

MARK SCHEME for the October/November 2007 question paper

0654 CO-ORDINATED SCIENCE

0654/03

Paper 3 (Extended Theory), maximum raw mark 100

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- 1 (a) **A**;
least / less, voltage required (to pass current of 0.4A); [2]
- (b) $R = V / I$;
 $= 0.3/0.4; = 0.75 \Omega$; [2]
- (c) (i) Power = $V \times I$;
 $= 6.2 \times 0.4 = 2.48 \text{ W}$; [2]
- (ii) **C** gets hottest because most power is dissipated; [1]
- (d) charge = current \times time;
 $= 0.4 \times 60 = 24 \text{ C}$; [2]
- 2 (a) (i) fractional distillation / fractionation ; [1]
- (ii) cool and pressurise; [1]
- (iii) two carbons and six hydrogens;
- $$\begin{array}{c}
 \text{H} \quad \text{H} \\
 | \quad | \\
 \text{H}-\text{C}-\text{C}-\text{H} \\
 | \quad | \\
 \text{H} \quad \text{H}
 \end{array}$$
- ; allow ecf if three carbons and eight hydrogens [2]
- (b) (i) so it does not melt / change shape during cooking / heating; [1]
- (ii) polymer molecules are (long) chains;
in thermosets there are, strong bonds / crosslinks between, chains / molecules;
polymer molecules cannot move past each other (when heated) / diagram;
in thermoplastics there are only weak forces between, chains / molecules;
polymer molecules can move past each other (when heated); [max 4]
- (c) (i) same sized atoms in a regular lattice; [1]
- (ii) reference to, sideways / distorting / suitable force (causing layers to slip) ;
reference to, layers / atoms, slipping (without material breaking) ; [2]

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- 3 (a) +3.8 kg and -1.4 kg
 one mark for figures + unit ;
 one mark for indicating (increase and) decrease ; [2]
- (b) cows with highest yield chosen ; *ignore references to genes*
 and used for breeding ;
 with bull whose, relatives / mother / sisters / daughter, had high milk yield ;
 repeat in subsequent generations ; [4]
- (c) *any reasonable suggestion, for example*
 cows with high milk yield are, less successful at breeding / less healthy ; [1]
- (d) (i) idea that selected line are less healthy because they have higher milk yields ;
 producing a lot of milk puts a strain on the cow ;
 more milk in / larger, udder makes it more likely it will be inflamed ;
 more milk carried / more mass, puts more strain on the legs ;
 idea that they have not been selected for health / may by chance
 be genes for poor health in this group of cows ; [max 2]
- (ii) more food needed ;
 to provide, energy / materials, for making milk ; [2]
- 4 (a) (i) speed = distance/time;
 = 320/20 = 16 m/s; [2]
- (ii) KE = $\frac{1}{2} mv^2$;
 momentum = m x v;
 KE depends on velocity squared so $\times 4$; [3]
- (b) (i) current = power/voltage;
 = 60/12 = 5 A; [2]
- (ii) 60 ; [1]

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- 5 (a) (i) nitrogen is too unreactive / bond in nitrogen molecule very strong; [1]
- (ii) (atmospheric) nitrogen converted into a nitrogen compound; [1]
- (iii) three shared pairs;
lone pairs on both atoms; [2]
- (b) (i) $N_2 + 3H_2 \rightarrow 2NH_3$; [1]
- (ii) two from: nitrogen/hydrogen/ammonia/named noble gas; [1]
- (iii) reference to large surface area (increasing efficiency); [1]
- (c) $(NH_4)_2SO_4$;
ref. to need for charges to be balanced; [2]
- 6 (a) label correct ; [1]
- (b) (i) (male) nucleus / (male) gamete ; [1]
- (ii) fertilisation ;
nucleus / male gametes, fuses with, egg cell (nucleus) / female gamete ;
to form a zygote ;
which develops into an embryo ;
ovule develops into a seed ; [max 3]
- (c) sexual because it involves, gametes / fertilisation / zygote ; [1]
- (d) anthers hang outside flower ;
stigma hangs outside flower ;
stigma is feathery ;
no petals / petals dull ;
no nectar ;
no scent ; [max 2]
- (e) drawing shows a fruit with features that would favour dispersal by animals (e.g. hooks, edible flesh) ;
labels indicate how the fruit would be dispersed (e.g. stick to fur, flesh eaten) ;
detail of dispersal (e.g. drops off fur, seeds egested) ; [3]

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- 7 (a) (i) an element which has atoms/nuclei containing the same number of protons but different numbers of neutrons; [1]
- (ii) has shorter half-life / decays faster ;
therefore less radiation emitted / radioactive for a shorter time ;

no beta emission;
beta is more ionising / dangerous ; [4]
- (b) proton number = 93;
nucleon number = 237; [2]
- 8 (a) palisade (mesophyll) ; [1]
- (b) chloroplasts ;
contain chlorophyll ;
absorb (sun)light (energy) ; [max 2]
- (c) (i) osmosis ; [1]
- (ii) **A** more dilute than **B**, which is more dilute than **C** ;
water moves, from high water concentration to low / from low concentration to high; [2]
- (d) (i) in xylem ;
through veins in leaf ;
ref. to idea of transpiration pull ; [max 2]
- (ii) it would increase ;
because transpiration rate greater ;
because evaporation is faster / rate of diffusion is faster ; [max 2]
- (e) turgor / cells push outwards on one another ;
xylem / lignin (provide strength) ; [2]

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- 9 (a) (i) (transverse)
wave motion is at right angles to direction of movement of medium; [1]
- (ii) $v = f \times \lambda$;
 $(\lambda = v/f) = 0.5 / 2 = 0.25 \text{ m}$; [2]
- (b) $E = m \times c \times \theta$;
 $= 60000 \times 4200 \times 5 = 1\,260\,000\,000 \text{ J}$ [2]
- (c) some molecules move faster than others / have more energy than others ;
fast particles / particles with enough energy, can escape;
overcome forces of attraction ; [2]
- (d) straight line leaving the liquid to right of normal ;
bending away from normal; [2]
- 10 (a) (i) **A**;
carbon dioxide produced;
colourless solution / magnesium not a transition metal; [2 max]
- (ii) **C**;
blue solution formed / copper solutions can be blue;
no gas / oxides do not produce gas with acid; [2 max]
- (b) (i) limestone contains calcium carbonate ;
limestone / calcium carbonate, reacts with (sulphuric) acid ;
neutralises the acid;
igneous rock not able to neutralise the acid; [max 2]
- (ii) total moles of acid = $10\,000\,000 \times 0.01$ or 100 000;
 M_r of sulphuric acid = $[(2 \times 1) + (32 \times 1) + (16 \times 4)] = 98$;
mass of sulphuric acid = $100\,000 \times 98 = 9\,800\,000 \text{ g} / 9.8 \text{ tonnes}$; [3]
- (c) grease (is molecular and) does not mix with water;
detergent molecule allows grease and water to mix / ref to emulsion ;
ionic part / hydrophilic head, dissolves in / attaches to, water molecules;
covalent part / hydrophobic tail, dissolves in / attracted to, grease; [max 3]