

MARK SCHEME for the May/June 2014 series

0654 CO-ORDINATED SCIENCES

0654/31

Paper 3 (Extended), 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.

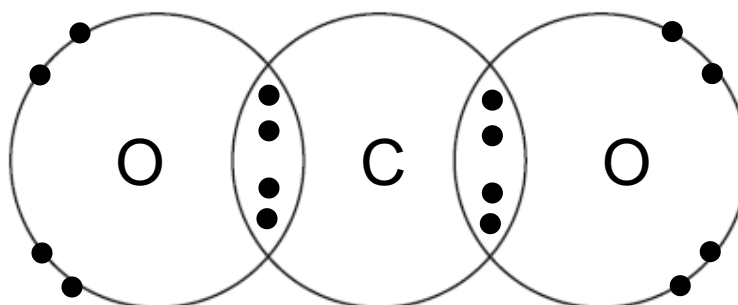
Cambridge will not enter into discussions about these mark schemes.

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- 1 (a) electrons are shared ;
electrons are transferred ; [2]

(b)



bonding electrons shown as two sets of two shared pairs ;
two lone pairs shown on both oxygen atoms ;
chemical symbols correctly indicated ; [3]

- (c) (i) **N** (most reactive)
L
M ; [1]

(ii) general statement that more reactive metal displaces less reactive metal ;
N displaces both **L** and **M** and so is more reactive than them / most reactive ;
M displaces neither **L** nor **N** and so is least reactive / less reactive than them ;
L displaces **M** and so is more reactive than **M** ;
L doesn't displace **N** and so is less reactive than **N** ; [max 3]

(iii) magnesium (atoms) / **Mg** lose electrons and are oxidised ;
silver (ions) / Ag^+ gain electrons and are reduced ;
general statement that loss of electrons defined as oxidation **AND** gain of electrons defined as reduction ; [max 2]

[Total: 11]

- 2 (a) **X** = stigma / carpel ;
Y = sepal ; [2]

(b) produces / releases pollen ; [1]

(c) ovary ; [1]

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(d) petals ;
 anthers/stamens inside the flower ;
 stigma inside the flower ;
 lobed stigma ; [max 2]

(e) no petals/smaller flowers ;
 anthers/stamens outside the flower ;
 stigmas outside the flower ;
 feathery stigmas ; [max 2]

(f) (i) to prevent the flower pollinating itself ; [1]

(ii) to prevent other (stray) pollen reaching it/pollination by other plants ; [2]

[Total: 10]

3 (a) (i) X – takes less time to stop/speed decreases more quickly/gradient is greater/line is steeper ; [1]

(ii) (deceleration =) $\frac{\text{change in speed}}{\text{time}}$;
 $\frac{15}{45} = 0.33 \text{ (m/s}^2\text{)} ;$ [2]

(iii) (force =) mass \times acceleration ;
 $= 2000 \times 0.5 = 1000 \text{ N} ;$ [2]

(b) (volume =) $\frac{\text{mass}}{\text{density}}$;
 $= \frac{1000}{2700} ;$
 $= 0.37 \text{ m}^3 ;$ [3]

(c) $E = m \times c \times \theta$ or $(c =) \frac{E}{m\theta} ;$
 $c = \frac{1820}{1000} \times 2 ;$
 $= 0.91 \text{ (kJ/ kg}^\circ\text{C)} ;$ [3]

[Total: 11]

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- 4 (a) (i) natural gas / methane / propane / butane / biogas / refinery gas / petroleum gas ;
used for heating / cooking / lighting / vehicle fuel / burners ; [2]
- (ii) exothermic ; [1]
- (b) reference to acid rain which damages building material / plants / aquatic life ;
reference to damage to respiratory system ;
other correct e.g. acidity of soil ; [max 2]
- (c) (i) powder has a greater surface area (mass for mass) ;
so greater chance of collision between (carbon and oxygen / air) particles ;
reference to higher collision frequency between (carbon and oxygen / air)
particles ; [max 2]
- (ii) smaller / less chemical potential energy in products / owtte ;
chemical potential energy (in reactants) is converted to heat energy ;
heat (and light) energy is lost / reaction is exothermic ; [max 2]
- [Total: 9]**
- 5 (a) so that all lamps get full mains voltage / have full brightness / v.v. ;
so that all lamps operate independently / if one lamp blows the rest still work / you
can have one light on without having them all on ; [2]
- (b) (i) electrons transferred ;
from cloth / to balloon ; [2]
- (ii) like charges repel ; [1]
- (c) circuit breakers cut electricity to a device if too much current flows / there is a
voltage surge ; [1]
- (d) current is low when voltage is high ;
less, energy / power loss, as heat (with low current) ; [2]
- [Total: 8]**

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- 6 (a) interaction between organisms ;
interaction between organisms and their environment ;
in a given area ; [max 2]
- (b) tree **OR** grass → insect → mongoose → serval → leopard ; ;
[correct organisms ; arrows correctly orientated ;] [2]
- (c) (i) energy lost between each trophic level ; [1]
(ii) less energy available to the lions (at the top of the chain)/reverse argument ; [1]
- (d) (i) organism that feeds on/breaks down/gets its energy from, dead/waste
(organic) matter ; [1]
(ii) bacterium/fungus ; [1]
(iii) all of them ; [1]
(iv) recycle nutrients/owtte ; [1]
- [Total: 10]**

7 (a)

<i>name of particle</i>	<i>number in the nucleus</i>
proton	17
neutron	18

(one for each correct row ;;) [2]

- (b) (i) kill microorganisms/prevent water-borne disease ; [1]
(ii) chlorine + sodium iodide → sodium chloride + iodine ; [1]
- (c) (i) look for $23 + 35.5 (= 58.5)$; [1]
(ii) look for $234 \div 58.5 = 4$; [1]
(iii) (look for any reference to 2:1 stoichiometry of NaCl : Cl₂)
2 moles of Cl₂ are produced ;
so volume produced is $2 \times 24 = 48 \text{ dm}^3$ (unit required) ; [2]
(iv) non-metals (other than H) appear at the positive electrode/anode ;
chloride ions are negative/are Cl⁻/are anions ;
chloride ions are attracted to the positive electrode/anode ;
chloride ions are discharged/lose electrons (at the anode) ; [max 3]
[electrode equation $2 \text{ Cl} \rightarrow \text{Cl}_2 + 2 \text{ e}^-$ award 2 marks]

[Total: 11]

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- 8 (a) (chemical to) thermal / heat energy ;
 heat water to produce steam ;
 (drives) turbine and generator ;
 reference to kinetic energy ;

[max 3]

- (b) (i) photographic film radiation badge / dosimeter ;

[1]

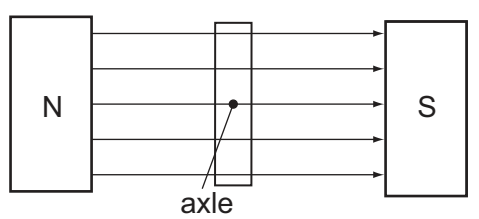
- (ii) cancer / mutation / radiation burns ;

[1]

- (c) radio waves
 micro waves
 infrared (all three in order) ;

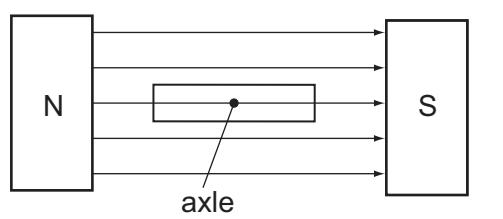
[1]

- (d) (i) zero



[1]

- (ii) greatest



[1]

- (e) sine curve ;
 approx. constant amplitude and half-period ;
 repeated once / 2 rotations ;

[3]

[Total: 11]

- 9 (a) lipase ;

[1]

- (b) (i) 37 ;

[1]

- (ii) molecules / particles move slowly have less kinetic energy ;
 so less rate of collisions ;
 less successful collisions ;

[max 2]

- (iii) denatured / destroyed by heat ;

[1]

- (c) (i) uses less energy ;
 less fossil fuel / less global warming ;

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(ii) (enzyme 1 – no mark)
the ECO programme works best/ designed for a temperature of 30 °C ;
(enzyme 1) works best/ more active (at 30 °C) than enzyme 2/owtte ; [2]

(d) add biuret solution/ (alkaline) Cu(II) sulfate ;
look for purple/ violet colour ; [2]

[Total: 11]

10 (a) (i) light waves travel faster than sound waves/ v.v ; [1]

(ii) as a series of compressions and rarefactions ;
as longitudinal waves ;
by transfer of vibrations of particles ; [max 1]

(iii) sound cannot travel through a vacuum/ sound requires a, medium/ particles ; [1]

(b) (i) 20 Hz to 20 000 Hz [1]

(ii) (distance =) speed × time ;
330 × 0.05 = 16.5 (m) ; [2]

(iii) $v = f \times \lambda$ / $(f =) \frac{v}{\lambda}$;

frequency = $\frac{330}{0.011} = 30\,000$ (Hz) ; [2]

(c) diagram shows more cells ;
diagram shows no resistor or resistor in parallel with buzzer **or** resistor less than
10 Ω/AVP ; [2]

[Total: 10]

11 (a) muscle ; [1]

(b) (i) coronary artery ; [1]

(ii) death of heart tissue/ cells cannot respire ;
because of lack of oxygen/ glucose ; [2]

(c) (i) lower (overall) rate in country **B**/ reverse ;
especially for men ;
25 per year per 100 000 fewer for men/ 5 fewer for women ; [max 2]

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(ii) stop smoking ;
lose weight ;
take (more) exercise ;
eat less salt ;
eat less (saturated) fat ;
avoid stress ;

[max 2]

(iii) people in country **A** more (genetically) susceptible/live longer/less likely to die from other causes/AVP ;

[1]

[Total: 9]

12 (a) (i) *metal* malleable, *non-metal* not malleable/brittle ;
metal electrical conductor, *non-metal* insulator ;
metal heat conductor, *non-metal* insulator ;
metal ductile, *non-metal* not ductile ;
metal lustrous, *non-metal* not lustrous/dull ;
metal sonorous, *non-metal* not sonorous ;
metal high density, *non-metal* low density ;

[max 2]

(ii) (metallic)
is in Group II/on left of Periodic Table/forms positive ions/2 valence electrons ;

[1]

(b) (i) (**X/2**)
reference to lowest pH ;

[1]

(ii) (**Z/7**)
pH is 7/water is pH 7/has a neutral pH ;

[1]

(iii) (**Y/12**)
metal oxides are alkaline/have pH greater than 7 ;

[1]

(c) no rust in tube **1** because water absent ;
no rust in tube **4** because air/oxygen absent ;
tubes **2** and **3** show that it is the oxygen from the air that is needed for rusting ;
rust formed in tubes **2** and **3** because both contained, air/oxygen, and water present together/general statement that rusting requires, air/oxygen, and water present together ;

[max 3]

[Total: 9]