



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

COMBINED SCIENCE

0653/21

Paper 2 Core Theory

October/November 2016

MARK SCHEME

Maximum Mark: 80

Published

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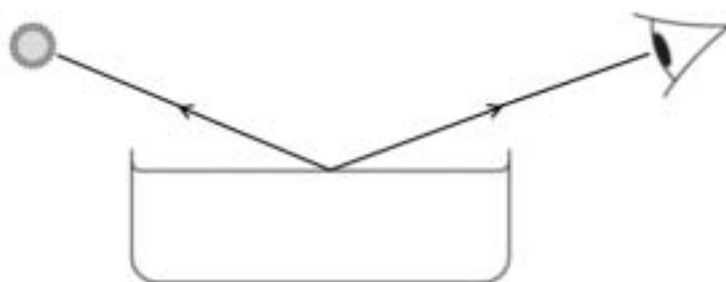
Page 2	Mark Scheme	Syllabus	Paper
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- 1 (a) (i) light/radiation (energy) ;
kinetic (energy) ; [2]
- (ii) (average) speed = distance/time OR $900/12$;
 75 (cm/s) ; [2]
- (iii) any two from:
volume/s = cross-sectional area $\times$ speed / volume = length $\times$ cross-sectional area ;
 75×10 ;
 $\times 60 \text{ (s)}$ seen ;
and
 $45\,000 \text{ cm}^3$; [3]
- (b) wind energy/hydro-power/AVA ;
use to turn a turbine (wind or water); [2]
- 2 (a) (i) electron ;
proton ; [2]
- (ii) 23 ; [1]
- (b) (i) electron loss ;
one (electron lost) ; [2]
- (ii) oxidation [1]
- (iii) exothermic [1]
- (iv) Na_2O ; [1]
- (c) (i) increases ; [1]
- (ii) decreases ; [1]

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- 3 (a) (i) oxygen ;
suitable temperature ; [2]
- (ii) geotropism ; [1]
- (b) seedlings get maximum amount of / more light ;
for photosynthesis ; [2]
- (c) (i) xylem ; [1]
- (ii) no leaves present ;
therefore no transpiration ; [2]
- (iii) any two from:
more humid ;
lower temperature ;
darker ; [2]
- 4 (a) (i) evaporation ; [1]
- (ii) infra-red ; [1]
- (iii) (thermal energy from Sun) causes water molecules to move faster / gain
more kinetic energy ;
(more) molecules moving fast enough / have enough energy to escape
(surface) ; [2]
- (iv) 10+ more molecules drawn touching below water level ;
in random arrangement ; [2]

(b)

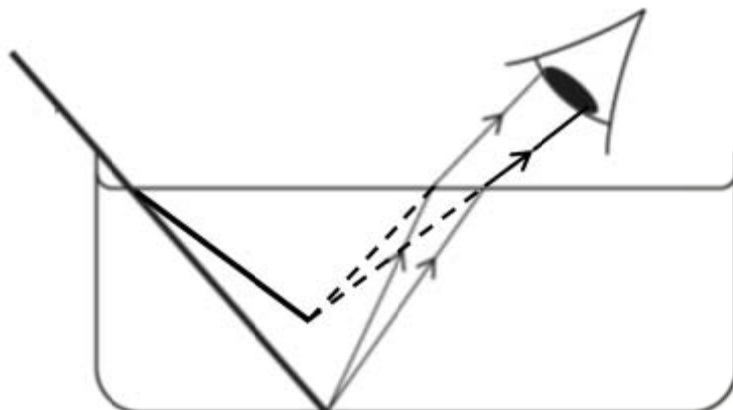


ray from Sun reflected at surface to eye ;
angles of incidence and reflection look equal (by eye) **and** (at least) one arrow ; [2]

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(c) (i) Second diverging ray refracted to eye ; [1]

(ii) rays to eye projected back and converge and image drawn ; [1]

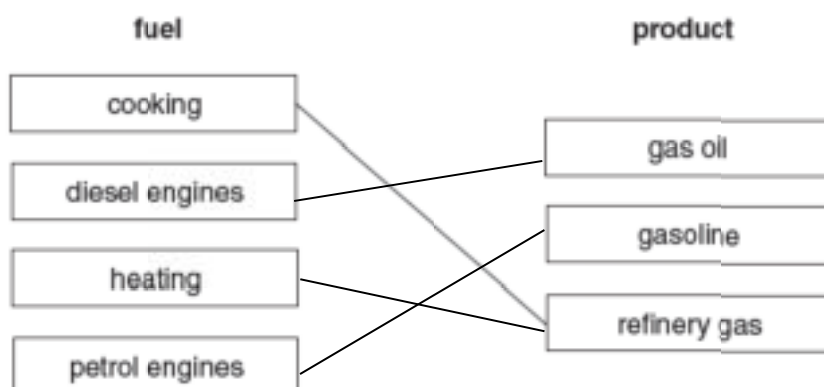


(d) microwaves ; [1]

5 (a) (i) fractional distillation ; [1]

(ii) **refinery gas / (bottled gas)**
gasoline / (petrol)
(kerosine)
gas oil / (oil)
(fuel oil)
(bitumen)
;;
three correct is 2 marks, one or two correct is 1 mark [2]

(iii)



1 mark for each correct ;;; [3]

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- (b) (i) C=C double bond and all four C–H bonds correct ; [1]
- (ii) carbon dioxide / CO₂ ; [1]
- (iii) test: cobalt chloride (paper) ;
result: (blue to) pink ;
or
test: copper sulfate ;
result: (white / anhydrous to) blue ; [2]
- 6 (a) (i) vitamins / named vitamin ;
prevent diseases / named disease / role of named vitamin ; [2]
- (ii) respiration ; [1]
- (iii) carbohydrates, fat and protein ; ;
all correct is 2 marks, two correct is 1 mark [2]
- (iv) fruit / vegetables / correctly named fruit or vegetable ; [1]
- (b) digestive ;
methane ;
greenhouse ;
global warming ; [4]
- 7 (a) electrons ;
stays the same ; [2]
- (b) (i) variable resistor ; [1]
- (ii) increase / decrease the resistance ;
decreases / increases the speed ; [2]
- (iii) correct circuit symbol connected across motor only ; [1]
- 8 (a) proton ;
metallic **and** non-metallic ;
high **and** high ; [3]
- (b) (i) iron
calcium
magnesium ; ;
3 correct is 2 marks, 2 correct is 1 mark [2]
- (ii) magnesium oxide / magnesium carbonate /
magnesium hydrogen carbonate / magnesium hydroxide
/ magnesium sulfide **or** correct formula ; [1]

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(c) chlorine / Cl_2 ; [1]

9 (a) ovary correctly labelled ; [2]
oviduct correctly labelled ;

(b) (i) attaches to the wall ; [2]
of the uterus ;

(ii) rich blood supply / good source of nutrients / suitable temperature ; [1]

(c) Any two from [2]
sexual intercourse
sharing needles
blood transfusions
(from mother to baby) at birth
(from mother to baby) during breast feeding
avp ;



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1 (a) radio (waves) in RH box ; [1]

(b) (i) cell / battery ; [1]

(ii) chemical (energy) ; [1]

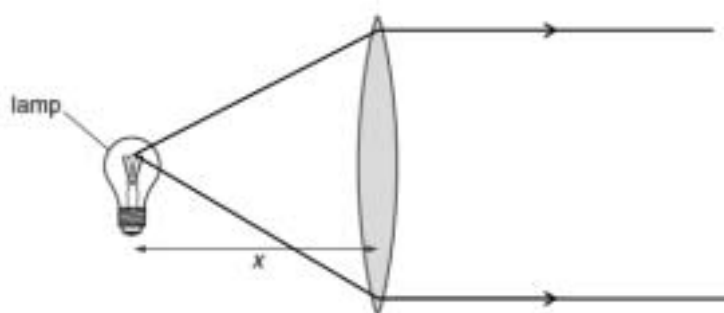
(c) (i) kinetic ;
sound ; [2]

(ii) (higher pitch) A **and** (larger amplitude) A ; [1]

(d) (i) any one from:
damp conditions / water ;
damaged insulation (in unit) ;
current too high / could overheat / cause a fire ; [1]

(ii) fuse ; [1]

(e) (i)



at least two diverging rays from a point on lamp to lens, then emerging from lens parallel (as shown, arrows not required) ; [1]

(ii) focal length ; [1]

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2 (a) C_2H_5OH / C_2H_6O any order / CH_3CH_2OH ; [1]

(b) (ethanol) + oxygen → carbon dioxide + water
LHS ; RHS ; [2]

(c)

	test	result
carbon dioxide	limewater ;	(turns) cloudy ;
oxygen	glowing splint ;	relights ;

[4]

(d) increases ; [1]

(e) fractional distillation ; [1]

3 (a) **A** cell wall ;
B chloroplast ;
C vacuole ; [3]

(b) (i) cuticle correctly labelled on diagram ; [1]

(ii) cell drawn right way up in palisade layer ; [1]

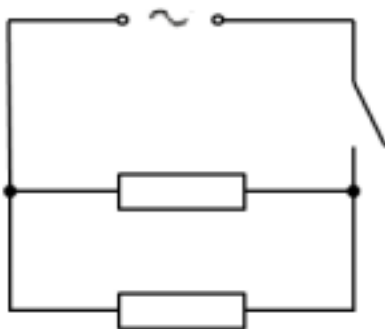
(c) sugar / glucose + oxygen ; [1]

(d) carbon dioxide - any two from:
by diffusion ;
through the stomata / intercellular spaces ;
from the air ;

water - any two from:
through the xylem ;
from the roots / by the transpiration stream ;
from the soil ; [4]

Page 4	Mark Scheme	Syllabus	Paper
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4 (a)



resistor **and** switch symbols ;
resistors in parallel ;
supply, switch, in series ;

[3]

(b) (i) conduction ;

[1]

(ii) density = mass / volume or $d = m / V$ or $V = m / d$ or $128/8$;
= $16 \text{ (cm}^3\text{)}$;

[2]

(iii) (thickness = volume / area = $16 / 160$) = 0.10 (cm)

[1]

(c)

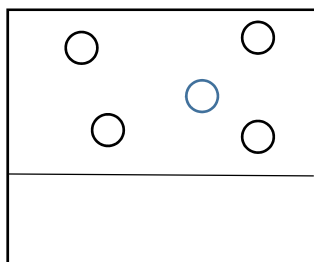


diagram shows example only – look for four similar-sized circles placed randomly apart from each other and from the given circle ;

[1]

(d) metals expand on heating ;
brass expands more than steel ;
so bends and breaks contact ;

[max 2]

Page 5	Mark Scheme	Syllabus	Paper
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- 5 (a) anode ;
cathode ;
electrolyte ; [3]
- (b) chlorine ;
copper ; [2]
- (c) (i) copper hydroxide / copper carbonate (/copper sulphide) ; [1]
(ii) increase temperature / increase concentration / catalyst / decrease particle size ; [1]
- (d) any two from:
(copper) forms coloured compounds ;
(copper) has higher melting point / boiling point ;
copper / copper compounds act as catalyst(s) ; AVP [2]
- (e) (bronze is) harder / stronger ; [1]
- 6 (a) arrow drawn going from plasma into alveolus ; [1]
- (b) (i) 0.6 dm^3 [1]
(ii) $(0.6 \times 3) = 1.8 \text{ dm}^3$ [1]
- (c) became faster ;
became deeper ; [2]
- (d) any two from:
muscle contraction ;
protein synthesis ;
cell division ;
growth ;
passage of nerve impulses ;
maintenance of body temperature ; [2]

Page 6	Mark Scheme	Syllabus	Paper
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- 7 (a) (i) newton ; [1]
- (ii) weight/gravitational force ; [1]
- (b) (i) points plotted at (45,15) and (60, 20) +/- half a small square ;
graph line extended to at least to (60, 20) ; [2]
- (ii) answer in range 24 (cm) to 30 (cm) ; [1]
- (c) 100 (N) ;
when cords are fully stretched, no further movement/change in length/forces
balanced / *owtte* ; [2]
- 8 (a) no new substance made/no chemical reaction occurs ; [1]
- (b) compound/molecule ;
any one from:
containing hydrogen and carbon ;
only; [2]
- (c) (refinery gas) heating/cooking ; AVP
(gasoline) car fuel/petrol ; AVP
(gas oil) lorry fuel/bus fuel/diesel ; AVP [3]
- (d) C–C bond shown (1)
fully correct structure (2) ;; [2]

Page 7	Mark Scheme	Syllabus	Paper
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- 9 (a)** (a network of) interconnected food chains ;
showing energy flow (through part of an ecosystem) ; [2]
- (b)** Sun ;
producers ;
consumers ;
water flea ;
turtle ; [5]
- (c) (i)** (algae) increase
less being eaten ; [1]
- (ii)** (large fish) decrease
less food ; [1]



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- 1 (a) (i) newton ; [1]
(ii) because a force moves through a distance ; *owtte* [1]

- (b) (i) chemical ;
potential / stored (elastic) ;
kinetic ; [3]
(ii) because some energy is still in longbow as e.g. vibration / is lost as
sound / thermal energy / AVR ; [1]

- (c) (i) $180 \text{ km/h} = 180 \times 1000 / 3600 = 50 \text{ m/s}$; [1]
(ii) time = distance / speed ; (or equivalent) OR $100 / 50$
= 2 (s) [2]

2 (a)

<i>particle</i>	<i>number</i>
proton	12
neutron	12

;;
2 or 3 correct boxes (1)
4 correct boxes (2) [2]

- (b) oxygen LHS ;
magnesium LHS **and** magnesium oxide RHS ; [2]

- (c) A **and** hydrogen / H_2 [1]

- (d) (i) sodium chloride ;
sodium is a metal **and** chlorine is a non-metal ; [2]

- (ii) water ;
hydrogen **and** oxygen are non-metals ;
or
hydrogen ;
hydrogen is a non-metal ; [2]

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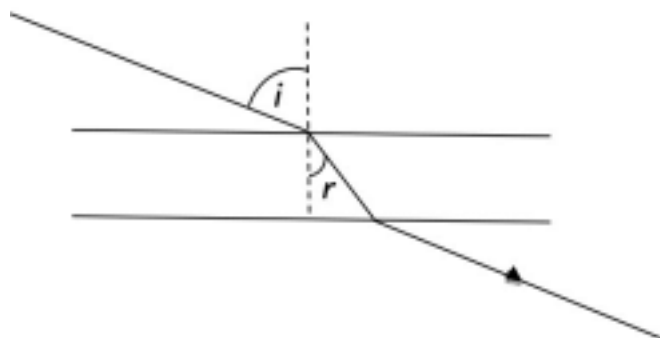
- 3 (a) (i) E vena cava / B pulmonary vein ; [1]
- (ii) valve ;
prevents backflow of blood ; [2]
- (iii) oxygen content increases ;
carbon dioxide content decreases ; [2]
- (b) (i) glucose + oxygen → carbon dioxide + water ; [1]
- (ii) any two from:
protein synthesis ;
cell division ;
growth ;
passage of nerve impulses ;
maintenance of a constant body temperature ; [2]
- (c) any suitable activity, e.g. walking **and**
activity is more energetic/active/uses more oxygen than sitting but less
energetic/active/uses less oxygen than running ; [1]

- 4 (a) infra-red ;

gamma radiation		ultra-violet		infra-red		radio waves
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- in correct box ; [2]
- (b) radiation ;
convection ; [2]
- (c) any reasonable description of good insulation around tank ; [1]
- (d) any reasonable description of thermal expansion ; [1]
- (e) any reasonable problem caused by water freezing/ice forming ; [1]

(f)



ray from air to glass bent towards normal ;
both angles marked correctly ;
exit ray into vacuum roughly parallel to incident ray ;

[3]

5 (a)

ion	reagent	result
copper(II)	NaOH / NH ₃ (aq) ;	(light) blue ppt / solid ALLOW dark_blue solution if NH ₃ used ;
chloride	AgNO ₃ ;	white ppt / solid ;

[4]

(b) (i) cathode ; anode ;
electrolyte ;
3 correct (2)
1 or 2 correct (1)

[2]

(ii) copper ;
brown / pink ;

[2]

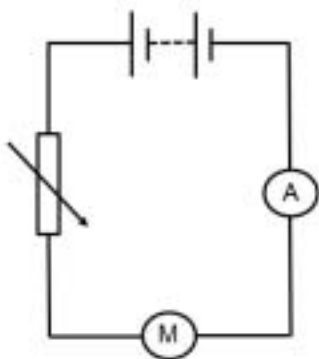
(iii) (chlorine) (pale) green ;
(litmus) white / bleached ;

[2]

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- 6 (a) (i) **F** stigma / carpel ;
G sepal ; [2]
- (ii) any anther correctly labelled ;
contains the male gamete / pollen [2]
- (iii) any one from:
large / brightly-coloured petals ;
scented ;
presence of nectar ; [1]
- (b) (i) any two from:
increased rate of transpiration (at 27 °C) ;
(due to) increased rate of evaporation / more water loss from plant ;
molecules have more kinetic energy ; [2]
- (ii) any value less than 1.1 cm because the rate of evaporation / transpiration is
lower in humid conditions ; [1]
- (c) (i) root **1 and**
it has root hairs cells (for absorption of water) ; [1]
- (ii) line drawn across the root through the cortex to the stele ;
line finishes in the xylem ; [2]
- 7 (a) (i) 50 (cm) ; [1]
- (ii) correct arrow ; [1]

(b)



variable resistor symbol ;
ammeter symbol ;
all connected in series to form a complete circuit ; [3]

- (c) (i) resistance ; [1]
- (ii) $(3/2 =) 1.5$;
ohm(s) / Ω ; [2]

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8 (a) process **B** filter(ing)/filtration ; [2]
process **C** evaporation/crystallisation ;

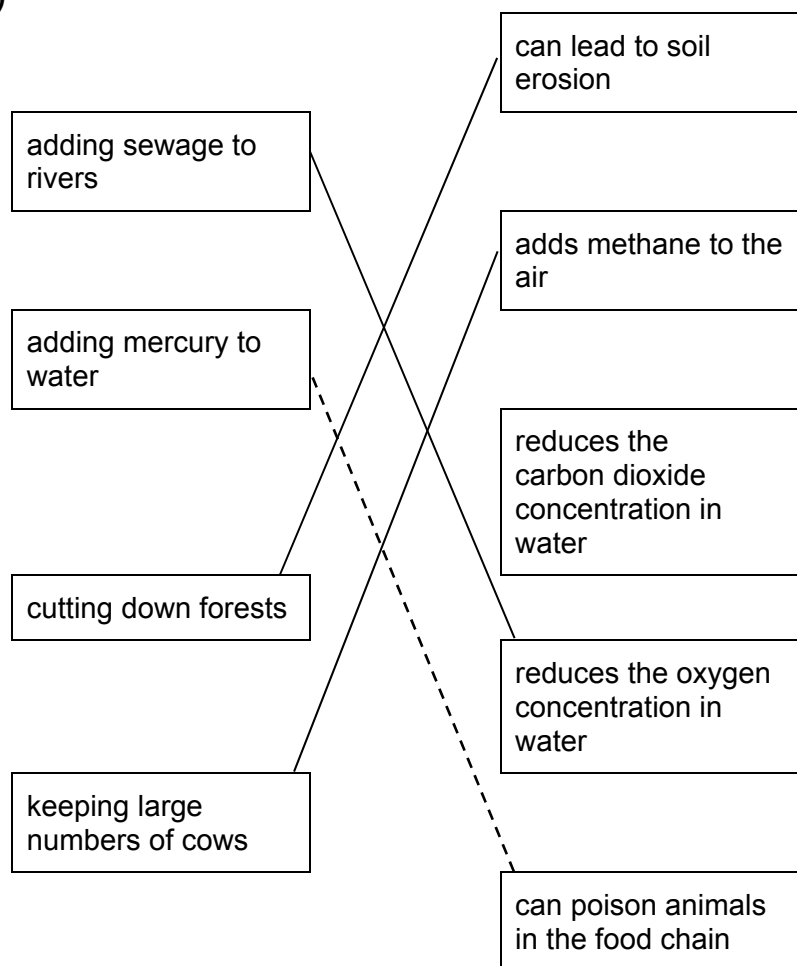
(b) increase concentration (of acid); [2]
increase temperature ;

(c) (i) sodium sulfate / Na_2SO_4 ; [2]
carbon dioxide / CO_2 ;

(ii) (pH number) increases/goes to 7 ; [1]

(iii) three/3 ; [1]

9 (a)



[3]

(b) (i) burning fossil fuels / deforestation ; [1]

(ii) causes the temperature of the atmosphere to rise / global warming / carbon dioxide is a greenhouse gas ; [2]
consequence, e.g. flooding / melting ice caps / changes in weather patterns ;
AVP