

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2013 series**

**0654 CO-ORDINATED SCIENCES**

**0654/32**

Paper 3 (Extended Theory), maximum raw mark 120

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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- 1 (a) (i) reference to positive charge on protons and negative charge on electrons ;  
reference to protons – electrons = 1 ; [2]
- (ii) decane is covalent/contains only molecules/no ions present ;  
solid NaCl ions are not mobile ;  
aqueous NaCl ions are mobile ; [3]
- (iii) hydrogen ;  
chlorine ;  
solution becomes alkaline ;  
because sodium hydroxide produced / OH<sup>-</sup> ion concentration increases ;  
because sodium hydroxide produced / OH<sup>-</sup> ion concentration increases ;  
because H<sup>+</sup> ion concentration decreases ; [max 4]
- (b) *any two of*  
sodium and chloride ions have opposite (electrical) charge ;  
reference to (strong) force of attraction (between opposite charges) ;  
reference to giant structure / many bonds ;  
large amount of (heat) energy needed to break bonds ; [3]  
(*max 1 if reference to atoms / molecules or electron and sharing / covalence*)
- [Total: 12]**

- 2 (a) (i) reflection ;  
total internal ;  
when angle is greater than critical angle / owtte ; [3]
- (ii) (time) = distance / speed ;  
0.03 s ; [2]
- (iii) distance is less (for optical fibre / infrared) / ORA ; [1]
- (b) sound waves (travel by) vibration of particles / air / medium / owtte ;  
as the air is sucked out there are / is less particles / air / medium (to convey sound) ;  
no particles / no air / no medium / vacuum so (sound waves cannot pass through) ; [max 2]
- [Total: 8]**

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- 3 (a) (i) increased ; [1]
- (ii) colour change (blue) to red ;  
effervescence / (gas) bubbles produced ; [2]
- (b) (i) (colour change of) cobalt chloride paper shows water and (cloudy) limewater shows carbon dioxide ; [1]
- (ii)  $2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$   
(LHS and RHS for 1 mark and balanced for 1 mark) [2]
- (iii) (paper covered with layer of) sodium hydrogen carbonate / owtte ;  
provides barrier between paper and air / oxygen ;  
(if paper does burn) sodium hydrogen carbonate decomposes to carbon dioxide / water which inhibit(s) burning / owtte ; [max 2]
- (iv) (endothermic) heat energy has to be supplied (to keep the reaction going) ;  
this heat is transferred to chemical energy / taken in to decompose the reactant / break bonds in reactant ; [2]
- [Total: 10]**
- 4 (a) (i) a change in a gene or chromosome ; [1]
- (ii) ionising radiation / named ionising radiation ; [1]
- (b) (i) more root hairs ;  
shorter root hairs ; [2]
- (ii) increase in number in both types is the same / 0.44 more root hairs per unit area ;  
decrease in length is much greater in mutant plants ; [2]
- (iii) reduced surface area ;  
less able to take up water / mineral ions / named mineral ion ;  
(reduced water) causes reduced photosynthesis ;  
less glucose made ;  
(less) glucose used for energy / respiration ;  
for growth / building up large molecules / building cell walls ;  
less nitrate (uptake reduces protein synthesis ;  
less phosphate (uptake) reduces cell membrane synthesis ;  
less magnesium uptake reduces chlorophyll synthesis ;  
less potassium uptake reduces protein synthesis ; [max 3]

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(c) (i) nitrate used to make, amino acids/proteins ;  
proteins needed to make new cells ; [2]

(ii) reference to eutrophication ;  
nitrate leached into waterways/owtte ;  
causes algal growth to increase ;  
reduces light to submerged plants ;  
algae/shaded plants, die ;  
bacteria feed on dead algae/dead plants ;  
bacteria use oxygen (for respiration) ;  
**which causes** animals die because of lack of oxygen ; [max 4]

[Total: 15]

5 (a)  $1/R = 1/R_1 + 1/R_2/(R) = R_1 \times R_2/R_1+R_2$  ;  
correct substitution ;  
 $R = 10/3 = 3.3 \Omega$  ; [3]

(b)  $I = V/R$  ;  
 $9/10 = 0.9 A$  ; [2]

[Total: 5]

6 (a) **A** to placenta ;  
**B** to amniotic fluid ;  
**C** to cervix ; [3]

(b) oxygen comes from mother's blood ;  
diffusion across/into placenta ;  
blood (vessels) in umbilical cord carry oxygen to fetus ;  
reference red blood cells ;  
reference haemoglobin /oxyhaemoglobin ; [max 3]

[Total: 6]

7 (a) (*gaseous/a gas*)  
reference to smaller/lighter molecules ;  
reference to low attraction between molecules ; [2]

(b) Group 0/noble gases ;  
(gases) are inert/unreactive/very stable ;  
reference to complete shells/outer octet ; [3]

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(c) (i) fluoride (ion) is very unreactive ;  
because has noble gas electron configuration/filled shells/outer electron octet ; [2]

(ii)  $M_r$  sodium fluoride = 42 ;  
 $0.000064 \times 42 \text{ g} = 1 \text{ dm}^3 / 0.64 \text{ moles in } 10000 \text{ dm}^3$ ;  
 $(0.000064 \times 42) \times 10000 \text{ g} = 26.88 \text{ or } 26.9 \text{ or } 27 \text{ g}$  ; [3]

[Total: 10]

8 (a) (i) work done = force  $\times$  distance ;  
 $= 10000 \times 1000 = 10\,000\,000 \text{ J}$  ; [2]

(ii) power = work/time ;  
 $10000000/100 = 100000 \text{ W}$  ; [2]

(b) (force) = pressure  $\times$  area ;  
calculates total area of 4 tyres ; (e.g. area =  $4 \times 150 = 600 \text{ cm}^2$ ) ;  
converts area to  $\text{m}^2$  (e.g.  $600 \text{ cm}^2 = 0.06 \text{ m}^2$ ) ;  
correct substitution in formula (e.g. force =  $300000 \times 0.06$ ) ;  
divides force by g (e.g. mass =  $18000/10 = 1800 \text{ kg}$ ) ; [max 4]

(c) (i) copper is a good conductor of heat ;  
(convection off) large surface area ;  
thin pipes shorter distance for conduction ; [max 2]

(ii) energy = mass  $\times$  specific heating capacity  $\times$  temp change ;  
 $= 5 \times 4200 \times 12$  ;  
 $= 252000 \text{ J}$  ; [3]

[Total: 13]

9 (a) (i) white allele identified as dominant **and** use of capital letter for its symbol ;  
small version of the same letter as symbol for himalayan allele ; [2]

(ii) (*allow whatever symbols have been chosen*)  
(parents' genotypes) **Aa** and **Aa** ;  
gametes **A** and **a** from both parents ;  
offspring genotypes **AA**, **Aa**, **Aa** and **aa** ;  
relates genotypes to phenotypes / 3 white to 1 himalayan ; [4]

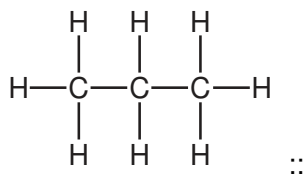
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- (b) (i) by respiration ;  
oxygen combined with glucose ;  
chemical energy in glucose transferred to/released as heat energy ; [max 2]
- (ii) fur traps air ;  
air, acts as an insulator/poor conductor ;  
reduces heat loss by, convection/radiation ; [max 2]
- (iii) ears/paws/nose, colder than other parts of body/below 25 °C ;  
enzyme is active in these areas ;  
black pigment produced in colder areas ; [max 2]

**[Total: 12]**

- 10 (a) (i) 7 ; [1]
- (ii) 8 ;  
covalent bonds exist between (halogen and carbon) atoms ;  
which involve sharing electrons (in pairs)/each halogen atom shares an  
electron with carbon ; [max 2]
- (b) (i) molecules in constant (random) motion ;  
molecules collide (repeatedly) with paint surface ; [2]
- (ii) ozone molecule has three oxygen atoms bonded and oxygen has two ; [1]

(c) (i)



[2]

(3 × C and 8 × H ; all C 4-valent and all H monovalent ;)

- (ii) flammable (so fire risk) /so adds to greenhouse gases ; [1]

**[Total: 9]**

11 (a)

<i>description</i>	<i>part</i>
<i>This transforms electrical impulses into sound energy</i>	speaker ;
<i>This transforms electrical energy to stored chemical energy</i>	battery ;
<i>This transforms electrical energy to light energy</i>	screen ;
<i>This reduces the mains voltage to a lower voltage.</i>	charger ;

[4]

(b) (i) formula e.g.  $N_p = V_p \times N_s / V_s$  ;  
 correct substitution into correctly arranged formula/ $120 \times 40 / 6$  ;  
 = 800 turns ;

[3]

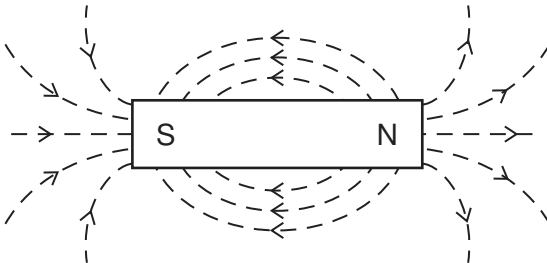
(ii) transmits changing magnetic field ;

[1]

(iii) (high voltage) means low current ;  
 less energy lost as heat ;

[2]

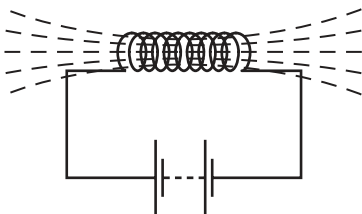
(c) (i)



shape ;  
 arrowheads ;

[2]

(ii)



lines passing through coil ;

[1]

**[Total: 13]**

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- 12 (a)** carbon monoxide  
tar  
particulates/ smoke particles  
nicotine  
4 correct = 2 marks, 2 or 3 correct = 1 mark ;; [2]
- (b)** mucus not swept upwards / away from lungs ;  
mucus accumulates in, lungs / alveoli ;  
bacteria breed in mucus ; [max 2]
- (c)** phagocytes engulf bacteria ;  
digest them / kill them ;  
lymphocytes, secrete / produce, antibodies ;  
which attach to bacteria and help to destroy them ; [max 3]
- [Total: 7]**