

Mark Scheme

IGCSE Science (Double Award) (4437)

June 2006

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Mark Scheme

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IGCSE SCIENCE (DOUBLE AWARD) 4437, MARK SCHEME

Symbols used in marking points

- ; indicates separate mark points
- / indicates alternatives
- eq means allow any correct equivalent

Paper 1F

- | | | | |
|----|-----|----|---|
| 1. | (a) | D; | 1 |
| | (b) | C; | 1 |
| | (c) | A; | 1 |
| | (d) | A; | 1 |
| | (e) | D; | 1 |
| | (f) | D; | 1 |
| | (g) | D; | 1 |

Total 7 marks

- | | | | |
|----|-----|--------------------|---|
| 2. | (a) | A trachea; | |
| | | B bronchus; | |
| | | C diaphragm; | 3 |
| | (b) | (i) coronary; | |
| | | fat / cholesterol; | 2 |
| | | (ii) oxygen; | |
| | | glucose; | 2 |

Total 7 marks

- | | | | |
|----|-----|---|---|
| 3. | (a) | rice/plant → insects/named insect → spiders
correct order;
arrows; | 2 |
| | (b) | stop it eating rice / increases yield / stop damaging crop / eq; | 1 |
| | (c) | spider is a living organism / spider is a predator;
reduces insect numbers / eq; | 2 |

Total 5 marks

4. (a) plants would not grow / disease passed on to other plants; 1
- (b) no microorganisms / eq;
would harm plants / infect plants / cause disease; 2
- (c) amino acids / protein;
chlorophyll / chloroplasts; 2
- (d) root;
shoot / stem / stalk / leaves; max
grows into carrot plant / cell division; 2

Total 7 marks

5. (a) (i) 18 - 64; 1
(ii) 53; 1
- (b) (i) 9;; (one mark for 51 - 42) 2
(ii) growing more/faster; 1
- (c) milk contains protein;
protein for baby; max
baby growing; 2
- (e) lines joining: carbohydrate to energy;
vitamin A to good sight;
iron to make haemoglobin;
calcium to healthy bones; 4

Total 11 marks

6. (a) (i) arrow (with arrowhead) from plants to animals; 1
arrow (with arrowhead) from plants to decomposers; 1
(ii) K; 1
(iii) J, L and N; 1
- (b) (i) carbon dioxide; 1
(ii) glucose / cellulose / starch / sucrose / acceptable 1
(iii) alternative; 1
bacteria / fungus / microorganisms / named decomposer;

Total 7 marks

7. (a) 100%;; 2
(1) for: $4 - 2 \div 2$ OR a number divided by 2 x 100 = 1
- (b) phagocytes;
ingest / digest / engulf / swallow / eat;
microorganisms / bacteria / pathogens / parasite / eq;
lymphocytes;
antibodies / antitoxins; max
3
- (c) plasma; 1

- (d) (combines with / transports) oxygen;
 haemoglobin;
 biconcave (or described e.g. doughnut) / large surface area;
 no nucleus / more space for oxygen;
 thin / flexible; max
3

Total 9 marks

8. 1. less photosynthesis;
 2. less carbon dioxide absorbed from air / more carbon dioxide in air / trees absorb carbon dioxide;
 3. less oxygen in air / trees release oxygen / no trees no oxygen;
 4. greenhouse effect / global warming;
 5. less transpiration / less rainfall / drought;
 6. erosion / leaching; max
5
 7. flooding;
 8. loss / change of habitat / loss of food;
 9. loss of species / extinction / genes / change in distribution;

Total 5 marks

9. (a) (i) 1st week / 2nd week; 1
 (ii) oestrogen; 1
 (iii) ovary; 1
- (b) progesterone; 1
- (c) ovulation / egg release; 1

Total 5 marks

10. (a) (i) digests / breaks down;
 protein; max
2
 amino acids;
 (ii) lower / reduce / decrease (gas exchange) / less oxygen
 absorbed;
 alveoli; max
2
 less surface;
- (b) (i) join / fuse / combine with sperm / male nucleus; 1
 (ii) mitosis; 1
 (iii) nucleus;
 egg / ovum;
 embryo;
 uterus / womb;
 milk;
 clones; 6

Total 12 marks

PAPER TOTAL 75 MARKS

Paper 2F

1. (a) atomic number (second box) 1
(b) hydrogen / H / H₂ 1
(c) silicon / Si 1
(d) lithium / Li 1
(e) three / all three correctly listed 1

Total 5 marks

2. (a) (i) from top to bottom: proton - electron - neutron 3
(ii) 8 1
(iii) Be/ Beryllium 1
(b) same number of protons / atomic number 1
different number of neutrons / atomic mass / mass number / nucleon number 1

Total 7 marks

3. (a) (i) bubbles / fizzing / effervescence / magnesium gets smaller / disappears NOT dissolves / gas made 1
(ii) increases / goes up NOT heat produced 1
(iii) magnesium + hydrochloric acid → magnesium chloride + hydrogen 1
(b) lighted splint / flame / burn 1
(squeaky) pop (ONLY if 1st mark awarded) 1
(c) ticks in 3rd, 4th and last boxes 3

Total 8 marks

4. (a) (iodine) element covalent
(magnesium oxide) compound ionic
(hydrogen chloride) compound covalent
bonding: all 3 correct = 2; 2 correct = 1
element/compound: all three correct = 2, 2 correct = 1

- (b) allotropes 4
(c) solid 1

Total 6 marks

5. (a) (i) A, C and D (any order) 1
(ii) C (accept B) 1
(iii) A and D (either order) 1
- (b) alkene(s) 1
- (c) C_nH_{2n+2} 1
- (d) add bromine (water) / Br_2 1
decolourised / (goes from orange to) colourless NOT 'clear' 1
remains orange/yellow/brown (or combination) / no change with C 1
- (e) 46 1

Total 9 marks

6. (a) aqueous / dissolved in water
gas
solid 3
- (b) (i) green 1
(to) black 1
(ii) carbon dioxide 1
- (c) nitric acid 1
- (d) magnesium oxide 1
copper (either order) 1
- (e) sulphuric acid / H_2SO_4 1

Total 10 marks

7. (a) 1 1
2 1
- (b) (i) sodium + water \rightarrow sodium hydroxide + hydrogen 1
(ii) sodium moves around / floats
melts / becomes a ball / gets smaller / disappears
NOT dissolves
effervescence / fizzing / bubbles NOT gas made 2
any two - max one from each line
- (c) indicator NOT 'universal indicator' 1
blue 1
- (d) (i) $Mg + H_2O \rightarrow MgO + H_2$ 1
(ii) white 1
- (e) potassium / K 1
magnesium / Mg 1

Total 11 marks

8. (a) carbon and hydrogen 1
- (b) (i) fractional distillation 1
(ii) (group of) compounds with same / similar boiling points 1
(iii) crude oil heated / boiled 1
(vapour) passed into column / tower 1
fractions collect at different heights 1
- (c) (i) carbon monoxide 1
(ii) poisonous / toxic / lethal / causes death 1
reduces capacity of blood to carry oxygen / combines with 1
haemoglobin

Total 9 marks

9. (a) acts as solvent
mixture melts at lower temperature / reduces operating temperature
/ allows lower temperature to be used
increases conductivity of mixture (any two) 2
- (b) (i) carbon / graphite / C 1
(ii) oxygen 1
(iii) they burn/combine with oxygen/form carbon dioxide 1
- (c) (aluminium) more reactive than carbon / too reactive 1
- (d) electricity / replacing anodes 1
- (e) (aeroplanes) low density NOT light 1
(overhead power cables) (good) conductor of electricity 1
low density (if not scored above)
(pans for cooking food) (good) conductor of heat 1

(Accept resists corrosion once as alternative for any of the above)

Total 10 marks

PAPER TOTAL 75 MARKS

Paper 3F

1. (a) metal 1
- (b) (i) green and yellow (either order) 1
(ii) (the metal case of) the iron 1
- (c) to prevent the user getting a shock 1
OR to carry (the) current to earth/the ground
if there is a fault/loose connection/wire (in the iron)
- (d) (i) (electric) current 1
(ii) prevent more than 13 A in the iron 1
- (e) frayed cables / water around sockets / pushing metal objects into sockets 1

Total 7 marks

2. (a) conduction and convection (either order) 1
- (b) glass is silvered glass 1
reflects heat back into flask 1
- (c) 1st box 1
4th box 1

Total 5 marks

3. (a) (i) A 1
(ii) 1. the temperature of 50°C in A must be the wall heater 1
2. heat moving straight up from the floor in B 1
- (b) less draught 1
warmer at floor level 1

Total 5 marks

4. (a) (i) R 1
Q 1
(ii) two 1
(iii) longitudinal 1
(iv) sound 1
- (b) (i) hertz ALLOW kilohertz 1
(ii) $20 \div 4$ 1
=5 1

Total 8 marks

5. (a) conserved 1
- (b) 10 / 100 - 90 2
- (c) (i) efficiency = useful energy output / total energy output 1
- (ii) no 1
- less of the energy goes for the intended purpose 1

Total 6 marks

6. (a) kinetic 1
- electrical 1
- (b) coal 1
- gas 1
- (c) work 1
- doing work / supply or transfer of energy 1
- (d) watt 1

Total 7 marks

7. (a) normal correctly labelled with N 1
- (b) $A = 90^\circ$ 1
- $B = 30^\circ$ 1
- (c) angle of incidence = angle of reflection 1
- (d) ray from top of ear to mirror 1
- ray reflected at mirror at same angle 1
- (e) virtual 1

Total 7 marks

8. (a) gamma rays = sterilising medical equipment 3
- infra-red = night vision equipment
- microwaves = satellite transmissions
- ultraviolet = fluorescent lamps
- all four correct (3); any two correct (2); any one correct (1)
- DO NOT credit lines to any box with two (or more) lines to/from it
- (b) gamma rays = mutations 3
- infra-red = skin burns
- microwaves = heat damage to internal body tissue
- ultraviolet = blindness

all four correct (3); any two correct (2); any one correct (1)

DO NOT credit lines to any box with two (or more) lines to/from it

Total 6 marks

9. (a) (i) centre of X along the vertical line 1
(ii) B
A all correct (2); any correct (1)
C 2
(iii) air resistance ALLOW drag / air friction 1
- (b) (i) slope/gradient (of the line) 1
ALLOW line increasing / line going up
(ii) 500 (m) 2
OR any clear indication, on the graph or elsewhere, that the distance is represented by (some of) the area under the graph e.g. $\frac{1}{2} (20 \times 30) = 300$ (1)

Total 7 marks

10. (a) (i) reflected NOT bounced / echoed 1
(ii) 3.5 (s) 1
(iii) 1155 (m) 2
(1) for working: 330×3.5
- (b) frequency (of the echo) 2
OR loudness / volume / amplitude; NOT sound of the echo increases
ALLOW shorter delay (2)
- (c) frequency and wavelength are inversely proportional 1
OR (wave) speed = frequency \times wavelength

Total 7 marks

11. (a) 0.025 (m²) 2
OR 0.25 \times 0.1 (1); 10 \times 25 (1)
- (b) (i) pressure = force \div area 1
(ii) 4800 (Pa) / 4.8 kPa 2
(1) for working: $120 \div 0.025$

Total 5 marks

12. (a) (i) all points plotted correctly (2) 3
OR four points plotted correctly (1)
DO NOT credit:
• blobs which are 2 mm or more across
• points which are more than 1 mm out in any direction
curve (1)
(ii) 2 (hours) 1
- (b) 1 000 000 (Bq) 1
ALLOW 1×10^6 / million

Total 5 marks

PAPER TOTAL 75 MARKS

Paper 4H

1. (a) (i) arrow (with arrowhead) from plants to animals; 1
arrow (with arrowhead) from plants to decomposers; 1
(ii) K; 1
(iii) J, L and N; 1
- (b) (i) carbon dioxide; 1
(ii) glucose / cellulose / starch / sucrose / acceptable alternative; 1
(iii) bacteria / fungus / microorganisms / named decomposer; 1

Total 7 marks

2. (a) 100%;; 2
(1) for: $4 - 2 \div 2$ OR a number divided by 2 x 100 = 1
- (b) phagocytes; 3
ingest / digest / engulf / swallow / eat; max
microorganisms / bacteria / pathogens / parasite / eq; 3
lymphocytes;
antibodies / antitoxins;
- (c) plasma; 1
- (d) (combines with / transports) oxygen; 3
haemoglobin; max
biconcave (or described e.g. doughnut) / large surface area; 3
no nucleus / more space for oxygen;
thin / flexible;

Total 9 marks

3. 1. less photosynthesis;
2. less carbon dioxide absorbed from air / more carbon dioxide in air / trees absorb carbon dioxide;
3. less oxygen in air / trees release oxygen / no trees no oxygen;
4. greenhouse effect / global warming;
5. less transpiration / less rainfall / drought;
6. erosion / leaching; max
7. flooding; 5
8. loss / change of habitat / loss of food;
9. loss of species / extinction / genes / change in distribution;

Total 5 marks

4. (a) (i) 1st week / 2nd week; 1
(ii) oestrogen; 1
(iii) ovary; 1
- (b) progesterone; 1
- (c) ovulation / egg release; 1

Total 5 marks

5. (a) (i) digests / breaks down;
protein; max
amino acids; 2
- (ii) lower / reduce / decrease (gas exchange) / less oxygen
absorbed;
alveoli; max
less surface; 2
- (b) (i) join / fuse / combine with sperm / male nucleus; 1
(ii) mitosis; 1
(iii) egg / ovum;
embryo;
uterus / womb;
milk;
clones; 5

Total 11 marks

6. (a) secondary consumers / carnivores; 1
- (b) level 1 and level 2; 1
- (c) energy is lost / used (up) / wasted;
respiration / excretion / faeces / movement / heat / not eaten; 2

Total 4 marks

7. (a) (i) parent genotypes: male + Hh female + hh;
gametes: H h (h) h;
offspring genotypes: Hh and hh;
offspring phenotypes: Huntington's disease, normal; 4
- (ii) 50% / 0.5 / 1/2 / 1:1 / 1 in 2; 1
- (b) would have children already / gene already passed on;
didn't know they had Huntington's; 2
- (c) receptors;
sensory / afferent neurones;
relay neurones / spinal cord;
motor / efferent neurones;
muscles / effector;
contracts;
synapse;
no brain involved; max
quicker; 5

Total 12 marks

8. (a) high in winter;
decreases in spring;
falls / low / rises in summer; max
high / rises in autumn; 2
- (b) less light in winter / more light in spring;
colder in winter / warmer in spring;
less light means less photosynthesis;
lower temperature means less photosynthesis; max
more photosynthesis means more numbers/growth; 3
- (c) starch is a large molecule;
insoluble / does not dissolve;
less space needed;
water is not taken in / osmosis;
starch not lost / diffuse from cell; max
starch not react in cell; 3

Total 8 marks

9. (a) (i) sweat evaporates;
using / loss of body heat / removes body heat; 2
- (ii) vasodilation;
blood vessels (NOT capillaries) get wider / eq;
(more) blood to skin / surface;
heat lost from skin / surface; max
radiation / convection; 3
- (b) water content (of blood) decreases;
(more) ADH released;
kidney / nephron / collecting duct;
(more) water reabsorbed / increases permeability;
water into blood; max
less water lost from body / more concentrated urine produced; 4
- (c) (i) homeostasis is keeping conditions / substances / levels
constant; 1
- (ii) temperature control;
glucose control; max
pH of blood / eq; 2

Total 12 marks

10. (a) (i) shoot has grown / bent towards the light; 1
- (ii) positive;
phototropism; 2
- (iii) more (auxin) on dark side;
growth / cell elongation; 2
- (b) obtain light;
more photosynthesis; 2

Total 7 marks

11. (a) fertilisers contain minerals/salts / named mineral/salt;
e.g. nitrate for amino acids/protein or magnesium for chlorophyll; 2
- (b) (i) advantage - less crop is destroyed / more crop growth;
disadvantage - affects other organisms / affects food chain
/ pollutes environment / needs reapplication /
pest resistance; 2
- (ii) biological control;
living organism/predator that eats insects/pests; max
example e.g. ladybirds eating aphids; 2
- (c) A - restriction;
B - plasmid / virus;
C - virus / plasmid;
D - ligase; 4

Total 10 marks

PAPER TOTAL 90 MARKS

Paper 5H

1. (a) 1 1
2 1
- (b) (i) sodium + water \rightarrow sodium hydroxide + hydrogen 1
(ii) sodium moves around / floats
melts / becomes a ball / gets smaller / disappears
NOT dissolves
effervescence / fizzing / bubbles NOT 'gas made'
any two - max one from each line 2
- (c) indicator NOT 'universal indicator' 1
blue 1
- (d) (i) $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$ 1
(ii) white 1
- (e) potassium / K 1
magnesium / Mg 1

Total 11 marks

2. (a) carbon and hydrogen 1
- (b) (i) fractional distillation 1
(ii) (group of) compounds with same / similar boiling points 1
(iii) crude oil heated / boiled 1
(vapour) passed into column / tower 1
fractions collect at different heights 1
- (d) (i) carbon monoxide 1
(ii) poisonous / toxic / lethal / causes death 1
reduces capacity of blood to carry oxygen / combines with 1
haemoglobin

Total 9 marks

3. (a) acts as solvent
mixture melts at lower temperature / reduces operating temperature
 / allows lower temperature to be used
 increases conductivity of mixture (any two) 2
- (b) (i) carbon / graphite / C 1
 (ii) oxygen 1
 (iii) they burn/combine with oxygen/form carbon dioxide 1
- (c) (aluminium) more reactive than carbon / too reactive 1
- (d) electricity / replacing anodes 1
- (e) (aeroplanes) low density NOT light 1
 (overhead power cables) (good) conductor of electricity 1
 low density (if not scored above)
 (pans for cooking food) (good) conductor of heat 1
- (Accept resists corrosion once as alternative for any of the above)

Total 10 marks

4. (a) $C + O_2 \rightarrow CO_2$
 C / carbon reacted with oxygen 1
 equation correct 1
- (b) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
 all formulae correct 1
 balancing correct 1
- (c) limestone decomposes to make CaO or $CaCO_3 \rightarrow CaO + CO_2$ (2) 1
 this reacts with silicon dioxide or $CaO + SiO_2 \rightarrow CaSiO_3$ (2) 1
 to form slag / calcium silicate 1
- (d) prevents rusting 1
 zinc more reactive than iron 1
 oxidises /corrodes instead of iron 1

Total 11 marks

5. (a) $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ 1
 all formulae correct 1
 state symbols correct 1
 balanced 1
- (b) (i) line steeper 1
 same final volume 1
 (ii) line not as steep 1
 produces half the final volume of gas 1
- (c) particles/ions move faster / have more energy 1
 more collisions per second / more frequent collisions / greater chance 1
 of collisions
 more successful/effective/fruitful collisions / idea of more collisions 1
 with E_A
- (d) add nitric acid 1
and silver nitrate (solution) 1
 white ppt (ONLY if silver nitrate mark awarded) 1

Total 13 marks

6. (a) electrolysis 1
 brine / sodium chloride solution 1
- (b) (i) $\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}$ 1
 all species correct 1
 balanced 1
 ACCEPT correct ionic equation / multiples of above
- (ii) redox / displacement 1
- (c) (i) (goes red then) bleached / goes white / decolorised / colourless 1
 (ii) goes red / pink 1
- (d) (i) division of percentages by A_r values 1
 division of numbers of moles by the smallest 1
 CH_2Cl 1
 (ii) $\text{C}_2\text{H}_4\text{Cl}_2$ only 1

Total 11 marks

7. (a) stoichiometric coefficients are: 2:3:2:2 1
- (b) (i) gives out (heat) energy / products have less energy than reactants 1
- (ii) $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$
correct species and balanced 1
using \rightleftharpoons (indep) 1
- (iii) temperature: decreases/less NOT "shifts left" 1
pressure: increases/more NOT "shifts right" 1
- (c) pipette to measure sodium hydroxide 1
sulphuric acid in burette 1
indicator used and colour change (NOT universal indicator) 1
add sodium hydroxide gradually near end point (and swirl) 1

Total 10 marks

8. (a) (i) carbon and hydrogen only 1
double bond / can undergo addition reactions / has multiple bond 1
- (ii) same molecular formula / same atoms 1
different spatial arrangement/structural formula 1
- (b) three isomers of C_5H_{10} (1 mark per isomer) 3
ACCEPT condensed methyl groups
- (c) correct structure with continuation bonds and brackets 1
poly(propene) / polypropylene 1
styrene / phenylethene 1
correct structure 1
- (d) (i) orange / yellow / brown 1
colourless NOT clear 1
- (ii) correct structure of 1,2 dibromoethane 1
- (iii) has no double bonds/saturated 1

Total 15 marks

PAPER TOTAL 90 MARKS

Paper 6H

1. (a) gamma rays = sterilising medical equipment 3
infra-red = night vision equipment
microwaves = satellite transmissions
ultraviolet = fluorescent lamps

all four correct (3); any two correct (2); any one correct (1)
DO NOT credit lines to any box with two (or more) lines to/from it

- (b) gamma rays = mutations 3
infra-red = skin burns
microwaves = heat damage to internal body tissue
ultraviolet = blindness

all four correct (3); any two correct (2); any one correct (1)
DO NOT credit lines to any box with two (or more) lines to/from it

Total 6 marks

2. (a) (i) centre of X along the vertical line 1
(ii) B
A all correct (2); any correct (1)
C 2
(iii) air resistance ALLOW drag / air friction 1

- (b) (i) slope/gradient (of the line) 1
ALLOW line increasing / line going up
(ii) 500 (m) 2
OR any clear indication, on the graph or elsewhere, that the distance is represented by (some of) the area under the graph e.g. $\frac{1}{2} (20 \times 30) = 300$ (1)

Total 7 marks

3. (a) (i) reflected NOT bounced / echoed 1
(ii) 3.5 (s) 1
(iii) 1155 (m) 2
(1) for working: 330×3.5

- (b) frequency (of the echo) 2
OR loudness / volume / amplitude; NOT sound of the echo increases
ALLOW shorter delay (2)

- (c) frequency and wavelength are inversely proportional 1
OR (wave) speed = frequency \times wavelength

Total 7 marks

4. (a) 0.025 (m²) 2
 OR 0.25 x 0.1 (1); 10 x 25 (1)
- (b) (i) pressure = force ÷ area 1
 (ii) 4800 (Pa) / 4.8 kPa 2
 (1) for working: 120 ÷ 0.025

Total 5 marks

5. (a) (i) all points plotted correctly (2) 3
 OR four points plotted correctly (1)
 DO NOT credit:
- blobs which are 2 mm or more across
 - points which are more than 1 mm out in any direction
- curve (1)
- (ii) 2 (hours) 1
- (b) 1 000 000 (Bq) 1
 ALLOW 1 x 10⁶ / million

Total 5 marks

6. (a) use of $F = ma$ 1
 $a = 1440 \div 60 = 24$ IGNORE minus sign 1
 m/s² ALLOW N/kg 1
- (b) *arrow*:
 left to right 1
 in correct place 1

Total 5 marks

7. (a) (i) R 1
 (ii) total internal reflection (takes place at the surface) 1
 (ONLY if R correct)
- (b) (i) $\sin c = \frac{1}{n}$ OR $\frac{1}{\sin c} = n$ 1
 (ii) 49° 1
- (c) (i) continues out of tank (IGNORE reflections) 1
 bends downwards (ONLY if first mark given) 1
 (ii) hits surface at an angle less than critical angle/ angle Q 1
 OR goes from more dense to less dense / gets faster
 therefore refraction takes place/ enters air at angle P 1
 OR refracts/bends away from normal

Total 8 marks

8. (a) formula / $\frac{1}{2} \times 0.400 \times 25$ 3
 = 5
 J
- (b) formula / $0.40 \times 10 \times 0.75$ 2
 = 3 (J)
- (c) (i) $5 - 3 = 2$ 2
 J
- (ii) conservation of energy 2
 means work = ke - pe OR ke = work done + pe
 ACCEPT "this is the minimum work done if the technician
 just lets the hammer fall (onto the nail)" for (2)

Total 9 marks

9. (a) (i) $120 \times 0.025 = 140 \times V$ 1
 $V = 0.021(4)$ 1
- (ii) fixed mass ACCEPT amount/ number of molecules 1
 no temperature change 1
- (b) (i) mass / volume 1
 (ii) increased 1
 (iii) same mass/amount 1
 decreased volume 1

Total 8 marks

10. (a) (i) line used to describe the shape/strength/direction/shape of 1
 a magnetic field / line going from N to S
- (ii) current in it / moved in a magnetic field / cuts magnetic 1
 field lines
- (b) (i) I downwards 1
 (ii) M from N to S 1
 (iii) F out of the paper 1
- (c) increase the current 2
 OR reduce resistance / increase power supply / thicker wire /
 shorter (connecting) wire
 move poles closer together
 OR stronger field/magnets
- (d) any two from: liquid (at room temperature) 2
 metallic
 conductor
 to allow the end of the wire to move
 non-magnetic

Total 9 marks

11. (a) $\begin{matrix} & & -4 \\ (+)1 & & 0 \\ 0 & & 0 \end{matrix}$ 5
- (b) $\begin{matrix} 3 \\ 2 \end{matrix}$ 2
- (c) protons (and electrons) ACCEPT atomic number 1
neutrons ACCEPT nucleons/ nucleon number/ mass number 1

Total 9 marks

12. (a) A : (most of) the atom is empty / space / hollow 1
ACCEPT arguments e.g. 'nucleus is a long way from electrons'
- (b) B: small(er than atom) ACCEPT larger than alpha particle 2
massive ACCEPT heavy / very dense
- (c) C : same as alpha / + ve 2
like charges repel

Total 5 marks

13. (a) neutron 4
uranium / plutonium
kinetic NOT heat
products / fragments ACCEPT neutrons
- (b) H: Ba 3
J: Kr
K and L and M: n

Total 7 marks

PAPER TOTAL 90 MARKS

Paper 7

- | | | |
|----|----|---|
| 1. | A; | 1 |
| | F; | 1 |
| | C; | 1 |
| | B; | 1 |

Total 4 marks

- | | | | | | |
|----|-----|-------|---|----|---|
| 2. | (a) | (i) | 9 | 1 | |
| | | | 8 | 2 | |
| | | | 7 | 3 | |
| | | | 1 | 9 | |
| | | | 0 | 10 | |
| | | | table correctly filled in;; | | 2 |
| | | (ii) | 70; | | 1 |
| | | (iii) | W: axes correct way; | | |
| | | | S: scales at least half and linear; | | |
| | | | U: axes labelled <u>with units</u> (% germinated / age in years); | | |
| | | | P: points accurate;; | | 5 |
| | | (iv) | not to use seeds / use younger seeds; | | |
| | | | they will not germinate / less chance of germination; | | 2 |

- | | | |
|-----|------------------------------|-----|
| (b) | time; | |
| | water / moisture / humidity; | |
| | temperature / warmth; | |
| | light (intensity); | |
| | number; | |
| | oxygen / air; | |
| | variety / type; | |
| | size / mass; | max |
| | pH; | 2 |

- | | | |
|-----|--|---|
| (c) | use more seeds / repeat; | 1 |
| | NOT using seeds of different ages to original experiment | |

Total 13 marks

- | | | | | |
|----|-----|-------|---|-----|
| 3. | (a) | (i) | equal numbers both sides / 15 seen / maggots evenly spread / equal areas/half of apparatus covered and uncovered; | 1 |
| | | (ii) | 25; | 1 |
| | (b) | (i) | 53; | 1 |
| | | (ii) | 4 / 14 - 16; | 1 |
| | | (iii) | cover not used / even light intensity / not left long enough; | 1 |
| | (c) | | all dish uncovered / clear / covered / dark; | max |
| | | | swap / rotate cover; | 1 |

Total 6 marks

4. (a) (i) measuring cylinder; 1
(ii) correct line; 1
- (b) (i) stop oxygen or air (NOT gas) getting in / keeps anaerobic; 1
(ii) count bubbles / amount of bubbles / volume of gas; reference to time; max
method for changing temperature of water bath; 2
- (c) (i) increases; peak / optimum / 45 °C; decreases; 3
(ii) molecules move slower at low temps / low kinetic energy / few collisions; optimum temperature / eq; enzymes denatured / destroyed by high temperatures; 3
- (d) smaller range / more readings; NOT repeats above and below or around 45 °C / optimum temperature; 2

Total 13 marks

5. (a) (i) heading with distance moved by bubble in mm; columns with still air and wind; four readings listed in each column; average present; 4
(ii) added up four numbers / all numbers; divided by four / all numbers; OR as a sum $36 \div 4$ 2
- (b) obtain more results; range of windy conditions e.g. less distance between plant & fan; use different types of plant / leaves; 3

Total 9 marks

6. C : tea and no tea / range of tea concentrations / before and after tea;
O : same person / age / sex / weight;
R : several people / several cups of tea / several times;
M1 : heart rate / pulse rate in set time;
2 : how measured;
S1 : same temperature;
2 : same concentration / volume / brand; max
3 : same level of activity; 5

Total 5 marks

PAPER TOTAL 50 MARKS

Paper 8

- | | | | | |
|----|-----|-------|----------------------|---|
| 1. | (a) | A | pipette | 1 |
| | | B | fractionating column | 1 |
| | | C | syringe | 1 |
| | | D | conical flask | 1 |
| | (b) | (i) | A / name | 1 |
| | | (ii) | C / name | 1 |
| | | (iii) | B / name | 1 |

Total 7 marks

- | | | | |
|----|-----|--|---|
| 2. | (a) | wear eye protection/gloves / wipe up spills
NOT glasses / don't get on skin | 1 |
| | (b) | 20.2 | 1 |
| | | 1.6 | 1 |
| | | 18.6 | 1 |
| | (c) | (i) ticks under 27.45 and 27.25 | 1 |
| | | (ii) 27.35 (to 2 or 3 decimal places) | 1 |

Total 6 marks

- | | | | |
|----|-----|---|--------|
| 3. | (a) | 2.7 (g)
45 (%) | 1
1 |
| | (b) | (i) it would dissolve more quickly / would take less time | 1 |
| | | (ii) less | 1 |
| | (c) | dry the filter paper / residue | 1 |
| | | THEN | |
| | | weigh filter paper with insoluble impurities (1) | |
| | | weigh the original/new filter paper/subtract mass of filter paper (1) | |
| | | OR | |
| | | remove insoluble impurities from filter paper (1) | |
| | | weigh insoluble impurities (1) | 2 |

Total 7 marks

4. (a) polystyrene is a (better) insulator / to reduce heat loss / glass conducts heat 1
- (b) 18.6 1
22.8 1
4.2 IGNORE sign 1
- (c) points for 1-3 1
line (NOT curve) of best fit for 1-3 MUST use ruler 1
points for 4-6 1
line (NOT curve) of best fit for 4-6 MUST use ruler 1
- (d) 27.2 - 27.4 °C 1
44 - 45 (cm³) 1
56 - 55 (cm³) 1
- (e) use 44 cm³ of KOH and 56 cm³ of nitric acid 1
MUST give two volumes, which total 100 cm³
- (f) KOH, because smaller volume than acid 1

Total 13 marks

5. (a) (i) 5 (cm) 1
(ii) 40 (seconds) 1
- (b) (i) 1 cm represents 1 cm for y axis 1
all points correct (deduct 1 for each error) 2
smooth line of best fit 1
(ii) any time between 85 and 90 (s) / cq on graph 1
- (c) (i) same surface area / powdered 1
same amount / same number of moles 1
NOT same mass or same quantity
- (ii) same proportions OR volumes of acid and detergent
same volume of mixture *any two*
same concentration of acid 2
(any of these could be scored in (iii) instead)
- (iii) temperature 1
(this could be scored in (ii) instead of here)
could score metal points here if not in (i)
- (d) (i) 2 1
(ii) Metal 3 for student S / 105 sec 1
(iii) clock read incorrectly / thought 100 sec = 1 min / used too little metal or mixture / did not use powder 1
(iv) 2 and 4 1
(v) results overlap / some times are same for both metals / results similar 1

Total 17 marks

PAPER TOTAL 50 MARKS

Paper 9

1. (a) 76 (mm) ALLOW 75.5 - 76.4 1
- (b) (i) (clamp) stand / retort stand 1
(ii) hang (NOT tie on) the weight/plumb line next to the tube 2
check same distance top and bottom / they appear to be parallel
- (c) stopwatch/ stopclock/ light gates/ electronic/electric timer/ 1
multiflash camera
- (d) ruler/ metre rule/ measuring tape 1
- (e) magnet next to (steel) ball / (bottom of) tube/bung 1
lift/ drag the ball out of the tube (with the magnet) 1
DO NOT credit either mark for magnet in the tube of oil.
DO NOT credit 2nd mark for magnet at the top of the tube to attract the steel ball
- (f) any two from: 2
* not all readings same/ there will be variations
* to give an average
* (this tends) to cancel out inaccuracies/ errors
OR increases reliability / accuracy
* allows anomalous result(s) to be identified (and discounted)
- (g) (i) faster/ more quickly/ with a greater speed/velocity 1
(ii) (electronic) thermometer/ temperature probe 1

Total 12 marks

2. (a) $i = 32-34$ 1
 $r = 60$ 1
- (b) ray box/ light box 1
OR laser/ torch with slit OR suitable diagram
- (c) (i) appropriate headings 1
all in order 1
unit given as degrees / ° seen (NOT °C) anywhere at least once 1
(ii) both axes labelled 1
 i on X axis r on Y axis 1
all points correctly plotted i.e. within 1 mm in any direction 3
(-1) for each incorrectly plotted point; or if point is a blob
smooth curve /curved line 1
either for the plotted points or for the plotted points and the origin
DO NOT credit dot-to-dot, straight lines or lines >1 mm thick
(iii) correct reading from candidate's graph when curve/line 1
extrapolated to $r = 90^\circ$

Total 13 marks

3. (a) (i) measure (the length of) each/ one side 1
 volume = $l \times b \times h$ OR $v = l^3$ 1
 (ii) water in measuring cylinder 1
 difference in readings (= volume of pebble) 1
 OR correct description of eureka can / equivalent (2)
- (b) (i) (top pan) balance ACCEPT electric/electronic/digital balance 1
 (ii) 78 1
- (c) (i) EITHER 2.4 in the table 3
 OR $98 \div 41$ (1)
 $= 2.39\dots\dots$ (1)
- (ii) mass and volume are (only) to 2 significant figures 1
 (so) result cannot be more precise (than this) 1
 ALLOW 'all the other densities are to 2 sig figs' for (1)
- (iii) (that) three of the objects are made of the same (sort of) glass 1
 (that) the other two are made of a different sort 1
 OR words to that effect / correct from candidate's table
- (iv) No; only three made of the same (sort of) glass 1
 OR words to that effect / correct from candidate's table

Total 14 marks

4. (a) (i) 5.2 1
 (ii) 6.6 1
- (b) suitable suggestion OR suitable comment re the 'tube' 1
 appropriate explanation OR suitable comment re 'black' 1
 e.g. to stop light getting in through the side(s) (1)
 only want light to get in through the (open) end (1)
 to reduce/stop reflection (from the inside surface of the tube) (1)
 only want to measure the light coming directly into the tube (1)
 DO NOT credit just 'focuses the light'
- (c) (i) resistance 2
 direction/angle AND degrees
- (ii) 276-280 1
 96-100 ACCEPT any answer in these ranges 1
 (1) only if both correct, but order reversed
- (iii) 500 (Ω) 1
 OR correct reading from clear extrapolation on the graph
- (iv) 360° is the same (direction) as 0° 1
 (so) the tube is back where it started 1
 NB these marks should only be credited if 500 given in (c)(iii)

Total 11 marks

PAPER TOTAL 50 MARKS

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