MARK SCHEME for the October/November 2012 series

0654 CO-ORDINATED SCIENCES

0654/33 Paper 3 (Extended Theory), maximum raw mark 120

1 **(a)** **(i)** <u>two</u> (complete) sets of / 23 pairs / 46, chromosomes ;   [1]

   (ii) fertilisation ;   [1]

 (b) **(i)** **A** ;
         D ;   [2]

   (ii) it has petals ;
         stigma is, enclosed / inside petals / not feathery ;
         anthers / stamens are, enclosed / inside petals ;
         so wind cannot reach them / wind cannot blow away pollen ;
         so insect must crawl past, anther / stigma (to reach nectar) ;   [3]

 (c) method of dispersal (wind, animals, water, self) ;
     reference to feature of fruit that aids dispersal ;
     description of how the feature aids dispersal ;   [3]

                                                                                           [Total: 10]

2 **(a)** **(i)** 78 (%);   [1]

   (ii) different boiling points ;
         gases boil off as their boiling point is reached / gases boil off separately ;   [2]

 (b) **(i)** transition ;   [1]

   (ii) improves (catalyst) efficiency / increases reaction rate ;
         increases (catalyst) surface area ;
         reactions occur on catalyst surface ;   [max 2]

   (iii) nitrogen **and** hydrogen ;   [1]

   (iv) idea that conversion of reactants through reactor is
         incomplete / economic / environmental argument for recycling
         reactants / reference. to equilibrium / reversible reaction ;   [1]

 (c) **(i)** force of attraction between, nuclei / protons, and electrons ;
         because, opposite electrical / positive and negative, charges (attract) ;
         energy / work, required to move particles apart against force of attraction ;   [max 2]

   (ii) idea that (relatively) <u>large</u> amount of energy required (to break bond) / difficult
         to break bond ;
         because high force of attraction ;
         because, many / 3 pairs / 6, shared electrons / electrons in the bond, / idea that
         bond is a <u>large</u> negative charge ;   [max 2]

                                                                                           [Total: 12]

3 (a) **A** – constant / steady, speed / velocity ;
   B – acceleration ;   [1]

(b) (distance = 20 × 90 =) 1800 (m) ;
   (work done =) force × distance ;
   = 1000 × 1800 = 1 800 000 J ;   [3]

(c) (i) (acceleration =) <u>change in</u> speed ÷ time = 33/11 ;
   = 3 m / s^2 ;   [2]

(ii) (force =) mass × acceleration ;
   = 950 × 3 = 2850 N ;   [2]

(iii) the faster a car goes the greater the air resistance / frictional force ;
   (eventually) air resistance balances (maximum) driving force ;   [2]

                                                                                    [Total: 10]

4 (a) (i) any number above 20 000 <u>Hz</u> ;   [1]

(ii) longitudinal ;   [1]

(b) (i) more drinking attempts from smooth than rough ;
   use of figures / almost no attempts from rough ;   [2]

(ii) reference to water having a smooth surface ;
   sound waves scattered in many directions from a rough surface / not
   scattered in many directions from a smooth surface ;
   bats receive fewer echoes from a smooth surface / more echoes from a rough
   surface ;
   other reasonable explanation ;   [max 2]

(c) (i) moths with the, genes / behaviour, are more likely to <u>survive</u> ;
   because they are less likely to be killed by bats ;
   so moths with the, genes / behaviour, are more likely to reproduce ;
   and pass their genes to their offspring ;
   over time / over many generations, most moths will have the,
   genes / behaviour ;   [max 4]

(ii) <u>travel along</u> sensory neurone ;
   to the central nervous system / brain ;
   <u>travel along</u> motor neurone ;
   to muscles ;   [max 3]

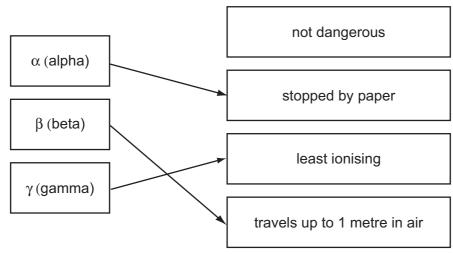   **[Total: 13]**

5 (a) (i) ions separated ;
randomly spread throughout the solution ; [2]

(ii) metal atoms form ions by losing (outer shell) electrons ;
calcium ions have 2 more protons than there are electrons ;
sodium ions have 1 more proton than there are electrons ;
(accept numerical answers based on atomic numbers) [max 2]

(b) (i) calculates M_r of $BaSO_4$ as 137 + 32 + (16 × 4) = 233 ;
calculates moles as 4.66 ÷ 233 = 0.02 ; [2]

(ii) states / implies that 0.02 moles magnesium sulfate in original solution ;
calculates mass of 0.02 moles $MgSO_4$ as 120 × 0.02 = 2.4 g ;

[2]

[Total: 8]

6 (a) (i) alternating current / owtte ;
which changes 50 times per second ; [2]

(ii) power = voltage x current / (I =) P/V ;
current = 2000 ÷ 250 = 8 A ; [2]

(b) (i) particles separate / escape ;
more energetic particles escape (from surface) ;
able to overcome attractive forces of other particles ; [max 2]

(ii) conduction ;
particles nearest heater (element) gain energy and vibrate more ;
vibrations / heat / energy, passed from particle to particle along the metal ;
reference to energy passing via mobile electrons ; [max 2]

(c) solid has particles touching in regular arrangement ;
liquid has most particles touching in random arrangement ; [2]

(d) (energy =) mass × shc × <u>change in</u> temperature ;
= 3 × 4200 × 40 ;
= 504 000 J ; [3]

[Total: 13]

7 (a) (i) amylase ; [1]

(ii) mouth / salivary glands / pancreas ; [1]

(b) (i) absorb amino acids ;
absorb glucose ;
which dissolve in blood (plasma) ; [max 2]

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    (ii) absorb, fats / fatty acids / glycerol ;   [1]

    (iii) increase surface area ;
increase rate of absorption ;   [2]

(c) taken up by liver <u>cells</u> ;
changed to glycogen ;
(glycogen) stored ;   [max 2]

[Total: 9]

8 (a) diagram shows close packed regular pattern of spheres ;
including some with a different diameter disrupting structure ;
idea that different sized atoms make it more difficult for atoms to move with respect to one another ;
when a force is applied ;   [max 3]

(b) $Cu_2S + O_2 \rightarrow 2Cu + SO_2$;   [1]

(c) (i) copper sulfate ;   [1]

    (ii) (some copper from) the anode has <u>dissolved</u> ;
at anode $Cu \rightarrow Cu^{2+} (+ 2e^-)$;
copper has deposited on the cathode ;
at cathode $Cu^{2+} (+ 2e^-) \rightarrow Cu$;   [max 2]

    (iii) impure copper is made the anode ;
only copper, (atoms) deposit on / ions discharge at, the cathode / owtte ;
impurities, fall out / are not deposited / owtte ;   [max 2]

[Total: 9]

9 (a) turns atoms into ions / charged particles, / atoms become charged ;
removal of electrons ;   [2]

(b) X-rays can damage cells ;
screen stops X-rays passing through ;   [2]

(c) $(3 \times 10^8 \, m/s)$ because all <u>electromagnetic</u> waves travel at same speed ;   [1]

(d)

all three correct two marks, two correct one mark ;; [2]

[Total: 7]

10 (a) through root hairs ;
across cortex of root ;
into xylem ;
additional detail about xylem in root / stem / leaf ;
to mesophyll cells in leaves ; [max 3]

(b) (i) to make amino acids / DNA ;
to make proteins ;
for growth / to build cells / to make enzymes ; [max 2]

(ii) no osmosis (into roots) ;
water potential outside lower than water potential inside / water concentration outside lower than water concentration, inside / ion concentration outside higher than ion concentration inside ;
because high concentration of (dissolved) ions reduces water potential ; [max 2]

(iii) fertiliser causes growth of, algae / plants ;
which, shade out other plants / die / decompose / decay ;
bacteria, feed on / decompose, dead plants / increase in bacterial growth ;
bacteria use oxygen (for respiration) ;
fish die <u>from lack of oxygen</u> ; [max 3]

[Total: 10]

11 (a) nucleus and 6 protons and 6 neutrons indicated ;
two electron shells with 2,4 configuration ; [2]

(b) diamond very hard <u>and</u> graphite softer / flaky ;

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diamond has C atoms all interconnected in three dimensional array/all atoms bonded into the structure/one huge macromolecule/reasonable attempt at diagram ;
all bonds in diamond are very strong ;
graphite arranged in layers (of hexagonally bonded C atoms) / reasonable attempt at diagram ;
only weak forces between layers (allows layers to slide) ;
OR
diamond poor conductor <u>and</u> graphite good conductor ;
diamond has C atoms all interconnected in three dimensional array/all atoms bonded into the structure/one huge macromolecule / reasonable attempt at diagram ;
all (valence) electrons in bonds ;
graphite arranged in layers (of hexagonally bonded C atoms)/reasonable attempt at diagram ;
free electrons between layers ;
(reject reference to melting point)   [max 4]

(c) (i) alkanes ;
only single bonds/saturated/fits general formula C_2H_{2n+2} ;   [2]

(ii) gasoline burns to produce carbon dioxide which is linked to greenhouse effect / climate change ;
gasoline burns to produce pollutants such as carbon monoxide / other named pollutants (which have adverse effects on health) ;
hydrogen waste product is (non-polluting) water ;   [3]

[Total: 11]

12 (a) heat energy turns water into steam / heats CO_2 ;
steam / kinetic energy, drives turbine (which drives generator) ;   [2]

(b) slip rings ;
coil connections are not reversed / slips rings rotate with coil / direction of current reverses as coil turns ;
maintain connection / avoid wires twisting ;   [max 2]

(c) (i) Vp / Vs = Np / Ns ;
Ns = 40 000 × 400 000 / 25 000 ;
= 640 000 (turns) ;   [3]

(ii) to enable transformers to change voltage / transformers only work with a.c. ;   [1]

[Total: 8]