

Physics B

General Certificate of Secondary Education

Unit **B751/02**: Modules P1, P2, P3 (Higher Tier)

Mark Scheme for June 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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For answers marked by levels of response:

- a. **Read through the whole answer from start to finish**
- b. **Decide the level that best fits** the answer – match the quality of the answer to the closest level descriptor
- c. **To determine the mark within the level**, consider the following:













| Descriptor | Award mark |
|--------------------------------------|------------------------------|
| A good match to the level descriptor | The higher mark in the level |
| Just matches the level descriptor | The lower mark in the level |

- d. Use the **L1, L2, L3** annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions include:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

Annotations

| Annotation | Meaning |
|---|---------------------------------------|
|  | correct response |
|  | incorrect response |
|  | benefit of the doubt |
|  | benefit of the doubt not given |
|  | error carried forward |
|  | information omitted |
|  | ignore |
|  | reject |
|  | contradiction |
|  | Level 1 |
|  | Level 2 |
|  | Level 3 |

Abbreviations, annotations and conventions used in the detailed Mark Scheme.

| | | |
|---------------|---|---|
| / | = | alternative and acceptable answers for the same marking point |
| (1) | = | separates marking points |
| allow | = | answers that can be accepted |
| not | = | answers which are not worthy of credit |
| reject | = | answers which are not worthy of credit |
| ignore | = | statements which are irrelevant |
| () | = | words which are not essential to gain credit |
| — | = | underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated) |
| ecf | = | error carried forward |
| AW | = | alternative wording |
| ora | = | or reverse argument |

SECTION A

| Question | | Answer | Marks | Guidance |
|----------|-----|--|-------|--|
| 1 | (a) | <p>most heat lost from hot / poorly insulated areas indicated by colours white / yellow / red (1)</p> <p>least heat lost from cool / well insulated areas indicated by colours black / dark blue / purple (1)</p> | 2 | <p>must correctly link heat loss area to correct colour</p> <p>must correctly link heat loss area to correct colour</p> <p>look also for a combination of ideas: eg red areas are hot and lose most heat, purple areas are cold (2)</p> <p>if no mark awarded idea of white is hotter and dark is colder scores (1)</p> |
| | (b) | <p>all 4 payback times correct in table or elsewhere in answer 48 / 6 / 3 / 2 (1)</p> <p>then idea that they (C and D) have a short / low payback times (1)</p> <p>they (C and D)</p> <ul style="list-style-type: none"> • save more (annually than A and B) / AW • are cheaper to fit (than A and B) / AW • reduce energy losses by 50% / AW (1) <p>maximum of (1) for each marking point</p> | 3 | <p>eg D – greatest annual saving (1) eg C is cheapest to fit (1)</p> |

| Question | | Answer | Marks | Guidance |
|----------|---------|--|----------|--|
| | (c) (i) | <p>70% (3)</p> <p>but if answer is incorrect</p> <p>$(7000 \div 10000) \times 100$ (2)</p> <p>but if this is incorrect</p> <p>useful energy = 7000(J) (1)</p> | 3 | <p>ignore 0.7 on answer line unless % clearly crossed out and no other unit added</p> <p>0.7 on its own scores max (2)</p> <p>alternatively allow $(3000 \div 10000) \times 100$ (1)</p> |
| | (ii) | <p>idea that wasted energy is given to surroundings / atmosphere / energy is conserved / AW (1)</p> <p>wasted energy and useful energy add up to input energy (so not totally lost/energy just transferred) / AW (1)</p> | 1 | <p>allow idea that 3000J / wasted energy is converted to different forms of energy (1)</p> <p>Eg. 3000J lost as heat (1)</p> <p>ignore lost as sound</p> <p>allow the idea of energy conservation (1)</p> <p>eg. 7000J + 3000J output = 10000J input</p> <p>eg. combined width / size of output arrows = input (1)</p> |
| | | Total | 9 | |

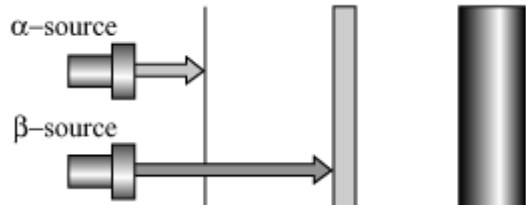
| Question | Answer | Marks | Guidance |
|----------|--|-------|---|
| 2 (a) | <p>Level 3 Answers should include the mechanisms of IR AND microwave cooking causing the relevant particles to gain KE. Also the answer should give a clear explanation of how IR cooking needs more energy or takes a longer time. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 Answers should include the simple mechanisms of IR AND microwave cooking causing the relevant particles to heat up. Also the answer should give some explanation of how IR cooking needs more energy or takes a longer time. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 Answers should include a simple mechanism of IR OR microwave cooking causing the relevant particles to heat up. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p> | 6 | <p>This question is targeted up to A* Indicative scientific points may include:</p> <p>Level 3:</p> <ul style="list-style-type: none"> • (microwaves) penetrate the food and are absorbed by water / fat particles which gain KE / vibrate or move faster • (microwave) less energy / cooking time needed as energy only used to heat food • (IR) only heat surface particles which gain KE / vibrate or move faster • (IR) idea that more energy / cooking time needed as oven / dishes need heating first • conduction to centre (for either type of wave) involving transfer of KE or movement between particles / AW • less food heated by conduction or convection with microwaves so less energy / cooking time needed <p>Level 2:</p> <ul style="list-style-type: none"> • (microwaves) penetrate the food and heat water / fat particles • (microwave) less energy / cooking time needed as energy only used to heat food • (IR) only heat surface particles • (IR) idea that more energy / cooking time needed as oven needs heating first <p>Level 1:</p> <ul style="list-style-type: none"> • (microwaves) heat the water / fat particles • (microwave) reflect from oven walls • (IR) only heat surface particles • (IR) idea that IR waves heat the oven / dishes • (microwaves) more efficient • microwaves penetrate further than IR <p>ignore characteristics not on mark scheme</p> |

| Question | | Answer | Marks | Guidance |
|--------------|-----|--|----------|---|
| | (b) | <p>comment on the data in terms of any one from:</p> <ul style="list-style-type: none"> less people studied / less evidence in A compared with C shorter time study in A compared with C more research for mobile phones than against study about old people / not about young people (eg C) idea that study about human / rat cells may not be representative or reproduced in humans (B) (1) conflict in conclusions (eg A&B or B&C) <p>then consideration of the risk against the possible benefits (1)</p> | 2 | eg idea of safety / social interaction for children / young people / teenagers versus risk of use (1) |
| Total | | | 8 | |

| Question | | Answer | Marks | Guidance |
|--------------|--|--|----------|---|
| 3 | | <p>300 (seconds) to 500 (seconds) (1)</p> <p>energy used to break intermolecular bonds / bonds between molecules (1)</p> | 2 | <p>allow 300 to 310 (1)</p> <p>allow overcome intermolecular forces ignore breaks intermolecular forces not intra-molecular forces</p> <p>ignore bonds between particles allow breaks bonds between liquid particles (1)</p> <p>both marking points are independent of each other</p> |
| Total | | | 2 | |

| Question | | Answer | Marks | Guidance | | | | | | | | | | | | | | | | |
|-------------------------|------------|--|------------|--|------------|------------|--------------------|---|--|--|-------------------------|---|--|--|------------------------|--|---|--|---|---|
| 4 | (a) (i) | 1.5×10^{14} (Hz) (2) but if answer is incorrect $2.2 \times 10^8 \div 1.5 \times 10^{-6}$ (1) | 2 | 1.47×10^{14} (2) allow other Hz prefixes eg 1.5×10^8 MHz/150THz if multiple clearly shown on answer line allow 1.4666×10^{14} (1) allow 146666660000000 (1) | | | | | | | | | | | | | | | | |
| | (ii) | <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>> in fibre</th> <th>= in fibre</th> <th>< in fibre</th> </tr> </thead> <tbody> <tr> <td>speed of IR in air</td> <td style="text-align: center;">✓</td> <td></td> <td></td> </tr> <tr> <td>wavelength of IR in air</td> <td style="text-align: center;">✓</td> <td></td> <td></td> </tr> <tr> <td>frequency of IR in air</td> <td></td> <td style="text-align: center;">✓</td> <td></td> </tr> </tbody> </table> | | > in fibre | = in fibre | < in fibre | speed of IR in air | ✓ | | | wavelength of IR in air | ✓ | | | frequency of IR in air | | ✓ | | 2 | all 3 correct (2) 1 or 2 correct (1) |
| | > in fibre | = in fibre | < in fibre | | | | | | | | | | | | | | | | | |
| speed of IR in air | ✓ | | | | | | | | | | | | | | | | | | | |
| wavelength of IR in air | ✓ | | | | | | | | | | | | | | | | | | | |
| frequency of IR in air | | ✓ | | | | | | | | | | | | | | | | | | |
| | (b) | max one from standard demand marks: rapid (high rate) of transmission of data (1) idea that it is easier to remove noise (1) any two from higher demand marks: multiple signals / more information transmitted / multiplexing (1) output signal / sound / picture is clearer (1) noise not recognised or amplified (1) | 2 | ignore interference can be removed ignore less interference in signal allow interference is not recognised (1) | | | | | | | | | | | | | | | | |
| Total | | | 6 | | | | | | | | | | | | | | | | | |

SECTION B

| Question | | Answer | Marks | Guidance |
|----------|-----|---|-------|--|
| 5 | (a) | arrow or line from alpha to front / rear face of paper and arrow or line from beta to front / rear of aluminium (1) | 1 | <p>allow alpha line slightly penetrating paper and beta line slightly penetrating aluminium but not passing all the way through</p>  <p>Do not allow mark if radiation emerges from barrier</p> |
| | (b) | <p>any two from: treating or curing cancer / killing cancerous cells / radiotherapy (1) non-destructive testing (1) tracers (1) sterilising equipment/killing bacteria on surgical equipment (1)</p> | 2 | <p>not chemotherapy</p> <p>ignore nuclear weapons</p> <p>allow industrial, environmental or medical benefits Eg testing for leaks in pipes (1) smoke detectors (0)</p> |

| Question | Answer | Marks | Guidance |
|----------|---|----------|--|
| (c) | <p>any two from the ideas that: (as gamma is highly penetrating) it must be placed in a material resistant or thick enough (to stop the radiation penetrating) (1)</p> <p>long term containment needed (1)</p> <p>it may remain radioactive for a long time so long term solutions are required / AW (1)</p> <p>it must be stored where there is no possibility of it contaminating water supply (1)</p> <p>they need to monitor levels of radioactivity for long periods of time (as acceptable radioactivity levels may change over time) (1)</p> | 2 | <p>Eg. encased in glass (1) Eg. placed deep underground (1)</p> <p>Eg, long half lives mean so container must not corode (2)</p> <p>allow long time to decay (1) but long time to decompose (0)</p> <p>allow idea of terrorist risk Eg. terrorist use plutonium (1) Eg terrorist use it to make a bomb / dirty bomb (1)</p> |
| | Total | 5 | |

| Question | Answer | Marks | Guidance |
|----------|--|----------|--|
| 6 | <p>Level 3 A clear description and reason why it is unusual for asteroids to be NEOs AND a clear description of the possible actions that could be taken to reduce the threat of this asteroid. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 A general description about why it is unusual for asteroids to be NEOs AND a limited description of the possible actions that could be taken to reduce the threat of this asteroid. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 A general description about why it is unusual for asteroids to be NEOs OR a general description of the possible actions that could be taken to reduce the threat of this asteroid. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p> | 6 | <p>This question is targeted up to grade A</p> <p>Indicative scientific points may include:</p> <p>why is it unusual for asteroids to be a threat</p> <ul style="list-style-type: none"> • unusual for predicted trajectory to be with the Earth as Earth is so small compared with space/probability idea • most asteroids orbit between Mars and Jupiter • (idea that) most small asteroids ‘burn up’ in the Earth’s atmosphere before they reach the Earth • unusual for asteroids to be near the Earth <p>possible actions that could be taken to manage the threat of this asteroid</p> <ul style="list-style-type: none"> • predict the trajectory • constant surveys by telescope • constant monitoring (by satellites / scientists) • could be deflected by explosions • (idea that) explosion need to be distant to the Earth so the explosion does not damage the Earth • if going to use an explosion need to do so soon as 2019 is not that far away • difficult to deflect 2002 NT7 because of large size or mass • easier to deflect away from collision further away from Earth. <p>Use L1, L2, L3 annotations in scoris; do not use ticks.</p> |
| | Total | 6 | |

| Question | | Answer | Marks | Guidance | |
|--------------|-----|--|--|--|---|
| 7 | (a) | <p>any two from: idea of renewable energy (1)</p> <p>idea of no polluting waste produced (1)</p> <p>crops can be grown under them / placed at sea (1) useful in remote locations (1) (idea that) new technology are making wind turbines more efficient (than conventional power stations) (1)</p> | 2 | <p>allow does not need fossil fuels or named fossil fuel (1)</p> <p>allow no carbon dioxide produced / no greenhouse gases (1) allow idea of less global warming (1)</p> <p>allow idea of less maintenance / labour or staff required (1) allow generation close to consumer / AW (1)</p> <p>ignore pollution unless qualified</p> | |
| O/L | (b) | (i) | as wind speed increases the noise increases / ora (1) | 1 | |
| | | (ii) | <p>idea of: for low speeds / up to 5 m/s / up to mean speed - the noise level is below background / 33dB (1)</p> <p>idea of: for high speeds / above 5 m/s / above mean speed - the noise level is generally below / not much above background (1)</p> | 2 | <p>allow 'most dots below background' (1) eg. 'turbine noise less than tree noise' (1)</p> <p>eg 'at high wind speeds the noise is rarely above background' (1)</p> <p>allow (if no other marks obtained) normal background is usually higher than turbine noise (1)</p> |
| Total | | | 5 | | |

| Question | | Answer | Marks | Guidance |
|----------|-----|--|----------|---|
| 8 | (a) | 0.115 (kW) (2) but if answer incorrect 0.5 x 230/1000 (1) or 115 (1) | 2 | allow 0.11/0.12 (kW) (2) |
| | (b) | 5 (hours) (2) but if answer incorrect 0.45 / 0.09 (1) | 2 | allow 0.45 / 90 or 0.005 (1) |
| | (c) | monitor desktop PC (keyboard) mouse (1) | 1 | all 3 correct = 1 mark |
| | (d) | Correct idea from Fatima AND a correct idea from Claire (1) AND any one from <ul style="list-style-type: none"> idea that it depends on the number of people taking up these initiatives (1) Claire's idea is impractical (1) | 2 | Eg. Fatima's and Claire's idea <ul style="list-style-type: none"> reduce global warming or use less energy or use less (fossil) fuels or resources used or reduce greenhouse gases / CO₂ eg. would only apply to short / local journeys (1) eg. unrealistic that people would give up using cars (1) eg. some vehicles essential, eg health reasons / jobs / living in country (1) |
| | | Total | 7 | |

| Question | | Answer | Marks | Guidance |
|----------|-----|---|----------|---|
| 9 | (a) | 500 000 (MJ) (1) | 1 | |
| | (b) | idea that readings change each side of the 0 / idea that readings are positive and negative or flow in two directions (during a cycle) / AW (1) | 1 | ignore merely up and down / same frequency, etc. ignore merely 'all have peaks and troughs' allow all change (in) direction (1) allow all change from + to - (1) |
| | | Total | 2 | |

| Question | Answer | Marks | Guidance |
|----------|--|----------|---|
| 10 | <p>Level 3 Answers must refer accurately to all the relative distances travelled in each 2 second period. Also the correct accelerations must be given. A good cover of all aspects of the scenario in the question is needed for 5-6 marks. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>Level 2 Answers refer to the accurate and relative accelerations for each 2 second period OR the correct distances travelled. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>Level 1 Answers are limited to correct relative accelerations which may be related to the steepness of the gradients. It may not refer to time at all. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p> | 6 | <p>This question is targeted up to grade A*</p> <p>Indicative scientific points may include</p> <p>Level 3:</p> <ul style="list-style-type: none"> • 4m in 1st 2s, 8m then 14m • and 2 (m/s²), then zero acceleration or steady speed, then 3 (m/s²) <p>Level 2:</p> <ul style="list-style-type: none"> • 4m in 1st 2s, 8m then 14m • or 2 (m/s²), then zero acceleration or steady speed, then 3 (m/s²) <p>Level 1:</p> <ul style="list-style-type: none"> • correct relative accelerations which may be related to the steepness of the gradients • low acceleration, then no acceleration then higher acceleration <p>Use L1, L2, L3 annotations in scoris; do not use ticks.</p> |
| | Total | 6 | |

| Question | | Answer | Marks | Guidance |
|--------------|--|--|----------|---|
| 11 | | weight – 2500 (N) (1) distance – 2(m) (2) but if final answer is incorrect then look for: $d = W/F$ 5000/2500 and award (1) | 3 | allow 5000 divided by incorrect calculated weight Eg weight = 25N (0) 5000 / 25 scores (1) but 5000 / 25 = 200 scores (2) 200m without working scores 0 |
| Total | | | 3 | |

| Question | | Answer | Marks | Guidance |
|----------|-----|--|-------|--|
| 12 | (a) | 0.66 or 0.67 (2) but if incorrect: 6/9 or 3/4.5 scores (1) | 2 | allow 0.7 (1) do not allow final answers over 3 or more Decimal place: Eg 0.666 scores (1) Eg. 0.6 or 0.6 reoccurring (1) |
| | (b) | no (no mark to be awarded) 12 (m) (1) doubling speed doubles thinking distance / thinking distance is proportional to speed / AW (1) OR from calculation 18×0.66 (1) | 2 | ignore no / yes answer allow reverse arguments Eg. $9 / 18 = 0.5s$ which is not the same as the answer to part a because thinking time is constant (2) |
| | (c) | no (no mark to be awarded) | 3 | If answer is yes award a maximum of (1) for the idea of KE |

| Question | Answer | Marks | Guidance |
|----------|--|-----------|---|
| | 54 (m) (1) any two from: <ul style="list-style-type: none"> • doubling speed quadruples braking distance / AW (1) • KE or braking distance is proportional to v^2 / AW (1) • KE is absorbed in braking (1) | | being absorbed allow correct answers derived through calculation |
| (d) | maximum of three marks Idea of 'the distance the car moves' (1) tired / drunk AW / distracted / not concentrating / drugged (1) (The road) is icy / wet / muddy / slippery / downhill AND (... the tyres) have little tread / grip / friction AW (1) | 3 | ignore old / ill allow worn tyres / bald tyres (1) |
| | Total | 10 | |

| Question | | Answer | Marks | Guidance |
|----------|---------|--|-------|--|
| 13 | (a) | <p>maximum of three marks from:</p> <p>more collision time (1)</p> <p>more collision distance (1)</p> <p>less acceleration (1)</p> <p>same quantity of energy absorbed / same change of momentum for each car (1)</p> | 3 | <p>allow ora for an old car</p> <p>longer collision (1)</p> <p>allow areas under graph correctly compared (1)</p> <p>allow higher level answers in terms of force = change in momentum / time:</p> <p>Eg. force = $\frac{\text{change in momentum}}{\text{time}}$ (1)</p> <p>but stating and using the equation can score (3):</p> <p>Eg. force = $\frac{\text{change in momentum}}{\text{time}}$ (1)</p> <p>so a longer collision time (1)</p> <p>means a smaller rate of change of momentum (1)</p> |
| | (b) (i) | <p>maximum of two marks from:</p> <p>experiment with collisions on a dummy (under controlled conditions) / model a real vehicle-pedestrian collision / AW (1)</p> <p>collect data / measurements / results from this collision (1)</p> <p>draw conclusions from this data (1)</p> <p>change or recommend changes in design / experiment (1)</p> | 2 | <p>Eg. try dummies of different heights (1)</p> <p>Eg. try crashes at different speeds (1)</p> <p>Eg. make bumpers lower (1)</p> |

| Question | | Answer | Marks | Guidance |
|----------|------|---|----------|---|
| | (ii) | (Important so that other scientists can) develop more/improve tests or research (1) (critically) look at their conclusions/findings (1) to see if their research agrees (1) add more data (in time as cars and traffic develop) (1) inform future design (1) inform customer choice (1) | 1 | allow 'check accuracy' (1) Eg. people can choose the safest car (1) |
| | | Total | 6 | |

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

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Facsimile: 01223 552553

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