WJEC Physics GCSE
Topic 2.6: The universe
Mark Schemes for Questions by topic

Marking Scheme

1.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	20 million years	20 million y		20 million light years
(b)			2	Tick in column B – top row (1) Tick in column A – bottom row (1)			More than one tick in a row
(c)			2	The lines are in different places / wavelengths / more lines (1) so it shows that [different] gases / elements [are present in their atmospheres] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Gases have got lines = 1 mark Gases have got different lines = 2 marks Different gas atoms		Different atoms
(d)	i		1	[The wavelengths have] increased	Got bigger or longer		Expanded Stretched Widened Moved to the red end
	ii		1	[The galaxies] are further away	Moving away faster		They are getting further away from us / far away / further apart
(e)			1	Cosmic microwave background radiation (or CMBR)			
Total			**8**				

2.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	In diagram B, the [black] lines are shifted to the red end of the spectrum / to bigger wavelengths / to the right (1) and in diagram C they are shifted but less far to the red end of the spectrum / to bigger wavelengths / to the right (1)	Both sets of lines are shifted to the red end / to bigger wavelengths / to the right (1) B is shifted more than in C (1)		The galaxies are shifted towards the red end of the spectrum
	(ii)		2	X is further away from us (1) because light has spent longer in space / X is moving away faster than Y (1) **The 1st mark must be linked to the 2nd mark.**	Accept B and C for X and Y		Reference to galaxy expanding
(b)	(i)		1	Big Bang [theory]			
	(ii)		2	Short wavelength waves **or** gamma rays [emitted by the Big Bang] have become longer or stretched or microwaves (1) because the Universe has expanded (1) **The 1st mark must be linked to the 2nd mark.**			Any other named parts of the em spectrum
	(iii)	I	1	0.5 [cm]	5 mm if cm is crossed out		
		II	1	Gets smaller / reduces / decreases	Gets shorter		
		III	1	210 ± 10 [units]			210 if developed further
TOTAL			10				

3.

Mark	Answer	Accept	Neutral answer	Do not accept
	3-4 marks – either composition or distance covered well or attempt made at both 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 – attempt made at either composition or distance** 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.			
8				

4.

HT	Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
6	(a)	6	**Indicative content:** Absorption spectra from distant galaxies consist of coloured light crossed with black lines. The wavelengths of the black lines are shifted to the red end of the spectrum when compared with light from similar sources in the laboratory. The black lines from more distant galaxies are more red shifted due to the expansion of space itself. This suggests that the Universe began its existence at a single point and has expended outwards ever since. CMBR on the other hand initially existed as gamma radiation of very small wavelength but an expanding Universe has caused the wavelength to increase into the microwave region of the em spectrum. **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.			

5.

Question			Marking details	Mark
1.			1st and 4th boxes ticked. **Question total**	2 **[2]**

6.

Question			Marking details	Mark
8.			Indicative content: In **cosmological red shift**, the **wavelength** at which the radiation is *originally* emitted is lengthened as it travels through expanding space. **Cosmological red shift** results from the expansion of space itself and *not* from the motion of an individual body. Compare a **galaxy** formed a long time ago, with a **galaxy** formed more recently. Although each **galaxy** emits the same **wavelength** of the **light**, the **light** from the older **galaxy** has spent longer travelling through the expanding **Universe**, and has therefore experienced a greater 'stretching' (**red shift**). The universe must have originated from a singularity, formed by a Big Bang and has been expanding ever since. 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. **Question total**	6 **[6]**
			Higher paper total	**[60]**

7.

Question				Marking details	Marks
7.				**Indicative content:** They are spectra of light crossed by dark lines. They can tell us the composition of the star/galaxy gas cloud because different elements will absorb light at different wavelengths to produce each dark line. They can also tell us how far away the galaxy is from us, and the further away from us the faster the galaxy moves because the further the dark lines are red shifted. **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. **Question total**	6 **[6]**
				HIGHER TIER PAPER TOTAL	**[60]**

8.

Question				Marking details	Marks
5.	(a)	(i)		Mass is the amount of inertia or material (accept "stuff" (1), whereas weight is the pull <u>of gravity</u> on the car (1). **Do not accept** that mass is measured in kg, weight is measured in Newtons.	2
		(ii)		weight = 800 × 10 = 8 000 [N] (1-ans)	1
	(b)	(i)		3 000 [N]	1
		(ii)		1 200 [N]	1
		(iii)		$a = \frac{1200(\text{ecf})(\text{ii})}{800}$ (1-sub) = 1.5 [m/s^2] (1-ans)	2
		(iv)		The [horizontal] forces become balanced (accept match / equal / level out) (1) because the <u>air resistance (or drag)</u> increases [with speed] (1) **To award both marks both statements must be linked.**	2
				Question total	**[9]**

9.

Question			Marking details	Marks
4.		(i)	2.22 × 10^6 years **Don't accept** light years	1
		(ii)	Atoms of gas (1) absorb light (1) at certain wavelengths / frequencies / colours **accept** re-emitted in all directions (1) **Either the 2nd mark must be linked to the 1st mark or the 3rd mark must be linked to the 2nd mark.**	3
		(iii)	Red shift measurements show that galaxies are continuing to move apart / away (1) CMBR originated from waves / gamma rays (produced at the birth of the Universe) which have stretched (1) **Don't accept** reference to any other em wave **which** means the Universe (space) is expanding / does not look the same over time (1) **Don't accept** started from the same point **Either the 3rd mark must be linked to the 1st mark or the 2nd mark.**	3
			Question total	**[7]**