MARK SCHEME for the May/June 2014 series

0654 CO-ORDINATED SCIENCES

0654/31 Paper 3 (Extended), maximum raw mark 120

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.
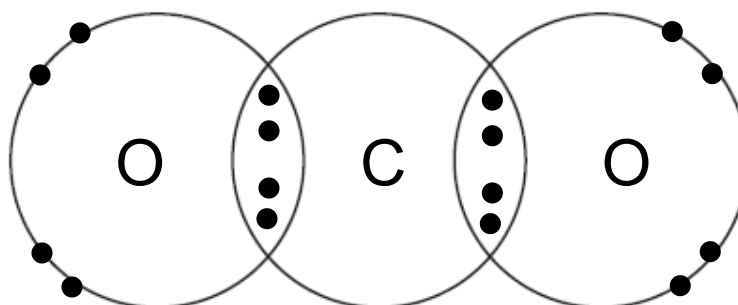
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1 (a) electrons are shared ;
electrons are transferred ;   [2]

(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 <u>pollen</u> ;   [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 =) $\dfrac{\text{change in speed}}{\text{time}}$;

   $\dfrac{15}{45}$ = 0.33 (m / s^2) ;   [2]

   (iii) (force =) mass $\times$ acceleration ;

   = 2000 $\times$ 0.5 = 1000 N ;   [2]

(b) (volume =) $\dfrac{\text{mass}}{\text{density}}$;

= $\dfrac{1000}{2700}$;

= 0.37 m^3 ;   [3]

(c) E = m $\times$ c $\times$ θ **or** (c =) $\dfrac{E}{m\theta}$;

c = $\dfrac{1820}{1000} \times 2$;

= 0.91 (kJ / kg °C) ;   [3]

                                                                                                [Total: 11]

4 (a) (i) natural gas / methane / propane / butane / biogas / refinery gas / petroleum <u>gas</u> ;
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]

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)**

name of particle	number in the nucleus
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 ÷ 58.5 = 4 ;   [1]

(iii) (look for any reference to 2:1 stoichiometry of $NaCl : Cl_2$)
2 moles of Cl_2 are produced ;
so volume produced is $2 \times 24 = 48\,dm^3$ (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 $2\,Cl \rightarrow Cl_2 + 2\,e^-$ award 2 marks]

[Total: 11]

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8 (a) (chemical to) thermal / heat <u>energy</u> ;
heat water to produce steam ;
(drives) turbine and generator ;
reference to kinetic energy ; [max 3]

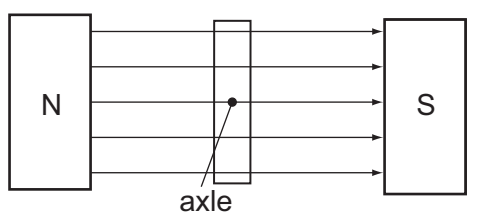**(b) (i)** photographic film radiation badge / dosimeter ; [1]

(ii) cancer / mutation / radiation burns ; [1]

(c) radio waves
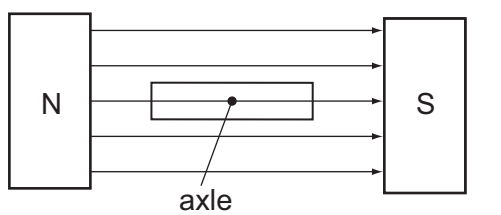micro waves
infrared (all three in order) ; [1]

(d) (i) zero

axle ;

[1]

(ii) greatest

axle ;

[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 <u>vibration</u>s 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) $v = f × \lambda$ / (f =) $\dfrac{V}{\lambda}$;

frequency = $\dfrac{330}{0.011}$ = 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]

    (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 elections ; [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]