

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

## **MARK SCHEME for the May/June 2015 series**

### **0654 CO-ORDINATED SCIENCES**

**0654/31**

Paper 3 (Extended Theory), maximum raw mark 120

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- 1 (a) Use of (energy =) power  $\times$  time ;  
 $= 24 \times 60 \times 60 \times 20\,000 = 1.73 \times 10^9$  (J) ; [2]
- (b) (i) cancer/mutation/damage to DNA/damage to cells/sunburn ; [1]
- (ii) radiation and correct use ;  
[both required for mark] [1]
- (c) (KE =)  $\frac{1}{2}mv^2$  ;  
 $= \frac{1}{2} \times 30 \times 0.8 \times 0.8 = 9.6$  (J) ; [2]
- (d) friction ;  
transfer of electrons/charged particles ; [2]
- (e) black surfaces emit more thermal energy/heat energy than white surfaces ; [1]
- (f) light travels faster than sound, etc. ; [1]
- [Total: 10]**
- 2 (a) (i) exothermic ; [1]
- (ii) the idea that thermal energy given out until (one of) the reactants is used up/thermal energy is only released while reaction occurs ;
- the idea that when reactants used up/reaction stops, the mixture cools/starts to return to room temperature/energy leaves beaker/temperature increases until reactants used up ; [2]
- (iii) no temperature change ;  
because no reaction occurs ;  
because copper is less reactive than zinc ; [3]
- (b)  $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$   
all formulae ;  
and then look for balanced ; [2]

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(c) (i) (G) no mark  
 G/larger grains have smaller surface area ;  
 smaller surface area causes lower speed of reaction/longer reaction time/time to use up reactants ;  
 lower speed of reaction causes longer reaction time/time to use up reactants ;  
 extra detail, e.g. correct collision theory ideas ; [max 3]

(ii) decreases ;  
 (chemical potential) energy is transferred (out of the mixture) as thermal energy/heat ; [2]

**[Total: 13]**

3 (a) (i) arrows on **Q** and **R**, both pointing to the right ; [1]

(ii) less CO<sub>2</sub> leaving the apparatus ;  
 more oxygen leaving the apparatus ;  
 cooler ; [max 2]

(iii) **A** – no change ;  
**B** – goes cloudy/milky ; [2]

(iv) more CO<sub>2</sub> in expired air ; [1]

(b) faster change/more cloudy (in tube **B**) ;  
 because more respiration/more CO<sub>2</sub> in expired air ; [2]

**[Total: 8]**

4 (a) (i) **H J** and **K**/argon hydrogen oxygen ;  
 only one type of atom/in Periodic Table/cannot be simplified ; [2]

(ii) it is a mixture/owtte ; [1]

(iii) measure the melting point ;  
 compare with published value/should be same as published value ;

**OR**

chromatography ;  
 compare with pure sample ; [2]

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(b) (i) total of 18 electrons ;  
arranged 2,8,8 ; [2]

(ii) both (argon) atoms have 18/same number of protons ;  
Ar – 36 has 18 neutrons (per atom) and Ar – 40 has 22 neutrons (per  
atom)/different numbers of neutrons (per atom) ; [2]

**[Total: 9]**

5 (a) (i) ray of light reflecting off mirror ;  
at approx. correct angle ; [2]

(ii) angle of incidence correctly labelled ; [1]

(b) (i) correct series circuit ;  
correct parallel circuit ;  
switch in correct place and all symbols correct ; [3]

(ii)  $1/R_T = 1/R_1 + 1/R_2$  (or  $R_T = \frac{R_1 R_2}{R_1 + R_2}$ ) /relevant working ;  
2.5( $\Omega$ ) ; [2]

**[Total: 8]**

6 (a) (i) needed for chlorophyll ; [1]

(ii) chlorophyll needed for photosynthesis ;  
(so) less photosynthesis ;  
(so) less sugar /energy for growth ; [max 2]

(b) (i) first 20 days: the same ; [1]  
next 100 days: do not grow as high in Field B ;  
grow slower in Field B ;  
approx. straight line instead of curve ;  
final (mean) difference of 35 cm ; [max 2] [max 3]

(ii) supplies extra nitrate;  
for making protein ; [2]

(c) washed (out of soil) into river /lake ;  
eutrophication ;  
increased growth of algae /surface plants ;  
blocks light to plants (deeper down) ;  
algae /plants, die ;  
bacteria feed on them /population increases ;  
bacteria, etc. use oxygen ;  
lack of oxygen kills fish ; [max 3]

**[Total: 11]**

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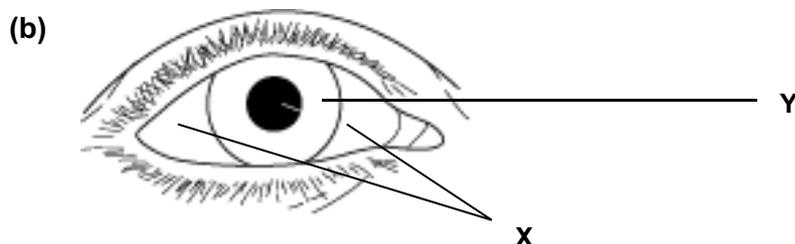
- 7 (a) (i) (C) no mark  
**A** is natural gas ;  
**B** is air ;  
products of decomposition (of organic material) are CH<sub>4</sub>/CO<sub>2</sub>; [max 2]
- (ii) carbon dioxide ;  
water ; [2]
- (b) (i) ref. to increasing the speed of a reaction ;  
remaining unchanged itself ; [2]
- (ii) air (taken into the engine) contains nitrogen and oxygen ;  
nitrous oxide formed from (direct) combination / reaction of nitrogen and oxygen ;  
(very) hot (and pressurised) in engine so (direct) combination / reaction possible ;  
carbon monoxide from reaction between the fuel / hydrocarbons and oxygen ;  
reference to incomplete combustion ; [max 4]
- [Total: 10]**
- 8 (a) contain starch / carbohydrate / oil / fat / contain chemical energy ;  
stored there (by the plant) ;  
for later development / until they can photosynthesise ; [max 2]
- (b) (i) (animals disperse the seeds) when they eat (the outer part) of the apple ; [1]
- (ii) stops animals eating / chewing the seeds ;  
which would damage / kill the embryo / seed would not grow into plant ;  
unchewed seeds can pass through intestines / in faeces / not digested ; [max 2]
- (c) (i) wind ; [1]
- (ii) colonising new areas ;  
reduces overcrowding / competition ; [2]
- [Total: 8]**

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- 9 (a) (i) particles gain thermal energy and vibrate faster / more ;  
this vibration passes through the metal saucepan ; [2]
- (ii) (efficiency =) useful energy output / energy input ; (or working)  
= 40 (%) ; [2]
- (b) evaporation can occur at any temperature / boiling only happens at the boiling point ;  
evaporation happens only at the surface / boiling occurs throughout the liquid ;  
during boiling all / most molecules have enough energy to leave / evaporation lets only the molecules with the highest kinetic energy out ;  
evaporation can occur using the internal energy of the system / boiling requires a(n external) source of heat ;  
evaporation produces cooling / boiling does not produce cooling ;  
evaporation is a slow process / boiling is a rapid process ; [max 2]
- (c) compressions are regions where the particles in air are close together / rarefactions are regions where the particles in air are spread out ;  
compressions are regions with air at higher pressure than normal / rarefactions are regions with air at lower pressure than normal ; [max 1]
- (d) (B) no mark  
because particles are closely packed and randomly arranged ; [1]
- (e) (pressure =) force / area ;  
= 20 / 0.03 ; (evidence of cm<sup>2</sup> to m<sup>2</sup> conversion)  
= 667 / 670 (N / m<sup>2</sup>) ; [3]

[Total: 11]

- 10 (a) V = lens ;  
W = retina ; [2]



;; [2]

(c)

structure	change when starting to focus on a near object
ciliary muscles	<b>contract ;</b>
suspensory ligaments	<b>less taut / AW ;</b> (accept: relax)
lens – shape	<b>thicker / fatter ;</b>
lens – focal length	decreased

[3]

(d) weaker ciliary muscles / AW ;  
so cannot make lens thick enough ;

**OR**

loss of lens elasticity ;  
so cannot become thick enough ;

[max 2]

**[Total: 9]**

11 (a) (i) (B) no mark

the idea that the electrolysis of copper chloride does not produce gas at the cathode / **R** / negative / does not produce two gases / produces gas only at the anode / **S** / positive / produces copper (a solid) and chlorine (a gas) ;

[1]

(ii) oxygen ;  
oxygen is evolved from the anode / positive electrode (when dilute sulfuric acid is electrolysed) ;

[2]

(iii) hydrogen ;

[1]

(b) (i) mass of copper deposited =  $178.38 - 177.42 = 0.96$  (g) ;  
moles of copper =  $0.96 \div 64 = 0.015$  ;

[2]

(ii) anode mass decreases ;  
anode dissolves / atoms break away as ions /  
 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$  ;

[max 2]

**[Total: 8]**

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**12 (a)** coal / petroleum / natural gas ; [1]

**(b)** cannot be replaced once used ; [1]

**(c)** (one named) alternative energy sources ;  
insulation ;  
low-energy appliances / equipment ;  
more public transport / less use of cars ;  
less use of / recycling of plastics ;  
AVP ; [max 2]

**[Total: 4]**

**13 (a) (i)** (time =) distance / speed ;  
= 240 / 1500 = 0.16 (s) ; [2]

**(ii)** (wavelength =) velocity / frequency ;  
= 1500 / 45 000 = 0.033 (m) ; [2]

**(iii)** 20 Hz to 20 000 Hz ; [1]

**(iv)** ultrasound waves have a frequency above 20 000 Hz ; [1]

**(b) (i)** float moves up and down ;  
makes magnet move in coil ;  
magnetic field in coil is changing / cut ;  
induces emf ; [max 3]

**(ii)** stronger magnet ;  
more turns ; [2]

**[Total: 11]**