WJEC Physics GCSE
Topic 1.6: Total internal reflection
Mark Schemes for Questions by topic

1.

Question			Marking details	Mark
2.	(a)	(i)	Refraction	1
		(ii)	Total internal reflection / TIR	1
	(b)	(i)	Change of speed [at boundary] / change of density **Don't accept** speeds up or lower density	1
		(ii)	Hits the edge at an angle greater than the critical angle **or** greater than 42° (accept between $41^\circ - 45^\circ$) (1) must be travelling [from more dense] to less dense medium (1)	2
	(c)		Emergent straight line should be drawn steeper (put tick or cross on the diagram)	1
			Question total	**[6]**

2.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	c shown in correct position on middle drawing i.e. drawn between the normal and the ray	Labelling using the words critical angle or 42°		
	(ii)	6	**Indicative content:** When the angle of incidence is less than the critical angle the light is refracted away from the normal as it passes into the air (A). This happens because light travels faster in air than in glass **or** the light is travelling into an optically less dense medium. When the angle of incidence is equal to the critical angle the light just escapes from the glass and travels along the glass-air boundary (B). If the angle of incidence is greater than the critical angle then total internal reflection occurs (C). TIR occurs when light is travelling from a more dense towards a less dense medium at an angle bigger than the critical angle. **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.			
(b)		3	Correct refraction at A i.e. refracted towards the normal (1) TIR shown - at the glass sides with straight lines (1) reflections show $i = r$ by eye (1)			
Total		10				

3.

Question Number	Answer	Acceptable answers	Mark
2(a)	B		(1)

Question Number	Answer	Acceptable answers	Mark
2 (b)(i)	substitution: (1) 3.2×10^7 = power/6.3×10^{-6} transposition (1) (power) = $3.2 \times 10^7 \times 6.3 \times 10^{-6}$ evaluation: (1) 200 (W)	substitution and transposition in any order ignore powers of 10 until evaluation 202(W) or 201.6(W) or 201(W) full marks for the correct numerical answer without working	(3)

Question Number	Answer	Acceptable answers	Mark
2 (b)(ii)	An explanation linking: EITHER • no light / energy is lost (1) OR • no <u>light</u> is refracted (out) (1) WITH • (because) idea of (total) internal reflection (1)	Ignore references to power No light / energy escapes All <u>light</u> stays in (the fibre) TIR Accept "<u>All light</u> is internally reflected" for 2 marks	(2)

Question Number	Answer	Acceptable answers	Mark
2 (c)	substitute and evaluate (sin c) = 1/1.7 (sin c) = 0.59 (1) from graph or calculation c = any value between 34° and 38° (1)	 0.588, 0.58, 0.6 full marks for the correct numerical answer without working	**(2)**