UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

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, which would have considered the acceptability of alternative answers.

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1 **(a)** angles approx correct ;
angles of incidence and reflection correctly labelled ;
arrow on reflected ray and straight lines ; [3]

(b) **(i)** violet / blue / indigo ; [1]

(ii) different wavelengths (frequencies) ; [1]

[Total: 5]

2 **(a)** bacteria / *Rhizobium*, use nitrogen (from the air) ;
to make, ammonium / nitrogen compounds ; (ignore nitrates)
fixed nitrogen / nitrogen compound, used for making, amino acids / proteins ; [max 2]

(b) choose, plants / soy beans, that have, high yields of seeds ;
or choose one plant with high yield of seeds and another with other good characteristic ;
breed them together ;
select the offspring with highest yields ;
repeat over many generations ; [max 4]

(c) **(i)** Dunfield ; [1]

(ii) Mandarin ; [1]

(iii) more photosynthesis ;
so more production of, carbohydrates / named carbohydrate /materials for making cells ;
carbon dioxide is a limiting factor at normal concentrations ; [max 2]

(iv) carbon dioxide in the atmosphere is increasing ;
ref to a reason for this, e.g. burning fossil fuels / deforestation ;
idea of needing to plan for future food production ; [max 2]

[Total: 12]

3 **(a)** phosphorus / P ;
(15 electrons so) 15 protons so atomic number 15 / proton number is 15 *or*
5 electrons in outer shell / in group 5, and, three shells / period 3 ; [2]

(b) carbon hydrogen oxygen / C H O ; [1]

(c) **(i)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$; [1]

(ii) nitrogen and hydrogen ;
reversible reaction / have not reacted ; [2]

(iii) use high pressure / at *or* above 200 ;
use low temperature / 200 °C ; [2]

(d) M_r of ammonia = 17 ;
mass of ammonia exiting reactor per minute = 1000 × 17/100 = 170 kg ;
= 170 000 g ;
moles of ammonia = 170 000 / 17 = 10 000 ; [4]

[Total: 12]

4 **(a)** **(i)** would affect enzymes ;
if temperature rises much above, 37 / 40 °C ;
ref. to denaturing them / altering their shape / destroying them ;
enzymes catalyse (metabolic) reactions ;
without enzymes reactions will not take place ; [3 max]

(ii) evaporation ;
of water (in sweat) ;
ref. to latent heat of evaporation ;
heat taken from skin ; [2 max]

(b) parents **Aa** × **Aa** ;
each produce gametes **A** and **a** ;
offspring shown as **AA**, **Aa**, **Aa** and **aa** ;
AA and **Aa** can smell, **aa** cannot smell ;
ratio is 3 can smell : 1 cannot smell ; *accept fraction or percentage* [4 max]

[Total: 9]

5 **(a)** **(i)** temperature **rise directly** proportional to energy input
or temperature (rise) proportional to energy input ; [1]

(ii) working ;
40 kJ ; [2]

(iii) working 40/2 × 20 ; *ecf from (ii)*
= 1 ; *ecf if 2000 used in calculation*
kJ / kg °C ;
can work in joules throughout – ensure units in answer are appropriate [3]

(iv) power = energy / time ;
40 000/600 = 66.7/67 W ; *ecf from (iii)* [2]

(v) current = 66.7/12 = 5.5 A ; *ecf from (iv)*
so fuse will not, melt / blow / break ; [2]

(b) **(i)** beta ;
alpha would be completely stopped and gamma not stopped at all ; [2]

(ii) lead ; [1]

[Total: 13]

6 **(a)** reduction / oxidation / redox ;
Si / SiO_2 has lost oxygen and is reduced / carbon has gained oxygen and is oxidised ; [2]

(b) **(i)** aluminium ions are positive ;
and are attracted to the negative (cathode) ; [2]

(ii) aluminium ions gain electrons ;
gain three electrons (each) / are discharged ; [2]

(c) light rays are, scattered / reflected, by dispersed solid in solution ;
light rays pass through solution (unaffected) ; [2]

(d) carbon dioxide is simple molecular ;
melting involves breaking weak forces between molecules ; (max 1)
silicon dioxide is giant (lattice) ;
melting involves breaking very many strong bonds between atoms ; (max 1)
[2]

[Total: 10]

7 **(a)** **A** scapula / shoulder bone
B humerus
C radius
D ulna
any two correct for one mark ; [2]

(b) **(i)** contracts / gets shorter ;
pulls, lower arm / forearm / ulna / radius, up ; [2]

(ii) transmit, force / pull, from muscle to bone ; [1]

(c) biceps exerts a turning force ;
elbow is, fulcrum / pivot ;
moment is force × distance from pivot ;
large force small distance from pivot can balance small force large distance from pivot ;
small, contraction / movement, of biceps causes large movement of hand ;
if distance from elbow was greater then, turning force would be greater / less force would be needed ;
but muscle would need to get much shorter ; [max 3]

(d) **(i)** supply of oxygen ;
supply of, nutrients / glucose ;
for respiration ;
energy needed for contraction ; [max 3]

(ii) **(**very) small / narrow ;
brings blood close to all cells ;

thin walls / walls only one cell thick ;
allows (rapid) movement of, substances / named substances (between cells and blood) ;

large surface area to volume ratio ;
allows (rapid) movement of, substances / named substances (between cells and blood) ; [max 2]

8 **(a)** **(i)** (momentum) = m × v ;
= 4000 × 0.5 = 2000 kg m / s ; [2]

(ii) total momentum is conserved / momentum equals zero ;
energy is lost to environment / sound / heat ;
speed (of each) becomes zero ; [3]

(b) (work done =) force × distance ;
= 3000 × 2 = 6000 J ; [2]

(c) (i) immerse in water ;
measure volume of liquid displaced ; [2]

(ii) (density =) mass / volume ;
= 4000 / 4 = 1000 kg / m^3 ; [2]

(d) (i) the number of waves per, second / unit time ; [1]

(ii) 20 Hz – 20 000 Hz ; *allow from 10 Hz up to 26 000 Hz* [1]

(iii) longitudinal - pattern of disturbance is in same direction as direction of wave (movement) / ref. compressions and rarefactions ;
transverse - pattern of disturbance is at right angles to direction of wave (movement) ; [2]

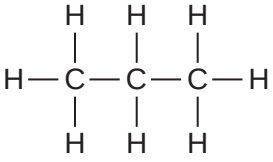
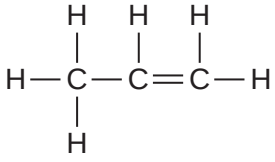
[Total: 15]

9 (a) *gasoline has:*
lower viscosity / lower boiling point / lower melting point / less coloured / higher flammability / less dense / more volatile ; [1]

(b) (i) carbon monoxide ; [1]

(ii) use of catalytic (converter) ; [1]

(c) (i)

ALKANE	ALKENE
	

[2]

(ii) **X** is bromine / bromine solution / bromine water /
potassium manganate(**VII**) solution ;
if hydrocarbon is an alkene then bromine changes from orange to colourless /
manganate(**VII**) from purple to colourless ; [2]

(d) $C_2H_4 + H_2O \rightarrow C_2H_6O$; [1]

(e) sulfur dioxide is produced (when sulfur compounds burn) ;
ref. acid rain ;
acidic gases / sulfur compounds, react with calcium hydroxide ;
ref. neutralisation ; [max 3]

[Total: 11]