CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2013 series

0654 CO-ORDINATED SCIENCES

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

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1 (a) (i) **A** labelled between 0 s and 20 s ; [1]

(ii) working on graph / calculation of area under graph ;
280 m ; [2]

(b) (i) energy input (to panel) from sun / energy from sun (to panel), varies ; [1]

(ii) 6 hours (as graph worked) ; [1]

(iii) efficiency = (useful) (energy) output / (energy) input ;
energy input = 2000/0.2 = 10000 J / s ; [2]

(iv) (kinetic energy =) ½ mv^2 ;
= ½ × 750 × 7 × 7 = 18 375 J ; [2]

(c) (i) voltmeter in parallel with photocell and correct symbol ; [1]

(ii) power = voltage × current ;
= 2.5 × 0.2 = 0.5 W ; [2]

[Total: 12]

2 (a) <u>fractional distillation</u> ; [1]

(b) (i) C_8H_{18} ;
total number of each type of atom must be same on both sides of equation ; [2]

(ii) double bond shown ;
single bonds shown ;

[2]
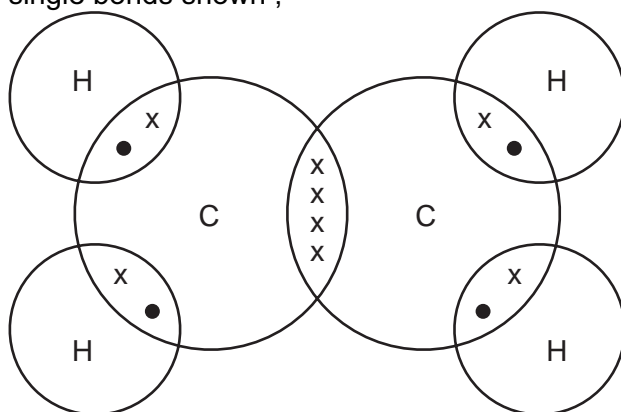
(max 1 mark if symbols missing or incorrect)

(c) (i) 480 ÷ 24 000 ;
= **0.02** ; [2]

(ii) number of moles of ethene used = 0.02 ÷ 2 = 0.01 ;
M_r ethene = (12 × 2) + (1 × 4) = 28 ;
mass of 0.01 moles ethene = 28 × 0.01 = **0.28 g** ; [3]

[Total: 10]

3 (a) (i) chemical (energy) ; (accept: potential) [1]

(ii) 1 (%) ; [1]

(iii) respiration ;
as heat ;
movement / kinetic ;
not all organisms eaten / not all parts of organisms eaten ;
not all food digested / some lost in faeces ; [max 2]

(b) less photosynthesis (as fewer trees) ;
so less carbon dioxide removed / used ;
trees burned ;
producing carbon dioxide ;
more carbon dioxide in atmosphere contributes to greenhouse effect / traps
heat ; [max 3]

[Total: 7]

4 (a) (i) $Mg + 2HCl \rightarrow MgCl_2 + H_2$;;; [3]
(LHS ; RHS ; and balanced ;)

(ii) heat energy has been transferred / released into the mixture ;
(heat released by) exothermic reaction ;
chemical energy transferred into heat energy ;
products have lower chemical energy content than reactants ; [max 2]

(b) (i) 2.5 ; [1]

(ii) the higher the temperature the higher the rate ;
if temperature increases then speed / KE of molecules increases ;
reactions occur when molecules collide ;
if speed increases collision frequency increases ;
and collision energy increases ;
which leads to greater chance of reaction ; [max 3]

[Total: 9]

5 (a) (i) 3×10^5 (km/s) ; [1]

(ii) infra-red ; [1]

(iii) wavelength / frequency ; [1]

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(b) both alpha radiation and beta radiation pass easily through the body   ☐

alpha radiation damages cells in a very localised part of the body   ☑

ionisation does not always kill cells – sometimes it causes them to mutate   ☑

cancer occurs when a large number of cells are killed   ☐

the dose of radiation received depends on the length of exposure   ☑

(*all five boxes correct = 2 marks, four boxes correct = 1 mark*) ;;   [2]

(c) half-life = 90 (minutes) ;

working ;   [2]

(d) (i) polonium –210 (no mark)

largest / longest half-life ;   [1]

    (ii) polonium and radon, (no mark)

alpha is most ionising / both emit alpha ;   [1]

(e) *use(s)*

B to inject into a person as a medical tracer ;

explanation

A and **C** need long half-lives to work ;

B needs short half-life so that it does not remain in body / owtte ;

but long enough so that it can be monitored ;   [max 3]

[Total: 12]

6 (a) arrow on **A** pointing downwards

arrow on **B** pointing downwards

arrow on **C** pointing upwards

arrow on **D** pointing upwards

(*all four correct for two marks, two or three correct for one mark*) ;;   [2]

(b) (i) urea / carbon dioxide ;   [1]

    (ii) water ;

one from – amino acid / glucose / fatty acid / glycerol / named relevant element /

named vitamin ;

antibodies ;   [max 2]

(c) (i) by red blood cells ;

by haemoglobin ;

combined with haemoglobin / as oxyhaemoglobin ;   [max 2]

(ii) reference to diffusion ;
shorter distance to travel (therefore less time taken (for diffusion)) ;
more surface area (therefore more can move across at once) ;
greater, rate of more, blood flow (so oxygen taken away faster) ;
idea that this maintains diffusion gradient ;
comparative use of figures, e.g. distance across surface in lungs is 7 times
smaller than in placenta ;   [max 4]

[Total: 11]

7 (a) copper unreactive / stable enough to exist as metal ;
sodium and magnesium react easily with, non-metals e.g. oxygen ;   [2]
(i.e. 1 general reactivity mark and 1 mark for relevant extra detail)

(b) (i) alloy ;   [1]

(ii) *harder*
tin atoms disrupt layers of copper atoms ;
making it more difficult for layers to move over each other / which means
more energy required to make layers slip ;   [2]

(iii) *mixture*
proportions of tin and copper can vary / no fixed chemical formula ;
OR
compound
<u>atoms</u> of different elements are bonded ;
some properties of bronze are different from either tin or copper ;   [max 1]

(c) (i) spoon / electrode **S** is a cathode / negatively charged ;
so attracts positive copper ions ;
copper ions gain electrons ;
copper ions gain two electrons / are discharged / converted into copper atoms ;
copper atoms bond together / stick to steel spoon ;   [max 4]

(ii) oxygen / carbon dioxide / carbon monoxide ;   [1]

(iv) weigh the electrode before and after the process ;
decrease in mass provides the required evidence ;
OR
use micrometer to find / measure electrode <u>thickness</u> before and after the
process ;
decrease in thickness provides the required evidence;   [max 2]

[Total: 13]

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8 (a) (i) (energy =) power × time ;
1100 × 40 × 60 ;
= 2 640 000 (J) ;   [3]

(ii) electricity could be produced by burning fossil fuels / named example ;
(fossil) fuels when burned / power stations release CO_2 ;
reduced demand for (fossil) fuels / electricity reduces amount of CO_2 released ;   [max 3]

(b) (i) (R =) V/I ;
R = 220 / 3 = 73 Ω ;   [2]

(ii) charge = current × time ;
= 3 × 12 × 60 = 2160 C ;   [2]

(c) (i) liquid particles touching and similar size ;
gas particles not touching ;
random arrangement for both ;   [3]

(ii) <u>faster</u> moving molecules ;
can do more work against attractive forces / can break bonds between them /
owtte ;
break free / separate turn into gas / leave liquid ;
energy / heat (from surroundings) used for this ;   [max 3]

[Total: 15]

9 (a) (i) from the air ;
by diffusion ;
through stomata ;   [3]

(ii) from the soil ;
absorbed by root hairs ;
by osmosis (into roots / xylem) ;
up xylem to leaves ;
pulled up by transpiration ;   [max 3]

(b) (i) breakdown of large molecules;
so that they can be absorbed / become soluble ;   [2]

(ii) enzymes ;
proteases ;
trypsin / pepsin ;   [max 2]

(c) (i) as a control / to make sure the only variable was the substance used ;　　　[1]

(ii) they moved away from the side containing the solution from the pitcher ;　　　[1]

(iii) pitchers have slippery rim (so insects fall in) ;
pitchers have downward-pointing spines (so insects can't crawl out) ;
rim attracts insects ;
avp ;　　　[max 3]

[Total: 15]

10 (a) (i) <u>max 2 from either part:</u>
reduce acidity / increase pH / neutralise acids ;
calcium carbonate reacts with / neutralises acids ;
releases nutrients from soil ;

increase plant nutrient levels / fertilises ;
potassium compounds are essential for healthy plant growth / increases yield ;
neutralises acids (if not credited above) ;　　　[max 3]

(ii) potassium ion is K^+ / charges must balance ;
so carbonate is CO_3^{2-} ;　　　[2]

(b) (i) iron ;　　　[1]

(ii) nitrogen and hydrogen too unreactive / react too slowly (without it) ;
catalyst speeds up the reaction / allows the reaction to occur ;　　　[max 1]

(iii) nitric acid ;　　　[1]

[Total: 8]

11 (a) curve goes up and then down again ;
peak between 30 and 45 °C ;
rate zero (by 60 °C or sensible figure) ;
OR
up and down (including two straight lines) ;
sensible scale shown ;
correct shape ending at zero ;　　　[max 3]

(b) (i) skin / brain / hypothalamus ;　　　[1]

(ii) contract / shiver ;
release heat ;　　　[2]

(iii) sensor / receptor detects a change from normal / example / owtte ;
brings about a response that returns factor towards normal / example ;　　　[2]

[Total: 8]