

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2015 series

0653 COMBINED SCIENCE

0653/31

Paper 3 (Extended Theory), maximum raw mark 80

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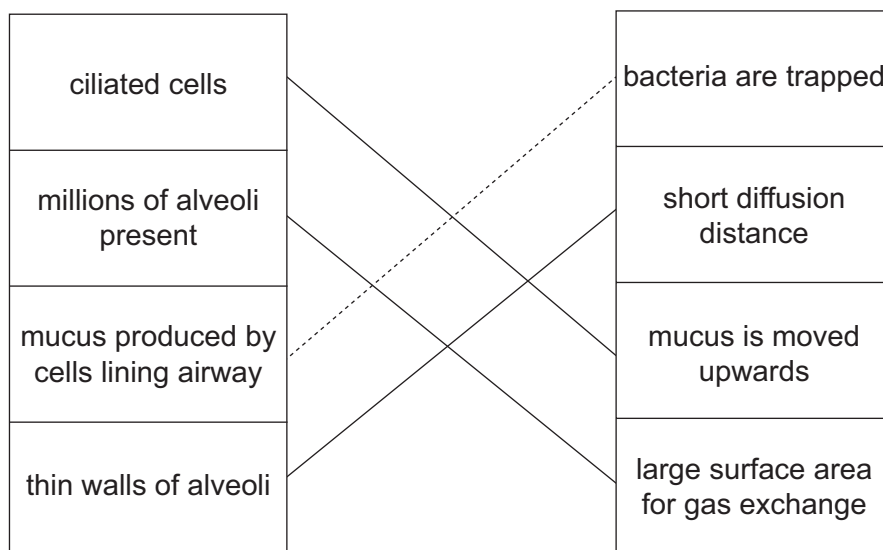
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1 (a)



three or two correct: 2 marks, one correct: 1 mark ;;

[2]

(b) (i) more mucus ;
cilia are paralysed / damaged ;

[2]

(ii) bacteria / pathogens remain in the mucus ;

[1]

(c) (i) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
formulae correct ;
equation is balanced and single arrow shown LHS to RHS ;

[2]

(ii) by red (blood) cells / haemoglobin ;

[1]

(d) (i) (person **C** - must be present to award mark)
(person **C** had) highest carbon monoxide concentration at 08.00 hours /
when first measurement taken / owtte ;

[1]

(ii) person **B** ;
carbon monoxide level in blood greater at 14.00 / 17.00 hours (compared
with 11.00 hours) / carbon monoxide level in blood increased during the day /
from 2.2 to 4.8 ;

[2]

[Total: 11]

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2 (a) increases ; [1]

(b) (i) bromine ; [1]

(ii) $2\text{NaBr} + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{Br}_2$
formulae ;
balancing consequential on formulae ; [2]

(iii) chlorine
bromine
iodine (*must be in this order*) ; [1]

(iv) a more reactive element/halogen displaces less reactive one / ORA ;
fluorine most reactive ; [2]

(c) (negative) fluoride ions move to / attracted to (positive) anode ;
electrons move from fluoride ion onto anode ;
ions are discharged / 1 electron moves from fluoride ion onto anode /
is lost (from each ion) ; [max 2]

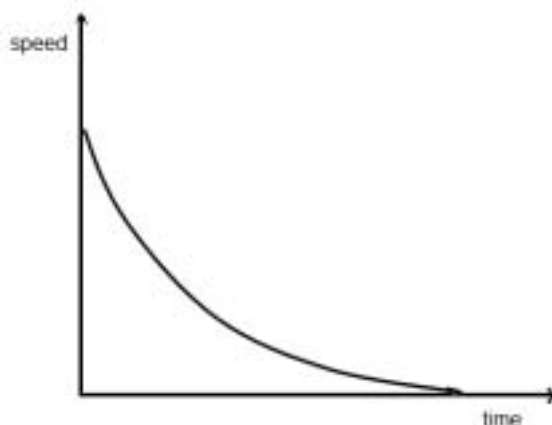
[Total: 9]

3 (a) (i) weight / gravitational force / gravity ; [1]

(ii) arrow pointing vertically upwards ; [1]

(b) (i) tick in first box ; [1]

(ii)



line from y-axis with negative gradient (accept straight or curved) ;
line meets x-axis ; [2]

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(c) (i) kinetic potential ; [1]

(ii) (potential energy transferred =) mgh **or** $80 \times 10 \times 40$;
= 32 000 (J) ; [2]

[Total: 8]

4 (a) (i) cell wall correctly labelled ;
(large) vacuole correctly labelled ; [2]

(ii) (*in either order*)
(*cell wall*) provides support (for the cell) ;
(*large vacuole*) contains cell sap / correct named nutrient (for storage) /
provides support / shape inside the cell ; [2]

(b) (i) leaf **X** has a smaller area than leaf **Y** / leaf **X** has deeper lobes / owtte ; [1]

(ii) smaller area gives less water loss ;
by transpiration ;
OR
deeper lobes allow more light through / owtte ;
for photosynthesis in lower leaves ; [max 2]

(iii) larger area for trapping light ;
for photosynthesis ; [2]

[Total: 9]

5 (a) natural gas / biogas / other correct ; [1]

(b) (i)

<i>before</i>		<i>just after</i>
(methane)		carbon dioxide
(oxygen)	→	water (vapour)
nitrogen		nitrogen

all 4 correct = 2 marks, 3 or 2 correct = 1 mark ; [2]

(ii) chemical (potential) **to** thermal (heat) / light / sound / kinetic ; [1]

(iii) exothermic ; [1]

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(c) (i) (2 because) in Period 2 ;
(6 because) in Group VI/6 ;
(allow explanations based on the electron configuration 2,6) [2]

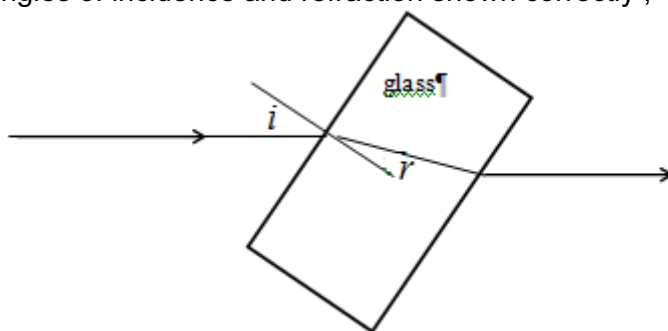
(ii) 4 shared pairs ;
correct symbols and all else correct ; [2]

(d) (i) noble/inert gases / Group 0 **or** 8 / Group VIII ; [1]

(ii) all / outer shells complete / filled ; [1]

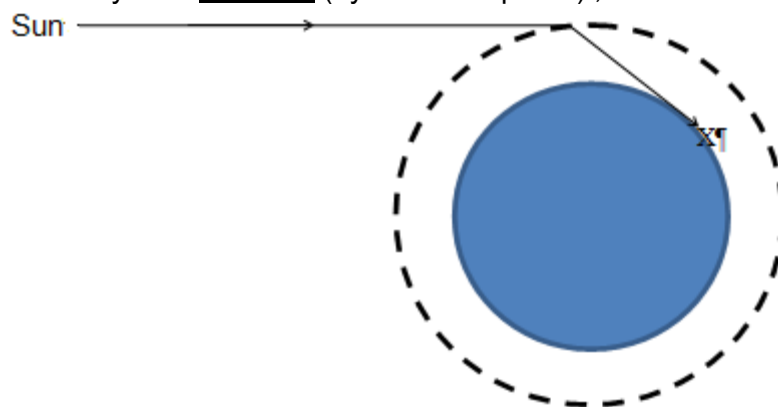
[Total: 11]

6 (a) (i) ray in glass bent towards normal ;
emergent ray parallel to incident ;
angles of incidence and refraction shown correctly ;



[3]

(ii) ray from Sun bending towards normal on entering atmosphere and reaching X ;
Sun's rays are refracted (by the atmosphere) ;



[2]

(b) (i) infra-red / IR ; [1]

(ii) sand is better absorber of infra-red / radiation than (sea) water ; [1]

(c) use of $v = f\lambda$;
 λ decreases ; [2]

[Total: 9]

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7 (a) organisms that feed on/get their energy from/reference to respiration ;
dead or waste organic matter ; [2]

(b) (i) enzymes break down the wood/large molecules into small molecules ;
that can be absorbed (by the fungi) ; [2]

(ii) may slow down/stop process ;
due to denaturation of digestive enzymes ; [2]

[Total: 6]

8 (a) (i) (rate of reaction decreases due to) decreasing concentration/OR A ; [1]

(ii) X vertically in line with 8–9 time units ; [1]

(iii) acid used up ; [1]

(b) (i) increased initial value on vertical axis ;
intercept with time axis before 8 minutes ; [2]

(ii) particles move/collide faster/have more kinetic energy ;
collide more frequently ;
greater chance of reaction during collision/owtte ;
(accept answers referring to activation energy) [max 2]

[Total: 7]

9 (a) (i) $(R =) \frac{V}{I} \text{ or } \frac{1.2}{0.5} ;$
 $= 2.4 (\Omega) ;$ [2]

(ii) $1.2 (\Omega)$ (ecf) ; [1]

(b) (i) $P = IV ;$ [1]

(ii) watt **and** W ; [1]

(iii) (energy =) power $\times$ time **or** $1.2 \times 0.5 \times 120 ;$
 $= 72 (\text{J}) ;$ [2]

(c) (i) convection ; [1]

(ii) by conduction ;
reference to particles in wire vibrating more quickly ;
reference to vibrational collisions (between resistance and connecting wires) ;
(also allow answers discussing the role of delocalised electrons) [max 2]

[Total: 10]

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- 1 (a) (i) ← frictional force, → driving force (*both required*) ;
↓ weight ; [2]
- (ii) 30 000 (N) ;
no movement / acceleration vertically, so must be balanced / owtte ; [2]
- (iii) pull of Earth / gravitational pull / gravity ; [1]
- (b) (i) (30–90 s) constant speed ;
(90–120 s) (negative) acceleration / deceleration (*do not accept: braking*) ; [2]
- (ii) distance travelled = area under graph ;
= $(20 \times 30 \times \frac{1}{2}) + [20 \times (90-30)]$;
= 1500 m = 1.5 (km) ; [3]
- [Total: 10]**
- 2 (a) (i) to kill any existing microbes ; [1]
- (ii) so that the enzymes in the bacteria are not denatured / optimum temperature for fermentation ; [1]
- (b) (i) proteins ; [1]
- (ii) by action of enzymes / protease / reference to digestion ; [1]
- (iii) amino acids produced by bacterium **B** will help growth / protein synthesis of bacterium **A** ;
growth factors produced by bacterium **A** will speed up growth of bacterium **B** ;
faster yoghurt production / more profit ;
(*if marking points 1 and 2 are not present then allow 1 mark for the idea that they each speed up the growth of the other*) [max 2]
- (c) (i) (*yoghurt D*)
contains less fat ; [1]
- (ii) (*yoghurt D*)
contains more calcium ; [1]
- [Total: 8]**
- 3 (a) (i) fractional distillation ; [1]
- (ii) physical because new substances are not made / involve only changes of state / owtte ; [1]

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(b) (i) increasing boiling point from **A** to **D** ; [1]

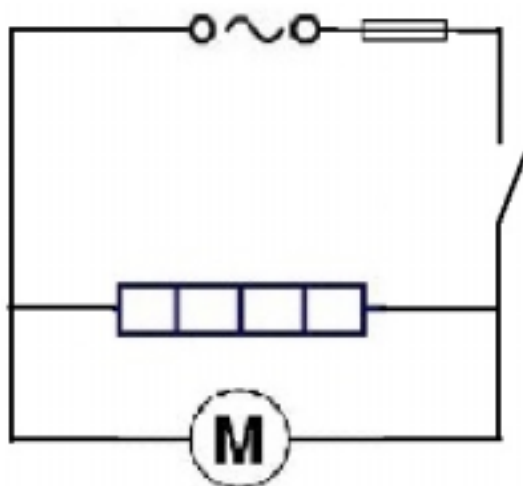
(ii) increasing size of molecules from **A** to **D** ;
 increasing force between molecules from **A** to **D** ;
 increasing energy required to separate molecules from **A** to **D** ; [max 2]

(c) 2C and 6H ;
 correct single bonds between C and H atoms ; [2]

(d) produces alkenes/ compounds with double bonds/unsaturated compounds ; [1]

[Total: 8]

- 4 (a) complete circuit with no open branches or short circuits ;
 on-off switch and fuse in main circuit using correct symbols (*fuse either side of supply, order of fuse and switch either way round*) ;
 heater and fan motor in parallel ;



[3]

(b) (i) **X** marked in the heater branch, either side of heater ; [1]

(ii) (as temperature rises, particle motion increases) and particles separate (expansion) ;
 (expansion) greater in brass than in iron ; [2]

(iii) in the air coming into the heater/owtte ;
 senses/switches off when air temperature in room is too high ; [2]

[Total: 8]

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- 5 (a) (i) any value between 1 and 10 (micrometres) inclusive ; [1]
- (ii) any answer of a million or more ;
any answer in hundreds ; [2]
- (iii) male gamete is haploid and zygote is diploid / it has half the number of chromosomes ;
(assume 'it' refers to the male gamete) [1]
- (b) amniotic fluid ;
protects against physical damage ; [2]
- (c) (i) reference to reduced rate of flow of blood to (and from) placenta ; [1]
- (ii) reduces growth rate ;
supply of nutrients / oxygen is reduced ;
(accept AVPs about lower rate of removal of waste products) [2]
- [Total 9]**
- 6 (a) (i) bubbles (gently) / owtte ; [1]
- (ii) zinc is above hydrogen in the reactivity series ;
zinc is below calcium / above copper in the reactivity series ; [2]
- (b) (i) (copper) atoms ; [1]
- (ii) loss of copper ions ; [1]
- (iii) zinc displaces copper ;
zinc has a greater tendency to form ions than copper ;
zinc is above copper in the reactivity series ; [max 2]

(c) (i)

(zinc)
(iron)
tin ;
(copper)

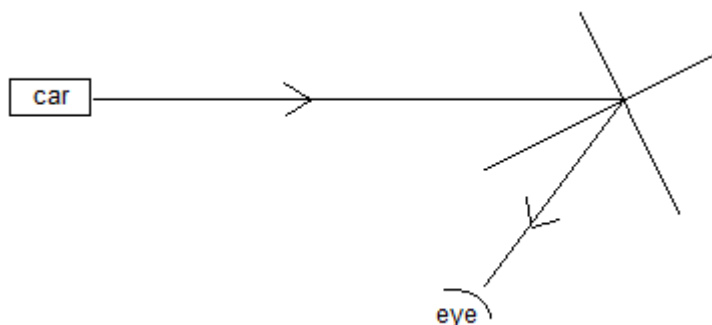
[1]

- (ii) tin displaces copper so is above copper in the reactivity series ;
tin does not displace iron so is below iron in the reactivity series ;

[2]

[Total: 10]

7 (a) (normal to mirror as shown)



incident ray drawn so that angles of incidence and reflection are equal by inspection ;
incident and reflected rays carefully drawn, with arrows in the correct direction and meeting at one point on mirror ;

[2]

(b) microwaves ;

[1]

(c) (i) $v = f\lambda$;

[1]

(ii) $f = \frac{v}{\lambda} = \frac{3 \times 10^8}{589 \times 10^{-9}} ;$
 $= 509 \times 10^{12} \text{ Hz} ;$

[2]

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(d) (i) $P = IV$ or $(I =) \frac{P}{V}$ or $\frac{36}{6}$;
 = 6 (A) ; [2]

(ii) total current = 6 + 6 + 1 = 13 (A)/ecf ; [1]

[Total: 9]

8 (a) (i) the position of an organism in a food chain or food web ; [1]

(ii) energy lost at each stage (of food chain) ;
 less energy for organisms further along chain ; [2]

(iii) badger correctly linked to all 3 organisms ;
 arrows all present and in correct direction ; [2]

(b) breaking down removal of dead bodies / waste ;
 recycling of nutrients ; [2]

(c) use an alternative source of food ;
 move to a different habitat ; [2]

[Total 9]

9 (a) (i) non-metals are on right-hand side of Periodic Table ; [1]

(ii) number of outer shell electrons = group number ; [1]

(iii) small number of outer shell electrons in metals / owtte ; [1]

(b) (i) $H_2 + Cl_2 \rightarrow 2HCl$
 1 mark for formulae ; balancing mark dependent on formulae ; [2]

(ii) 1 shared pair ;
 no extra electrons ; [2]

(c) (i) green ; [1]

(ii) 7 to any less than 4 ; [1]

[Total: 9]

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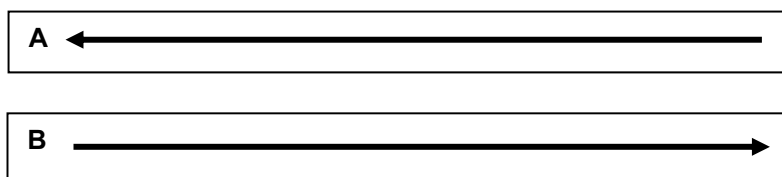
- 1 (a) large ;
into ;
capillaries ; [3]
- (b) smaller airway diameter ;
presence of mucus obstructing flow ; [2]
- (c) (i) $12.5 - 5.8 = 6.7 \text{ (dm}^3\text{/min)}$;
 $\frac{6.7}{5.8} \times 100 = 115(\%) \text{ or } 116(\%)$;
or
 $\frac{12.5}{5.8} = 215$;
 $215 - 100 = 115 (\%)$; [max 2]
- (ii) to get more oxygen (into the blood)/remove more carbon dioxide ;
for respiration ; [2]
- (d) (*cilia become paralysed*)
mucus cannot be shifted upwards ;
airways become even more restricted/more mucus for bacteria to breed in/
bacteria/tar will not be removed from the lungs/increases risk of bronchitis ;
or
(*more mucus is produced*)
airway becomes even more restricted/blocked ;
more mucus for bacteria to breed in/remain in lungs/increases chances of
chest infections/reduces oxygen supply for the body ; [max 2]
- [Total: 11]**
- 2 (a) thermal energy to chemical energy ; [1]
- (b) (i) steeper gradient than solid line ; [1]
- (ii) increasing concentration increases rate of reaction ;
increased frequency of collisions ; [2]
- (c) (i) atoms ions
ions atoms ; (*must be in this order*) [1]
- (ii) silver written below copper ; [1]
- (iii) the atoms of more reactive metals become ions more readily than those of
less reactive metals ; [1]
- [Total: 7]**

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- 3 (a) weight/gravitational force (*accept gravity*) ; [1]
- (b) (gravitational) potential (energy) to kinetic (energy) ; [1]
- (c) (i) accelerating ;
constant speed ; [2]
- (ii) area under graph between **A** and **C** or $(\frac{1}{2} \times 2 \times 9) + (2 \times 9)$ or $\frac{1}{2}(2+4) \times 9$;
= 27 (m) ; [2]
- (d) particles far apart in air/gas, but close together/touching in water/liquid
(*accept diagrammatic description*) ;
stopping the skateboarder requires loss of KE ;
more work done/loses more KE / more difficult to push water particles aside
than pushing air particles aside/owtte/diagrams ;
harder to push water molecules apart because of the forces between them/more
particles ; [max 3]
- [Total: 9]**
- 4 (a) (i) contains the correct proportions of nutrients for an individual ; [1]
- (ii) to prevent scurvy/AVP ; [1]
- (b) (i) as temperature increases the amount of vitamin C decreases ; [1]
- (ii) rate/amount of decomposition/breakdown/disappearance increases with
temperature ; [1]
- (iii) temperature will vary in different parts of the world ;
this will affect the amount of vitamin C (in fruit before the experiment) ;
OR
amount of water given/contained in 1 fruit may vary ;
this could affect concentration of the fruit juice ;
OR
different variety of orange/fruits vary genetically ;
(naturally) contains different amounts of vitamin C ;
AVPs ; [max 2]
- (c) boiling water destroy some/all of the vitamin C ; [1]
- (d) (*advantage*)
convenient if you need to leave the baby / mother may not have enough milk/AVP ;
(*disadvantage*)
does not contain antibodies/any reference to bonding/AVP ; [2]
- [Total: 9]**

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5 (a)



[1]

(b) (i)

observation	explanation
(bubbles of gas)	hydrogen ;
(changes from green to purple)	alkaline solution ;

[2]

(ii) more vigorous reaction / hydrogen produced faster / greater temperature rise ;
alkali metals become more reactive down the group ;
(accept correct references to ease of ionisation of metal atoms)

[2]

(iii) one electron in shell ;
all Group I elements have 1 electron in outer shell ;

[2]

[Total: 7]

6 (a) (i) $\left(\frac{10}{20} =\right) 0.5$;
Hz / hertz ;

[2]

(ii) $\left(\frac{30}{10}\right) = 3$ (m/s)

[1]

(iii) $v = f\lambda$ (in any form) / $\frac{3}{0.5}$;
= 6 (m) ;
(allow ecf from (i) and/or (ii))

[2]

(b) $2 \times \text{amplitude } (0.5) = 1$ (m) ;

[1]

(c) R placed in right-hand end box ;

[1]

(d) (i) tidal energy more predictable / nearer to land so easier access / installation / any other reasonable suggestion based on access to the energy involved or easier technology / ORA ;

[1]

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(ii) $\left(\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \right)$
 $= \frac{150}{500} \times 100 = 30(\%) ;$ [1]

[Total: 9]

- 7 (a) allows solar radiation to reach the Earth's surface ;
contains greenhouse gas molecules/ example ;
(greenhouse gases in the atmosphere) absorb infra-red radiation (that is emitted from the Earth's surface) ;
infra-red radiation is then (re-)emitted by the greenhouse gases into the atmosphere/ back to the Earth's surface ; [max 2]

- (b) *two from*:
carbon dioxide / methane / water vapour ; [1]

- (c) *two from*:
(increased) use of fossil fuels / example;
(increased) deforestation ;
(increased) keeping of cows / growing rice ;
AVP ; [max 2]

- (d) reduced use of fossil fuels / removal of carbon dioxide from exhaust / promote the use of public transport ;
reduced deforestation ;
reduced agricultural practices that cause methane to be produced ;
plant more trees ;
use more renewable energy sources ;
AVP ; [max 1]

[Total: 6]

- 8 (a) (i) $2\text{HCl} + (\text{CuCO}_3) \rightarrow (\text{CuCl}_2) + \text{CO}_2 + \text{H}_2\text{O}$
formulae ; balanced ; [2]

- (ii) limewater ;
turns milky / cloudy etc. ; [2]

- (b) (i) copper (deposit on cathode) ;
chlorine (gas at anode) ; [2]

- (ii) (*copper ions*):
move towards cathode / negative (electrode) ;
(*chloride ions*):
move towards anode / positive (electrode) ; [2]

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(c) (i) CuCl ;
reference to the need for charge balance ; [2]

(ii) high density / high melting point / form coloured compounds / act as catalysts ; [max 1]

(d) correct structure of methane molecule ;
correct structure of ethane molecule ; [2]

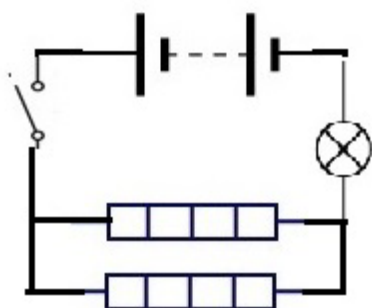
[Total: 13]

9 (a) (i) move towards each other ;
unlike charges attract ; [2]

(b) (i) force ; [1]

(ii) any path heading towards the upper positive plate ; [1]

(c) (i) complete circuit with 2 extra components included in series and/or in parallel ;
two heaters in parallel ;
lamp in series in main circuit ;



[3]

(ii) water expands / volume increases / particles get further apart water becomes less dense ;
(less dense) / warm water rises (above denser colder water) / owtte ; [2]

[Total: 9]