

Physics B

General Certificate of Secondary Education

Unit **B751/02**: Unit1 – Modules P1, P2, P3 (Higher Tier)

Mark Scheme for January 2012

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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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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

Subject-specific Marking Instructions

- / = 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

Question			Answer	Marks	Guidance
1	(a)	(i)	<p>in support of danger max. two from possible health risks from radiation / m.w. [1]</p> <p>concentrated microwaves / lots of signals emitted / greater power near the mast [1]</p> <p>lots of time spent in house so high dose / continuous exposure [1]</p> <p>in support of little danger max. two from mast is well above house [1]</p> <p>idea of fabric of the house absorbing some microwaves [1]</p> <p>microwave power output is low / AW [1]</p> <p>reference to long wavelength or lower frequency not harming (human) cells [1]</p>	2	<p>allow reference to heating effects / health risks or examples eg brain tumours / cancer / heating brain / damage to human or body cells / tissue / m.w. could be absorbed by human cells or tissue</p> <p>ignore danger from mast falling</p> <p>ignore can be struck by lightning / cause electric shocks</p> <p>ignore illness on its own / affects mind / harm people</p> <p>ignore interference with house circuits</p> <p>ignore idea of interfering with other signals</p> <p>ignore heat fat or water molecules only eg absorbed by water molecules [0] but absorbed by / heats water in the brain [1]</p> <p>ignore gives a better phone signal</p> <p>allow not ionising (like X-rays / gamma rays etc)</p> <p>allow little evidence for the harmful effect of m.w.</p>

Question	Answer	Marks	Guidance
(b)	<p>any two from:</p> <p>idea of explanations being provisional [1]</p> <p>lack of (enough) data / quality of data [1]</p> <p>not enough evidence or proof that m.w. cause cancer / not certain of the risks of using phones [1]</p> <p>idea of conflicting evidence [1]</p> <p>idea of low power of mobile phones / different phones emit different levels / use of headset / texting (at arms length) [1]</p> <p>long time for symptoms to occur [1]</p> <p>idea of difficulty of control group / elimination of other factors [1]</p>	2	<p>but idea of not enough data to make a firm conclusion yet [2]</p> <p>allow examples of conflicting evidence</p> <p>allow no correlation between m.w. and effects on humans</p> <p>allow examples eg phones only widespread for last few /15 years / mobile phones not in use long enough [1]</p> <p>allow examples eg examples people affected differently frequency / amount of use different levels of exposure can't test everyone that has a mobile phone</p>
	Total	4	

Question	Answer	Marks	Guidance
2 (a)	<p>[Level 3] A detailed explanation of the conduction in the glass together with a link to the energy transfer from air in the room to the glass or from the glass into the (cold) air outside. Quality of written communication does not impede communication of the science at this level. (5-6 marks)</p> <p>[Level 2] Limited explanation of one process by which energy is transferred between particles and leads to energy loss from the room or window. The description may not be specific to the window or glass. Quality of written communication partly impedes communication of the science at this level. (3-4 marks)</p> <p>[Level 1] An incomplete explanation, naming some processes by which energy is transferred or lost from the room. 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 at grades up to A/A* Indicative scientific points at Level 3 may include: warm air particles:</p> <ul style="list-style-type: none"> • move around quickly • hit glass particle making them vibrate (move) more <p>glass particles:</p> <ul style="list-style-type: none"> • vibrate more / gain KE • pass vibrations / KE through glass <p>cold air particles:</p> <ul style="list-style-type: none"> • hit (warm) glass particles • gain KE / bounce off with more speed <p>Indicative scientific points at Level 2 may include one of : warm air particles:</p> <ul style="list-style-type: none"> • move around quickly • hit glass particle making them vibrate or move more <p>glass particles:</p> <ul style="list-style-type: none"> • vibrate or move more / gain energy • pass vibrations or movement or energy through glass <p>cold air particles:</p> <ul style="list-style-type: none"> • hit (warm) glass particles • gain energy / bounce off with more speed • change of air density causes convection (outside) <p>Indicative scientific points at Level 1 may include:</p> <ul style="list-style-type: none"> • idea of particles passing on energy • idea of conduction through window / glass • idea of convection in air outside / in the room • idea of radiated heat from outer surfaces of window <p>ignore heat escapes or draughts ignore heat particles / particles move through glass ignore references to double glazing</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks</p>

Question		Answer	Marks	Guidance
	(b) (i)	61.67 / 61.7 / 61.66 / 62 [3] if answer incorrect then 41.67 / 41.7 / 41.66 / 42 [2] or 2100 000 / (12 x 4200) scores [1]	3	allow 61.666666 etc [3] allow 61 / 61.6 [2] allow 41.666666 etc [2] allow 41 / 41.6 [1]
	(ii)	heat or energy heating steel / metal / case / radiator [1] idea of heater / steel / case / metal / radiator conducting [1] heat / energy being given out or lost to or from the room / surroundings / atmosphere / air / AW [1]	1	ignore lost / wasted unless qualified ignore references to electricity but allow steel or metal conducts electricity [1] allow explanation eg heat passes through the steel [1] ignore references to change of state or boiling point of water ignore efficiency
	(c)	water or 'it' heats (gets to 50°C or maximum) slower / AW / ORA for oil [1] water or 'it' contains more energy / has higher (specific) heat capacity / ORA for oil [1] linked to water or 'it' stays hotter for longer / gives out more heat or energy to the room / AW [1]	3	does not have to appear in this order to gain full marks allow idea that water reaches 50°C more gradually or heats up more gradually but ignore merely its gradual allow water (graph) has a lower gradient / AW / ORA ignore efficiency ignore cost ignore references to boiling points allow oil cools down quicker / gives out less heat to the room
Total			13	

Question	Answer	Marks	Guidance
3	<p>three marks from any of:</p> <p>microwaves:</p> <ul style="list-style-type: none"> • idea of directly heating water / fat in food / AW [1] • idea of (partial) penetration or penetrates more than IR / AW [1] • and so less potato to be heated to centre / by conduction / ORA for IR or convection oven [1] • do not (directly) heat oven / containers / AW [1] • idea of cooks in less time or uses or wastes less energy / ORA for IR or convection oven [1] <p>infrared:</p> <ul style="list-style-type: none"> • (only) reaches / heats surface / cooks from the outer part of potato [1] • heats oven or oven parts, container / surroundings / air [1] 	3	<p>use ✓'s in this question throughout answer</p> <p>ignore liquids</p> <p>ignore efficiency</p> <p>ignore reflection</p> <p>ignore convection (in potato)</p> <p>ignore m.w. cook from the inside or m.w. penetrate to the centre</p> <p>allow moisture or liquid as AW for water</p> <p>allow idea of less food heated by passing on energy or heat or movement on to other particles</p>
	Total	3	

Question		Answer	Marks	Guidance
4	(a)	total internal reflection / TIR [1]	1	<p>allow correct description of TIR not merely 'reflection'</p> <p>ignore just waves ignore diagrams unless TIR is shown in a label</p>
	(b)	<p>more information capacity / higher transmission rate / transmits information or data or signal more quickly / AW [1]</p> <p>less (chance of) interference / tapping / hacking / idea of interference can be removed [1]</p>	2	<p>allow carry more than one signal (at the same time) allow higher level answers eg multiplexing allow its quicker / AW</p> <p>ignore damage ignore no interference in fibres allow less heating or energy loss or attenuation or less need for amplification as an addition marking point</p>
	(c)	<p>(narrow) beam of single coloured / monochromatic light [1]</p> <p>but (narrow or intense) beam of light that</p> <ul style="list-style-type: none"> • is same frequency / wavelength [1] • is in phase [1] • has low divergence [1] 	2	<p>allow one / single colour or pure colour</p> <p>max 2 can be gained from higher level answers in second part of M.S. allow coherent [2] allow in sync. (for in phase) ignore idea of (low) dispersion ignore more focused ignore light from a torch spreads out</p>
		Total	5	

Question		Answer	Marks	Guidance
5	(a)	<p>number of kWh 0.75 (kWh) [2]</p> <p>but if answer incorrect 0.5 x 1.5 [1]</p> <p>cost of using iron 13.5 (pence) [1]</p>	3	<p>Use ✓'s in this question allow 750 [1]</p> <p>allow ecf from kWh calculated eg 7.5 kWh.....135p / £1.35 [1] 750 kWh.....13500p / £135 [1] allow 13 or 14 (p) if correct working shown</p>
	(b)	<p>8.5 (A) [2]</p> <p>if answer is incorrect 1955 ÷ 230 [1]</p>	2	
	(c) (i)	<p>advantage less cost / AW [1]</p> <p>disadvantage any one from available at inconvenient times / inconvenient / AW[1]</p> <p>another meter required / extra wiring / time switches for storage heaters [1]</p> <p>day-time electricity can be more expensive than non-off peak users / extra standing charge [1]</p>	2	<p>ignore few people using it then</p> <p>allow he can only use electrical appliances at night / night time use only / can only be used at night / appliances or 'it' is noisy (to use) at night / risk from unattended appliances = inconvenience</p> <p>ignore just chance of a fire</p> <p>ignore not always available / cannot use it at peak times</p> <p>ignore more efficient</p>
	(ii)	<p>any one from idea of evens out demand / avoids spikes in demand [1]</p> <p>electricity cannot be stored (so not wasted) [1]</p>	1	<p>allow don't have to / cannot switch off power stations / can keep it running continuously / avoids need to run or build more power stations</p> <p>allow lowest level of acceptability: evens out selling times</p> <p>allow idea of reducing waste of electricity or energy at night</p> <p>ignore pollution during the day</p>
Total			8	

Question		Answer	Marks	Guidance
6	a	<p>any two from</p> <p>global warming has happened before human race / pre-measurable times / AW [1]</p> <p>other natural events in past may be responsible [1]</p> <p>some scientists have an economic interest in supporting or disregarding the global warming [1]</p> <p>difficulties in data collection / variable average temperatures [1]</p> <p>different interpretations of data / evidence / results [1]</p> <p>idea of conflicting or different data / evidence / results [1]</p>	2	<p>allow difficult to tell what greenhouse gases are naturally made or man-made or how much global warming is due to natural or man made activities[1]</p> <p>allow volcanoes</p> <p>allow idea of natural warming / cycle of warming and cooling or description eg ice age followed by warming</p> <p>ignore global warming affected by many factors</p> <p>allow difficult to prove a causal link</p> <p>allow no definite proof either way but ignore merely no definite proof</p> <p>ignore not conclusive on its own</p>

Question		Answer	Marks	Guidance
6	b	<p>[Level 3] Explanation should include detail of at least two of the mechanisms involved in terms of different wavelengths. Quality of written communication does not impede communication of the science at this level. (5-6 marks)</p> <p>[Level 2] Explanation should include at least on of the general mechanisms involved in terms of different wavelength of radiation. Correct order of wavelength not essential. Quality of written communication partly impedes communication of the science at this level. (3-4 marks)</p> <p>[Level 1] Simple description of the mechanisms or processes involved. 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 at grades up to A/A*</p> <p>Indicative scientific points at Level 3 may include:</p> <ul style="list-style-type: none"> • Sun is very hot so wavelength of radiation emitted is very small • short wavelength radiation comes from the Sun • short wave radiation from Sun is absorbed by and heats the Earth • the Earth radiates or emits heat as longer wavelength • the longer wavelength radiation that heats the Earth is infrared radiation • greenhouse gases or atmosphere absorb some of the longer waves <p>Indicative scientific points at Level 2 may include:</p> <ul style="list-style-type: none"> • absorption of infrared radiation warms the greenhouse gases • radiation at most wavelengths can pass through the Earth's atmosphere • Earth radiates or emits heat out / back • certain wavelengths are absorbed or some reflected <p>Indicative scientific points at Level 1 may include:</p> <ul style="list-style-type: none"> • (greenhouse) gases produced trapped (in atmosphere) • Sun's radiation reaches or is absorbed by Earth • Earth gives out heat / radiation / energy • radiated heat cannot penetrate the atmosphere / is trapped / reflected • radiated heat cannot be absorbed by the atmosphere • atmosphere warms the Earth <p>ignore ultraviolet reference to ozone layer limits mark to max 2</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
Total			8	

Question		Answer	Marks	Guidance
7	(a)	<p>36% / 0.36 [2]</p> <p>but if answer is incorrect</p> <p>$180 \div 500 \text{ (x 100)}$ [1]</p>	2	<p>if answer is 36 without % and working shown [2]</p> <p>just 36 or 0.36% [1]</p> <p>if another unit added max [1]</p> <p>eg 36 J [1]</p> <p>0.36 N [1]</p>
	(b)	<p>idea of use of waste heat or energy / idea of recycle the waste heat or energy [1]</p> <p>but</p> <p>idea of use the waste heat to warm homes / buildings / to heat power station [2]</p> <p>or</p> <p>idea of recycling the waste heat back into the power station to heat water or make steam [2]</p>	2	<p>allow re-use the wasted energy or allow [1]</p> <p>allow use wasted heat in power station [1]</p> <p>ignore alternative energy</p> <p>ignore insulation</p> <p>ignore generate more electricity</p> <p>allow recycle the steam [2]</p>
Total			4	

Question		Answer	Marks	Guidance												
8	(a)	<table border="1"> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>smoke detector [1]</td> <td></td> </tr> <tr> <td></td> <td>thickness gauges or thickness control [1]</td> <td>a few mm / cm of aluminium [1]</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>					smoke detector [1]			thickness gauges or thickness control [1]	a few mm / cm of aluminium [1]				3	<p>allow smoke alarm but ignore fire alarm</p> <p>allow tracer 1] allow sheets of or thin aluminium or metal</p> <p>allow treating cancer</p> <p>ignore paper on its own allow steel or lead or few mm of metal or thick metal or named metal</p> <p>allow thick or few cm. of card or wood</p> <p>ignore aluminium foil or tinfoil / just aluminium / metal on its own</p>
	smoke detector [1]															
	thickness gauges or thickness control [1]	a few mm / cm of aluminium [1]														
		<p>any two from</p> <p>leak into water / rivers / lakes / sea / water supply / drinking water [1]</p> <p>enters the food chain or food supply / transferred to or taken by living organisms [1]</p> <p>cause mutations / increased cancer risk in animals or humans [1]</p> <p>remain radioactive or active or harmful for a (very) long time [1]</p> <p>idea of change of safe or acceptable (radiation) levels in the future [1]</p>	2	<p>use ✓'s in this question</p> <p>ignore could leak on its own</p> <p>allow specific examples eg iodine absorbed by thyroid gland</p> <p>throughout answer;</p> <p>ignore just kill / harm animals or people</p> <p>ignore destroys or harms habitats</p> <p>ignore harms soil or land or environment</p> <p>ignore terrorist threat</p> <p>ignore geological damage</p>												
Total			5													

Question		Answer	Marks	Guidance
9	(a)	<p>yes (no mark)</p> <p>A is a positive gradient or slope but C and D are negative gradient or slope [1]</p> <p>D is higher / steeper gradient or slope (than C) [1]</p>	2	<p>allow A is a line going up and C is a line going down</p> <p>allow illustrative calculations from graph in either response eg accelerations : A 2.5/40 / 0.625 C -0.5/40 / -0.0125 D -2/100 / -0.020 (units not needed) [2] eg if correct values for C and D given with no minus sign [1]</p> <p>allow correct descriptions in either response eg speed or values increasing in A but decreasing in C / AW or graph goes up in A but down in C / AW [1] speed decreasing more rapidly in D than C / AW or graph goes down more rapidly in D compared to C / AW [1]</p>
	(b) (i)	50m [1]	1	if no answer is ringed or otherwise indicated allow a written answer of 50m in answer space no working mark
	(ii)	<p>667 (s) [2]</p> <p>but if answer is incorrect</p> <p>1200 ÷ 1.8 or 666.666 or 666.667[1]</p>	2	<p>allow 666 [1]</p> <p>allow time = distance ÷ speed or 1.2 ÷ 1.8 [1]</p>
Total			5	

Question		Answer	Marks	Guidance
10	(a)	15[1]	1	
	(b)	<p>(car) C (no mark)</p> <p>and max 3 from marking points any other choice from D E F max 2 from marking points</p> <p>because of windows open or roof box (causing increased drag) [1]</p> <p>linked to idea of more KE / energy needed or engine / car having to do more work / engine has to work harder [1]</p> <p>then max one for the link to one of the following additional factors</p> <p>higher speed / changing speed a lot / accelerating more [1]</p> <p>different driving styles / frequent braking / electrical equipment in use [1]</p> <p>different terrain or road surface [1]</p>	3	<p>use ✓'s in this question ignore references to emissions throughout question</p> <p>allow just more energy or power needed from engine or car</p> <p>allow examples eg fog lights / radio used</p> <p>allow examples eg driven on hills eg driven over roads with poor grip</p>
		Total	4	

Question	Answer	Marks	Guidance
11	<p>[Level 3] Explanation of the reasons for having crumple zones in a car including ideas about force reduced or lower rate of change of momentum. A more detailed description of the method(s) of testing or the use of the data or retesting should be included. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>[Level 2] Ideas of longer time of collision or lower acceleration or transfer of energy resulting in reduction of injury. Some reference to testing should be included. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>[Level 1] Idea of changing shape and protecting occupants or reduce injuries in a crash may be included or mentions simple points in the testing process. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p>	6	<p>This question is targeted up grade C Indicative scientific points at Level 3 may include:</p> <ul style="list-style-type: none"> • idea of spreading the momentum change on passenger • longer time collision time to transfer momentum • retest with new design feature • measure forces on test dummies • how crumple zones protect dummies • crumple zone design or placement improved • collection and analysis of data from actual crashes • video crash tests <p>allow higher level answers at level 3</p> <ul style="list-style-type: none"> • forces reduced due to increased stopping / collision distance or time • lower acceleration (of driver or passenger) • spreading change in momentum over longer time reduces forces on driver or passenger and reduces potential injury <p>Indicative scientific points at Level 2 may include :</p> <ul style="list-style-type: none"> • longer time collision time or distance produced • idea of transfer of car or driver's energy • injuries in a crash are due to rapid deceleration of parts of the body • features are to reduce injuries to driver or passenger • measurements made on test dummies • assessment of effectiveness of crumple zones • new improved design fitted to car <p>Indicative scientific points at Level 1 may include:</p> <ul style="list-style-type: none"> • features change shape in a crash • features absorb energy in a crash • crash simulation • 'dummy' driver / passengers used • crumple zones examined

Question			Answer	Marks	Guidance
			<p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit.</p> <p style="text-align: right;">(0 marks)</p>		<p>throughout answer ignore slows down impact or force ignore absorbs force or impact</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
			Total	6	

Question	Answer	Marks	Guidance
12 (a)	<p>Z is most economical / more fuel efficient / best fuel consumption / lowest fuel costs [1]</p> <p>(idea that) Trevor has read fuel consumption data the wrong way around / back to front / 16.1 or X is the worst consumption / least km per ltr / ORA [1]</p> <p>and one from</p> <p>least environmental harm; Y quietest or gives out less noise pollution or least dB and is best in terms of lowest CO₂ or greenhouse gas emissions or pollution given out or emitted [1]</p> <p>OR</p> <p>Z is close (to Y) in terms of low(er) noise pollution and CO₂ or greenhouse gas emissions or pollution given out or emitted [1]</p>	3	<p>use ✓'s in this question</p> <p>allow car with biggest engine or highest top speed or V has low or poor fuel consumption / AW OR X is least fuel efficient / AW [1] allow choice of Y because of high km/hr / close to Z fuel consumption / small engine size [1] allow most economical or fuel efficient cars go further on a litre of petrol</p> <p>allow car with biggest engines or highest top speed or acceleration (figures) or V has highest CO₂ emissions / pollutes most and is noisier or noisiest / AW ignore references to pollution on its own</p> <p>allow a correctly reasoned choice eg choose Z because it is fairly quiet and has close to the lowest CO₂ emissions [1] eg he should choose Z as it has the best fuel economy and is fairly quiet and has close to the lowest CO₂ emissions [2] ignore references to pollution on its own</p>
(b) (i)	<p>12 (kW) [2]</p> <p>but if answer is incorrect</p> <p>(500 x 850) ÷ 35 or 12143 or 12.1(43) [1]</p>	2	<p>allow 12000 – 12200 [1]</p> <p>allow power = (force x distance) ÷ time [1] ignore number of decimal places if answer is left in watts [1]</p>

Question			Answer	Marks	Guidance
12	b	(ii)	<p>any one from</p> <p>car V because it has biggest engine size [1]</p> <p>car V because it has the highest top speed / speed of 210 (km/hr) [1]</p> <p>car V because it has highest acceleration [1]</p>	1	<p>allow 201 (km/hr) /engine size 1800 (cm³) / 5 seconds to reach 90 km/hr as these clearly indicate V</p> <p>allow V because it has the highest power</p>
	(c)		<p>driver: any one from</p> <p>need to recharge battery / need a charging point / AW [1]</p> <p>limited range / problems of recharging or refuelling [1]</p> <p>limited top speed / lower performance [1]</p> <p>no pollution or harmful gases at point of use / given out [1]</p> <p>more economical to run [1]</p> <p>could be no congestion charge [1]</p> <p>pedestrians: any one from</p> <p>dangers from more vehicles on roads / in city centres [1]</p> <p>accident danger increased because the cars are quiet / difficult to hear [1]</p> <p>idea of less noise pollution [1]</p> <p>no pollution or harmful gases at point use / given out [1]</p> <p>danger from vehicle on pavement if scooter/ Segway is named [1]</p>	2	<p>use ✓'s in this question</p> <p>allow scooter type carries only one person [1]</p> <p>allow idea using electric cars still produces pollution / gases / CO₂ when electricity is produced</p> <p>allow idea of burning fossil fuels to produce electricity or electricity is made in a power station / power stations produce pollution</p> <p>only award point of use mark once</p> <p>ignore vehicle purchase cost</p> <p>allow lower speeds safer for pedestrians if the low speed mark is not gained for the driver response</p> <p>allow idea of less emissions to breath in if pollution mark not awarded in driver response</p> <p>only award point of use mark once</p>
			Total	8	

Question		Answer	Marks	Guidance
13		<p style="text-align: center;">Statement</p> <p>all sheets.. <input type="checkbox"/></p> <p>the weight of.. <input type="checkbox"/> ✓</p> <p>the time to... <input type="checkbox"/></p> <p>the drag on A >... <input type="checkbox"/> ✓</p> <p>at terminal speed.... <input type="checkbox"/> ✓</p>	2	three correct = [2] one or two correct = [1] any additional tick over three: minus one to minimum of zero
Total			2	

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