



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**CO-ORDINATED SCIENCES**

**0654/31**

Paper 3 Extended Theory

**May/June 2016**

MARK SCHEME

Maximum Mark: 120

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**Published**

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**[Turn over**

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1 (a) white surfaces are better reflectors of thermal energy /  
white surfaces are poorer absorbers of thermal energy ; [1]

(b) kinetic to electrical ; [1]

(c) (i) efficiency = energy out/energy in or  
energy used =  $15/100 \times 400\,000$  ;  
= 60 000 (J) ; [2]

(ii) (temperature rise =) energy/mass  $\times$  shc or  
 $60\,000/(4 \times 4200)$  ;  
3.6 ( $^{\circ}\text{C}$ ) ; [2]

(d) tidal, wave, geothermal, HEP, (named) biomass: any two ;; [2]

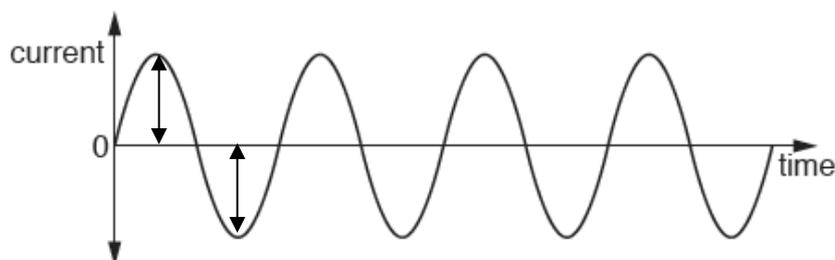
(e) (i) in space of left of infra-red ;

	X rays		<i>visible light</i>	infra-red		radio waves
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[1]

(ii)  $300\,000\,000/3 \times 10^8$  (m/s) ; [1]

(f) amplitude correctly indicated ;  
either :



[1]

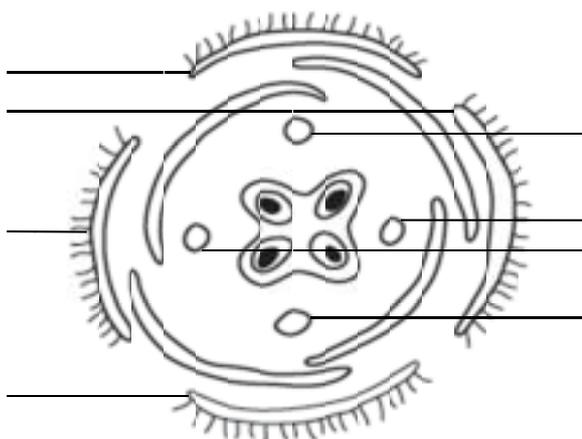
[Total: 11]

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- 2 (a) (i) sepal correctly labelled ;  
stamen correctly labelled ;

any sepal

any stamen



[2]

- (ii) unable to pollinate (other flowers) ;

[1]

- (iii) stigma / stamens inside petals ;  
has petals ;  
flat / lobed stigma ;

[max 2]

- (b) (i) 33–34 ;

[1]

- (ii) 35–100.0 (metres) ;

[1]

- (iii) range is greater than the others / AW ;

[1]

- (iv) colonises new areas ;  
prevents overcrowding / competition within the species ;

[2]

- (v) animals / edible fruits / carried on fur ;

[1]

- (vi) both dispersed further ;  
because longer in the air subject to influence of wind /  
force is greater ;

[2]

- (c) plumule labelled ;  
radicle labelled ;  
plumule touching radicle ;  
cotyledon labelled ;

[4]

**[Total: 17]**

- 3 (a) (i) filtration / passed through a filter ;

[1]

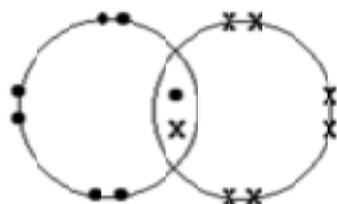
- (ii) reference to risk of (named) disease ;

[1]

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- (b) (i) electrolysis ; [1]
- (ii) hydrogen ; [1]
- (iii) (damp) litmus / (Universal) indicator paper ;  
bleached / changes colour to white ; [2]
- (iv) 7 to value  $> 7$  up to a maximum of 14 ;  
solution becomes alkaline / sodium hydroxide is produced ; [2]

(v)



- one shared pair ;  
all lone pairs and no extra electrons ; [2]

[Total: 10]

- 4 (a) (i) (acceleration =) change in speed / time or  
(acceleration =)  $15 / 10$  ;  
 $= 15 \text{ (m/s}^2\text{)} ;$  [2]
- (ii) (force =) mass  $\times$  acceleration or  
(force) =  $2000 \times 1.5$  ;  
 $= 3000$  ;  
N ; [3]
- (iii) area under graph or evidence on graph or  
 $\frac{1}{2} \times 20 \times 10$  ;  
100 (m) ; [2]

- (b) (i) charge ;  
friction ;  
electron transfer ;  
(complete circuit) to / from earth ; [max 2]
- (ii) (charge =) current  $\times$  time or  
 $= 0.004 \times 0.0001$  ;  
 $= 0.0000004 / 4 \times 10^{-7} \text{ (C)} ;$  [2]

[Total: 11]

- 5 (a) X = (plant) respiration ;  
Y = decomposition / decay / respiration ; [2]

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(b) (i) CO<sub>2</sub> used for photosynthesis ;  
less CO<sub>2</sub> absorbed / less photosynthesis ;  
CO<sub>2</sub> produced by burning timber / CO<sub>2</sub> produced by decomposition / AW [3]

(ii) because combustion produced CO<sub>2</sub> ; [1]

[Total: 6]

6 (a) (i) number of protons in the nucleus/one atom ; [1]

(ii) proton positive(ly charged) and electron negative(ly charged) ;  
proton has greater mass ; [2]

(b) (i) caesium 1 and iodine 7 ; [1]

(ii) CsI ;  
ionic ; [2]

(iii) caesium atom loses one / its outer electron ;  
iodine atom gains one electron ; [2]

(c) (i) the higher the temperature the greater mass of solid dissolves ; [1]

(ii) 130 (g) [1]

(iii) calculation of M<sub>r</sub> [CsI]  
133 + 127 / 260 ;  
change volume units from 100 cm<sup>3</sup> to dm<sup>3</sup>  
mass dissolving in 1 dm<sup>3</sup> = 1300 g ;  
calculation of concentration in moles / dm<sup>3</sup>  
1300 ÷ 260 = 5 (mol / dm<sup>3</sup>) ;  
OR  
calculation of M<sub>r</sub> [CsI]  
133 + 127 / 260 ;  
calculation of concentration in mol / 100 cm<sup>3</sup>  
130 / 260 = 0.5 mol / 100 cm<sup>3</sup> ;  
change volume units from 100 cm<sup>3</sup> to dm<sup>3</sup>  
concentration = 5 mol / dm<sup>3</sup> ; [3]

[Total: 13]

7 (a) plastic / glass  
iron  
glass / plastic  
copper  
4 correct = 2 marks, 3 or 2 correct = 1 mark ; [2]

(b) (i) 54 ; [1]

(ii) <sup>56</sup>/<sub>26</sub>Fe [1]

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(iii) time taken for a sample of radioactive isotope to decay by half/  
time taken for count rate of radioactive isotope to decrease by half ; [1]

(c) evaporation can occur at any temperature/  
boiling only happens at the boiling point ;

evaporation happens only at the surface/  
boiling happens throughout the liquid ;

evaporation lets only the molecules with the highest kinetic energy out/  
boiling taken energy in (endothermic) to occur ;

evaporation can occur using the internal energy of the system/  
boiling requires an external source of heat ;

evaporation produces cooling/  
boiling does not produce cooling ;

evaporation is a slow process/  
boiling is a rapid process ;

[max 1]

(d) reference to induced magnetism ; [1]

(e) **A** (no mark)  
regular arrangement ; [1]

(f) workable method of measurement of displacement ;  
ref to displacement/ subtraction of two volumes ; [2]

**[Total: 10]**

8 (a) obesity ;  
blocking coronary arteries ;  
(leading to) (coronary) heart disease ; [3]

(b) (i) liver labelled on Fig. 1.1 ; [1]

(ii) emulsifies ;  
increases surface area for, enzyme action / faster digestion ; [2]

(iii) large surface area ;  
thin wall ;  
lacteals ; [max 2]

**[Total: 8]**

9 (a) (i) transition (metals / series / elements) ; [1]

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- (ii) elements or their compounds can behave as catalysts ;  
compounds have colours other than white ; [2]
- (iii) iron atoms ;  
reference to electrons being lost ; [2]
- (iv) this alloy does not rust ; [1]
- b** (i) blast furnace ; [1]
- (ii)  $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$   
formulae ;  
balancing ; [2]
- [Total: 9]**
- 10** (a) (i) ray of light correctly drawn from Y to X ; [1]
- (ii) normal correctly drawn ; [1]
- (iii) angle of incidence correctly labelled ; [1]
- (iv) same size as object, upright, virtual ; [1]
- (b) compression: particles close together/rarefaction: further apart  
OR  
compression: region of high pressure/rarefaction: region of low pressure ; [1]
- (c) (i) ammeter and voltmeter ; [1]
- (ii)  $1/R_T = 1/R_1 + 1/R_2$  or  $1/R_T = 1/12 + 1/4 = 1/3$  or  
 $R_T = R_1R_2/(R_1 + R_2)$  or  $R_T = 48/16$  ;  
 $R_T = 3 (\Omega)$  ; [2]
- [Total: 8]**
- 11** (a) (i) **FF** and Ff ; [1]
- (ii) have ff genotype ; [1]
- (b) (i) camouflage / AW ; [1]
- (ii) less well adapted / less likely to survive / more likely to be preyed on ;  
(so) less likely to reproduce ; [2]

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- (c) (correct gametes) H, h, H, h ;  
 (correct genotypes) HH, Hh, Hh, hh ;  
 (correct phenotypes) short fur, short fur, short fur, long fur ;  
 (correct ratio) 3 short : 1 long ; [4]

[Total: 9]

12 (a) (i) L diamond and M graphite ; [1]

(ii) contains only one type of atom ; [1]

(iii) (M)  
 reference to the layer structure ;  
 reference to (layers) sliding ;  
 reference to weak (attractive) forces (between layers) ; [max 2]

(b) (i) (reactants)  
 energy is transferred from reactants ;  
 as thermal energy / reaction is exothermic ; [2]

(ii) powder has a large surface area ;  
 the idea that the probability / frequency of collision (between oxygen molecules and the solid surface / carbon atoms) is higher ; [2]

[Total: 8]