

MARK SCHEME for the October/November 2012 series

0653 COMBINED SCIENCE

0653/31

Paper 3 (Extended Theory), maximum raw mark 80

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- 1 (a) *statement given* *word required*
a complete loop of conductors circuit ;
a particle with an negative electrical charge electron ;
measures potential difference voltmeter ;
unit of power watt ; [max 2]
(all correct for 2 marks, 2 or 3 correct for 1 mark)
- (b) (i) (goes out) [1]
incomplete circuit ;
- (ii) so that they can be individually turned on and off ;
so that they all get the full mains voltage ;
so that if one fails the rest still operate ; [max 2]
- (iii) $1/R = 1/R_1 + 1/R_2$;
 $= 1/1.2 + 1/1.2$;
 $R = 0.6 \Omega$; [3]
- [Total: 8]
- 2 (a) (i) A ;
B, E, F ; (all required) [2]
- (ii) starch/cellulose/sugar/any other correct ; [1]
- (b) feed on dead (plant or animal) material/waste products (from plants or animals) ;
use carbon-containing substances/sugar ;
for respiration ;
return carbon dioxide to the air ; [max 2]
- (c) (i) idea that the graph shows a maximum ;
(the maximum occurs) at 480 ± 20 Hz ;
idea of steeper decrease than increase ; [2]
- (ii) crawl out of soil when they hear vibrations (of 500 Hz) ;
where moles cannot catch them ; [2]
- [Total: 9]
- 3 (a) (i) 7 ;
>7 up to 14 ;
<7 down to 1 ; [2]
- (ii) meter is more accurate/precise/reference to quantitative ; [1]
- (iii) add (acidified) silver nitrate/ethanoate (solution) ;
white precipitate/solid indicates hydrochloric acid/chloride (ions) ; [2]

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(b) (i) magnesium + copper oxide $\longrightarrow$ magnesium oxide + copper ;

[1]

(ii) (no reaction)

G reacts with copper oxide ;

G more reactive than copper ;

so copper cannot remove oxygen from oxide of **G**/owtte ;

[max 2]

[Total: 8]

4 (a) mass = 60 kg so weight is 600 N ;
(work done =) force $\times$ distance / (P.E. gained =) gravitational field strength $\times$ height ;
 $= 600 \times 1.3 = 780 \text{ J}$;

[3]

(b) 780 (J) ;

[1]

(c) power = work/time ;
 $780/0.5 = 1560 \text{ W}$;

[2]

[Total: 6]

5 (a) (i) $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$; ;
(left hand side and right hand side)

[2]

(ii) carbon dioxide would not be absorbed ;

volume of carbon dioxide produced = volume of oxygen used ;

so no change in volume ;

[max 2]

(b) (i) as a control / to check that movement was caused by germinating / living seeds ;

[1]

(ii) increased rate of respiration with increased temperature / positive correlation ;
 10°C rise doubles rate ;

use of data linking distance moved and rate of respiration ;

[max 2]

(iii) no movement ;

enzymes do not work at high temperatures / enzymes denatured ;

[2]

[Total: 9]

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- 6 (a) reference to high rate/fast reaction ;
powder has high surface area ;
high surface area (of solids) increases rate/ref. to collision frequency ; [m
- (b) (i) electrons transferred from aluminium (atoms) to oxygen (atoms) ;
reference to filled outer shells ;
reference to formation of positive and negative ions ;
correct detail i.e. aluminium ions positive and oxide ions negative ;
strong (force of) attraction between ions ; [max 4]
- (ii) (not balanced)
balanced requires same number of each type of atom on both sides ;
reference to the oxygen imbalance ;
correct detail about oxygen imbalance/correctly balances equation ; [max 2]
- (c) (components in) firework mixture must burn/require oxygen to burn/need
to be oxidised ;
potassium perchlorate produces oxygen (when heated) ;
idea that oxygen needs to be produced in situ/air cannot easily get into
firework mixture ; [max 2]
- [Total: 10]

- 7 (a) amplitude labelled ;
wavelength labelled ;
correct dimensions for both ; [3]
- (b) (i) **A** is louder than **B** ; [1]
- (ii) **X** has higher pitch ; [1]
- (iii) $\frac{\text{speed of sound}}{\text{m/s}}$, therefore
vacuum 0 ;
solid 5000 ;
liquid 1500 ;
gas 330 ; [max 2]
(all correct for 2 marks, 2 or 3 correct for 1 mark)
- (iv) *compression*
region of high pressure/lots of (air) particles/particles closer ;
rarefaction
region of low pressure/fewer (air) particles/particles more spaced ; [2]

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(c) radiation ;
(only) radiation can travel through vacuum/conduction and convection
need medium ;

(d) ray continued as series of straight lines ;
angles approx correct ;

[2]

[Total: 13]

8 (a) (i) **A** carries, sperm/semen ;
B produces fluid, for sperm to swim in/containing sugar/secretes
seminal fluid ;
C carries, sperm/semen and urine ;

[3]

(ii) label to testis ;

[1]

(b) smaller ;
produced in larger quantities ;
more mobile ;
have a tail/pointed head/streamlined ;

[max 2]

(c) virus destroys/attacks white blood cells ;
reference to (T) lymphocytes/T cells ;
reduces ability to, destroy viruses/fight infection ;

[max 2]

[Total: 8]

9 (a) (i)

methane	ethane
$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$

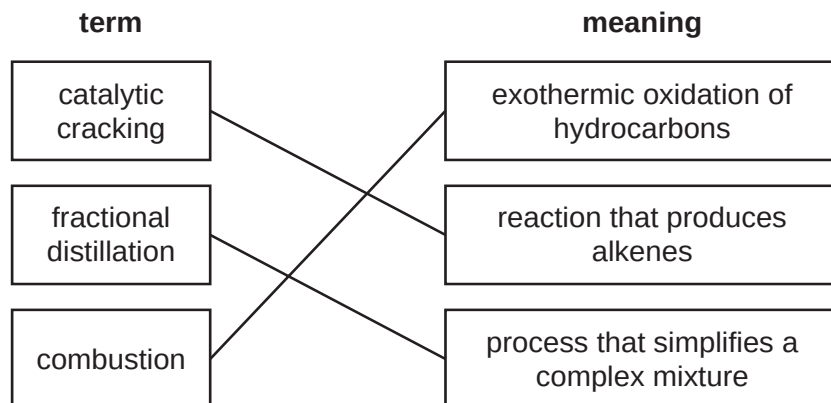
[2]

(ii) bottled gas ;
heating ;
cooking ;

[max 1]

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(b)



(all correct for 2 marks, 1 correct for 1 mark)

[2]

- (c) (i) decane reacted / decomposed / cracked ;
 products include alkenes / ethene / unsaturation ;
 alkenes react with bromine / decolorise bromine ;

[3]

- (ii) makes catalyst more efficient / work better / increases reaction rate ;

[1]

[Total: 9]

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- 1 (a) haemoglobin ;
- (b) (i) absorb, water / mineral ions / correct named ion ;
- (ii) large surface area ;
idea that more water / ions can be absorbed (at the same time) ; [2]
- (c) (i) inner parts of at least one oval shaded ; [1]
- (ii) **C, B, A** ; [1]
- (iii) transpiration / evapotranspiration ;
as water vapour / reference to evaporation ;
through the stomata ;
by diffusion ; [max 3]
- [Total: 9]
- 2 (a) 118 ;
7 ; [2]
- (b) (i) accept yellow through orange ;
and brown through black (solid) ;
(reaction occurs because) chlorine displaces / oxidises the other
halide / halogen ;
because chlorine is more reactive / reactivity decreases down the group ; [3]
- (ii) (no)
most vigorous would be between most reactive halogen and most reactive
alkali metal ;
most reactive alkali metal is rubidium / reactivity increases down Group 1 ;
student should use rubidium (with fluorine) ; [max 2]
- (c) $2K + Br_2 \longrightarrow 2KBr$; ;
[1 mark for KBr, 1 mark for Br₂, 1 for balanced] [3]
(do not allow balance mark for $K + Br \longrightarrow KBr$)
- [Total: 10]

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- 3 (a) (i) particles are closer together in liquid / correct reference to density ;
particles collide / transmit energy more quickly in liquid ;
- (ii) greater amplitude ;
same frequency ; [2]
- (iii) 10 to 20 (Hz) **to** 20 000 to 25 000 (Hz) ; [1]
- (iv) sound waves – longitudinal ;
water waves – transverse ; [1]
- (b) (i) (time =) distance/speed ;
= 0.0012 s ; [2]
- (ii) speed = frequency × wavelength **or** wavelength = speed/frequency ;
= 330/2200 = 0.15 m ; [2]

[Total: 10]

- 4 (a) (i) (all) organisms and their environment ;
interacting together ; [2]
- (ii) energy (flow) ; [1]
- (iii) secondary consumer / third trophic level ; [1]
- (iv) energy lost, between trophic levels / from one organism to another ;
not enough energy to support more than five levels ; [2]
- (b) reference to sexual reproduction ;
pollination ;
bees carry pollen from anther / to stigma / to a another plant ;
pollen contains male gametes ;
reference to fertilisation (following pollination) ;
seeds formed ; [max 3]

[Total: 9]

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- 5 (a) goes cloudy ;
because solid / precipitate / calcium carbonate produced ;
OR
goes cloudy and then clears ;
because precipitate / calcium carbonate forms and re-dissolves ; [max 2]
- (b) (i) **D** ; [1]
- (ii) increasing temperature increases rate / ORA ;
decreasing concentration / higher ratio water:acid decreases rate / ORA ; [2]
- (iii) increasing temperature causes increase in particle speed / K.E. ;
increases frequency of collisions between acid particles and tablet ;
increases energy of collisions between acid particles and tablet ; [max 2]
- [Total: 7]**
- 6 (a) (i) $R = V/I$;
 $= 2/0.2 = 10\ \Omega$ **and** $= 4/0.31 = 12.9\ \Omega$; [2]
- (ii) current not (directly) proportional / current does not increase as much / rate of
increase decreases / begins to level off ; [1]
- (b) (i) angle of incidence labelled and angle of reflection labelled ; [1]
- (ii) 45° ; [1]
- [Total: 5]**

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7 (a) E ;
C ;

(b) (i) fatty acids produced ;
acids lower pH ; [2]

(ii) tube **B** was at a higher temperature ;
the reaction took place faster ;
reference to greater kinetic energy of (reacting) particles / greater collision
frequency between enzyme and substrate ; [3]

(c) heart disease ;
reference to atherosclerosis / build-up of plaques / cholesterol in arteries ;

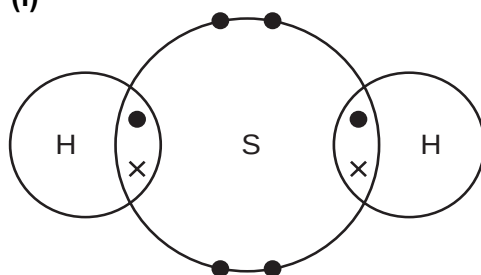
reference to obesity ;
(obesity leads to) greater risk of diabetes / heart disease / high blood pressure ; [max 2]

[Total: 9]

8 (a) (i) methane ;
methane + oxygen ; $\longrightarrow$ carbon dioxide + water ; (LHS,RHS) [3]

(ii) fuels combusted reference to combustion / oxidation ;
sulfur dioxide produced ;
reacts / dissolves in atmospheric water to form acid rain ;
acidic water gathers in rivers and lakes / acid does not evaporate from lakes ; [4]

(b) (i)



two shared pairs ;
lone pairs on sulfur ; [2]
(max 1 if symbols missing or incorrect or if extraneous electrons present)

[Total: 9]

Page 6	Mark Scheme	Syllabus
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- 9 (a) (KE =) $\frac{1}{2}mv^2$;
 $= \frac{1}{2} \times 0.5 \times 0.5 \times 0.5 = 0.0625 \text{ J}$;
- (b) friction ;
friction between materials ;
electrons are lost from car/gained by plastic surface ;
correct reference to imbalance of positive and negative charges ; [max 3]
- (c) (i) D to E ; [1]
- (ii) B to C (no mark)
0.4 (m/s) ; [1]
- (iii) A to B ;
acceleration = change in speed/time = $0.4/5 = 0.08 \text{ m/s}^2$; [2]
- (iv) area under graph implied ;
 $= (\frac{1}{2} \times 0.4 \times 5) + (0.4 \times 2.5) + (\frac{1}{2} \times 0.4 \times 12.5) = 1.0 + 1.0 + 2.5$;
4.5 m ; [3]
- [Total: 12]

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- 1 (a) (i) two complete sets of chromosomes/23 pairs/46 chromosomes ;
(ii) fertilisation ;
- (b) (i) **A** ;
D ; [2]
- (ii) it has petals ;
stigma is enclosed/inside petals ;
anthers/stamens are enclosed/inside petals/not dangling outside petals ;
so wind cannot reach them/wind cannot blow away pollen ;
so insect must crawl past, anther/stigma, to reach nectar ; [max 3]
- (c) (lettuce) seeds need oxygen (for germination) ;
(lettuce) seeds need water (for germination) ;
(lettuce) seeds do not need light (for germination) ; [3]
(max 2 marks if germination not mentioned)

[Total: 10]

- 2 (a) ions separated ;
randomly spread throughout the solution ; [2]
- (b) metal atoms form ions by losing electrons/outer shell electrons ;
calcium ions have 2 more protons than there are electrons ;
sodium ions have 1 more proton than there are electrons ; [3]
(accept numerical answers based on atomic numbers)
- (c) Na_2CO_3 ;
reference to charge balance ; [2]

[Total: 7]

- 3 (a) **A** – constant speed, **and B** – (constant) acceleration ; [1]
- (b) (i) work done = force $\times$ distance ;
reference to $20 \times 90 = 1800 \text{ (m)}$;
 $= 1000 \times 1800 = 1\,800\,000 \text{ J}$; [max 3]
- (ii) power = work/time **or** power = energy/time ;
 $1\,800\,000/90 = 20\,000 \text{ W}$; [2]
- (c) (acceleration = change in speed/time) = $33/11$;
 $= 3 \text{ m/s}^2$; [2]

[Total: 8]

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- 4 (a) (i) any number above 20 000 Hz ;
(ii) longitudinal ;
- (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 ;
bats receive fewer echoes from a smooth surface ; [max 2]
- (c) fertiliser causes growth of algae / plants ;
which shade out other plants / plants die ;
bacteria feed on dead plants / increase in bacterial growth ;
bacteria use oxygen (for respiration) ;
fish die from lack of oxygen ; [max 3]
- [Total: 9]
- 5 (a) diagram shows close packed regular pattern of spheres ;
including a few with a different diameter ;
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) $\text{Cu}_2\text{S} + \text{O}_2 \longrightarrow 2\text{Cu} + \text{SO}_2$; [1]
- (c) (i) cathode is the negative electrode ;
attracts positive (copper) ions / attractive force between opposite charges ; [2]
- (ii) (copper) ions gain electrons ;
copper ions are discharged / gain two electrons / $\text{Cu}^{2+} + 2\text{e}^- \longrightarrow \text{Cu}$;
copper atoms join together / bond to the steel spoon ; [3]
- [Total: 9]

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- 6 (a) heat ;
kinetic ;
- (b) (i) faster-moving more energetic particles ;
escape from surface ;
able to overcome attractive forces of other particles ; [max 2]
- (ii) lowers average energy of the remaining particles in the
liquid/evaporated particles take heat energy away from the liquid ; [1]
- (iii) reference to conduction ;
particles nearest heater (element) gain energy and vibrate more ;
vibration passes from particle to particle (through the metal) ; [2]
- (c) solid – particles touching and regular arrangement ;
liquid – most particles touching and random arrangement ; [2]
- (d) efficiency = useful energy out/energy in ;
OR
the fraction of input energy which is transferred to useful energy/owtte ; [max 1]

[Total: 10]

- 7 (a) (i) **A** incisor/canine ;
B molar/premolar ; [2]
- (ii) crush/grind ;
increase surface area ;
idea of better access for enzymes ; [max 2]
- (b) (i) mouth/small intestine/duodenum/ileum ; [1]
- (ii) small intestine/duodenum/ileum ; [1]
- (c) pH7 is optimum/enzyme more active at pH 7 than pH 5 ;
shape of enzyme is altered at pH 5 ;
so substrate cannot fit into active site ;
reference to denaturation ; [max 3]

[Total: 9]

Page 5	Mark Scheme	Syllabus
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- 8 (a) (i) nucleus and 6 protons and 6 neutrons indicated ;
two electron shells with 2,4 configuration ;
- (ii) **P, Q, S** ;
made of only one type of atom ;
- R** ;
made of different atoms (bonded) ; [4]
- (b) (i) (physical)
only changes of state involved / no new compounds produced ; [1]
- (ii) gasoline has larger molecules ;
larger molecules have greater attractive forces between themselves ;
so more energy needed to separate molecules ; [max 2]
- (c) 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: 12]

- 9 (a) (i) 3 ; [1]
- (ii) correct symbol **and** in parallel with battery ; [1]
- (iii) $R = V/I$;
 $= 6/0.3 = 20\ \Omega$; [2]
- (b) (i) angle of incidence and angle of reflection ; [1]
- (ii) 45° ; [1]

[Total: 6]