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) $CH_4 + H_2O \rightarrow 3H_2 + CO$
1 mark for H_2 ; 1 mark for 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 <u>photosynthesis</u> ;
(carbon dioxide) from <u>respiration</u> ;
(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]

(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 × time ;
= 18 000 × 3600 = 64 800 000 J **or** 18 × 3600 = 64 800 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 <u>in the parents</u> ;
<u>passed on</u> to offspring in reproduction ; [2]

(ii) <u>ionising</u> radiation / γ / 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 × 6) + (1 × 12) + (16 × 6) = 180 ; [1]

(iii) idea that moles dissolved = volume × concentration / so may see
moles = 5.0 × 3.5 = 17.5 moles ;
then required mass = moles × molar mass / so may see
mass = 17.5 × 180 = 3150 (g) **or** 3.15 kg ;
(5.0 × 3.5 × 180 = 3150 (g) award 2 marks)
OR
mass in 1 dm^3 = 3.5 × 180 = 630 g ;
mass in 5 dm^3 = 630 × 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]

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 (A) ;
amps / A ; [3]

(ii) (charge =) current × time ;
= 4.8 × 2 × 60 = 576 (C) ; [2]

(iii) use of $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$;
R_T = 1.25 (Ω) ; [2]

(c) (energy =) SHC × mass × change in temperature ;
= 4200 × 4 × 80 = 1 344 000 (J) ; [2]

[Total: 11]

9 **(a)** electrolysis ; [1]

(b) **(i)** A*l* ions are positive / opposite charges attract ; [1]

(ii) each A*l* ion gains electrons ;
ions are discharged ;
(each ion gains 3 electrons, award 2 marks) [2]

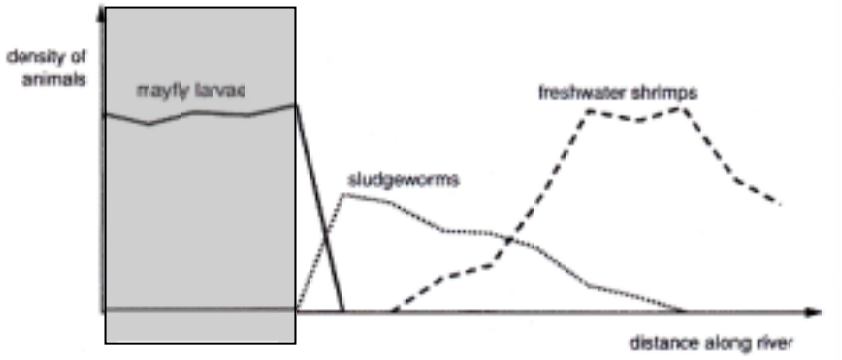
(c) **(i)** Fe^{3+} ;
reference to charge balance / 3 × 2– balanced by 2 × 3+ / owtte ; [2]

(ii) iron more reactive than copper / aluminium more reactive than copper (from own knowledge of reactivity series) ;
since A*l* more reactive than iron it must be more reactive than copper (from information in question) ;
(*so Al does displace Cu)* [2]

[Total: 8]

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 =) ½ mv^2 ;
= ½ × 4000 × 0.4 × 0.4 = 320 (J) ; [2]

(b) (work done =) force × distance ;
= 3000 × 2 = 6000 (J) ; [2]

(c) (i) (pressure =) $\frac{\text{force}}{\text{area}}$;

$\frac{40\,000}{1600} = 25\,(\text{N/cm}^2)$; [2]

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

(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 ;
<u>volume</u> of water displaced is the volume of the object ; [2]

[Total: 14]

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

(b) (i) thermal energy → 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^3 ; [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]

(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]