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

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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CAMBRIDGE
International Examinations

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]

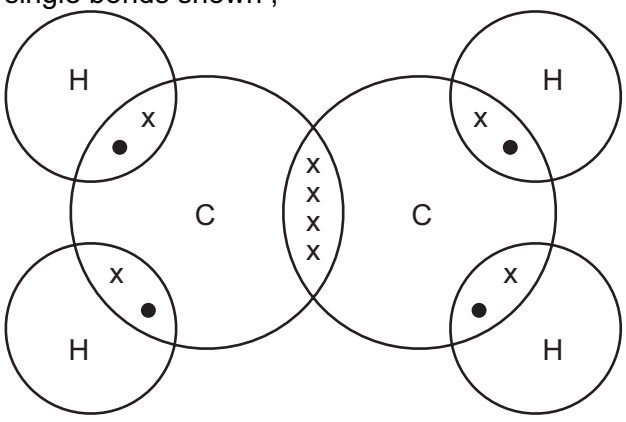
(ii) power = voltage × current ;
= 2.5 × 0.2 = 0.5 W ; [2]

[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 = **<u>0.28 g</u>** ; [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]

(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
atoms 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 thickness before and after the process ;
decrease in thickness provides the required evidence; [max 2]

[Total: 13]

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) faster 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]