

Mark Scheme Summer 2007

IGCSE

IGCSE Dual Award Science (4437)

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Summer 2007

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Contents

| | | |
|----|----------|----|
| 1. | Paper 1F | 4 |
| 2. | Paper 2F | 8 |
| 3. | Paper 3F | 11 |
| 4. | Paper 4H | 17 |
| 5. | Paper 5H | 21 |
| 6. | Paper 6H | 25 |
| 7. | Paper 7 | 33 |
| 8. | Paper 8 | 35 |
| 9. | Paper 9 | 37 |

DA SCIENCE (BIOLOGY) 4437, MAY 2007, MARK SCHEME

Key

- ; indicates separate mark points
/ indicates alternatives
eq allow for correct equivalent
— word underlined means no alternatives allowed

Paper 1F

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

Total 7 marks

- | | | | |
|----|--|----------------------------------|-------------------|
| 2. | | Function | Donated body part |
| | | breaks down toxic chemicals | (liver) |
| | | produces urine | kidney; |
| | | pumps blood around the body | heart; |
| | | fills with air during breathing | lung; |
| | | bends light as it enters the eye | cornea / lens; |
| | | secretes insulin | pancreas; |

Total 5 marks

- | | | | |
|----|-----|----|-----|
| 3. | (a) | A; | (1) |
| | (b) | D; | (1) |
| | (c) | B; | (1) |
| | (d) | C; | (1) |

Total 4 marks

- | | | | |
|----|-----|---|------------|
| 4. | (a) | (i) human; | (1) |
| | | (ii) 105; | (1) |
| | (b) | amino acids; protease; hydrochloric acid; | (3) |
| | (c) | Energy /used as fuel; insulation / less heat loss / eq; cold (environment); | max (2) |
| | (d) | vitamins / minerals / named vitamin /named mineral;; I antibodies | (2) |

Total 9 marks

5. (a) take up water;
take up nutrient / eq; support / anchorage; max
(2)
- (b) no microorganisms / eq; (1)
- (c) nitrate / phosphate / eq; (1)
- (d) stop entry of micro-organisms;
stop disease / eq; maintain humidity; max
(2)
- (e) light;
temperature / warmth;
carbon dioxide; water; max
(2)

Total 8 marks

6. (a) 15;
60; (2)
- (b) prevents growth / eq;
due to acid /eq; (2)

Total 4 marks

7. (a) B;
D;
C; (3)
- (b) muscles;
contract;
peristalsis; max
(2)
- (c) (i) cellulose; (1)
(ii) skin / gums / prevent scurvy / help connective tissue /
protect against infection / help immune system; (1)
Ignore keep healthy
- (d) (i) the faster the exercise the more energy needed /eq; (1)
(ii) 5 250; (1)

Total 9 marks

8. (a) (i) gas used = oxygen (1)
gas produced = carbon dioxide;
- (ii) yeast in middle; (2)
arrows correct;
- (b) (i) 38; (1)
(ii) 50;;
38 - 57 / 19 / 57 - 38 for 1 mark (2)
- (c) optimum / best / ideal / better temperature / warmer / high;
enzymes / respiration / metabolism / reactions / eq; max
yeast reproduced; (2)
more food;
- (d) (i) XX and XY;
female and male;
gametes X and Y and all X / X and X;
offspring XX and XY; Allow ecf from wrong parents
50:50 ratio given / eq; max
due to chance / random fertilisation / (5)
- (ii) fewer Y sperm / more X sperm / wrongly sexed /
miscounted / eq; (1)
Ignore gene
Ignore temperature
- Total 14 marks
9. (a) reduce yield / eat crop / eat leaf;
less leaf / less surface area / trap light / absorb carbon dioxide;
less photosynthesis; (3)
- (b) kill/destroy pests / insects;
increase yield / reduce crop loss / prevent eating crop / eq; (2)
- (c) (i) 28; (1)
(ii) 48 / 48 thousand / 48 000; (1)
- (d) kills other insects / not specific;
affect consumer / disrupts food chains / persistent / accumulation
/ not broken down / eq; max
reapplication needed / short lasting; (2)
resistant; Ignore immune
effect on humans / eq;
Ignore expensive
Ignore eutrophication
- Total 9 marks
10. (a) (i) urea / water / salt / urine / mineral ion /
named mineral ion; (1)
(ii) (less) oxygen transport; (1)
- (b) (i) white blood cells / lymphocytes / white / B / B cells / wbc; (1)
- (ii) diaphragm / intercostal muscles;
no contraction;
no volume/pressure changes (in lung/chest);

no air/gas/oxygen in / no air/gas/carbon dioxide out;
less oxygen to cells/blood/body;
less respiration / energy;
Ignore suffocation / death

max
(3)

Total 6 marks

PAPER TOTAL 75 MARKS

Paper 2F

- | | | | |
|----|-----|---|---------------|
| 1. | (a) | Mg | 1 |
| | (b) | C | 1 |
| | (c) | O ACCEPT 8 | 1 |
| | (d) | 2 / alkaline earth | 1 |
| | (e) | 7 / halogen | 1 |
| | | | Total 5 marks |
| 2. | (a) | nucleus / centre | 1 |
| | (b) | electrons | 1 |
| | (c) | protons | 1 |
| | (d) | protons and neutrons | 1 |
| | (e) | isotopes | 1 |
| | | | Total 5 marks |
| 3. | (a) | oxygen water | 2 |
| | (b) | iron oxide / rust | 1 |
| | (c) | oil / grease / paint / plastic / zinc <i>(Any two for 1 each)</i> accept chrome / chromium reject copper / magnesium | 2 |
| | | | Total 5 marks |
| 4. | (a) | iron tube diagram completed with 5 or fewer bubbles magnesium diagram completed with 7 or more bubbles | 2 |
| | (b) | zinc + hydrochloric acid → zinc chloride + hydrogen | 1 |
| | (c) | copper / silver / gold / platinum | 1 |
| | (d) | water / H ₂ O / steam oxygen/O ₂ / air metal salt (solutions) <i>(Any two for 1 each)</i> Allow metal oxides | 2 |
| | | | Total 6 marks |
| 5. | (a) | aq (H ⁺) l (H ₂ O) g (CO ₂) | 3 |

- (b) any acid identified by name (not carbonic) 1
- (c) carbonate (CO_3^{2-})
carbon dioxide (CO_2) 2
- (d) (i) calcium hydroxide 1
(ii) limewater 1
(iii) milky / cloudy / white precipitate 1
(iv) CaCO_3 2
 H_2O
(incorrect balancing - deduct 1 mark)
- (e) (makes it) acidic / forms carbonic acid 1

Total 12 marks

6. (a) hydrogen
carbon (either order) 2
- (b) rise to different height
(according to) different condensation temperatures (allow boiling points) 2
- (c) (gasoline) petrol / (fuel for) cars 2
(bitumen) tarmac / (making) roads / roofs
- (d) refinery gases / kerosene / diesel / fuel oil / naphtha 2
(Any two for 1 each)
- (e) (i) carbon dioxide / CO_2
water / H_2O 2
(ii) Any two from
CO made
toxic / poisonous (accept lethal / death)(reject suffocate)
correct reference to blood / haemoglobin 2

Total 12 marks

7. (a) catalyst 1
- (b) (i) *line steeper*
reaches same level 2
(ii) *line shallower*
reaches same level 2
- (c) glowing spill
relights (dependent on first point) 2

Total 7 marks

8. (a) heat 1
- (b) (i) diffusion 1
(ii) ammonium chloride / NH_4Cl 1

- | | | |
|-------|---|---|
| (iii) | ammonia faster / hydrogen chloride slower | 1 |
| (iv) | A : red | |
| | B : blue | 2 |

Total 6 marks

- | | | | | |
|----|-----|------|---|---|
| 9. | (a) | (i) | ticks in 1 st and 3 rd boxes | 2 |
| | | (ii) | contains a double/multiple bond / can undergo addition reactions (accept a specific addition reaction except bromine) | 1 |
| | (b) | (i) | orange / yellow | 2 |
| | | (ii) | colourless correct structure of 1,2-dibromoethane | 1 |
| | (c) | | correct structures for two isomers of C ₄ H ₈ but-1-ene, but-2-ene (cis + trans) cyclo-butane, cyclo-methyl propane, methyl propene | 2 |

Total 8 marks

- | | | | | |
|-----|-----|-------|---|--------|
| 10. | (a) | (i) | any two from: fizz / bubble move / darts about melts / forms a ball gets smaller / disappears (reject dissolves) | 2 1 |
| | | (ii) | sodium + water → sodium hydroxide + hydrogen | |
| | | (iii) | blue / purple (solution made is) alkaline / (contains) hydroxide ions / OH ⁻ not just "alkali metal" pH 11 → 14 (any in range) | 2 |
| | (b) | (i) | electrons being transferred between oxygen and sodium (can be wrong way round) idea of sodium losing electron(s) and oxygen gaining electron(s) correct numbers of electrons involved (sodium lose 1, oxygen gain 2) (sharing = 0 marks) | 3 |
| | | (ii) | Na ₂ O. If write an equation - then only mark the formula of the sodium oxide. | 2 |

Total 9 marks

PAPER TOTAL 75 MARKS

Paper 3F

Question 1

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|--|---------|
| a (i) | A | | 1 |
| a (ii) | B | | 1 |
| b(i) | frequency | | 1 |
| b(ii) | period | | 1 |
| c(i) | any two of <ul style="list-style-type: none"> • gamma • X-rays • ultra violet • (visible) light • infra red • microwaves • radio waves • rope/slinky spring waggled side to side • | Allow 'electromagnetic' for 1 mark but do not award another mark for a part of the electromagnetic spectrum or words to that effect, but not just 'slinky spring' | 2 |
| c(ii) | longitudinal (waves) | allow sound waves or slinky spring pushed and pulled | 1 |
| | | | 7 marks |

Question 2

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|--|--|---------|
| a (i) | case/plug is damaged/broken/has piece missing | fuse/earth exposed | 1 |
| a (ii) | could touch inside/live wire/fuse | | 1 |
| | get (an electric) shock | | 1 |
| a(iii) | fuse | | 1 |
| a(iv) | any two of <ul style="list-style-type: none"> • get hotter • melt • fail to conduct/breaks/switches off | accept 'get hot' accept 'switch off' ignore effects on glass | 2 |
| b(i) | insulator/non-conductor | | 1 |
| | will not get a shock (if you touch it) | ora | 1 |
| (b)(ii) | any two of <ul style="list-style-type: none"> • has an earth wire /connection/it is earthed • if there is a fault, electricity will go to earth/metal will not be live • will not get a shock if touch it | but not if already credited in (b)(i) | 2 |

10 marks

Question 3

| Qu part | Answer(s) | Extra Information | |
|------------|--|---|---------|
| A | all points correct | to the nearest mm in any direction and not 'blobs' (more than 1 mm across) deduct (1) for each wrong point to a minimum of zero | 3 |
| (b)(i) | answer in range 67 to 68 inclusive | or correct from candidate's graph | 1 |
| (b)(ii) | answer in range 2.3 to 2.4 inclusive | or correct from candidate's graph allow 2 hr 18 m - 2 hr 24 m | 1 |
| c | (average) speed = distance (moved) ÷ time (taken) | or correctly transposed version allow use of letters e.g. $a = d/t$ | 1 |
| | | | 6 marks |

Question 4

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|--------------------------|---|---------|
| a | insulation | | 1 |
| | conduction | | 1 |
| b | ... cold ... down | both correct for the mark | 1 |
| | ... warm .. up | may be reversed with the pair above allow 'hot' for 'warm' | 1 |
| | ... cold ... warm no ecf | order must be correct but allow 'hot' for 'warm' | 1 |
| | convection | | 1 |
| | | | 6 marks |

Question 5

| Qu part | Answer(s) | Extra Information | |
|------------|---------------------------------------|--|---------|
| a | density = mass ÷ volume | or any correctly transposed version do not accept 'weight' for 'mass' allow use of letters | 1 |
| b(i) | (volume) = length x thickness x width | or any correctly transposed version accept 'breadth' for 'width' allow use of letters | 1 |
| b(ii) | millimetres/mm | | 1 |
| c | none/no change | accept 'the same' | 1 |
| d | 2.7 (g/cm ³) | accept 'the same' | 1 |
| | | | 5 marks |

Question 6

| Qu part | Answer(s) | Extra Information | |
|------------|---------------------------------|---|----------|
| a | Z X A | all three correct allow (1) for one or two correct | 2 |
| b(i) | proton(s) | | 1 |
| | nucleus | | 1 |
| (b)(ii) | neutron(s) | | 1 |
| (b)(iii) | proton(s) (1) neutron(s) (1) | | 2 |
| (b)(iv) | ... electron(s) ... proton(s) | either order | 1 |
| b(v) | alpha/α | | 1 |
| | beta/β | order of α and β may be reversed | 1 |
| | gamma/γ | | 1 |
| | | | 11 marks |

Question 7

| Qu part | Answer(s) | Extra Information | Mark(s) |
|---------|---|---|-------------|
| a(i) | C | | 1 |
| a(ii) | sloping downwards | slowing down | 1 |
| a(iii) | constant | less than acceleration / decreases slowly / takes a longer time than the acceleration / (area) A is less than (area) C / (train) travels a greater distance while decelerating than when accelerating | 1 |
| b(i) | area (under graph) | A + B + C | 1 |
| b(ii) | horizontal non zero line below line on graph for the correct time | dop independent | 1 1 1 |
| 7 marks | | | |

Question 8

| Qu part | Answer(s) | Extra Information | Mark(s) |
|---------|---|-------------------|---------|
| a(i) | resistor/resistance/rheostat power supply/battery/cell | | 1 1 |
| a(ii) | = 0.4×20 = 8 (C) | | 1 1 |
| b | lamp in parallel switch in series with second lamp | dop | 1 1 |
| 6 marks | | | |

Question 9

| Qu part | Answer(s) | Extra Information | Mark(s) |
|---------|---|---|---------|
| a | <u>angle</u> of incidence equals <u>angle</u> of reflection | (angle) i = (angle) r $\hat{i} = \hat{r}$ $\angle i = \angle r$ | 1 |
| b(i) | correct ray striking window any ray reflected off at correct angle | | 1 |

| | | | |
|-------|--------------------------------|---|---------|
| | | independent | 1 |
| b(ii) | cover <u>outside</u> of window | open/close/tilt window/fit shutters (outside) | 1 |
| c(i) | infra-red | i.r ignore heat / radiation | 1 |
| c(ii) | ultraviolet | u.v | 1 |
| d | (same) speed / velocity | transverse | 1 |
| | | | 7 marks |

Question 10

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|-------------------------|-------------|
| a | 50 000J of <u>chemical</u> 30 000 J of <u>heat / thermal</u> energy | ignore sound / chemical | 1 1 1 |
| b | = 700×2 (000) convert km to m = 1 400 000 (J) | 1400 (J) scores 2 | 1 1 1 |
| | | | 6 marks |

Question 11

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|---|-------------|
| a | magnetic field / flux (in coil) changes voltage / current <u>induced</u> / electromagnetic induction / emi | dop | 1 1 1 |
| b | pedal faster | more wire on coils use <u>stronger</u> magnet reduce gap(s) | 1 |
| | | | 4 marks |

Paper 4H

1. (a) B;
D;
C; (3)
- (b) muscles;
contract;
peristalsis; max
(2)
- (c) (i) cellulose; (1)
(ii) skin / gums / prevent scurvy / help connective tissue /
protect against infection / help immune system; (1)
Ignore keep healthy
- (d) (i) the faster the exercise the more energy needed /eq; (1)
(ii) 5 250; (1)
- Total 9 marks
2. (a) (i) gas used = oxygen (1)
gas produced = carbon dioxide;
(ii) yeast in middle; (2)
arrows correct;
- (b) (i) 38; (1)
(ii) 50;;
38 - 57 / 19 / 57 - 38 for 1 mark (2)
- (c) optimum / best / ideal / better temperature / warmer / high;
enzymes / respiration / metabolism / reactions / eq; max
yeast reproduced; (2)
more food;
- (d) (i) XX and XY;
female and male;
gametes X and Y and all X / X and X;
offspring XX and XY; Allow ecf from wrong parents
50:50 ratio given / eq; max
due to chance / random fertilisation / (5)
(ii) fewer Y sperm / more X sperm / wrongly sexed /
miscounted / eq;
Ignore gene (1)
Ignore temperature
- Total 14 marks

3. (a) reduce yield / eat crop / eat leaf;
less leaf / less surface area / trap light / absorb carbon dioxide;
less photosynthesis; (3)
- (b) kill/destroy pests / insects;
increase yield / reduce crop loss / prevent eating crop / eq; (2)
- (c) (i) 28; (1)
(ii) 48 / 48 thousand / 48 000; (1)
- (d) kills other insects / not specific;
affect consumer / disrupts food chains / persistent / accumulation
/ not broken down / eq; max
reapplication needed / short lasting; (2)
resistant; Ignore immune
effect on humans / eq;
Ignore expensive
Ignore eutrophication

Total 9 marks

4. (a) (i) urea / water / salt / urine / mineral ion / (1)
named mineral ion;
(ii) (less) oxygen transport; (1)
- (b) (i) white blood cells / lymphocytes / white / B / B cells / wbc; (1)
- (ii) diaphragm / intercostal muscles;
no contraction;
no volume/pressure changes (in lung/chest);
no air/gas/oxygen in / no air/gas/carbon dioxide out;
less oxygen to cells/blood/body;
less respiration / energy; max
Ignore suffocation / death (3)

Total 6 marks

5. (a) 15 : 1 / 300:20 / 150:10 / 75:5; (1)
- (b) (lots of) waste / organic material /eq;
microorganisms / bacteria / decomposers /eq;
respiration; max
using up oxygen; (3)
- (c) goes up / increase / rise / eq; (1)

Total 5 marks

6. tar;
coughing;
effect on cilia;
mucus build up;
bronchitis;
bacteria / microorganisms / infection;
cancer / carcinogen;

blockage to tubes / difficulty in breathing/ventilation;
 emphysema;
 reduced surface area / less/damage to alveoli / less gas exchange / less diffusion;
 max
 (5)

Total 5 marks

7. (a) 1 mark for each correct arrow;;; (4)
 (b) arrow from any box to carbon in atmosphere; (1)

Total 5 marks

8. (a) palisade; (1)
 (b) 420 to 460; Ignore blue
 650 to 690; Ignore orange (2)
 (c) less photosynthesis;
 reflects / does not absorb green light; (2)
 (d) temperature;
 CO₂;
 light intensity; max
 (2)

Total 7 marks

9. (a) (i) has atrium;
 has ventricle;
 has valve;
 blood in via vein;
 blood out via artery;
 Ignore chambers max
 (2)
 (ii) Atrium and ventricle similar size / atrium bigger;
 thicker walled ventricle;
 one valve;
 two chambers / one atrium / one ventricle / human has 4;
 no septum / not left or right / eq; max
 (2)
 (b) blood passes through heart once;
 heart to gas exchange organ to body / not to lung / to gill / ref to double circ
 two pumps / one atrium and one ventricle /
 in humans blood to lungs and to body (2)

(c)

| Substance | Origin | Destination |
|-----------|--|---|
| Oxygen | lungs; | respiring cells |
| Glucose | <u>small</u> intestine / ileum / villi; | respiring cells |
| Urea | liver | kidney / renal tubules / nephron; |
| ADH | pituitary; | kidney / renal tubules / nephron / collecting duct; |

(3)

Total 12 marks

10. (a) (i) restriction / endonuclease; (1)
(ii) ligase; Reject lipase (1)
- (b) (i) insulin / eq; (1)
(ii) can be made quickly / in large quantities/ exact substance; (1)
Reject cheap

Total 4 marks

11. explants;
agar / nutrient / growth;
nutrients / minerals / growth regulators / glucose / H₂O / vitamins;
nutrients / minerals / growth regulators / glucose / H₂O / vitamins;
compost / soil / eq;
temperature / carbon dioxide / light / humidity / water;
temperature / carbon dioxide / light / humidity / water;
clones;
identical;

Total 9 marks

12. change/damage/mistake to genetic material / eq;
passed on / inherited;
rare / random / eq;
alters characteristic / named example eg sickle cell/Down's
harmful / description of effect;
few beneficial / description of effect; max
increase/decrease of gene/allele/condition/numbers in population; (5)
natural selection / evolution / speciation / eq;

Total 5 marks

PAPER TOTAL 90 MARKS

Paper 5H

- | | | | |
|----|-----|--|---------------|
| 1. | (a) | catalyst | 1 |
| | (b) | (i) <i>line steeper</i> reaches same level | 2 |
| | | (ii) <i>line shallower</i> reaches same level | 2 |
| | (c) | glowing spill relights (dependent on first point) | 2 |
| | | | Total 7 marks |
| 2. | (a) | heat | 1 |
| | (b) | (i) diffusion | 1 |
| | | (ii) ammonium chloride / NH_4Cl | 1 |
| | | (iii) ammonia faster / hydrogen chloride slower | 1 |
| | | (iv) A : red B : blue | 2 |
| | | | Total 6 marks |
| 3. | (a) | (i) ticks in 1 st and 3 rd boxes | 2 |
| | | (ii) contains a double/multiple bond / can undergo addition reactions (accept a specific addition reaction except bromine) | 1 |
| | (b) | (i) orange / yellow | 2 |
| | | (ii) colourless correct structure of 1,2-dibromoethane | 1 |
| | (c) | correct structures for two isomers of C_4H_8 but-1-ene, but-2-ene (cis + trans) cyclo-butane, cyclo-methyl propane, methyl propene | 2 |
| | | | Total 8 marks |
| 4. | (a) | (i) any two from: fizz / bubble move / darts about melts / forms a ball gets smaller / disappears (reject dissolves) | 21 |
| | | (ii) sodium + water \rightarrow sodium hydroxide + hydrogen | |
| | | (iii) blue / purple (solution made is) alkaline / (contains) hydroxide ions / OH^- not just "alkali metal" pH 11 \rightarrow 14 (any in range) | 2 |

- (b) (i) electrons being transferred between oxygen and sodium (can be wrong way round)
 idea of sodium losing electron(s) and oxygen gaining electron(s)
 correct numbers of electrons involved (sodium lose 1, oxygen gain 2)
 (sharing = 0 marks) 3
- (ii) Na_2O 2
- Total 9 marks

5. (a) (compounds containing) carbon and hydrogen (atoms) only 2
- (b) cracking
 heat / 400 - 1000 °C / high temperature (reject boil)
 steam / catalyst / (high) pressure / 5-100 atm 3
- (c) (i) $2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$
 all formulas correct = 1; balancing = 1 2
- (ii) toxic / poisonous / death / fatal (reject suffocate)
 correct reference to blood or haemoglobin 2
- Total 9 marks

6. (a) NH_4^+
 Cl^- 2
- (b) $\text{NH}_4\text{Cl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{NH}_3$ (reject NH_4OH)
 $\text{NaCl} + \text{H}_2\text{O} = 1$ NH_4Cl , NaOH , $\text{NH}_3 = 1$ 2
 incorrect balancing = max 1
- (c) silver nitrate
 white precipitate - only if AgNO_3
 $\text{NH}_4\text{Cl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NH}_4\text{NO}_3$ / $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}$ 3
 (allow $\text{AgNO}_3 + \text{Cl}^- \rightarrow \text{AgCl} + \text{NO}_3^-$)
- Total 7 marks

7. (a) 2.8.7 1
- (b) 7 1
- (c) brown / orange
 (to) colourless 2
- (d) (i) red / pink
 (hydrobromic) acid formed / H^+ ions present 2
- (ii) blue
 no acid formed / no reaction / no H^+ ions 2
- Total 8 marks

| | | | |
|-----|-----|--|----------------|
| 8. | (a) | atoms of the same element / atoms with same number of protons/atomic number (but) different numbers of neutrons/mass numbers | 2 |
| | (b) | (i) $\begin{array}{cc} 26 & 54 \\ 26 & 30 \end{array}$ both 26 = 1; 54 = 1; 30 = 1 | 3 |
| | | (ii) $(54 \times 0.08) + (56 \times 0.92)$ 55.8 (final answer = 2) | 2 |
| | (c) | same number of (outer shell) electrons / same electronic configuration | 1 |
| | | | Total 8 marks |
| 9. | (a) | (i) X Y and Z | 2 |
| | | (ii) X and Y and Z X (ignore Z) | 2 |
| | | (iii) X / CO ₂ only weak forces/forces between molecules to be overcome little energy needed to overcome / weaker than covalent bonds | 3 |
| | | (iv) Z / graphite layers / plates slide over each other (easily) (reject if delocalised electrons given) | 3 |
| | (b) | covalent bonds need to be broken/overcome (which are) strong / many / need a lot of energy (to break) (reject if ionic / internal / 4 bond etc) | 2 |
| | | | Total 12 marks |
| 10. | (a) | decreased decreased | 2 |
| | (b) | (i) move closer together move more slowly / lose energy | 2 |
| | | (ii) H ₂ | 1 |
| | (c) | 6 shared electrons between two N atoms (ideally 3 • and 3 x) both N atoms with 2 unshared electrons (dependent on above) (ACCEPT all dots or all crosses or any mixture) | 2 |
| | | | Total 7 marks |

11. (a) (i) $(1 + 80 =) 81$ 1
- (ii) $1.62 \div 81$ 2
 $= 0.02$ ALLOW ecf
- (b) (i) $\text{HBr} + \text{NaOH} \rightarrow \text{NaBr} + \text{H}_2\text{O}$ 1
- (ii) pipette 2
burette
- (iii) methyl orange / phenolphthalein 3
red / colourless
yellow / orange / pink / red
- Total 9 marks

PAPER TOTAL 90 MARKS

Paper 6H

Question 1

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|---|------------------------|
| a(i) | C | | 1 |
| a(ii) | sloping downwards | slowing down | 1 |
| a(iii) | constant | less than acceleration / decreases slowly / takes a longer time than the acceleration / (area) A is less than (area) C / (train) travels a greater distance while decelerating than when accelerating | 1 |
| b(i) | area (under graph) | A + B + C | 1 |
| b(ii) | horizontal non zero line below line on graph for the correct time | dop independent | 1 1 1 7 marks |

Question 2

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|-------------------|-------------------|
| a(i) | resistor/resistance/rheostat power supply/battery/cell | | 1 1 |
| a(ii) | = 0.4×20 = 8 (C) | | 1 1 |
| b | lamp in parallel switch in series with second lamp | dop | 1 1 6 marks |

Question 3

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|--|---|---------|
| a | <u>angle</u> of incidence equals <u>angle</u> of reflection | $\hat{i} = \hat{r}$ (angle) i = (angle) r $\angle i = \angle r$ | 1 |
| b(i) | correct ray striking window | | 1 |
| | any ray reflected off at correct angle | independent | 1 |
| b(ii) | cover <u>outside</u> of window | open/close/tilt window/fit shutters (outside) | 1 |
| c(i) | infra-red | i.r ignore heat / radiation | 1 |
| c(ii) | ultraviolet | u.v | 1 |
| d | (same) speed / velocity | transverse | 1 |
| 7 marks | | | |

Question 4

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|-------------------------|-------------|
| a | 50 000J of <u>chemical</u> 30 000 J of <u>heat / thermal</u> energy | ignore sound / chemical | 1 1 1 |
| b | = 700×2 (000) convert km to m = 1 400 000 (J) | 1400 (J) scores 2 | 1 1 1 |
| 6 marks | | | |

Question 5

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|--|---|------------------|
| a | magnetic field / flux (in coil) changes voltage / current <u>induced</u> / electromagnetic induction / emi | dop | 1 1 1 |
| b | pedal faster | more wire on coils use <u>stronger</u> magnet reduce gap(s) | 1 4 marks |

Question 6

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|--|---|---------|
| a (i) | F (is larger) because the lorry is accelerating | or B is smaller because..... not just ' F ' | 1 |
| a (ii) | (unbalanced) force = mass x acceleration / $F = ma$ | or any correctly transposed version | 1 |
| a (iii) | 1.2 (2) m/s^2 or ms^{-2} or N/Kg | or = $15\,000 \div 12\,500$ (1) | 2 |
| b | direction changes | allow any specific direction change e.g. goes round a bend e.g. goes uphill | 1 |
| | only two of: <ul style="list-style-type: none"> • (because) acceleration is (rate of) change of <u>velocity</u> • (and) velocity is speed in a particular direction • acceleration / velocity is a vector / not a scalar | | 2 |
| c(i) | (driver) has consumed alcohol/taken drugs/is tired/inexperienced/elderly | accept '... has been drinking' do not credit factors which may only affect the time before the driver reacts e.g. poor weather/ visibility /eyesight/ hearing/ lack of concentration accept 'high speed' but not just 'speed' | 1 |
| c(ii) | poor brakes/ slippery road/ worn tyres | must be qualified, do not credit just 'brakes' for example accept 'high speed' but not just 'speed' note 'high speed' may be credited for d(i) and again for d(ii) do not credit any unqualified response e.g. just 'friction' | 1 |

10 marks

Question 7

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|--|---------|
| a(i) | direct current | | 1 |
| a(ii) | loudspeaker / speaker | do not accept a vague response such as 'in a radio' | 1 |
| b | (magnetic) field (1) north ... south (1) (electric) current (1) positive ... negative (1) motion/movement/force (1) | allow north (pole)...south (pole) or + and - | 5 |
| c | increase the strength/intensity of the magnetic field (1) increase the current (1) | accept 'use a more powerful magnet' accept 'increase the voltage/p.d.' do not credit references to 'resistance' or 'number of coils/turns' | 2 |
| | | | 9 marks |

Question 8

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|---|---------|
| a(i) | normal | do not accept 'perpendicular' or 'vertical' | 1 |
| a(ii) | (angle) e / E | | 1 |
| a(iii) | (angle of) refraction | accept phonetic spelling but not anything which could be taken for refelction | 1 |
| a(iv) | refractive index = sine of angle of incidence ÷ sine of angle of refraction | $n = \frac{\sin i}{\sin r}$ | 1 |
| a(v) | continues in the same direction / does not bend | allow 'it's a straight line' | 1 |
| a(vi) | any one of <ul style="list-style-type: none"> • ray is on the normal • angle of incidence = 0° • angle of refraction = 0° • at 90° / right angles to the boundary / perpendicular | | 1 |
| b(i) | refraction towards normal (1) then refraction away from normal at the opposite face (1) emergent ray appears to be parallel to incident ray (1) | | 3 |
| b(ii) | ray continues in a straight line to back face (1) reflects down and straight out at right angles (1) | dop | 2 |

11 marks

Question 9

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|---|--|----------|
| a | gravitational/potential (1) kinetic/movement (1) | correct order essential ignore energy | 2 |
| b(i) | (some) energy transferred as thermal energy/heat | or some energy transferred as <u>internal</u> kinetic energy or friction (between/with) or energy changes not 100% efficient | 1 |
| b(ii) | higher the waterfall then the higher the temperature increase | allow ('temperature increase is directly) proportional (to the height' of the waterfall) | 1 |
| (c) (i) | axes labelled speed and kinetic energy / ke (1) with linear scales (1) both axes labelled with units (1) either all points correct (2) or four points correct (1) smooth curve of best fit to candidate's points (1) | to the nearest mm in any direction and not 'blobs' (more than 1 mm across) not dot-to-dot or tram-lined or thicker than 1 mm ignore 0 to 3 m/s | 6 |
| c(ii) | answer in range 3.7 to 4.0 inclusive | or correct from candidate's graph | 1 |
| | | | 11 marks |

Question 10

| | | | |
|--------|---|---|--------|
| a | fast random | both required with no additions allow any clear and unambiguous method of indication | 1 |
| b | hit/collide with it/the inside / walls creates/exerts a force | or words to that effect | 1 1 |
| | on the surface/area (not walls) | or pressure = force ÷ area or $P = F/A$ | 1 |
| c(i) | 270 (2) | accept $150 \times 90 = \text{pressure} \times 50$ for (1) | 2 |
| c(ii) | mass remains constant / the same (1) temperature remains constant / the same (1) | or no gas escapes either order | 2 |
| c(iii) | kilopascal(s) | accept phonetic spellings | 1 |

9 marks

Question 11

| | | | |
|--------|--|--|---|
| a | 230 and 90 for thorium (1) | any change to thorium symbol cancels this mark | 2 |
| | 4 and 2 for helium (1) | any change to helium symbol cancels this mark | |
| | | any change to uranium deduct (1) from positive total | |
| b(i) | to allow/give/produce a (narrow) beam /in one direction (of alpha particles/radiation) | 'so that they go straight to the gold (foil)' | 1 |
| b(ii) | <u>most</u> of the (gold) atom is empty space | not 'all go straight..... do not credit just 'there is space in the gold' | 1 |
| b(iii) | <u>repelled</u> by the <u>centre/nucleus</u> (of an atom) (1) (as) both have positive / +ve / same charge (1) | or affected by electrostatic force (1) between the nucleus and the (alpha) particles (1) | 2 |
| b(iv) | centre/nucleus <u>very</u> small/tiny | not just '... small' | 1 |
| b(v) | (these were) further away from the centre/nucleus (1) (these were) moving faster (1) | either order or more (kinetic) energy | 2 |
| b(vi) | (tiny) spark/flash (of light)/scintillation | do not credit 'there was a colour change' ignore references to sound/noise | 1 |

10 marks

Paper 7

1. (a) (i) measuring cylinder; (1)
 (ii) line correctly drawn eg horizontal across the cylinder at 5; (1)
- (b) (i) Benedicts; (1)
 (ii) blue / light blue; (2)
 red / brick-red / brown-red / orange / yellow / green;

Total 5 marks

2. (a) 3. Remove a leaf from the plant;
 5. Heat the leaf in boiling ethanol;
 7. Add iodine solution; (3)
- (b) no photosynthesis / light needed for photosynthesis;
 uses up starch / destarch / respire starch; (2)
 Ignore glucose
- (c) safety / dangerous;
 (ethanol) flammable / prevent fire; (2)
- (d) blue-black / black / blue / dark blue; (1)
 Reject brown

Total 8 marks

3. (a) find pulse in wrist / neck;
 count number of pulses in a time period; (2)
- (b) (i) increases;
 up to a peak / eq; (2)
 (ii) 4 / 64 ; (1)
 (iii) stays the same / remains high for a while;
 goes down / decreases; max
 to 68 / normal / resting rate; (2)
- (c) table with temperature and time headings;
 two columns;
 units present; (4)
 order;

Total 11 marks

4. (a) (i) Plant B: tally correct + 12;
 Plant C: tally correct + 4; (2)
 (ii) 192mm³ ;;
 4 x 8 / 32 for 1 mark only (2)
- (b) conclusion based on only one experiment / need to repeat /
 one 10 s period;
 reference to volume of bubble / content;
 plant not equal in mass / eq; max
 abiotic factor(s) or example(s);; (3)

Total 7 marks

5. (b) C - different fish foods;
 O - same species/age / size of fish /eq;
 R - several fish used;
 M1 - growth measured in mass / length / size;
 M2 - time period stated (more than a week);
 S - named condition controlled;; e.g. temperature, water pollution, mass of food max (5)

Total 5 marks

6. (a) 2.56;
 3.18; (2)
- (b) (i) S - linear scale chosen for sucrose;
 L - line through points;
 A - axes correct way around;
 A - labels for % change and sucrose (M); (5)
 P - points plotted; (1)
- (ii) point read off graph;
- (c) the same; (1)
- (d) (sucrose) concentration greater in potato / reference to gradient;
 water enters (the potato);
 (by) osmosis; (3)
- (e) (i) more sensitive balance / measure mass to 3 d.p. / (1)
 take more readings at different concentrations;
- (ii) repeat each experiment /take averages / reference to (1)
 anomalies / ensure other factors are controlled;

Total 14 marks

PAPER TOTAL 50 MARKS

Paper 8

- | | | | |
|----|-----|--|---|
| 1. | (a) | A thermometer B stop clock C pipette D measuring cylinder E funnel | 5 |
| | (b) | C / pipette D / measuring cylinder (answers in either order) | 2 |
| | (c) | E / funnel | 1 |

Total 8 marks

- | | | | |
|----|------|--|---|
| 2. | (a) | any three from: amount/moles of metal (allow mass) particle size/form/surface area of metal concentration of copper(II) sulphate volume of copper(II) sulphate starting temperature (reject amount copper sulphate) | 3 |
| | (b) | (i) before: 27 after: 32.5 | 2 |
| | | (ii) 5.5 (<i>ecf</i>) | 1 |
| | (c) | 5.2/5.17 (or greater number sig figs, 13.0/13 (both needed) (<i>ecf</i>) both numbers to 1 dp | 2 |
| | (d) | iron repeats not similar / most different / furthest apart / widely spaced / far apart | 2 |
| | (e) | bars drawn for iron, lead, nickel and zinc | 1 |
| | | all bars correct height (-1 per error) cq on table | 2 |
| | (f) | (i) zinc biggest temp change | 2 |
| | | (ii) no reaction / silver is not more reactive than copper | 1 |
| | | (iii) some/two (or three) did not change temperature/ has same temp change/did not react | 1 |
| | | Gold + silver (+ copper) did not change temperature/ same temperature change/did not react | 1 |
| | (iv) | silver nitrate (solution) (ACCEPT any salt of a metal less reactive than copper regardless of solubility). | |

Total 18 marks

- | | | | |
|----|-----|--|---|
| 3. | (a) | (i) all point plotted correctly (-1 per error) | 2 |
| | | smooth curve | 1 |
| | | (ii) point at (46,65) circled | 1 |
| | | (iii) any one from: | |

- marble chips bigger / surface area less
acid too cool 1
volume of acid too small
mass of chips too small
acid more dilute - or reason that could cause this
- (b) (i) read values from graph: 76 ± 1
cq 45 ± 1 2
(ii) cq on (i): 0.013
0.022 min 2 significant figures 2
(iii) (the higher the temperature the) faster (the reaction) cq on (ii) 1
(iv) particles have more energy
move faster / more have energy greater than activation energy
more collisions per second/more frequent collisions/
greater proportions of collisions are successful 3
- (c) reduces/stops heat/energy loss
temperature remains (more) constant/stays at required temperature 2
- (d) any suitable way of cooling flask/contents e.g. an ice bath 1
do not accept ideas based on doing the reaction somewhere else.

Total 16 marks

4. (a) 25.4
32.8 2
- (b) table shows:
3 suitable column headings with units for mass
data recorded correctly (accept 11 or 11.0 etc)
volume of oxygen calculated correctly (7.8, 9.2, 12.6) 3
- (c) tap of burette open / no iron put in 1
- (d) (i) do not know starting volume of air / burette not calibrated all the way to end 1
(ii) use a measuring cylinder in place of burette / use tube calibrated to end 1
(do not accept 'use syringe')
(do not accept ideas of calibrating rest of burette)
measure volume between '50' and the top

Total 8 marks

PAPER TOTAL 50 MARKS

Paper 9

Question 1

| Qu part | Answer(s) | Extra Information | Mark |
|------------|--|--|------|
| (a) | $x = 11-12 \text{ mm}$ | | 1 |
| (b)(i) | two diagonals (part of) | or from centres of opposite sides | 1 |
| | where they cross indicated dop | G does not have to be labelled | 1 |
| (b)(ii) | <i>vertical lines (by eye)</i> through pin | | 1 |
| | through candidate's G or dot | | 1 |
| (b)(iii) | $x = 22-23 \text{ mm}$ | | 1 |
| (b)(iv) | anticlockwise | down/down(ward)s/falls/falls to the right/rotates to the right | 1 |
| | G left of vertical through pin | do not accept moving/goes to the right | 1 |
| | | do not credit answer to (b)(v) here | |
| (b)(v) | G vertically/ below pin | As in Diag 2 pin above G | 1 |
| (c) | not regular/not symmetrical/not uniform/asymmetric/uneven/not equal/irregular/non uniform | ignore: no corners or straight lines or edges or the sides are not equal | 1 |
| (d) | 1. clamp pin | | 1 |
| | 2. pin through card | 1.use pin | 1 |
| | 3. plumb line on pin | 2. balance card max 2 | 1 |
| | 4. plumb line to draw vertical line | | 1 |
| | 5. repeat through another part of card | clamp card max 2 | |
| | 6. point where lines cross | max 4 | |
| (e) | to be able to swing freely (about pinhole) sharp pencil no draughts card of uniform thickness | repeat for more holes/third hole not repeat and take average <i>credit where seen</i> or balance on pin | 1 |

15 marks

Question 2

| Qu part | Answer(s) | Extra Information | Mark(s) |
|------------|-----------|-------------------|---------|
|------------|-----------|-------------------|---------|

- | | | | | | | | | | |
|---------|---------------------|---|----|----|----|----|----|----|---|
| (a) | 40 scores 3 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 1 |
| | 37-43 scores 1 | 1 | 1 | 2 | 3 | 2 | 1 | 1 | 1 |
| | 39-41 scores 2 | | | | | | | | 1 |
| | values below 37 | | | | | | | | |
| | score 0 | | | | | | | | |
| | values above 43 | | | | | | | | |
| | score 0 | | | | | | | | |
| (b)(i) | 95 / 2 x their area | factor of 2 errors in F or A lose 1 st mark only | | | | | | | 1 |
| | = 1.2 ecf/ecf | | | | | | | | 1 |
| | sig fig 2 or 3 only | must refer to sig fig in F or A or raw data | | | | | | | 1 |
| (b)(ii) | explain sig.fig. | independent of (b)(i) | | | | | | | 1 |

Pressure for one shoe

| | | | | | | | | | | | |
|--------------------------|------|------|------|-----|------|------|------|------|------|------|------|
| A/cm^2 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
| $P/\text{N}/\text{cm}^2$ | 2.71 | 2.64 | 2.57 | 2.5 | 2.44 | 2.38 | 2.32 | 2.26 | 2.21 | 2.16 | 2.11 |

7 marks

Question 3

| Qu part | Answer(s) | Extra Information | Mark(s) |
|---------|---|---|----------|
| (a) | <u>Series</u> circuit showing ; | | |
| | Fuse | see | 1 |
| | power supply - any symbol | | 1 |
| | ammeter | Any 3 | 1 |
| | means of changing current | | 1 |
| | switch | | 1 |
| | | | 1 |
| | | | MAX 4 |
| | Values | | |
| | Suitable values of voltage and resistance to give appropriate current | | 1 |
| | 1-10A ammeter | range at least 1A - 4 A '10 A' means 0 - 10A | 1 |
| | | | MAX 1 |
| | Method | | |
| | 1. Switch on circuit | | 1 |
| | 2. Adjust current (to a certain value) | adjust voltage or resistance - must mention current | 1 |
| | 3. Record current | | 1 |
| | 4. Start stopwatch | measure time scores 1 | 1 |
| | 5. Stop stopwatch when fuse blows | | 1 |
| | 6. Repeat for same current | | |
| | 7. Repeat for other currents | circuit switched on, current varied until fuse blows score 1. 3. 4. only | MAX 4 |
| (b) | ammeter : 3.5 A | | 1 |
| | stopwatch : 28.02 s | | 1 |
| | | | 11 marks |

Question 4

| Qu part | Answer(s) | Extra Information | |
|---------|---|---|---|
| (a) | (lead) container/surrounding of source (lead) | | 1 |
| (b) | 24 | | |
| (c) | $78 - 24 = 54$ | | |
| (d)(i) | Correct plotting $\pm 1\text{mm}$ Curve | blobs > 2mm -1 once | 2 |
| | | | 1 |
| (d)(ii) | procedure for reading off time axis 6 - 7 minutes | Allow fraction e.g. $6\frac{1}{2}$ | 1 |
| | | Can be up to 8 min for lower values of count rate | 1 |
| (e)(i) | 54 - 55 | | |
| (e)(ii) | 4.6 - 5.0 min mention 24 | read off for 55 do not allow greater than 5 | 1 |
| | correct use of 24 and graph $55 - 24 = 31$ leading to 10-12 min regardless of working | $55 + 24 = 79$ 1.5 min (2) | 1 |
| (f) | count from source decreasing (quickly)/changing (not increasing) | source decaying/only time for one result | 1 |
| | not appropriate to average | readings will be different | |
| (g) | | | 1 |
| | read incorrect scale/wrong reading not in counts per minute | | 1 |
| | not corrected for background | | 1 |
| | not 5 minutes after start of experiment | different starting time max 3 | 1 |

17 marks

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