



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 ;
Al 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 antibodies ;
rejection ; [2]
- (b) (i) (artery) carries blood away from the heart /
vein carries blood towards the heart ; [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 (m³) ; [1]
(ii) (mass =) density × volume or 880 × 37.5 ;
= 33 000 (kg) ; [2]
- (b) coal and natural gas
all the rest renewable ; [1]

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- (c) (i) from 20 (Hz) (allow 10 Hz) to 20 000 (Hz) (allow 25 000 Hz) ; [1]
- (ii) (distance =) speed \times time or $1500 \times 1.2 (= 1800)$;
(divide by 2) 900 (m) ; [2]
- (iii) compressions further apart and distance between two
compressions / rarefactions identified ; [1]

[Total: 8]

- 4 (a) grass \rightarrow zebra \rightarrow lion \rightarrow 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 $= 1.5 \times 300$;
 $= 450$;
C ; [3]
- (b) (i) speed = wavelength \times frequency or $4.8 \times 10^{-7} \times 6.25 \times 10^{14}$;
 $= 3.0 \times 10^8$ (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]

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- (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 59s) ;
 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]

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- 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 \times change in temperature) or
 $3.03 / 0.20 \times 15$;
 $= 1.01 (\text{J/kg } ^\circ\text{C})$; [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) $19 \times 2 = 38$; [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]

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- 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) $(KE =) \frac{1}{2} m v^2$ 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) $2 \times C$ and $4 \times H$;
correct bonding ; [2]
- (c) (i) addition ; [1]
- (ii) colourless ; [1]
- (iii) calculate the M_r of dibromoethane = 188 ;
calculate mass of 0.00625 moles = $188 \times 0.00625 = 1.175$; [2]
- (iv) no reaction ;
(as alkane/ethane has no double bond to react/owtte) ; [1]
- [Total: 11]**

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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) CO₂ needed for photosynthesis ; [1]

(iii) more oxygen/less CO₂ ;
due to photosynthesis ; [2]

[Total: 6]