

**MARK SCHEME for the October/November 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) reference to reactivity of elements/compound is more stable ; [1]
- (ii) compound has elements in fixed proportions/has a formula ;  
mixture has no fixed proportions ;  
compound has a unique set of properties ;  
constituents of a mixture retain individual properties ;  
compound cannot/can only be separated by chemical means ;  
mixture can be separated by physical means ;  
compound has all constituents chemically bonded/formed by a chemical reaction ;  
mixture does not have chemical bonds between all constituents/is not formed by a chemical reaction ; [max 2]
- (iii) (try to) find melting point ;  
sharp m.pt./801 °C indicates sodium chloride ;  
unclear m.pt. indicates mixture/low sodium salt ; [max 2]
- (b) (i) potassium and calcium (both required) ; [1]
- (ii) reference to charge balance/correct electron transfer shown ;  
 $\text{Ca}_3\text{N}_2$  ; [2]
- (c) each ion gains (two) electrons/is discharged ;  
gain of electrons is reduction ; [2]
- [Total: 10]**
- 2 (a) (i) arrow going downwards ; [1]
- (ii) cooler air gas contracts/particles closer together/particles move slower/  
particles have less kinetic energy/particles are less energetic ;  
cold air is denser (therefore moves down) ; [2]
- (b) (energy =) mass  $\times$  SHC  $\times$  temp. change ;  
 $= 0.19 \times 1.01 \times 4 = 0.77 \text{ J}$  ; [2]
- (c) (i) energy required, for work done against forces of attractions/to break the  
intermolecular  
forces/to break the intermolecular bonds ;  
energy required for particles to break free from a solid state ;  
reference to latent heat of fusion ; [max 1]
- (ii) solid – all particles touching, regular arrangement particles of similar size ;  
liquid – at least half particles touching, irregular arrangement particles of  
similar size ; [2]

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- (d) refrigerator **D**/white and shiny refrigerator (no mark)  
white/light surfaces are worst absorbers/reflect most radiation ;  
shiny surfaces are worst absorbers/reflect most radiation ; [2]

**[Total: 10]**

- 3 (a) increases concentration/decreases water potential, of blood plasma ;  
water drawn out of cells ;  
by osmosis ; [max 2]

- (b) (i) increased then decreased ;  
increased more rapidly than it decreased ;  
maximum 6.6 (units)/peak reached after 40 mins ;  
returned to normal by 100 minutes ; [max 3]

- (ii) starch digested to, sugar/glucose ;  
by enzymes/amylase ;  
sugar/glucose, absorbed into the blood in the small intestine (causing increase) ;  
sugar/glucose, used in respiration (causing decrease) ;  
insulin secreted when glucose level rises ;  
glucose is converted to glycogen ;  
insulin causes glucose level to decrease ; [max 4]

- (iii) reference specific health benefits of blood glucose concentration staying lower ;  
(fibre) reduces, constipation/bowel cancer/aids egestion ; [2]

**[Total: 11]**

- 4 (a) silicon ;  
in Group IV (and third period)/(atoms has) four outer electrons/calculation of proton number from 2, 8, 4 electronic configuration ; [2]

- (b) (i) (Group 1)  
reference to at least one of the proton numbers plotted on graph ; [1]

- (ii) allow anywhere in range 20–34 °C ;  
at proton number 55 ; [2]

- (c) (i) carbon monoxide ; [1]

- (ii) carbon + oxygen → carbon dioxide ;  
iron oxide + carbon monoxide → iron + carbon dioxide ;  
calcium carbonate → carbon dioxide + calcium oxide ; [max 2]

- (iii) carbon dioxide reacts with (hot) carbon/carbon dioxide + carbon → carbon monoxide ; [1]

**[Total: 9]**

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- 5 (a) (i) area under graph/working/  $120 \times 0.75 + \frac{1}{2} \times 120 \times 0.25$  ;  
= 105 km ; [2]
- (ii) (acceleration =) gradient or  $120/0.25$  ;  
=  $480 \text{ (km/h}^2\text{)}$  ;  
=  $0.037 \text{ m/s}^2$  ; [3]
- (b) (i) 10% ; [1]
- (ii)  $1,000,000 \times 0.10 \times 0.70$  ;  
= 70,000 J ; [2]
- (c) (i) mirror drawn as straight line in correct position ;  
at correct angle ; [2]
- (ii) normal drawn and angle identified ;  
 $30^\circ$  ; [2]
- (d) parallel rays brought to a focus on principal axis ;  
at 5 cm ; [2]

[Total: 14]

- 6 (a) (i) increases pressure ;  
pushes blood out into the aorta/out of heart ; [2]
- (ii) closes it ; [1]
- (b) (i) constantly using energy for contraction ;  
energy obtained by respiration ;  
respiration uses oxygen ; [max 2]
- (ii) most of area below the label line and to the left of the septum shaded ; [1]
- (iii) eating too much/high fat diet ;  
not enough exercise ;  
stress ;  
smoking ; [max 3]
- (c) (i) blood in artery is at higher pressure ;  
blood in artery is pulsing ;  
blood in artery has more carbon dioxide ;  
blood in artery is deoxygenated ; [max 2]
- (ii) artery has a thicker wall ;  
artery has more elastic tissue ;  
artery does not have valves ; [max 2]

[Total: 13]

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7 (a) (i)

<i>isotope</i>	<i>protons</i>	<i>neutrons</i>	<i>electrons</i>
Zr – 90	40	50	40
Zr – 96	40	56	40

1 mark for a correct row ;; [2]

(ii) (weighted) mean mass ;  
of isotopes/compared to mass of a hydrogen atom/carbon – 12 isotope ; [2]

(b) (i)  $A_r$  of zirconium = 91 ;  
 $182000 \div 91 = 2000$  (moles) ; [2]

(ii)  $M_r$  magnesium chloride = 95 ;  
 $4000 \times 95 = 380000$ g/380 kg ; [2]

(c) (i) powder has higher surface area ;  
which increase reaction rate/allows efficient contact between oxygen and  
metal/increases particle collision frequency/owtte ; [2]

(ii) (reactants)  
reaction is exothermic/gives out heat/gives out thermal energy ;  
so chemical potential energy has transferred into surroundings ; [2]

**[Total: 12]**

8 (a) 2.0 A  
14 A ; (both required for the mark) [1]

(b) 1300 (ohms) ;  
 $V = I \times R$  ;  
 $12/1300 = 0.009$ A ; [3]

(c) (i) sine graph ;  
regular amplitude and frequency ; [2]

(ii) strength of magnetic field ;  
speed of rotation ;  
number of turns on the coil ; [max 2]

**[Total: 8]**

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- 9 (a) (i) a change in a gene/chromosome/DNA ; [1]
- (ii) ionising radiation/named ionising radiation ; [1]
- (b) (i) phenotype ; [1]
- (ii) (parents' genotypes) **Aa** and **Aa** ;  
gametes **A** and **a** from both parents, ;  
offspring genotypes **AA**, **Aa**, **Aa** and **aa** ; [3]
- (iii) 2 white : 1 normal ;  
none of the **AA** zygotes develop ; [2]
- (c) fur traps air ;  
air, acts as an insulator/is a poor conductor ;  
reduces heat loss by, convection/radiation ; [max 2]

[Total: 10]

- 10 (a) butane ;  
alkanes ; [2]
- (b) (i) orange/yellow to colourless ; [1]
- (ii) addition ; [1]
- (iii)
- $$\begin{array}{c}
 \text{H} \quad \text{H} \\
 | \quad | \\
 \text{H}-\text{C}-\text{C}-\text{C}/ \\
 | \quad | \\
 \text{H} \quad \text{H} \quad ;
 \end{array}$$
- [2]
- (2 carbons connected by a single bond 1 mark, all else correct 1 mark)
- (iv) ethanol ; [1]
- (c)  $\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3 \text{H}_2$  ;;; [3]  
(LHS formulae 1 mark, RHS formulae 1 mark, balanced 1 mark)

[Total: 10]

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11 (a) removes electrons from atom/produces a charged particle ; [1]

(b) ultraviolet ;  
fluorescent tubes/security marking/tanning/sterilisation/detecting biological fluids ; [2]

(c)  $3 \times 10^8$  m/s ; [1]

(d) (i) time for half radioactive atoms to decay/time for count rate of radioactive material to halve ; [1]

(ii) find time when count rate was a particular value and find the time when count rate was half this value ;  
time difference is the half-life ; [2]

**[Total: 7]**

12 (a) energy in sunlight absorbed/trapped by chlorophyll ;  
*plus any two of:*  
carbon dioxide and water react together ;  
to produce glucose ;  
glucose contains chemical energy ; [max 3]

(b) CO<sub>2</sub> levels in the atmosphere increase ;  
due to fewer trees to photosynthesise/less photosynthesis to remove carbon dioxide ;  
also due to burning trees produce CO<sub>2</sub>/rotting trees produce CO<sub>2</sub> by respiration of microbes ;  
carbon dioxide, traps long-wave radiation/infra-red/heat/thermal energy/is a greenhouse gas ;  
reduces rate of loss of heat from the Earth's surface ; [max 3]

**[Total: 6]**