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COMBINED SCIENCE

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Paper 4 Extended Theory

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MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

| Question | Answer | Marks |
|-----------|--|-------|
| 1(a)(i) | 1 ovulation ; 2 fertilisation ; | 2 |
| 1(a)(ii) | amnion / amniotic membrane ; contains (amniotic) fluid ; | 2 |
| 1(b)(i) | carbon dioxide ; | 1 |
| 1(b)(ii) | (waste product of / produced by) respiration ; | 1 |
| 1(b)(iii) | through umbilical cord ; | 1 |
| 1(c) | reduces oxygen available (to fetus) ; any consequence e.g. reduced respiration / growth ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 2(a)(i) | chemical AND the idea that new substance(s) made ; | 1 |
| 2(a)(ii) | copper(II) / Cu^{2+} AND chloride / Cl^- ; (copper(II) / Cu^{2+}) gains (2) electrons ; (chloride / Cl^-) loses (1) electron ; | 3 |
| 2(b)(i) | reduction / redox ; | 1 |
| 2(b)(ii) | $\text{C} + 2\text{CuO} \rightarrow \text{CO}_2 + 2\text{Cu}$ all formulae correct ; correctly balanced ; | 2 |
| 2(c) | act as catalysts / form (compounds which act as) catalysts / other valid answers ; | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 3(a) | weight ; | 1 |
| 3(b) | speed = distance / time (or rearranged) ; distance (= speed × time) = 28 000 × 90 / 60 = 42 000 (km) ; | 2 |
| 3(c)(i) | density = mass / volume (or rearranged) ; mass (= volume × density) = 1.08 × 10 ²¹ × 5530 = 5.97 × 10 ²⁴ (kg) ; | 2 |
| 3(c)(ii) | (average) density of mantle and core is higher (than 2700 kg / m ³) ; in order to give an average density higher than the density of the crust / owtte ; | 2 |
| 3(c)(iii) | atoms in outer core randomly arranged / inner core regular arrangement / owtte ; atoms in outer core able to move freely / inner core fixed positions / orderly pattern / owtte ; | 2 |
| 3(d) | electrical ; <u>chemical</u> (potential) ; | 2 |

| Question | Answer | Marks |
|----------|---|-------|
| 4(a) | line drawn from R to any nucleus ; line drawn from S to any xylem tube cross section ; | 2 |
| 4(b)(i) | P is nearer to the surface / top so it captures more light ; | 1 |
| 4(b)(ii) | P has more chloroplasts than Q ; chloroplast is the site of photosynthesis ; reference to increased light absorption / increased amounts of chlorophyll ; | max 2 |
| 4(c) | traps light energy ; converts it to chemical energy / for formation of carbohydrates ; | 2 |

| Question | Answer | Marks | | | | | | | | | | | | |
|-------------|---|-------------------------------|--------------------|-------------------------------|-------------|---------------------|-----------------------|------------|--------------------|---|-----------|---------------------|---|---|
| 5(a)(i) | (electrons) 35 (neutrons) 44 (protons) 35 ;; all three correct (2) one or two correct (1) | 2 | | | | | | | | | | | | |
| 5(a)(ii) | <table border="1"> <thead> <tr> <th>(particle)</th> <th>(relative charges)</th> <th>(approximate relative masses)</th> </tr> </thead> <tbody> <tr> <td>(electrons)</td> <td>-1 / negative / -ve</td> <td>negligible / 1 / 2000</td> </tr> <tr> <td>(neutrons)</td> <td>0 / none / neutral</td> <td>1</td> </tr> <tr> <td>(protons)</td> <td>+1 / positive / +ve</td> <td>1</td> </tr> </tbody> </table> <p>each column correct ;;</p> | (particle) | (relative charges) | (approximate relative masses) | (electrons) | -1 / negative / -ve | negligible / 1 / 2000 | (neutrons) | 0 / none / neutral | 1 | (protons) | +1 / positive / +ve | 1 | 2 |
| (particle) | (relative charges) | (approximate relative masses) | | | | | | | | | | | | |
| (electrons) | -1 / negative / -ve | negligible / 1 / 2000 | | | | | | | | | | | | |
| (neutrons) | 0 / none / neutral | 1 | | | | | | | | | | | | |
| (protons) | +1 / positive / +ve | 1 | | | | | | | | | | | | |
| 5(b) | (sodium) ionic / electrovalent and (hydrogen) covalent ; (ionic) idea of gain / loss / transfer of electrons ; (covalent) electrons are shared ; | 3 | | | | | | | | | | | | |
| 5(c) | iodine / astatine ; | 1 | | | | | | | | | | | | |
| 5(d)(i) | 2, 8, 8 ; | 1 | | | | | | | | | | | | |
| 5(d)(ii) | lamps / inert atmosphere / other valid answers ; | 1 | | | | | | | | | | | | |

| Question | Answer | Marks |
|----------|---|-------|
| 6(a) | the idea that current is flow of (electrical) charge ; identifies the charge carriers as <u>electrons</u> ; | 2 |
| 6(b)(i) | between mouth and handset / handset and ear ; sound waves ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 6(b)(ii) | between handset and base station / satellite dish and satellite ; microwaves <i>or</i> radio waves ; | 2 |
| 6(c) | the idea that waves (of any kind) have an associated speed of travel ; the idea that waves / signals will take time to cover distance ; reference to great distance / high speed of emr : | max 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 7(a)(i) | making of / contained in haemoglobin ; | 1 |
| 7(a)(ii) | feel tired / dizzy / other correct symptoms ; | 1 |
| 7(b)(i) | 1 to pasteurise the milk / kill unwanted microbes ; 2 so that the microorganisms in the (added) yoghurt do not get killed ; | 2 |
| 7(b)(ii) | microorganisms will multiply in the milk ; | 1 |
| 7(b)(iii) | yes –no mark (student's yoghurt) contains live organisms ; | 1 |
| 7(c) | the acid denatures / destroys the proteins in the milk ; the proteins lose their (3D) shape / owtte ; | 2 |
| 7(d)(i) | prevents constipation; | 1 |
| 7(d)(ii) | adding fruit ; | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 8(a) | (fraction P) lower boiling point ; smaller molecules ; weaker intermolecular (attractive) forces ; greater flammability ; lower viscosity ; | max2 |
| 8(b) | (catalytic or thermal) cracking ; | 1 |
| 8(c)(i) | increases surface area ; | 1 |
| 8(c)(ii) | particles move faster / have greater kinetic energy ; particles collide (with the catalyst) more often ; | 2 |
| 8(d) | (A) alkene / unsaturated and (B) alkane / saturated ; | 1 |
| 8(e)(i) | CO ₂ ; | 1 |
| 8(e)(ii) | reference to global warming / excessive (runaway / enhanced) greenhouse effect / negative effects such as climate change / polar melting / rising sea levels / ocean acidification ; | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 9(a) | total current of 14 A needs higher value fuse / reference to the safety margin / owtte ; | 1 |
| 9(b) | (R =) V / I ; (R =) 240 / 14 = 17.1 (Ω) ; OR 1 / R = 1 / R ₁ + 1 / R ₂ ; R ₁ = 240 / 4 = 60 Ω and R ₂ = 240 / 10 = 24 Ω and so 1/R = 1/60 + 1/24 = 7/120, so R = 17.1 Ω ; | 2 |

| Question | Answer | Marks |
|----------|--|----------|
| 9(c) | $E = IVt$; $= 10 \times 240 \times 8 \times 60 \times 60 = 69\,120\,000 \text{ (J)}$; | 2 |
| 9(d) | reference to <u>convection</u> ; the idea that water at higher temperature rises / has a lower density ; the idea that the convection current from heater 1 does not affect the water in the lower part of the tank / water below heater 1 has greater density and so does not mix with heated water / owtte ; | 3 |