

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0653 COMBINED SCIENCE

0653/31

Paper 3 (Extended Theory), maximum raw mark 80

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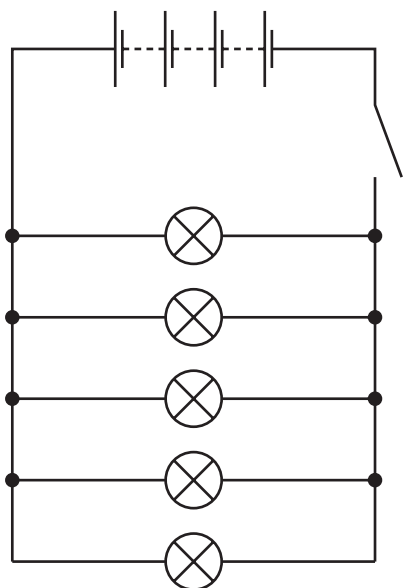
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1 (a)



symbols all correct ;
circuit connected correctly (allow ± 1 cell or lamp) ;

[2]

(b) (i) $5 \times 0.5 = \underline{2.5}$ (A) ;

[1]

(ii) $(R =) V/I$ (or words) ;
 $= 6 / 2.5 = \underline{2.4}$ (Ω) ;

[2]

(c) series: all bulbs go out **AND** parallel: rest of bulbs stay alight ;

[1]

[Total: 6]

2 (a) B C ;

(B C) D A ;

(allow 1 mark if both B and A are correctly located)

[2]

(b) (i) catalyst ;

[1]

(ii) increases rate / frequency of collision of particles ;
increases speed of reaction / increases surface area (of catalyst) ;

[2]

(iii) (petroleum) jelly
(diesel) oil
(refinery) gas
in order ;

[1]

(iv) (petroleum) jelly
(diesel) oil
(refinery) gas
in order ;

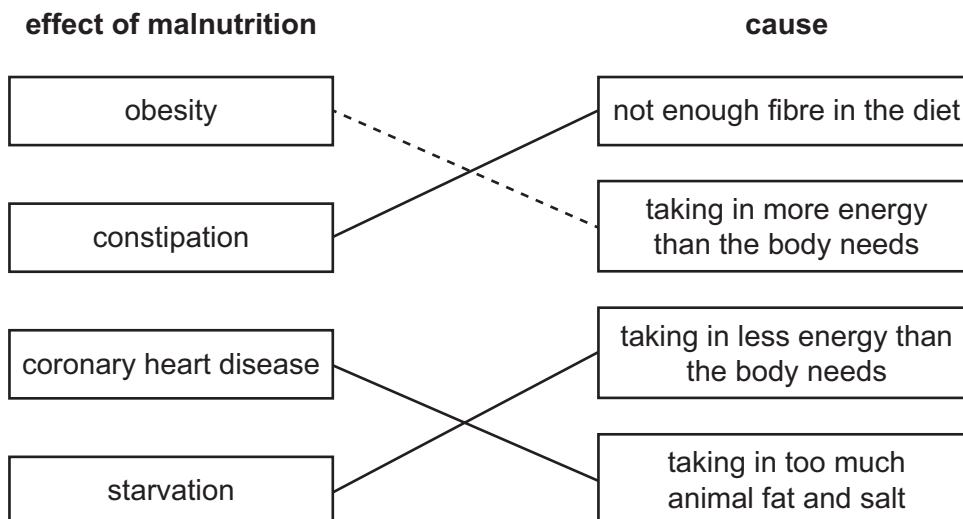
[1]

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- (v) the higher the boiling point the longer / larger the molecules ;
reference to greater / stronger intermolecular forces ; [2]
(allow reference to intermolecular bonds)

[Total: 9]

3 (a) (i)



correctly completed diagram ;; [2]
(3 correct = 2 marks, 2 or 1 correct = 1 mark)

- (ii) example of fruit or vegetable containing fibre ;
provides bulk to propel food through the intestines ; [2]
- (iii) any food rich in carbohydrate or fat / carbohydrate or fat (no mark)
reference to reducing energy intake / avoiding the carbohydrate or fat content of the
stated food ; [1]

- (b) (i) more females than males / fewer males than females took exercise ;
more normal weight than obese / fewer obese than normal weight took exercise ; [2]
- (ii) reference to small sample size ;
reference to the lack of information about variables that should be controlled (if the study
were to be extended) ;
reference to the need for information gathered over a longer time period ; [max 2]

[Total: 9]

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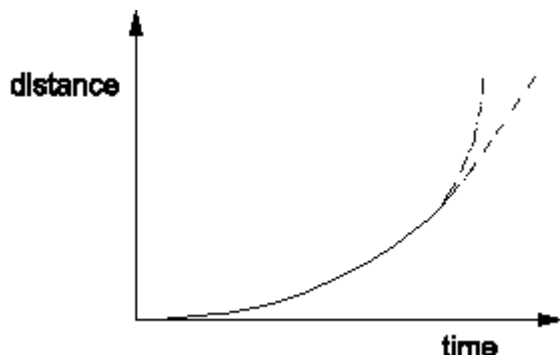
- 4 (a) (i) initial between 8 and 14 to 7 (final) ; [1]
(ii) purple / blue to green ; [1]
- (b) (i) KCl ;
 H_2O ; [2]
- (ii) repeat without indicator / use pH meter / use indicator paper ;
using same volume(s) of solution(s) ;
evaporate (the water from the neutral mixture) / heat (the solution) then cool ; [3]
- (c) reference to the involvement of ions / ionic compound / particles with opposite charges ;
the idea of strong forces / bonds between particles that must be broken /
ions must be separated ;
(breaking bonds / separating ions) requires a large amount of energy ; [max 2]
- [Total: 9]**
- 5 (a) **X** label line to green area and **Y** label line to white area ;
green area containing chlorophyll / chloroplasts only in cell **X** /
white area does not contain chlorophyll / chloroplasts shown in cell **Y** ; [2]
- (b) (i) black or shaded in area matching green area of leaf and indicated as black ; [1]
- (ii) chlorophyll / chloroplasts traps light energy ;
for photosynthesis ;
which makes (glucose / sugar which leads to) starch ; [3]
- (c) acid denatures enzyme ;
no longer optimum pH / owtte ;
changes shape of enzyme / active site / substrate no longer fits active site ; [3]
- [Total: 9]**

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6 (a) (i) P and R ; [1]

(ii) R ;
(R) is the weight ; [2]

(iii)



(ignore whether curve becomes linear or continues to curve) [1]

(b) (i) gravitational / potential energy and kinetic energy ; (both required) [1]

(ii) (rest of energy transferred to) heat / sound ; [1]

(c) (i) $(720 \times 1000) \div 3600$ / 200 (m/s) ; [1]
(OR $200 \times 3600/1000 = 720$ km/h)

(ii) $(KE =) \frac{1}{2} m v^2$;
 $= \frac{1}{2} \times 200\,000 \times 200 \times 200 = 4\,000\,000\,000$ (J) ; [2]
(allow ecf from (c)(i))
(allow answers in kJ or MJ provided unit is stated)

[Total: 9]

7 (a) (i) starch digested to glucose / sugar ;
(glucose / sugar) absorbed and taken to cells (of sheep) ;
(glucose broken down by) respiration ;
(respiration produces) carbon dioxide /
carbon dioxide breathed out into the air ; [max 3]
(allow reference to respiration and exhalation in the wild cat)
(allow correct reference to the formation and release of methane)

(ii) decomposers ;
feed on dead / decaying organisms / feed on waste from organisms ;
release carbon / carbon dioxide (into the air) ;
by respiration ; [max 3]

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- (b) (i) increases level of carbon dioxide / carbon monoxide ;
reduces oxygen level ;
increases sulfur dioxide level ; [max 2]

- (ii) *carbon dioxide*:
(increases) global warming / described consequence
e.g. changed rainfall patterns / floods and or droughts ;

sulfur dioxide:
causes acid rain / described consequence
e.g. chemical weathering of structures / damage to trees or aquatic organisms ;
reference to harmful effects in relation to breathing ;
(allow other valid answers) [max 1]

[Total: 9]

- 8 (a) (i) number of vibrations / waves per second / unit of time ; [1]

(ii)

highest frequency				lowest frequency		
(gamma radiation)	X-rays	ultra-violet	(visible light)	infra-red	(microwaves)	(radio waves)

all three correctly named ;
and in correct positions ; [2]
(allow 1 mark if two are correctly named and located)

- (b) (i) move further apart / increase distance between them ;
decrease / weaken / get less ;
quicker / more rapidly / faster / further apart ; [3]

- (ii) infra-red radiation (from Sun warms water) ;
(energy from sun) absorbed by water (molecules) ;
which move faster / gain kinetic energy. ;
forces between molecules are weakened / broken ;
(molecules) evaporate / leave the (liquid) surface / turn to gas / vapour ; [max 2]

- (c) (i) sound is a longitudinal wave ;
sound needs medium to travel through ;
space is a vacuum / owtte ; [max 2]

- (ii) 8 minutes / the same time / they travel at the same speed, because all
electromagnetic waves travel at the same speed through space / vacuum ; [1]

[Total: 11]

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- 9 (a) (i) exothermic ; [1]
- (ii) chemical (potential) → thermal / heat / kinetic ; [1]
- (iii) aluminium (gains oxygen and) is oxidised ;
 iron (oxide) (loses oxygen and) is reduced ; [2]
(allow correct references to electron gain by iron and electron loss from aluminium)
- (iv) iron will not react with / reduce aluminium oxide ;
 iron is lower in the reactivity series / less reactive than aluminium ; [2]
- (b) (i) cations / aluminium ions migrate / move / are attracted to the cathode
 / negative electrode ;
 electrons flow on to ions / ions gain electrons ;
 the idea that the ions are discharged as the result of electron gain ; [max 2]
- (ii) oxygen ; [1]

[Total: 9]

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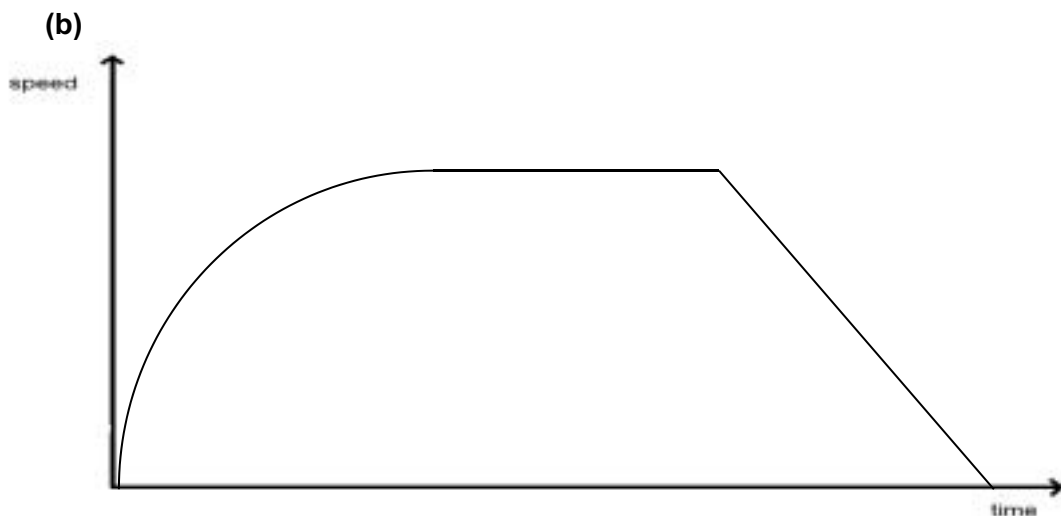
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- 1 (a) iron oxide
carbon
oxygen
calcium carbonate ;;
(1 mark for 2 or 3 correct, 2 marks for 4 correct) [2]
- (b) (i) carbon dioxide ; [1]
- (ii) iron (oxide loses oxygen) and is reduced ;
carbon (monoxide gains oxygen) and is oxidised ; [2]
(allow correct reference to electron transfer)
- (iii) carbon dioxide is a greenhouse gas / increases the greenhouse effect /
reference to global warming ;
description of how greenhouse effect operates ;
the idea that climates could change / example of one consequence of climate change ;
[max 2]
- (c) (i) brown / pink / copper (coloured) deposit ;
blue colour fades / becomes greener ;
temperature increase / change ; [max 2]
- (ii) copper ions become atoms ;
iron atoms became ions ;
(reaction occurs) because iron higher in reactivity series than copper ; [max 2]

[Total: 11]

Page 3	Mark Scheme	Syllabus	Paper
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- 2 (a) $135 \text{ km / hr} = 135\,000 \text{ m / hr}$;
 $135\,000 \text{ m / hr} = 135\,000 / 60 \times 60 \text{ m / s} = \underline{37.5} \text{ (m / s)}$; [2]



curved line from origin to level out at horizontal (allow any reasonable shape of curve) ;
horizontal line in middle of graph ;
straight line descending to meet time axis ; [3]

- (c) (i) (stage 1 / first 500 m) no mark
reference to acceleration occurring (in this stage) / acceleration requires a resultant /
unbalanced (driving) force ; [1]
- (ii) chemical (potential) energy in the rider ;
kinetic energy of the bicycle and rider ;
heat / thermal / sound energy during braking ; [max 2]
(2 marks for 3 correct, 1 mark for 2 correct)

[Total: 8]

- 3 (a) **A** trachea ;
B bronchiole ; [2]

- (b) large surface (area) ;
thin cells in alveoli (and blood capillaries) ;
good blood supply ; [max 2]

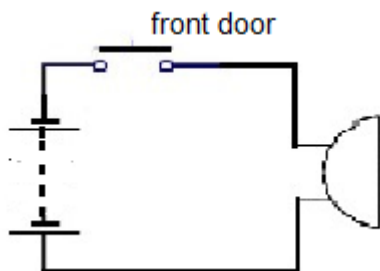
- (c) (i) $0.5 \text{ (dm}^3\text{)}$;
 $42 \text{ (dm}^3\text{)}$; [2]

- (ii) faster rate of respiration ;
for muscle contraction ;
more oxygen needed / oxygen needed more quickly ;
need to get rid of more carbon dioxide /
need to remove carbon dioxide more quickly ; [max 3]

[Total: 9]

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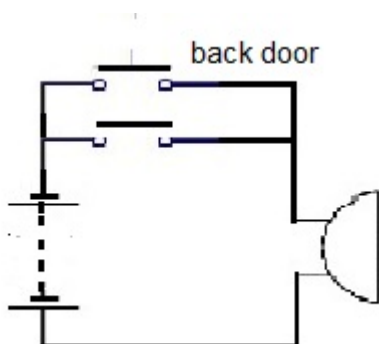
4 (a) (i)



correct use of circuit symbols ;
complete functioning circuit ;

[2]

(ii)



correctly placed second switch in parallel to first switch ;

[1]

(b) (i) number of vibrations per unit time ;

[1]

(ii) $v = f\lambda$ / ($\lambda =$) v/f ;
 $= 330 / 400 = \underline{0.825 / 0.83}$ (m) ;

[2]

(c) (i) $(R =) V / I$;
 $= 4 \times 1.5 / 2 = \underline{3}$;
ohms / Ω ;

[3]

(ii) $(E =) V I t / I^2 R t$;
 $= 6 \times 2 \times 10 / 2^2 \times 3 \times 10 = \underline{120}$;
joules / J ;

[3]

[Total: 12]

5 (a) (i)

	in nucleus	outside nucleus
number of protons	14	0 / blank
number of neutrons	14	0 / blank
number of electrons	0 / blank	14

1 mark for each column ;; [2]

(ii) 4 ;
number of electrons in outer shell shown by group number / owtte ; [2]

(b) (i) 4 shared pairs ;
atoms correctly labelled with symbols ;
(max 1 mark if valence electrons $\neq$ 8) [2]

(ii) $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
all correct formulae ;
then correctly balanced ; [2]

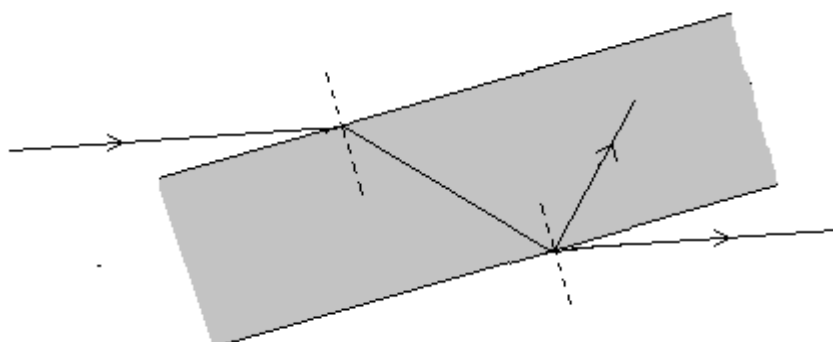
[Total: 6]

6 (a) (i) infra-red ; [1]

(ii) good absorber (of radiation) ; [1]

(b) molecules / particles move faster / gain more (kinetic) energy ;
faster / more energetic molecules escape (from liquid) / evaporate ; [2]

(c)



refracted emergent ray bent away from normal ;
angle of reflection equal to angle of incidence (by inspection) ;
emergent ray parallel to original incident ray (by inspection) ; [3]

[Total: 7]

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7 (a) phototropism ; [1]

(b) (i) auxins move across stem / move to shaded side ;
cause cell elongation (on shaded side) ;
more growth on shaded side / reference to differential growth (between lit and shaded sides) ; [3]

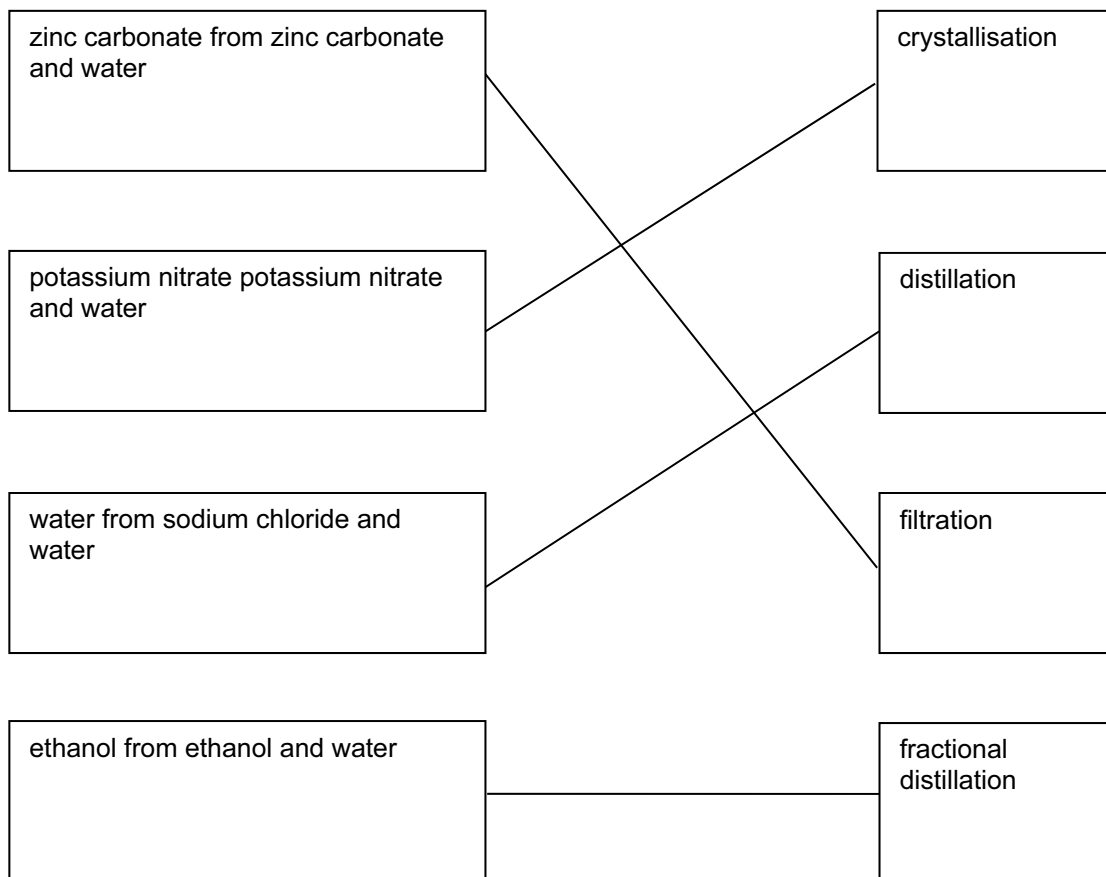
(ii) auxins cannot move back from tip / through plastic ; [1]

(iii) growth is less in the absence of light / owtte ;
auxins prevented from moving on one side / auxins cannot reach the right side / owtte ; [2]

(c) increase in blood glucose ;
increase in pulse / heart rate / blood pressure ;
for increased metabolic activity / rate of respiration ; [max 2]

[Total: 9]

8 (a)



all correct 2 marks, 3 or 2 correct 1 mark ;; [2]

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(b) (i) (marks may be awarded from a combination of words with a clear diagram)
solutions spotted on / added to (chromatography) paper / the line / origin ;
paper suspended in water / solvent with spots above the solvent ;
spots move up the paper (with the water/solvent) / reference to distance moved
related to solubility ; [3]

(ii) **A** and **C** ; [1]

(iii) both produce spots at same position as dye **X** / owtte ; [1]

[Total: 7]

9 (a) (i) burning / combustion of (fossil) fuels / burning material that produces sulfur / nitrogen
oxides ; [1]

(ii) acid gases carried by the wind ;
react with / dissolve in (rain) water (to form acid rain) ;
(acid) rain falls on land/river / drains into river ; [max 2]

(b) (i) rate of water flow into the river may vary ;
variation in amount and location of rainfall ;
variation in factory working / energy requirements ;
variation in wind speed and direction ;
may get pollutants from other sources (which themselves change pH) ; [max 2]
(marks can also be awarded for other valid reasons)

(ii) 3 ;
all animals needing a higher pH than 4.5 would not survive ; [2]

(iii) enzymes will not function as well / will not be at optimum ;
enzymes may be denatured / simple description of denaturation in terms of molecular
shape change ; [2]

[Total: 9]

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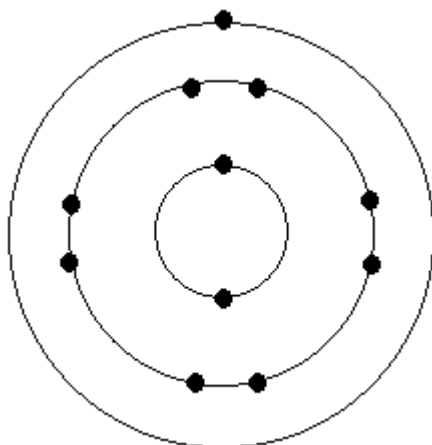
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- 1 (a) (i) iron has reacted with oxygen in the air / water takes the place of oxygen that has reacted with the iron ; [1]
- (ii) iron has not reacted with helium / helium is unreactive ; [1]

- (b) (i) same number of electrons ;
same number of electron shells ;
full electron shells / reference to complete outer shell ; [max 2]

(ii)



2,8,1 configuration ; [1]

- (iii) sodium atom has lost an electron ; [1]

- (iv) (no reaction)
sodium ions have electron configuration with full outer shell / sodium ions do not gain or lose electrons ; [1]

- (c) name and use of noble gas ;
property related to use ; [2]

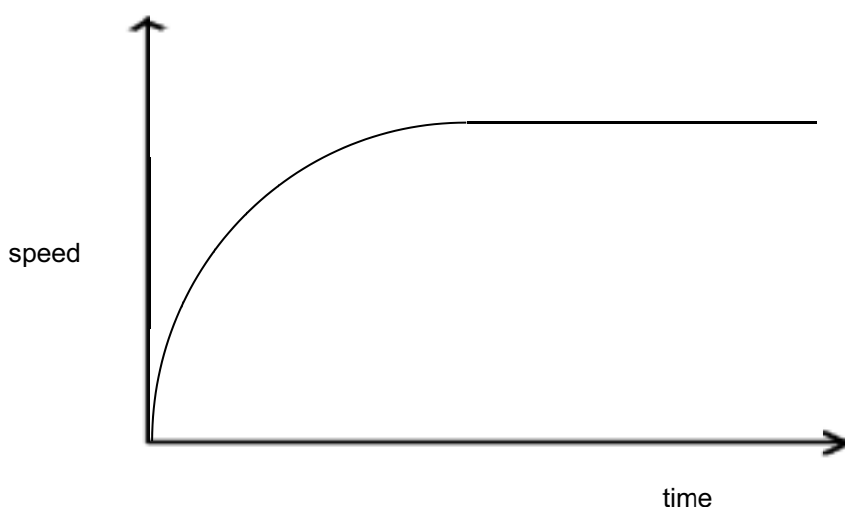
[Total: 9]

- 2 (a) (i) R, T ; [1]

- (ii) T ;
T is the weight of canoe and man / description of downward force due to gravity / the Earth ; [2]

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(iii)



line drawn steepest at first ;
smooth curve levelling off to horizontal ;
horizontal section continuing ;

[3]

(b) (transfers to) thermal (heat)/movement of water/sound ;

[1]

(c) (kinetic energy =) $\frac{1}{2} mv^2$;
 $= \frac{1}{2} \times 250 \times 2 \times 2 = 500 \text{ (J)}$;

[2]

[Total: 9]

3 (a) (i) placenta correctly labelled ;
cervix correctly labelled ;

[2]

(ii) glucose ;
carbon dioxide ;

[2]

(iii) amniotic fluid ;
cushions/protects/supports the fetus ;

[2]

(b) (i) amylase ✓ and x ;
protease ✓ and x ;

[2]

(ii) digestion takes place in small intestine/enzymes are secreted here ;
large intestine mainly absorbs water/enzymes not secreted here /
food already digested ;

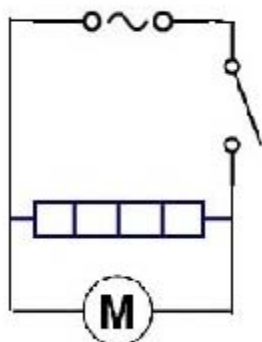
[2]

(c) destroys white blood cells ;
(destroys) T cells ;
reduces/weakens immunity ;

[max 2]

[Total: 12]

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- 4 (a) complete circuit + switch ;
correct parallel connection ; [2]
- (b) water molecules move faster / has increased kinetic energy as they are heated by warm air / owtte ;
attraction forces between more water molecules are broken ;
more water molecules have enough energy to escape (from water / hair) / owtte ;
air flow removes escaped molecules so cannot return to hair / owtte ; [max 3]
- (c) air molecules further apart as temperature rises ;
(heated) air becomes less dense (than surrounding air), so rises ; [2]
- (d) (i) watt(s) ; [1]
(ii) $I = (P/V) = 1100/220 (= 5 \text{ A})$; [1]
- (e) (i) short circuit (accept other reasonable ideas which might lead to fuse melting) ;
e.g. too much current flowing in the circuit ; [1]
(ii) 10 A (no mark)
2 A and 5 A fuses would blow / 10 A is the smallest fuse which will not flow ;
15 A fuse gives less protection than 10 A ; [2]
- [Total: 12]**
- 5 (a) (i) geotropism ; [1]
(ii) makes sure roots grow downwards / does not matter which way up the seed is planted
(the roots will always grow downwards) ;
to anchor plant ;
absorbs mineral ions / water ; [max 2]
- (b) auxins / the hormones inhibit slow down growth ;
retarded cell elongation where shaded / at bottom of the root ;
cells at top grow / expand normally / reference to differential growth ; [max 2]

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- (c) (i) no oxygen therefore slows or stops respiration ; [1]
- (ii) slows growth due to less / no energy being released ; [1]

[Total: 7]

- 6 (a) calcium chloride ; [2]
water ;

- (b) (i) carbon dioxide lost from apparatus ;
carbon dioxide gas has mass ; [max 1]

- (ii) rate decreases ;
quickly at first then more slowly / stops at mass 203 g / after 6 minutes ;
(because) acid concentration decreases ;
(because) surface area of calcium carbonate decreases ;
reference to reduced collision frequency ; [max 3]

- (c) (i) 203 g ; [1]

- (ii) particles have more (kinetic) energy / move faster at higher temperature ;
collide more frequently ;
increased chance of successful collision ; [max 2]

[Total: 9]

- 7 (a) (i) visible light ;
radio waves (and) ultra-violet (both required for mark) ; [2]

- (ii) reflection ; [1]

- (b) (i)

gamma radiation	X ;				microwaves	
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[1]

- (ii) X-rays and light will reach the Earth at the same time ;
all electromagnetic radiation travels at same speed (in vacuo) ; [2]

[Total: 6]

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- 8 (a) as the light intensity decreases the rate of photosynthesis decreases / or a ;
not a linear / proportional relationship / numbers taken from graph to illustrate relationship ; [2]
- (b) faster rate with plant **P** (than plant **Q**) or vice versa because it gets more light ;
water / plants / debris prevent some light from reaching plant **Q** ; [2]
- (c) (i) causes surface plants / algae to grow faster ; [1]
- (ii) reduces light to plant **Q** ;
little or no photosynthesis ;
(leading to) reduced growth of plant / plant dies ; [max 2]
- [Total: 7]**
- 9 (a) (i) aluminium / oxygen is an element because it / an element, consists of one
type of atom ;
aluminium oxide is a compound because it / a compound contains different atoms /
elements bonded together ; [max 1]
- (ii) bauxite is a mixture because it has a variable composition / can be separated ;
aluminium oxide is a compound because it contains a fixed proportion of
elements / can only be separated by chemical methods ; [max 1]
- (b) Al_2O_3 ;
idea of balanced charges ; [2]
- (c) aluminium ions migrate / move to / go to are attracted to the negative electrode / cathode ;
electrons flow from cathode to each aluminium ion ;
3 electrons / aluminium ions are discharged ; [max 3]
- (d) carbon is less reactive than aluminium / below aluminium in the reactivity series / aluminium
is more reactive than carbon / above carbon in the reactivity series / copper is less reactive
than carbon ;
carbon will not react with / reduce / remove oxygen from aluminium oxide / carbon will not
displace aluminium ; [2]
- [Total: 9]**