Cambridge International Examinations
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CO-ORDINATED SCIENCES **0654/33**

Paper 3 Extended Theory **May/June 2016**

MARK SCHEME

Maximum Mark: 120

Published

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1 (a) (i) malleability ; [1]

(ii) resistant to corrosion ; [1]

(b) (i) alloy ; [1]

(ii) (alloy is) stronger ;
so can withstand the increased pressure inside the can ; [2]

(c) (i) electrolyte must be kept liquid / molten / aluminium oxide has a high melting point ;
reference to the need for ionic mobility ; [2]

(ii) 3 ;
A*l* ions have 3+ charge / discharged at the cathode / owtte ; [2]

(iii) $C + O_2 \rightarrow CO_2$ / $2C + O_2 \rightarrow 2CO$
formulae ;
balancing ; [2]

[Total: 11]

2 (a) (i) red blood cell ; [1]

(ii) engulfs / surrounds foreign particles ;
digests them ; [2]

(iii) produce <u>antibodies</u> ;
rejection ; [2]

(b) (i) (artery) carries blood <u>away from the heart</u> /
vein carries blood <u>towards the heart</u> ; [1]

(ii) stronger wall / prevents bursting ;
(because) blood pressure is high ; [2]

(iii) stretch / recoil / expand ;
smooths out (variation in rate of) blood flow /
(variations in) pressure / pulses ; [2]

[Total: 10]

3 (a) (i) volume = 37.5 (m^3) ; [1]

(ii) (mass =) density × volume or 880 × 37.5 ;
= 33 000 (kg) ; [2]

(b) coal and natural gas
all the rest renewable ; [1]

(c) (i) from 20 (Hz) (allow 10 Hz) to 20 000 (Hz) (allow 25 000 Hz) ; [1]

(ii) (distance =) speed × time or 1500 × 1.2 (= 1800) ;
(divide by 2) 900 (m) ; [2]

(iii) compressions further apart and distance between two compressions / rarefactions identified ; [1]

[Total: 8]

4 (a) grass → zebra → lion → flea
four organisms in correct order ;
correct arrows ; [2]

(b) (i) ecosystem ; [1]

(ii) trophic level ; [1]

(iii) decomposer ; [1]

(c) grass ;
energy losses at each stage ; [2]

[Total: 7]

5 (a) (i) lamps in parallel / all correct symbols ;
all else correct ; [2]

(ii) (Q =) It or = 1.5 × 300 ;
= 450 ;
C ; [3]

(b) (i) speed = wavelength × frequency or $4.8 \times 10^{-7} \times 6.25 \times 10^{14}$;
= 3.0×10^{8} (m / s) ; [2]

(ii) all travel at same speed ;
are transverse waves ;
have electric and magnetic field components ; [max 1]

(c) all droplets have same charge ;
thus repel each other ; [2]

(d) laterally inverted / upright / virtual ; [1]

(e) increased airflow ;
increased temperature ;
larger surface area ;
lower humidity ; [max 2]

[Total: 13]

6 **(a)** **(i)** D on any cell after fertilisation
and
H on either sperm or egg ; [1]

(ii) mitosis ; [1]

(iii) 23 ;
46 ; [2]

(b) **(i)** mutation ; [1]

(ii) some individuals more tolerant of drought / AW ;
some bacteria more resistant to the antibiotic ; [2]

(c) **(i)** A ; [1]

(ii) discontinuous / discrete ; [1]

(iii) (different) genes / alleles / genotypes ; [1]

[Total: 10]

7 **(a)** oxygen ; [1]

(b) **(i)** (**A**)
amount of gas produced in a given time is greatest / the gradient is greatest ; [1]

(ii) 59 ± 1 seconds ; [1]

(iii) volume stops increasing / no more gas being produced (after 59 s) ;
graph becomes horizontal, flattens, gradient = 0 [1]

(c) 2.0 (g) ;
catalysts are not consumed / permanently changed ; [2]

(d) rate of reaction would be greater ;
the idea that molecules of **R** must collide with the surface of **Q** ;
higher concentration of **R** means larger number of molecules (per unit volume) ;
reference to increased frequency of (reactive) collisions ; [max 3]

[Total: 9]

8 **(a)** particles move more slowly / have less energy ;
particles become closer together ;
gas becomes more dense ; [max 2]

(b) **B** AND (most) particles are touching ;
and random arrangement ; [2]

(c) energy required to overcome attractive forces between particles ;
red. to latent heat of fusion ; [max 1]

(d) $1/R_T = 1/R_1 + 1/R_2$ or $1/R_T = 1/5500 + 1/5500 = 2/5500$ or
$R_T = R_1R_2/(R_1 + R_2)$ or $R_T = 5500 \times 5500/(2 \times 5500)$ or
effective resistance of two equal resistances in parallel is half one of the resistances or owtte or 5500 / 2 ;
$R_T = 2750\ (\Omega)$; [2]

(e) (SHC =) energy / (mass × change in temperature) or
3.03 / 0.20 × 15 ;
= 1.01 (J / kg °C) ; [2]

(f) current produces magnetic field around coil ;
magnetic field produced interacts with other magnetic field ;
force on current carrying conductor in magnetic field ;
force acts on side of coil ;
forces act in opposite direction on each side of coil ;
current reverses every half turn ;
keeps coil turning in same direction ; [max 3]

[Total: 12]

9 **(a)** **(i)** a carbon atom / nucleus contains 6 protons ;
(on average) an oxygen atom has a mass 16 times greater than a hydrogen atom / 1 / 12 mass of C-12 /
other valid forms of the definition ; [2]

(ii) 19 × 2 = 38 ; [1]

(iii) neon ;
all electron shells are full / outer shell is complete / has 8 electrons / does not need to bond to complete outer shell ; [2]

(b) **(i)** 7 electrons / in shells / energy levels surrounding the nucleus ;
2,5 configuration ; [2]

(ii) three shared pairs ;
both lone pairs and no extra electrons ; [2]

[Total: 9]

10 (a) ability to detect / sense changes in the environment ;
(and) to respond to them ; [2]

(b) (i) phototropism ; [1]

(ii) stem would grow upwards, with or without light / anyway ;
no control experiment ;
(could be) growing against / responding to gravity ; [max 2]

(iii) auxin accumulates on lower / darker side ;
so more growth / cell elongation on this side ; [2]

[Total: 7]

11 (a) (i) area under graph or evidence in working ;
distance = $(\frac{1}{2} \times 20 \times 6) + (20 \times 6) + (\frac{1}{2} \times 5 \times 6)$;
195 (m) ; [3]

(ii) (KE =) $\frac{1}{2}\ mv^2$ or $\frac{1}{2} \times 80 \times 6 \times 6$;
= 1440 (J) ; [2]

(b) arrow labelled **A** going downwards ;
arrow labelled **B** going to the left ; [2]

[Total: 7]

12 (a) (i) **L** is fractional distillation ;
M is (catalytic / thermal) cracking ; [2]

(ii) contain only carbon and hydrogen / is a hydrocarbon ;
relatively unreactive ;
are saturated / contain only single bonds ;
have the general formula C_nH_{2n+2} ; [max 2]

(b) 2 × C and 4 × H ;
correct bonding ; [2]

(c) (i) addition ; [1]

(ii) colourless ; [1]

(iii) calculate the M_r of dibromoethane = 188 ;
calculate mass of 0.00625 moles = 188 × 0.00625 = 1.175 ; [2]

(iv) no reaction ;
(as alkane / ethane has no double bond to react / owtte) ; [1]

[Total: 11]

13 (a) for food / energy / oxygen ; [1]

(b) (i) if further then less light / colder; (ORA)
rate of photosynthesis depends on light (intensity) / temperature ;
needs liquid water ; [max 2]

(ii) CO_2 needed for photosynthesis ; [1]

(iii) more oxygen / less CO_2 ;
due to photosynthesis ; [2]

[Total: 6]