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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CAMBRIDGE
International Examinations

1 **(a)** Use of (energy =) power × time ;
= 24 × 60 × 60 × 20 000 = 1.73 × 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 =) ½mv^2 ;
= ½ × 30 × 0.8 × 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) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$
all formulae ;
and then look for balanced ; [2]

(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_2 leaving the apparatus ;
more oxygen leaving the apparatus ;
cooler ; [max 2]

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

(iv) more CO_2 in expired air ; [1]

(b) faster change / more cloudy (in tube **B**) ;
because more respiration / more CO_2 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]

(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 (Ω) ; [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]

7 **(a)** **(i)** (**C**) no mark
A is natural gas ;
B is air ;
products of decomposition (of organic material) are CH_4/CO_2 ; [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]

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]

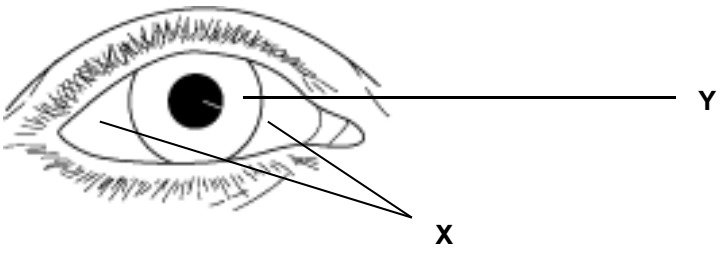
(d) (**B**) no mark
because particles are closely packed and randomly arranged ; [1]

(e) (pressure =) force / area ;
= 20 / 0.03 ; (evidence of cm^2 to m^2 conversion)
= 667 / 670 (N / m^2) ; [3]

[Total: 11]

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

(b)



;; [2]

(c)

structure	change when starting to focus on a near object
ciliary muscles	**contract ;**
suspensory ligaments	**less taut / AW ;** (accept: relax)
lens – shape	**thicker / fatter ;**
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 ÷ 64 = 0.015 ; [2]

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

[Total: 8]

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]