

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2015 series**

**0654 CO-ORDINATED SCIENCES**

**0654/31**

Paper 3 (Extended Theory), maximum raw mark 120

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- 1 (a) (i) 8 ; [1]
- (ii) neutron ; [1]
- (iii) 15 electrons ;  
arranged 2.8.5 ; [2]
- (b) 3 shared pairs ;  
1 lone pair on central atom and no extra electrons ;  
(max 1 if symbols missing or incorrect) [2]
- (c) (i) Haber (process) ; [1]
- (ii)  $\text{CH}_4 + \text{H}_2\text{O} \rightarrow 3\text{H}_2 + \text{CO}$   
1 mark for  $\text{H}_2$  ; 1 mark for  $\text{CO}$  ; 1 mark for fully correct ; [3]
- (iii) catalyst / to speed up the reaction / to facilitate reaction ; [1]
- [Total: 11]**
- 2 (a) chloroplast ; [1]
- (b) light ;  
chemical ; [2]
- (c) (i) (oxygen) from photosynthesis ;  
(carbon dioxide) from respiration ;  
(nothing) because rate of photosynthesis equals rate of respiration ; [3]
- (ii) dead / no chloroplasts ; [1]
- [Total: 7]**
- 3 (a) **B** (no mark)  
particles are touching and randomly arranged ; [1]
- (b) (i) warmer ;  
larger surface area ;  
faster air flow ; [max 1]

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- (ii) evaporation can occur at any temperature (above melting point)/boiling only happens at the boiling point ;  
 evaporation happens only at the surface/boiling happens throughout the liquid ;  
 boiling takes energy in (endothermic) to occur/evaporation lets only the molecules with the highest kinetic energy out ;  
 evaporation can occur using the internal energy of the system/boiling requires an external source of heat ;  
 evaporation produces cooling/boiling does not ;  
 evaporation is a slow process/boiling is a rapid process ; [max 2]

(c) (i) (energy =) power  $\times$  time ;  
 $= 18\,000 \times 3600 = 64\,800\,000 \text{ J}$  or  $18 \times 3600 = 64\,800 \text{ kJ}$  ; [2]

- (ii) when voltage is high, current is lower ;  
 less energy is transferred as thermal energy ; [2]

- (iii) lowers the voltage/has less turns on secondary coil than primary ; [1]

[Total: 9]

- 4 (a) a change in a gene or a chromosome ; [1]

- (b) (i) mutation in the parents ;  
passed on to offspring in reproduction ; [2]

- (ii) ionising radiation/ $\gamma$ /X-rays/ultraviolet rays ; [1]

- (iii) less able to find food/find a mate/escape predators ; [1]

- (c) adapted ;  
 survive ;  
 alleles ;  
 selection ; [4]

[Total: 9]

- 5 (a) (i) (with propane) no change/no reaction ;  
 (with propene) bromine solution decolourised ; [2]

- (ii) propene molecules contain double bond propane all single bonds/propene contains fewer hydrogen atoms/correct formulae given and assigned ; [1]

- (b) (i) goes milky (cloudy)/goes milky then clears ;  
 it is reacting with carbon dioxide/the reaction gives off carbon dioxide ; [2]

- (ii)  $(12 \times 6) + (1 \times 12) + (16 \times 6) = 180$  ; [1]

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- (iii) idea that moles dissolved = volume  $\times$  concentration / so may see  
 moles =  $5.0 \times 3.5 = 17.5$  moles ;  
 then required mass = moles  $\times$  molar mass / so may see  
 mass =  $17.5 \times 180 = 3150$  (g) **or** 3.15 kg ;  
 ( $5.0 \times 3.5 \times 180 = 3150$  (g) *award 2 marks*)

**OR**

- mass in  $1 \text{ dm}^3 = 3.5 \times 180 = 630$  g ;  
 mass in  $5 \text{ dm}^3 = 630 \times 5 = 3150$  (g) ;

[max 2]

- (c) (i) nitrogen ; [1]

- (ii) protein / polypeptide ; [1]

[Total: 10]

- 6 (a) rays hit wall at angle greater than critical angle ;  
 only reflection / no refraction / no light exiting side of fibre ;  
 rays undergo total internal reflection at walls of fibre ;

[max 2]

- (b) (i) can pass through tissue ;  
 less ionising so less damage caused ;

[max 1]

- (ii) 13 (hours) ; [1]

- (iii) 4 half-lives ;  
 50 (counts per minute) ; [2]

[Total: 6]

- 7 (a) any part of the nervous system except brain / spinal cord ; [1]

- (b) (i) response to a stimulus / response to protect body ;  
 immediate / automatic / without conscious thought ; [2]

- (ii) carry impulses / AW from receptors to CNS ;  
 carry impulses / AW from CNS to effectors / muscle ;  
 reference to sensory neurons / motor neurons ; [max 2]

- (c) (i) (nervous system is) shorter lasting ; [1]

- (ii) nervous system has electrical impulses ;  
 hormones are chemicals carried in blood ; [2]

[Total: 8]

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- 8 (a) (i) less attraction / filler not magnetic but steel is / owtte ; [1]
- (ii) no – aluminium is not magnetic ; [1]
- (b) (i)  $I = \frac{V}{R}$  ;  
 $= \frac{12}{2.5} = 4.8 \text{ (A)}$  ;  
amps/A ; [3]
- (ii) (charge =) current  $\times$  time ;  
 $= 4.8 \times 2 \times 60 = 576 \text{ (C)}$  ; [2]
- (iii) use of  $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$  ;  
 $R_T = 1.25 \text{ (}\Omega\text{)}$  ; [2]
- (c) (energy =) SHC  $\times$  mass  $\times$  change in temperature ;  
 $= 4200 \times 4 \times 80 = 1\,344\,000 \text{ (J)}$  ; [2]

[Total: 11]

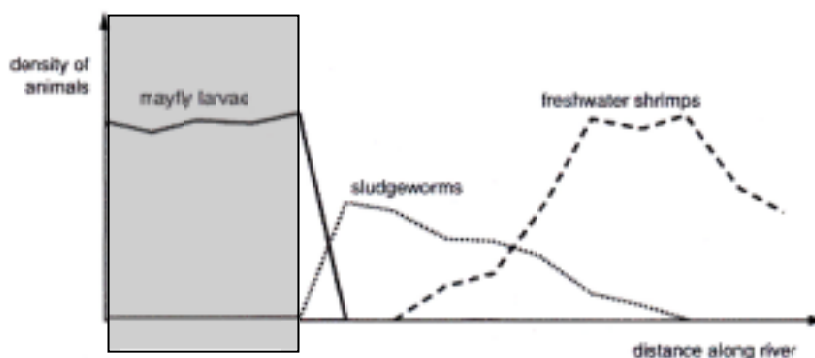
- 9 (a) electrolysis ; [1]
- (b) (i) Al ions are positive / opposite charges attract ; [1]
- (ii) each Al ion gains electrons ;  
ions are discharged ;  
*(each ion gains 3 electrons, award 2 marks)* [2]
- (c) (i)  $\text{Fe}^{3+}$  ;  
reference to charge balance /  $3 \times 2-$  balanced by  $2 \times 3+$  / owtte ; [2]
- (ii) iron more reactive than copper / aluminium more reactive than copper  
(from own knowledge of reactivity series) ;  
since Al more reactive than iron it must be more reactive than copper  
(from information in question) ;  
*(so Al does displace Cu)* [2]

[Total: 8]

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10 (a) mayfly larvae / caddis flies / freshwater shrimps / water lice / bloodworms ; [1]

(b) (i) arrow anywhere in the shaded area ; [1]



(ii) microorganisms ;  
respiration deoxygenates water ;  
which prevents respiration ;  
toxic ;  
heavy metals bioaccumulation ; [max 3]

(c) (i) rain of low pH / pH less than 7 / polluted with (named) acid ; [1]

(ii) reduced use of fossil fuels ;  
public transport ;  
alternative energy sources ;  
(chemical) absorbers / filters on (factory) chimneys ;  
education / taxation / public awareness measures ; [max 2]

**[Total: 8]**

11 (a) (KE =)  $\frac{1}{2} mv^2$  ;  
 $= \frac{1}{2} \times 4000 \times 0.4 \times 0.4 = 320$  (J) ; [2]

(b) (work done =) force  $\times$  distance ;  
 $= 3000 \times 2 = 6000$  (J) ; [2]

(c) (i) (pressure =)  $\frac{\text{force}}{\text{area}}$  ;  
 $\frac{40\,000}{1600} = 25$  (N/cm<sup>2</sup>) ; [2]

(ii) 250 000 (Pa) ; [1]

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(d) (i) (*higher than 30 Hz – no mark*)  
lowest frequency detected is 10–30 Hz ; [1]

(ii) particles vibrate ;  
(particles vibrate) parallel to direction of sound travel/energy transfer ;  
compressions and rarefactions ;  
description of compressions/rarefactions ; [max 2]

(e) (time =)  $\frac{\text{distance}}{\text{speed}}$  ;  
 $\frac{6000}{330} = 18.(18)$  (s) ; [2]

(f) eureka can / displacement method ;  
volume of water displaced is the volume of the object ; [2]

**[Total: 14]**

12 (a) magnesium + sulfuric acid ;  
zinc carbonate + sulfuric acid  $\rightarrow$  (*zinc sulfate + carbon dioxide +*) water ; [2]

(b) (i) thermal energy  $\rightarrow$  chemical (potential) energy ; [1]

(ii) reaction is endothermic/temperature decreases ; [1]

(c) (i) no gas produced / gas stops after 75 s ;  
because reaction is complete / all the calcium carbonate has reacted ; [2]

(ii) generally similar shape ;  
everywhere below original curve ;  
maximum volume of gas at 45 to 50 cm<sup>3</sup> ; [3]

(iii) (kinetic) energy / speed of (acid) particles increases ;  
increases the frequency of collision / more successful collisions ; [2]

**[Total: 11]**

13 (a) anther correctly labelled (at the top) ; [1]

(b) pollen ;  
male gamete ; [2]

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(c) large/bright petals ;  
scent ;  
nectar ;  
flower parts / anthers / stigmas inside the flower ;  
sticky pollen ;

[max 2]

(d) (i) by animals ;  
hook to attach to fur / eaten and egested ;

[2]

(ii) seed / embryo ;

[1]

**[Total: 8]**