Question number	Answer	Additional guidance	Mark
1(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • at the time, there was only naked eye evidence (1) • which indicated Sun/Moon/planets appear to move across the sky (1) • in the same direction, same motion each day (1)	allow valid alternatives, e.g. references to comets	**(3)**

Question number	Answer	Additional guidance	Mark
1(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • both theories predict an expanding universe and the Big Bang theory also predicts that the universe had a beginning (1) • the red shift theory indicates that the universe is expanding so supports both theories (1) • whereas CMB also indicates that the universe had a beginning, so supports Big Bang theory (1)	provided evidence that the steady state theory was incorrect	**(3)**

Question number	Answer	Mark
1(c)(i)	B	(1)

Question number	Answer	Mark
1(c)(ii)	B	(1)

Question number	Answer	Mark
1(d)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (2 marks): • galaxy C is furthest away (1) • because it has the greatest red shift (1) • and therefore it has the greatest speed (1)	(3)

Question number	Answer	Additional guidance	Mark
2(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • at the time, there was only naked-eye evidence (1) • which indicated Sun/Moon/planets appear to move across the sky (1) • in the same direction, same motion each day (1)	allow valid alternatives, e.g. references to comets	**(3)**

Question number	Answer	Additional guidance	Mark
2(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • both theories predict an expanding universe and the Big Bang theory also predicts that the universe had a beginning (1) • the red shift theory indicates that the universe is expanding so supports both theories (1) • whereas CMB also indicates that the universe had a beginning, so supports Big Bang theory (1)	provided evidence that the Steady State theory was incorrect	**(3)**

Question number	Answer	Mark
2(c)(i)	B	**(1)**

Question number	Answer	Mark
2(c)(ii)	B	**(1)**

Question number	Answer	Mark
3(a)(i)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (2 marks): • galaxy C has the greatest red shift (1) • so this galaxy has the greatest speed (1) • since the galaxy with the greatest speed will be furthest away, then galaxy C is at the furthest distance(1)	**(3)**

Question number	Answer	Additional guidance	Mark
3(a)(ii)	20 (nm)	Allow answers in the range 19 to 25	**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(iii)	Substitution (1) $v = \frac{\left(3\times10^{8}\right)\times\left(20\times10^{-9}\right)}{\left(390\times10^{-9}\right)}$ Answer (1) = 15 400 000 (m/s)	allow ecf from (c)(i) power of 10 error = max 1 accept 15 384 615 (m/s) award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)	Any **two** from the following improvements: • use wider aperture telescope/camera (1) • better quality objective lens (1) • use longer exposure time while telescope is locked onto star (1) • move telescope to better seeing conditions, e.g. dry desert, higher up a mountain, dark skies (1)	allow improvements from photography, e.g. use longer exposure time use a satellite telescope ignore use pc to adjust the sharpness of the image	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	moons (1) heliocentric (1)	must be in correct order	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	A description including two of the following points Reflecting telescope has mirror(s) (1) Galilean telescope has only lenses (1) Reflecting telescope can gather more light / can have a larger objective (1) Image viewed from the side of reflecting telescope (1) Image viewed from end of Galilean telescope. (1)	refracting telescope reverse argument	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	5 (cm) (1) 8 (cm) (1)	+ - 0.08 m 80 mm	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	B		**(1)**