

Physics B J645

Gateway Science Suite

General Certificate of Secondary Education

Mark Scheme for the Units

January 2008

J645/MS/R/08J

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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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GCSE Gateway Physics B J645

MARK SCHEMES FOR THE UNITS

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General advice to Assistant Examiners

- 1 Correct answers to calculations always gain full credit even if no working is shown. (The 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)
- 2 Some questions may have a 'Level of Response' mark scheme. Any details about these will be in the rationale.
- 3 If an answer has been crossed out and no alternative answer has been written then mark the answer crossed out.
- 4 Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/ = alternative and acceptable answers for the same marking point

(1) = separates marking points

not = answers which are not worthy of credit

reject = answers which are not worthy of credit

ignore = statements which are irrelevant

allow = answers that can be accepted

() = words which are not essential to gain credit

 = underlined words must be present in answer to score a mark

ecf = error carried forward

AW = alternative wording

ora = or reverse argument

B651/01 Unit 1: Modules P1, P2 and P3 Foundation Tier

Question		Expected Answers	Marks	Rationale	
1	a	double glazing — wall loft insulation — roof carpet — window cavity-wall insulation — door draught proofing — floor	3	more than one line = contradiction and should be marked wrong one correct = 1 two correct = 2 all correct = 3	
	b	i	4 (1)	1	correct answer only
		ii	air is an (good) insulator / poor conductor (1)	1	allow reduced convection / AW (1) Not description ie keeps room warm
Total			5		

2	a	i	infrared / IR / microwaves (1)	1	either or both answers (1) if two answers given both must be correct
		ii	infrared / IR (1)	1	more than one answer (0)
		iii	<u>skin</u> cancer / sunburn / <u>skin</u> damage (1)	1	not cancer not damage allow suntan / eye damage / skin damage (1)
	b		B (crest) (1) C (amplitude) (1) wavelength (1)	3	allow lambda symbol for wavelength (1)
Total			6		

Question			Expected Answers	Marks	Rationale
3	a	i	reflection from inside surface (1) l = r by inspection (1) BUT TIR / all reflections completed (2)	2	Mark diagram first If more than 6 reflections max 1 ignore refraction /or not at the start of the fibre allow description of TIR eg reflection at surface (1) angle of incidence greater than critical angle (1) Check writing for contradiction refraction in writing overrides reflection in diagram ignore rebounds/bounces off
		ii	analogue - continuously variable / AW (1) digital - either on / 1 or off / 0 or specific value / pulses (1)	2	ignore analogue varies allow correct labelled diagrams (1) allow noise can be filtered from digital (1) look for both answers in first space
	b		any two from: no wiring needed / does not need a landline / AW (1) portable / convenient / can take it anywhere (1) text on mobile (1) internet access for mobiles (1)	2	allow send photo (1) not take photo allow available 24 hours a day (1)
			Total	6	

4	a	i	ice (1)	1	
		ii	hot tea (1)	1	
	b		any one from: energy used for melting / latent heat / AW (1) temperature stays the same until all ice melts (1)	1	allow change of state (1)
			Total	3	

Question			Expected Answers	Marks	Rationale
5	a	i	electrical (1)	1	
		ii	any one from: solar collecting / heating / panels (1) (produce convection currents in) wind / wave / biomass / biofuels / plants growing (1)	1	not heat / light
	b	i	any one from: low maintenance / no need for power cables / remote use / no need for fuel / long life / rugged / renewable energy / no pollution (1)	1	allow free (to use) low running costs (1)
		ii	no power if dark / bad weather / depend on intensity (1)	1	allow higher level response efficiency (1) allow low power output (1)
		Total		4	

6	a		move the magnet (1) close to / inside the coil (1)	2	allow move the coil (1) close to / around the magnet (1) put magnet inside coil =2
	b		any two from: stronger / more powerful magnet (1) more / larger coils (1) move magnet faster (1)	2	not larger / bigger / more magnet(s)
	c		DC / dc / direct current (1)	1	allow direct (1)
		Total		5	

Question		Expected Answers	Marks	Rationale
7	a	wood	1	
	b	230 x 8 (1) '= 1840 (W) (1)	2	no mark for equation 1840 (W) on own = 2 marks
	c	oven (1)	1	
Total			4	

8	a	any one from: smoke detectors / cancer treatment / thickness gauging / non destructive testing / sterilizing / any tracer application (1)	1	allow nuclear power / AW (1) not Weapons
	b	any two from: protective clothing / named eg gloves (1) tongs / idea of remote handling (1) short exposure time (1) shielding (1) warning detectors (1)	2	allow have Geiger counter near them (1)
Total			3	

9	a	planets (1)	1	
	b	hot / burning /give out light /shine /glow (1)	1	not just light /are bright allow higher level answers
	c	any two from: food (1) water (1) oxygen (1)	2	allow suitable temperature (1) CO ₂ / waste removal (1)
Total			4	

Question			Expected Answers	Marks	Rationale
10	a	i	tape / tape measure / trundle wheel / AW (1) time (1)	2	not ruler / metre rule / metre stick (0) not pedometer not seconds
		ii	m/s (1)	1	more than one answer scores (0)
	b	i	Audi (1)	1	more than one answer scores (0)
		ii	BMW (1)	1	more than one answer scores (0)
			Total	5	

11	a	i	distance moved / AW (1) while driver reacts / AW (1)	2	not how long (0) not time (0) time it takes to think about stopping = 1
		ii	36 (m) (1)	1	
	b		(road surface) icy / wet / slippery / greasy / AW (1) (car condition) bald tyres / AW (1)	2	allow poor or worn brakes or suspension (1) for a car condition allow more mass / AW (1) allow no ABS (1)
			Total	5	

12	a		kinetic / KE (1)	1	allow movement energy (1)
	b		weight = drag / forces balance / AW (1)	1	not upthrust (0) allow no resultant force (1)
	c		D (1)	1	more than one answer (0)
	d		C (1) E (1)	2	either order
			Total	5	

Question		Expected Answers	Marks	Rationale
13	a	Diesel and petrol (1)	1	both needed
	b	i Sue's (1)	1	
		ii 80 (1)	1	
	c	5000 x 9 (1) 45 000 (2)	2	correct answer on own (2)
		Total	5	
		Overall Total	60	

B651/02 Physics B: Unit 1 Modules P1, P2, P3 Higher Tier

Question			Expected Answers	Marks	Rationale
1	a	i	5 (1)	1	
		ii	any two from: wasted less energy / cooler / more efficient (1) brighter / more light output (1) longer life (1) less cost to run (1)	2	allow uses less power/energy/watts/less energy input/less power input/less electrical input(1) ignore less electricity used allow better for the environment/reduces carbon dioxide/ AW(1)
	b		4 (1)	1	
	c		less conduction (through foam) (1) (silver) surface reflects (heat away)/reduces radiation (1) air in cavity cannot move / trapped (1)convection reduced(by foam) (1)	3	whilst in foam is not required check that answer applied to foam and not just the gap not just it is an insulator radiation must be linked to foil / shiny surface
			Total	7	

2	a	i	reflection from surface (1) $i = r =$ greater than critical angle by inspection (1) BUT TIR written in text(2)	2	if more than 6 reflections this cannot gain TIR mark ignore refraction /or not at the start of the fibre allow description of TIR eg reflection at surface(1) angle of incidence greater than critical angle (1) If contradictions then written answer overrides diagram for example refraction in writing contradicts reflection on diagram for 1 of the marks
		ii	analogue - continuously variable value / take any value / AW (1) digital - either on / 1 /High or off / 0 / Low or specific value (1)	2	Ignore analogue vary allow correct labelled diagrams (1) allow noise can be filtered from digital (1) look for both answers in 1st space
	b	i	Explanation of multiplexing (1)	1	allow multiplexing / interweaving (1)
		ii	noise not recognised / amplified / signal conversion improved / AW (1)	1	allow diagram not just a better signal / no noise / interference
			Total	6	

Question		Expected Answers	Marks	Rationale
3	a	microwaves: reflect from metal / sides (1) go through glass (1) penetrate (surface / a little / 1cm) (1) absorbed by water / ice (1) increase KE of / ice / water (1) increased KE of particles/ molecules (1) conduction / convection to centre (1)	4	increase KE of water / ice particles / molecules(2) idea that all (microwave) energy goes into ice / none heats oven (directly) (1)
	b	energy used for melting / latent heat / AW (1)	1	allow higher level answers in breaking (inter molecular) bonds not just simple statement of the ice is melting / changing state
		Total	5	

4	a	same frequency / wavelength / in phase (1)	1	allow in step (1) coherent (1)
	b	(reflects) from patterns of pits on disc / AW (1)	1	
		Total	2	

5	a	i	any one from: low maintenance / no need for power cables / remote use / no need for fuel / long life / rugged / renewable energy / no pollution (1)	1	allow free (to use) low running costs (1)
		ii	no power if dark / bad weather / intensity dependant (1)	1	allow low power output ignore costs
	b	more / larger windows (1) face Sun / south (1)	2	allow higher level answers: Sun's rays / IR passes through glass (1) short wavelength rays from Sun (1) energy re-emitted is long wave IR (1) cannot get out / trapped /acts like the greenhouse effect (1) note 1 award marks from above even if active solar heating is being described note 2 for Sun's rays accept sunlight ,Sun's energy not Sun / light / heat	
		Total	4		

Question		Expected Answers	Marks	Rationale
6	a	any two from: stronger / more powerful magnet (1) more / larger coils (1) move magnet / coil faster (1)	2	not larger / bigger magnet not more wire
	b	efficiency = 35% / 0.35 (3) BUT efficiency = $\frac{350\,000}{1\,000\,000}$ (2) BUT energy lost = 650 000 J OR useful output 350 000 (1)	3	35% / 0.35 on own (3) mark answer first then look for working if incorrect
	c	for higher voltage lower current (1) less heat produced /heat lost/ energy lost (1) more efficient /less wastage(1) for low voltage accept reverse statements	2	lighter cables (1) higher level answers in terms of I^2R acceptable ORA for high current Must be clear that energy loss is reduced
Total			7	

7	a	= 1840 W (2) BUT 230 x 8 (1)	2	no mark for equation mark answer first then look for working if incorrect
	b	max 3 max 2 from either section advantages: no greenhouse gases (1) no fumes / SO ₂ (1) conserve fossil fuels (1) disadvantages: pollution from fuel processing (1) decommissioning / set-up costs high / AW(1) high maintenance (1) risk of radioactive emission / leaks / terrorist risks (1)	3	allow large fuel reserves ignore renewable allow problems with how to deal with waste / AW (1)
Total			5	

Question		Expected Answers	Marks	Rationale
8	a	asteroid belt between planets Mars and Jupiter (1)	1	any order
	b	any two from: long time required (1) lots of fuel required (1) effect of low gravity on health (1) shielding from cosmic rays (1) enough oxygen /air (1) enough food / water (1) keeping warm / right temperature / not too cold (1)	2	allow rocketry answers / payload etc. look for AW eg might run out of food
	c	stronger gravitational field / gravitational field increases (near to stars) (1)	1	allow gravity for gravitational field
		Total	4	

Question			Expected Answers	Marks	Rationale
9	a	i	(risk of) crash (1) driving within thinking distance / thinking distance is more than 8 metres / AW (1)	2	allow idea of not enough time / distance to stop (1)
		ii	(road surface) icy / wet / slippery / greasy / AW (1) (car condition) bald tyres / AW (1)	2	allow poor or worn brakes or suspension (1) for a car condition allow more mass (1) allow no ABS (1) not just road conditions / weather / tyres etc. must be qualified to give a longer braking distance
	b	i	120 m scores (3) 96 / 216 scores (2) 192 scores (1)	3	allow ecf for incorrect braking distance so $192 + 24 = 216$ scores 2 If no marks allocated award 1 mark for any number + 24, the addition does not need to be correct Note the last marking point can be awarded for any of the following evidence of area identified / attempted calculation or $1/2 \times s \times t / 32 \times 6$
		ii	any three from: With more people more mass (1) more KE / energy to be absorbed (1) Braking force same (1) acceleration less (1) With wet road idea of less friction / grip (1) Braking force reduced (1) less acceleration (1)	3	allow more weight (1) allow mark if candidates correctly apply $F = m a$ for example larger mass (1) force would need to increase for same acceleration/ stopping distance (1)
			Total	10	

Question		Expected Answers	Marks	Rationale
10	a	weight = drag / forces balance / AW (1)	1	no resultant (1)
	b	(open parachute) larger area (1) more drag /upward force (for same weight)(1) drag and weight balance at lower speed.(1)	2	not upthrust
Total			3	

11	a	80 (1)	1	
	b	any two from: road conditions / journey / mass (1) driving styles / speed (1)	2	e.g. wet road (1) brakes a lot (1) revs a lot (1) allow mark for different speeds/driving styles/ etc even if they are the wrong way round eg Glenn accelerates more gently
	c	45 000 scores (2) but 5000 x9 (1)	2	
	d	i	1	allow less polluting in city (1)
		ii	1	not just electricity comes from power stations. allow idea that battery need to be disposed of when worn out.(1)
Total			7	

Overall Total			60	
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B652/01 Unit 2: Modules P4, P5 and P6 Foundation Tier

Question		Expected Answers	Marks	Rationale
1	a	A (1)	1	
	b	B (1)	1	
	c	safety / AW (1)	1	allow high level answers e.g. protecting appliance / rcd acts quickly to protect user (1) allow stops current owtte (1)
		Total	3	

2	a	rod is charged (1)	1	
	b	how: due to friction / rubbing (1) between trainers and pitch (1) why: goal posts earthed (1) charge / electrons flow (1) to earth (1)	3	why = 2 max
	c	any three from: spray gun charged (1) paint charged / AW (1) fine spray produced (1) object charged opposite to paint (1) attracts paint (1) better coat / less paint used / shadows painted (1)	3	
		Total	7	

Question			Expected Answers	Marks	Rationale
3	a	i	frequency (1)	1	
		ii	rarefaction (1)	1	
	b		sound waves of very high frequency / pitch / very short wavelength (1) too high to hear / above 20 000 Hz (1)	2	allow above up to 25 000 Hz as range not cannot hear
			Total	4	

4	a		radiographers (1)	1	not radiologist / doctor / nurse / surgeon
	b		alpha (1)	1	
	c		any two from: tracers (1) sterilisation of equipment (1) radiotherapy (1)	2	
			Total	4	

5	a		chain reaction (1)	1	allow fission (1)
	b		explode / blow up / nuclear bomb (1)	1	allow melt down / too many neutrons (1)
			Total	2	

6	a		continue path of middle ray horizontally (1) bottom ray mirror image of that drawn (1)	2	ignore path of ray in lens
		b	F clearly at intersection of rays (1)	1	allow ecf
	c		4.0 (1)	1	
	d		convex (1)	1	
			Total	5	

Question		Expected Answers	Marks	Rationale
7	a	any three from: refraction / change direction / deviate (1) at each surface (1) dispersion (1) into different colours (1)	3	allow description of same allow speed / velocity change (1)
	b	any suitable material e.g. plastic / Perspex / water (1)	1	not crystal
	c	ray reflected from first surface (1)	1	allow internal reflection if ray continued into prism (1)
		Total	5	

8	a	D (1)	1	
	b	the stone has a constant horizontal velocity (1)	1	
	c	an arrow shot from a bow (1)	1	
	d	25 x 1.5 (1) 37.5 (1)	2	correct answer with no working (2)
		Total	5	

Question		Expected Answers	Marks	Rationale
9	a	Moon (1)	1	
	b	gravitational / gravity (1)	1	allow centripetal (1)
	c	any two from: weather (1) GPS / sat nav (1) mapping (1) military / weaponry / security / spying (1) research / example of research (1)	2	not TV / radio / mobile phone / data transmission
	d	24 (1)	1	allow 1 day (1)
		Total	5	

10	a	cell (1)	1	
	b	current increases (1)	1	not faster / stronger / more powerful
	c	wire becomes hot (1)	1	allow reflex action (1) not shock
	d	1.5 / 0.5 (1) 3 (1) Ω / ohm (1)	3	correct answer with no working (2) correct answer and unit with no working (3)
		Total	6	

11	a	5V (1)	1	
	b	high / 1 (1) low / 0 (1)	2	
	c	LED (1)	1	
		Total	4	

Question		Expected Answers	Marks	Rationale
12	a	step-down (1)	1	
	b	115 x 10 000/230 / any correct substitution (1) 5000 (1)	2	correct answer with no working (2)
	c	reference to safety (1)	1	
	d	50 (Hz) (1)	1	
		Total	5	

13	a	i	concentric / circular field (1)	1	not radial
		ii	any two from: fields interact / force produced (1) wire moves (1) at right angles to magnet's field (1)	2	
	b		wire moves in opposite direction (1)	1	allow moves into gap (1)
	c		any one from: microwave (1) mixer / blender (1) washing machine (1) tumble dryer (1)	1	allow any sensible answer including non kitchen household equipment e.g. shaver / drill
			Total	5	

		Overall Total	60	
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B652/02 Unit 2: Modules P4, P5 and P6 Higher Tier

Question			Expected Answers	Marks	Rationale
1	a	i	electron (1)	1	
		ii	repel / move apart (1)	1	not just move
	b		any three from: spray gun charged (1) paint charged / AW (1) fine spray produced (1) object charged opposite to paint (1) attracts paint (1) better coat / less paint used / shadows painted (1)	3	
			Total	5	
2	a		$V = IR$ (no mark) $I = 0.0013A$ (2) BUT $I = 20/15000$ (1)	2	mark answer first if incorrect look for correct working
		b	to stop them becoming live / AW (1)	1	allow stop charge build up on metal surface (1) allow higher level answers e.g. carry static charge away to earth (1) not just safety / stop shocks / stop electrocution
			Total	3	
3	a		sound waves of very high frequency / pitch / very short wavelength (1) too high to hear / above 20 000 Hz (1)	2	allow above up to 25 000 Hz as range not cannot hear
		b	does not damage cells (1) gives image of soft tissue / AW (1)	2	allow non ionizing (1) not X-rays show bone allow specific reason linked to safety e.g. pregnant women baby scan (1) but not just safer
			Total	4	

Question		Expected Answers	Marks	Rationale
4	a	alpha (1)	1	allow α
	b	any two from: neutron ejected / AW (1) uranium (atom / nucleus) splits (1) energy released (1) neutrons split other atoms / nuclei (1) increase in neutron number (1)	2	allow higher answers eg neutrons absorbed
	c	i	1	
		ii	1	allow large count rate / high concentration of tracer at blockage (1) allow change in gamma count rate (1) not change in gamma
		Total	5	

5	a	electron (1) fast moving (1)	2	allow higher level answers in terms of production of an electron
	b	39 protons 51 neutrons (1)	1	both needed
		Total	3	

6	a	continue path of middle ray horizontally (1) bottom ray mirror image of that drawn (1)	2	ignore path of ray in lens
	b	distance is less (1)	1	
	c	any two from: virtual / not real (1) erect (1) magnified (1)	2	allow AW
		Total	5	

Question		Expected Answers	Marks	Rationale
7	a	the stone has a constant horizontal velocity (1)	1	
	b	25 x 1.5 (1) 37.5 (1)	2	correct answer with no working (2)
	c	30 (1)	1	allow 20 (1)
		Total	4	

8	a	any three from: light source / sound source / ripple tank (1) single slit / same frequency / vibrating bar (1) two slits / two loudspeakers / two dippers (1) screen / walk along line in front of speakers / observe pattern on screen (1) trough meets trough / trough meets crest / AW (1)	3	allow any marking point on clearly labelled diagram
	b	i	destructive / AW (1)	1
		ii	constructive / AW (1)	1
		Total	5	

Question			Expected Answers	Marks	Rationale
9	a	i	24 hours (1)	1	allow 1 day (1)
		ii	any two from: same time as Earth takes to spin (1) stays in same position above Earth (1) orbits above equator (1)	2	
	b	i	NOAA closer to Earth / lower orbit (1)	1	
		ii	any two from: can see whole of Earth's surface in a few hours (1) frequent updates on weather patterns (1) keep in (correct) orbit (1)	2	
Total			6		

10	a	115 x 10 000/230 / any correct substitution (1) 5000 (1)	2	correct answer with no working (2)
	b	specific mention of live terminal / 230V / mains being inaccessible to use (1)	1	
	c	any two from: energy loss depends on (square of) current (1) higher voltages means lower current (1) reference to power equation (1)	2	allow less energy loss (1)
Total			5	

Question		Expected Answers	Marks	Rationale
11	a	current increases (1)	1	not faster / stronger / more powerful
	b	i 1.5/0.5 (1) 3 (1)	2	correct answer with no working (2)
		ii straight line with positive gradient / curve with increasing gradient (1) passing through origin (1) passing through (0.5,1.5) (1)	3	allow maximum of 1 mark if point (0.5,1.5) plotted but no line down (1)
Total			6	

12	a	input - all possibilities (1) output - 1 in first row, 0 in others (1)	2	
	b	brief 1 at set input gives 0 at A output (1) 0 fed back plus 0 at reset gives 1 at B output (1) 1 fed back to A gate keeps 0 as output (1)	3	
Total			5	

13	a	wire moves in opposite direction (1)	1	allow moves into gap (1)
	b	i motor spins faster (1)	1	
		ii any two from: current in coil changes direction (1) idea of brushes contacting different halves of commutator (1) every half-turn (1)	2	
Total			4	

Overall Total			60	
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Grade Thresholds

General Certificate of Secondary Education
Physics B (Specification Code J645)
January 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
B651/01	Raw	60	-	-	-	38	30	23	16	9	0
	UMS	100	-	-	-	60	50	40	30	20	0
B651/02	Raw	60	49	40	31	23	16	12	-	-	0
	UMS	100	90	80	70	60	50	40	-	-	0
B652/01	Raw	60	-	-	-	34	27	21	15	9	0
	UMS	100	-	-	-	60	50	40	30	20	0
B652/02	Raw	60	46	39	32	26	20	17	-	-	0
	UMS	100	90	80	70	60	50	40	-	-	0

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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