

## **MARK SCHEME for the May/June 2007 question paper**

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

**0654/03**

Paper 3 (Extended Theory), maximum raw mark 100

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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- 1 (a) (i) (intercostal muscles) shorter / contracted;  
(diaphragm) gone downwards / flattened / contracted ; [2]
- (ii) ribs pulled up and out;  
volume in thorax increased;  
pressure reduced;  
air moves, down pressure gradient / from higher pressure outside body; [max 3]
- (b) goblet cells make mucus;  
mucus traps, bacteria / viruses / particles;  
cilia sweep them upwards; [max 2]
- (c) (i) goblet cells make more mucus;  
cilia, stop working / paralysed / destroyed ; [2]
- (ii) walls break down ;  
fewer / larger, alveoli ;  
walls become thicker / tar deposited ; [max 2]
- 2 (a) (i) they contain different numbers of protons and neutrons; [1]
- (ii) atoms have filled electron shells / outer shell is full; [1]
- (iii) if they were then properties would not match other members of group / order had to be changed to preserve the pattern in properties / potassium would be in group 0 and argon in group 1 ; [1]
- (b) (i)  $0.96 \div 24 / 0.04$ ; [1]
- (ii)  $0.5 \text{ mol in } 1000 \text{ cm}^3 \text{ so } 0.05 \text{ in } 100 \text{ cm}^3 / 0.05$ ; [1]
- (iii) use of equation  $1 \text{ mol Mg requires } 2 \text{ mol HCl} / 2 \times 0.04 \text{ mol HCl needed ;}$   
calculation plus logical conclusion ; [max 2]
- (c) (i) (anode)  
fluorine is a non-metal ;  
anode is positive;  
attractive force between positive anode and negative fluoride ions; [max 2]
- (ii) fluorine is very reactive / most reactive halogen / very corrosive and reacted with body tissue / reacted with airway if breathed in / poisonous / toxic ; [1]
- (iii) gold and platinum are very unreactive / reduces chance of reacting with fluorine;  
low temperature reduces rate of reaction (between fluorine and container) ; [2]

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- 3 (a) (i) work = force × distance ;  
distance travelled = 20 × 30 = 600m / use of 600 in correct context ;  
(800 × 600) 480 000J ; [3]
- (ii) kinetic energy =  $\frac{1}{2} mv^2$ ;  
=  $\frac{1}{2} \times 1200 \times 20 \times 20 = 240\ 000\ J$ ; [2]
- (b) (i) deceleration = change in speed / time;  
= 20/4 = 5 m/s<sup>2</sup>; [2]
- (ii) reaction distance = 24m; (or working)  
braking distance = 40m; (or working)  
total distance = 64m; [3]
- 4 (a) change in, genes / chromosomes / DNA; [1]
- (b) (i) it increases;  
more steeply at higher X-ray doses; [2]
- (ii) ionising radiation;  
removes electrons / damages DNA; [2]
- (c) 7; [1]
- (d) if in body cell, only one of many cells / other cells can carry out that function;  
if in gamete-forming cells, can be passed on to offspring;  
all cells in offspring have that mutation; [max 2]
- (e) (i) pesticides can damage other organisms / humans;  
so food chain disrupted;  
insect pollinators killed;  
pest's predators killed;  
pests develop resistance to pesticide; [max 2]
- (ii) X-rayed males may, be infertile / have one less chromosome / have mutated sperms;  
their offspring may, be weak / die;  
normal males produce fewer offspring (because of competition for mates with X-rayed males); [max 2]

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- 5 (a) (i) 24; [1]
- (ii) starch is a polymer / long chain molecule;  
of unspecified / unknown length / whose length can vary / cannot (with certainty) tell how many atoms are in a starch molecule; [2]
- (b) (i) test shows glucose present (inside tube);  
glucose molecules have passed through the membrane;  
  
colour results from (inter)action between starch and iodine;  
shows iodine has moved through the membrane; [4]
- (ii) (should not be blue-black)  
starch does not pass through the membrane;  
because starch molecules too large / membrane allows only small molecules to pass; [2]
- (c) (i) double bond between carbons ;  
all else correct ;
- $$\begin{array}{c}
 \text{F} \quad \text{F} \\
 | \quad | \\
 \text{C} = \text{C} \\
 | \quad | \\
 \text{F} \quad \text{F}
 \end{array}$$
- [2]
- (ii) **A** was thermoplastic and **B** was thermosetting;  
only weak forces between molecules in **A**;  
strong cross-links / chemical bonds between molecules in **B**;  
(diagrams can gain marks) [3]
- 6 (a) 0.5 (A) ; [1]
- (b)  $1/R = 1/R_1 + 1/R_2$ ;  
 $= 1/60 + 1/40$ ;  
 $R = 24\Omega$ ; [3]
- (c) (i) current is induced;  
when coil is in changing magnetic field; [2]
- (ii) energy input / motion;  
coil rotated (on axis); OR magnet rotated ;  
in magnetic field; OR in coil ;  
coil connected to split ring commutator;  
effect of split ring; [max 4]

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- 7 (a) one oak tree can, support / feed, many caterpillars ;  
 one small bird needs to eat many caterpillars / one hawk needs to eat many small birds;  
 loss of energy between levels;  
 less biomass at each level; [max 2]
- (b) photosynthesis;  
chlorophyll traps energy in sunlight;  
 carbon dioxide reacts with water;  
 produces, sugars / glucose / starch / carbohydrates;  
 contain, chemical energy / stored energy;  
 (energy) passes along chain as food is eaten; [max 4]
- (c) water enters roots by osmosis;  
 transpiration (from leaves);  
 reduces pressure;  
 water moves up xylem;  
 down pressure gradient; [max 3]
- 8 (a) filtration;  
 sedimentation / treatment with aluminium sulphate;  
 boiling / sterilisation / treatment with chlorine / ozone; [max 2]
- (b) (i)  $\text{Ca}^{2+}$ ; [1]
- (ii) boiling reduces hardness / not all hardness reduced by boiling ;  
 water contains both permanent and temporary hardness;  
 water contains calcium hydrogencarbonate; [max 2]
- (c) (i) potassium correctly shown as 2.8.8;  
 chloride correctly shown as 2.8.8; [2]
- (ii) particles, are (electrically) charged / are positive and negative ions;  
 which attract each other strongly;  
 ions form into a giant ionic structure;  
 much energy needed to separate the particles (during melting); [max 2]

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- 9 (a) (i) vibrations / compressions and rarefactions;  
of air molecules; [2]
- (ii) louder; [1]
- (iii) within 5000– 20 000Hz; [1]
- (b) (i) speed (in vacuo) / transverse waves/can travel through a vacuum; [1]
- (ii) wavelength / frequency; [1]
- (iii)  $v = f \times \lambda$ ;  
 $= 10\,000\,000 \times 30 = 300\,000\,000 \text{ m/s}$ ; [2]
- (c) (i) particles collide, more frequently / more forcefully ;  
with, tyre / wall; [max 2]
- (ii)  $P_1/T_1 = P_2/T_2$ ;  
 $P_2 = 200\,000 \times 303/283$  ;  
 $= 214\,130 \text{ N/m}^2$ ; [3]