph at 2 min ; [1]
- (ii) decrease of/or negative value indicated ;
7°C ; [2]
- (iii) (reaction is) endothermic/heat energy is, removed from mixture/taken in ;
thermal/heat/kinetic energy converted to (internal) chemical energy ;
products have more chemical energy than reactant/owtte ; [max 2]
- (c) (i) carbon dioxide would react with the water ;
producing an acidic solution/lowering pH/CO₂ is an acidic gas ;
which would change the indicator colour/turn indicator orange/red ; [max 2]
- (ii) formula is CO ;
logical statement(s) ;
e.g. (must be at least one O, so) 28 – 16 = 12 (which can only be one C)
OR
(both carbon oxides have only one carbon atom so) 28 – 12 = 16
(so only one oxygen also) [max 2]

[Total: 11]

Page 8	Mark Scheme	Syllabus	
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11 (a)



[3]

(b) large surface area ;
reference to moist surface / owtte ;
good blood supply ;
thin wall ;

[max 3]

(c) goblet cell produces mucus ;
mucus traps, bacteria / pathogens / dust / particles ;
cilia sweep mucus, upwards / away from lungs / to throat ;

[max 2]

(d) (i) alpha would be too ionising ;
reference to specific harm done by radiation – mutation / DNA damaged / cells
killed / burns / cancer ;

[2]

(ii) (people) 3, 4 and 5 ;

[1]

(iii) reference to bronchitis / inflammation in airways ;
(because) more mucus produced / damaged cilia unable to remove mucus
(as efficiently) ;
in which bacteria breed ;
reference to emphysema / breakdown / destruction of alveolar walls ;
so gas exchange less efficient / difficult to get enough oxygen ;
reference to tar reduces efficiency of gaseous exchange ;
carbon monoxide, inhibits uptake / takes the place of, oxygen by red blood
cells ;
reference to lung / other relevant cancer / reference to other specific disease
related to smoking ;

[max 4]

[Total: 15]

Page 9	Mark Scheme	Syllabus	
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- 12 (a)** *transverse* – vibration at right angles to motion ;
 electromagnetic waves do not need a medium ;
 e.g. vibration \updownarrow ~~~~~ \Rightarrow direction of wave motion
- longitudinal* – vibration in direction of motion ;
 series of compressions and rarefactions ;
 e.g. vibration \Leftrightarrow III I I III I \Rightarrow direction of wave motion [max 3]
- (b) (i)** accuracy ;
 straight lines ;
 arrow(s) in right direction ; [3]
- (ii)** one which cannot be projected on to a screen etc. ; [1]
- (c) (i)** any two of:
 one ray from top of object parallel with principal axis, then through principal focus ;
 one ray from top of object through optical centre of lens ;
 one ray from top of object through principal focus on object side of lens then parallel with principal axis ; (for 2 marks)
 image drawn and labelled in the correct place ; [max 3]
- (ii)** object height = 2.0 cm, image height = 2.8 to 3.4 cm ; [1]
- (iii)** magnification = height of image / height of object ;
 $3.1 / 2.0 = 1.6$; [2]
- [Total: 13]**