

Physics B

General Certificate of Secondary Education

Unit **B651/02**: 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

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

Question		Answer	Marks	Guidance
1		70 (°C) (3) but if answer is incorrect 50 (°C) (2) but if this answer is incorrect 42000 ÷ (4.2 x 200) or 42000 ÷ 840 or 42000 ÷ (4200 x 0.2) or 42000 ÷ (200 x 4200) (1)	3	allow ecf with 20 added on to incorrect temperature rise allow correct rearrangement without figures ie temp. rise = energy or heat / s.h.c. x mass (1) if answer is incorrect when several different calculations are offered including the correct one no working mark can be awarded
		Total	3	

Question			Answer	Marks	Guidance
2	(a)	(i)	idea of surface (layer) or outer part or top part cooked / heated / browned (1) (IR) reflected (onto toast) (1)	2	allow outside part cooked or heated or browned or toasted allow particles in surface or outer parts gain kinetic energy / k.e. allow heats the outside and then the middle or toasts from outside to inside ignore heating elements radiate IR onto toast ignore conduction and convection allow heat or energy reflected ignore bounce ignore idea of (shiny) sides reradiating IR back onto bread
		(ii)	0.75 (2) but if answer is incorrect $36000 \div 48000$ (1)	2	allow 75% (2) if % clearly shown allow other units eg 0.75 N (1) 0.75 % scores (1) allow 75 alone (1) but if working is clearly shown ($36000 \div 48000 \times 100$) and answer is 75 (2)
	(b)		idea of microwaves absorbed by water or fat particles / molecules causing an increase in their kinetic energy (1) idea that energy or vibrations transferred from particle to particle or passed on between particles (1) rest of food heated or energy transferred by conduction and / or convection (1)	3	USE ✓'s IN THIS QUESTION allow sugar particles / molecules ignore merely absorbed by particles or food particles or layers ignore penetration ignore merely gives them KE allow idea of microwaves increasing energy / vibrations / movement of particles but ignore makes the particles vibrate or starts particles vibrating ignore idea of passing on heat ignore increasing (kinetic) energy of meal no need to specify the type of particle for this marking point allow descriptions of conduction or convection allow higher level answers as additional marking points eg microwaves cause charges in water or fat or sugar (particles) to oscillate / vibrate more (1) friction caused by moving particles heats food (1)
			Total	7	

Question			Answer	Marks	Guidance
3	(a)	(i)	105 (minutes) (1)	1	
		(ii)	210 minutes longer or three times as long (1)	1	<p>allow 210 (minutes) (1)</p> <p>allow answer of 2 x answer to (a)(i) (1)</p> <p>allow error if method shown but mistake made with the number subtracted</p> <p>eg $315 - 100 = 215$ (minutes) (1)</p> <p>allow ecf from (a)(i)</p> <p>eg answer to (a)(i) is 90 then $(270-90 =) 180$ (1)</p> <p>eg answer to (a)(i) 15 then $(45-15=) 30$ (1)</p>
	(b)		<p>ozone..... This.....depleted or thinner.....</p> <p>..... CFC or chlorofluorocarbon</p>	2	<p>allow less dense but not just less</p> <p>ignore weaker or damaged or destroyed</p> <p>ignore stratosphere</p> <p>ignore aerosol gases</p> <p>allow nitric oxide / nitrous oxide / bromofluorocarbon or BFC / hydroxyl (ions) / chlorine / bromine</p> <p>3 correct = (2)</p> <p>2 correct = (1)</p> <p>1 correct = (0)</p>
Total				4	

Question		Answer	Marks	Guidance
4	(a)	<p>analogue is continuously variable / can have any value (within a range) (1)</p> <p>digital has two values or 2 states / 0, 1 / high, low / on, off / pulsed (1)</p>	2	<p>allow has a range of values allow more than 2 or multiple values (1) allow a series of binary codes (1) ignore vary in amplitude or frequency eg vary in frequency (0) continuously variable frequency (1) ignore merely analogue varies all the time ignore merely is continuous ignore a range of signals / variable signals</p> <p>ignore frequency or wavelength eg digital only has an on off frequency (1) ignore a range between 0 and 1 / 2 settings / 2 variables ignore any two values or two signals ignore signal not can be turned or switched on and off</p>
	(b)	similar frequency (1)	1	<p>allow similar wavelength (1) allow same frequency or same wavelength ignore because Jack / radio is moving</p>
	(c)	<p>reflect</p> <p>ionosphere (1)</p>	1	<p>both needed in correct order allow TIR allow refract ignore bounce</p> <p>ignore stratosphere</p>
	(d) (i)	6 (1)	1	if answer line is blank allow correct answer ticked circled or underlined or clearly indicated on the diagram

Question		Answer	Marks	Guidance
	(ii)	<p>the wave is 4 cm high <input type="checkbox"/></p> <p>the wave travels 4cm in 1 second <input type="checkbox"/></p> <p>the wave is 4 cm long <input type="checkbox"/></p> <p>there are 4 complete waves every second <input checked="" type="checkbox"/></p> <p>there are a total of 4 cycles in the whole wave <input type="checkbox"/></p>	1	if r.h. boxes are blank allow correct answer ticked circled or underlined two or more ticks no mark
		Total	6	

Question		Answer	Marks	Guidance
5	(a)		2	3 correct scores (2) 1 or 2 correct scores (1)
	(b)	rocks / soil / cosmic rays or cosmic radiation / building materials or named building materials / isotopes of carbon (1)	1	<p>allow <u>nuclear</u> testing or <u>nuclear</u> or <u>atomic</u> bombs or <u>nuclear</u> weapons / <u>nuclear</u> accidents / examples of medical use / radon / <u>nuclear</u> or <u>radioactive waste</u> (1)</p> <p>ignore nuclear power / nuclear plants ignore nuclear fallout unless qualified ignore merely buildings or equipment or hospitals or industry ignore radioactive materials ignore food / drink / animals / plants ignore simple references to the Sun e.g. from Sun (0) cosmic rays / gamma from Sun (1) solar flares (1) alpha / beta from Sun (0) not X-rays or microwaves or other e.m. waves any incorrect response (in a list) negates the mark</p>
	(c)	(i) uranium / U (1)	1	
		(ii) nuclear weapons (1)	1	<p>allow nuclear bombs / nuclear explosions (1) allow atomic weapons / bombs / explosions allow nuclear testing (1) allow dirty bombs allow named explosion. Eg Hiroshima / Nagasaki (1) allow enrichment fuel [1] but not just fuel on its own not merely bombs / explosions / weapons / testing</p>

Question	Answer	Marks	Guidance
(d)	<p>advantages any one from: independence from fossil fuels / no greenhouse gases or named greenhouse gas emitted / no carbon emissions (1)</p> <p>idea of (relatively) high fuel stocks (1)</p> <p>disadvantages any one from: decommissioning / maintenance costs high (1)</p> <p>risk of emissions / radiation given out / leaks (1)</p> <p>ionising radiations (from radioactive waste) can cause cancer (1)</p>	2	<p>allow idea of conserving fossil fuels ignore produces more energy or more efficient ignore reference to cost</p> <p>allow uses non-renewable resources only if conserving fossil fuels has not be awarded allow idea of waste remains radioactive for a long time eg waste has a long half life eg waste radioactive for hundreds of years</p> <p>allow difficulty or cost of dealing with radioactive / nuclear waste allow radioactive / nuclear waste has to be stored underground ignore terrorist threat or merely accidents ignore merely gives off radiation ignore merely cancer threat</p>
	Total	7	

Question		Answer	Marks	Guidance
6		<p>electrons knocked or released from silicon / silicon atoms / photocell (1)</p> <p>electrons carry charge / electrons flow (in photocell / circuit) / free or delocalised electrons produced (1)</p> <p>idea that direct current flows in one direction (1)</p> <p>but electrons or charge travel in one direction / one way (2)</p>	3	<p>USE ✓'s IN THIS QUESTION</p> <p>allow more electrons are released or produced</p>
		Total	3	

Question		Answer	Marks	Guidance
7	(a)	<p>16.8 scores (3)</p> <p>but if final answer is incorrect</p> <p>1.4 x 12 (2) or 7 x 0.2 x 12 (2)</p> <p>OR</p> <p>7 x 0.2 or 1.4 or 168 (1)</p>	3	<p>allow 17 (3)</p> <p>if answer is incorrect when several different calculations are offered including the correct one no working mark can be awarded</p> <p>allow 84 (1) but 84 x 0.2 (2)</p> <p>2.4 (1) but 2.4 x 7 (2)</p> <p>7 x 12 / 0.2 x 12 (1)</p> <p>allow 1.4 x 0.12 = 0.17 or 7 x 0.2 x 0.12 = 0.17 (2)</p>
	(b)	<p>advantage: any one from:</p> <p>idea of costs less (1)</p> <p>disadvantage: any one from:</p> <p>available at inconvenient times / inconvenient / only available at night / 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>allow advantages for producer</p> <p>eg prevents closing power stations at night / (more) efficient or cost effective (for the producer / power station)</p> <p>eg saves money for producer</p> <p>eg idea of evens out demand / avoids spikes in demand</p> <p>eg don't have to / cannot switch off power stations</p> <p>eg can keep it running continuously / avoids need to run or build more power stations</p> <p>eg low demand at night</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>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 / attending to appliances at night (= an inconvenience) / have to fit schedule of life (style) around it</p> <p>allow fire risk from unattended appliance (at night)</p> <p>ignore just chance of a fire on its own</p> <p>ignore merely not always available / cannot use it at peak times / cannot use it all the time</p> <p>ignore few people using it then</p> <p>ignore just dangerous to use appliances at night</p> <p>ignore more pollution during the day</p>
		Total	5	

Question			Answer	Marks	Guidance
8	(a)	(i)	48 (MJ) (2) but If answer incorrect $40 = ? / 120 \times 100\%$ (1) or $0.4 = ? / 120$ (1)	2	
		(ii)	32 (MJ)	1	allow ecf from part (a)(i) eg 32 in (a)(i) 48 in this part (1) eg 20 in (a)(i) 60 in this part (1)
	(b)		answers must include use of figures from diagram, figures alone do not gain credit they must be linked to an explanation 70 (MJ) / 35% (cooling water) idea that energy is now used to heat homes or schools (1) max one from idea that 150(MJ) or 80(MJ) + 70 (MJ) or 75% is useful (1) idea that (only) 50MJ / 25% is wasted (1)	2	i.e. no values in answer, no mark allow calculation eg $150 \div 200$ ignore merely 80MJ of electricity produced
			Total	5	

Question			Answer	Marks	Guidance
9	(a)	O/L	4 m/s (2) but if answer is incorrect 18 ÷ 4.5 (1)	2	
	(b)	(i)	accelerates <input checked="" type="checkbox"/> stays stationary <input type="checkbox"/> slows down gradually (decelerates gradually) <input type="checkbox"/> moves at a constant speed <input type="checkbox"/> slows down rapidly (decelerates rapidly) <input type="checkbox"/> (1)	1	if answer line blank allow correct answer ringed ticked or underlined in list
		(ii)	stays stationary <input type="checkbox"/> slows down (decelerates) more than in B <input checked="" type="checkbox"/> slows down (decelerates) at the same rate as in B <input type="checkbox"/> slows down (decelerates) less than in B <input type="checkbox"/> moves at a constant speed <input type="checkbox"/> (1)	1	if answer line blank allow correct answer ringed ticked or underlined in list
		(iii)	distance (travelled) (1)	1	ignore 18m
Total				5	

Question		Answer	Marks	Guidance	
10	(a)	<p>greater mass or weight (1)</p> <p>higher velocity or speed (1)</p>	2	<p>allow examples eg more passengers / roof box (added) / increased load</p> <p>allow moving faster</p> <p>allow examples that would increase speed eg increased thrust or force eg decreased air resistance or drag eg (more) acceleration eg pressing hard(er) on the accelerator eg going downhill if no mark gained allow (1) for mass / weight and speed</p>	
	(b)	(i)	9000 N (1)	1	if more than one answer ringed zero but if no answer ringed allow the correct answer written down
		(ii)	405000 J (1)	1	if more than one answer ringed zero but if no answer ringed allow the correct answer written down
	(c)	<p>thinking tiredness / alcohol or drugs / poor concentration or distractions / AW (1)</p> <p>braking wet or icy or leaves on road / poor condition of brakes or tyres (1)</p>	2	<p>allow examples eg kids in back of truck / loud music / radio on / using mobile phone / accident on road / signs on roadside</p> <p>allow poor road surface / slippery road (surface) but ignore merely poor road or poor road condition</p> <p>allow examples eg bald(y) tyres / worn out tyres / poor or less tread on tyres / worn brakes</p> <p>allow low or poor / friction or grip from tyres</p> <p>ignore size (of truck) but</p> <p>allow increased mass / weight / load (in truck)</p> <p>ignore merely weather but allow examples eg raining / snowing / ice or frost on road</p> <p>ignore old brakes or tyres or condition of brakes or tyres</p>	

Question		Answer	Marks	Guidance
	(d)	<p>any one from: Samuel drives at higher speed / faster (1)</p> <p>idea of Samuel using excessive or more braking (1)</p> <p>Samuel speeds up / accelerates more often or more quickly / not at a steady or constant speed / idea of stopping and starting a lot (1)</p>	1	<p>allow ora in terms of Alisha</p> <p>allow driving in incorrect gear / incorrect use of gears</p> <p>allow examples eg Samuel pulls away from the lights quicker than Alisha</p> <p>allow Samuel has the heating or screen heater(s) on but</p> <p>ignore other electrical items</p> <p>allow examples of causing acceleration or high speed eg pressing hard(er) on the accelerator</p> <p>ignore terrain driven on</p> <p>ignore more mass or weight or passengers or towing</p> <p>ignore Samuel uses a roof rack or box / sunroof open</p>
		Total	7	

Question	Answer	Marks	Guidance
11	<p>(seat belts) (no mark)</p> <p>any two from: increase stopping or collision or impact time / increased time to transfer or absorb energy / keeps wearer in seat for longer time(1)</p> <p>decrease deceleration / decreased acceleration / decreased (rate of) momentum change (1)</p> <p>increase stopping or collision distance (1)</p> <p>if initial answer is air bags award max one mark for any of the above points</p>	2	<p>USE ✓'s IN THIS QUESTION</p> <p>allow slows down collision or prolongs collision allow brings to a stop (more) slowly ignore wearer does not go forward as much / prevent people going forward ignore slows down movement ignore merely energy absorbed</p> <p>allow correct use of $f = m \times a$ eg $a = \frac{f}{m}$ so less 'f' reduces 'a' allow slows down the deceleration / decelerates more slowly / slowing down more slowly</p> <p>ignore stops rear passengers hitting the driver in a crash ignore cushions or absorbs impact / force / collision</p>
	Total	2	

Question		Answer	Marks	Guidance
12	(a)	<p>max two from: as speed increases drag / (air) resistance / friction increase (1)</p> <p>at terminal speed / velocity weight = drag / (air) resistance / friction (1)</p> <p>max two from: A has a greater (surface) area so more drag / (air) resistance / friction (1) / ora for B</p> <p>idea that B reaches a higher (terminal) speed / velocity or reaches (terminal) speed / velocity quicker / ora for A (1)</p>	3	<p>USE ✓'s IN THIS QUESTION assume answers refer to sheet B unless otherwise stated first two marking points can refer to A or B</p> <p>allow weight and drag / (air) resistance / friction are balanced but ignore merely forces are equal or balanced ignore gravity for weight in response ignore upthrust</p>
	(b)	PE does work against friction or drag / AW (1)	1	<p>allow PE transferred to air particles / AW allow converted / transferred / changed into heat (and sound) energy but ignore lost as heat / sound energy but not sound on its own allow increase internal energy or KE of the air (particles) ignore converted / transferred to other forms of energy ignore pushes air out of the way</p>
Total			4	

Question			Answer	Marks	Guidance
13			2.2 (m) (2) but if answer is incorrect (h =) $1540 \div (70 \times 10)$ or $1540 \div 700$ (1)	2	
			Total	2	

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