H-R Diagrams Mark Scheme

Q1.

Question Number	Answer	Mark
	B	1

Question Number	Answer	Mark
	A	1

Q2.

Question Number	Answer	Mark
	D	1

Question Number	Answer	Mark
	A	1

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	B		1

Q4.

Question Number	Acceptable answer	Additional guidance	Mark
	C	The only correct answer is C: main sequence – red giant – white dwarf A is not correct because it is white dwarf – red giant – main sequence B is not correct because it moves along the main sequence from large to small D is not correct because it moves along the main sequence from small to large	1

Q5.

Question Number	Acceptable answer	Additional guidance	Mark
	B	The only correct answer is **B** because the y axis is luminosity and the x axis shows temperature decreasing A is not the correct answer because the y axis is luminosity but the x axis shows temperature increasing C is not the correct answer because the x axis is luminosity and the y axis is luminosity D is not the correct answer because the x axis is luminosity and the y axis is luminosity	1

Q6.

Question Number	Answer	Mark
	The only correct answer is B ***A** is not correct because V, X and Z are all on the main sequence* ***C** is not correct because Z is on the main sequence and the sun will become a white dwarf, which is position Y* ***D** is not correct because Z, X and V are all on the main sequence*	1

Q7.

Question Number	Answer	Mark
	B – (point on graph with luminosity $\neq L_{\odot}$)	1
	Incorrect Answers: A – luminosity $\neq L_{\odot}$ C – luminosity $\neq L_{\odot}$ D – luminosity $\neq L_{\odot}$	

Q8.

Question Number	Answer	Mark
	D	1

Q9.

Question Number	Answers	Mark
	The only correct answer is B ***A*** *is incorrect because a red giant star has larger surface area but a lower surface temperature than the Sun* ***C*** *is incorrect because a red giant star has larger surface area but a lower surface temperature than the Sun* ***D*** *is incorrect because a red giant star has larger surface area but a lower surface temperature than the Sun*	1

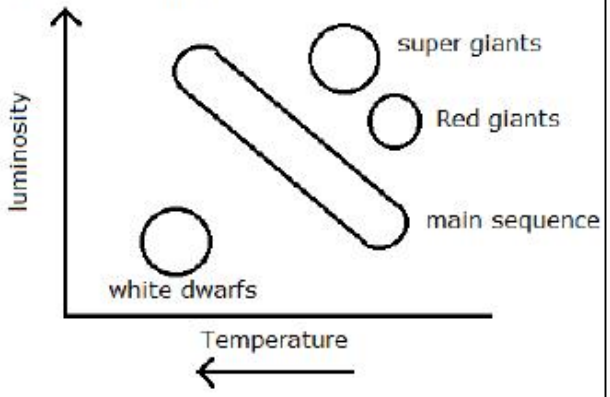
Q10.

Question Number	Acceptable answers	Additional guidance	Mark
(c)	• Add to top right (1) • Red giant/supergiant (1)	Consistent with the answer from (a) for both marking points Accept hypergiant	2

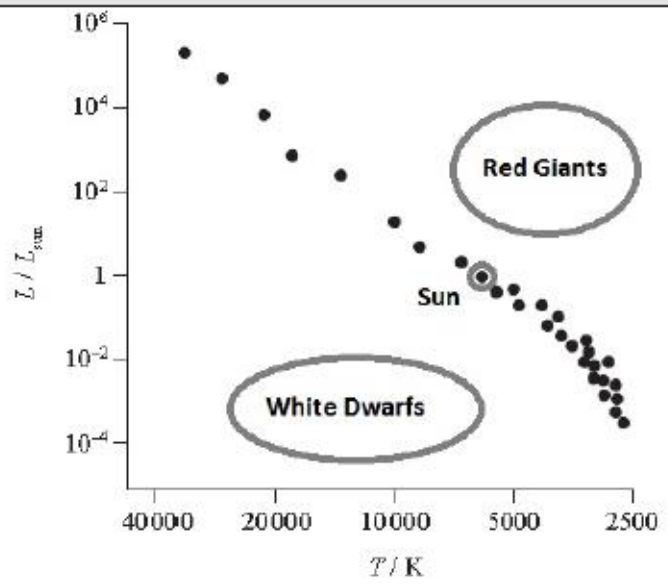
Q11.

Question Number	Acceptable answers	Additional guidance	Mark
	A description that makes reference to the following: • (main sequence) stars are (primarily) converting hydrogen to helium in their core (1) • stars on main sequence maintain a constant luminosity (for most of their lifetime) (1)		(2)

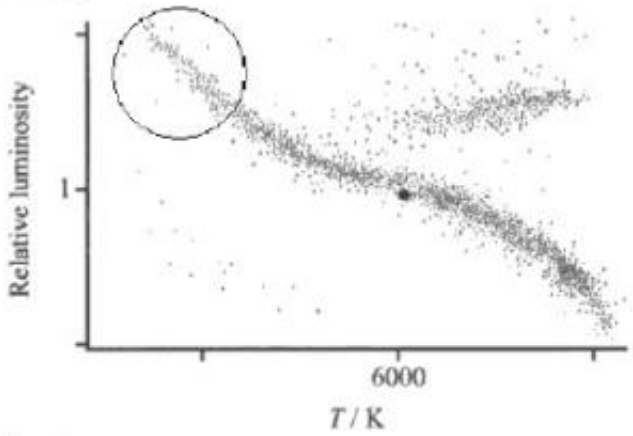
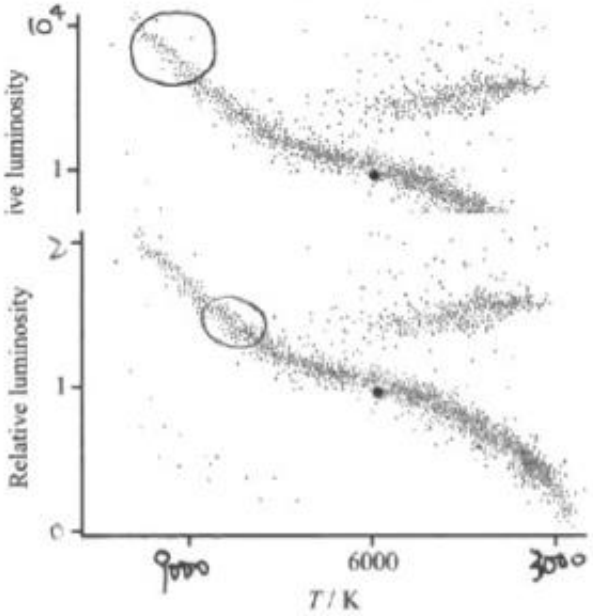
Q12.

Question Number	Acceptable answers	Additional guidance	Mark
	• *y* axis: luminosity (/ luminosity of Sun) (1) • *x* axis: (surface) temperature, with indication of decreasing temperature (1) • 2 or 3 correct regions (1) • 4 correct regions (1)	Example of graph:  	(4)

Q13.

Question Number	Answer	Mark
		
(i)	Sun's position identified [single point identified] (1)	
(ii)	White dwarf region (1) Red giant region (1)	3
*(iii)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) White dwarf stars have: high temperature T (because λ_{max} is small) (1) low luminosity L (1) $L = \sigma A T^4$ linked to a determination of the surface area (1)	3

Q14.

Question Number	Answer		Mark
(a)	Luminosity scale: Log scale [$10^{3} \rightarrow 10^{6}$ (top) and $10^{-3} \rightarrow 10^{-6}$ (bottom)]	(1)	
	Temperature scale: reverse log/power scale [e.g. 12,000 (left) and 3000 (right)]	(1)	2
(b)(i)	(Fusion of) hydrogen into helium [accept symbols]	(1)	1
(b)(ii)	Circle around stars top left of main sequence [included in the area indicated below]	(1)	
			
	Max 2		
	They have the highest temperatures **Or** they are the most luminous [accept brightest]	(1)	
	(Because) they fuse H (into He) at the highest/higher rate	(1)	
	(Because) they have the largest/larger gravitational forces	(1)	3
	[Max 1 mark if no comparative]		
			
	Both scale marks and correct area identified		
	Neither scale mark and area too low		

Q15.

Question Number	Answer	Mark
(a)	**Max 6** The young star cluster consists (mainly) of main sequence stars (1) The old star cluster has a truncated main sequence (1) The old star cluster has lost its heaviest main sequence stars (1) The old star cluster has (many) red giant stars (1) The old star cluster has (some) white dwarf stars (1) Massive main sequence stars are the first stars (to deplete sufficient hydrogen in their core) to evolve into red giant stars. (1) Some red giant stars have evolved into white dwarf stars in the old cluster (1)	6

Q16.

Question Number	Answer	Mark
(a)(i)	Reverse direction for temperature [at least 2 values seen] (1) Logarithmic/power temperature variation [at least 3 realistic values seen increasing by the same factor] (1)	2
(a)(ii)	QWC – Work must be clear and organised in a logical manner using technical wording where appropriate **Area 1: Max 2** The Sun is fusing/burning hydrogen (into helium in its core) (1) When (hydrogen) fusion/burning ceases the core of the Sun cools [accept radiation pressure drops when fusion/burning ceases in the core] (1) The core collapses/contracts (under gravitational forces) (1) **Area 2: Max 2** (1) The Sun expands and becomes a red giant (1) The core becomes hot enough for helium fusion/burning to begin (in the core) Helium begins to run out and the core collapses again (under gravitational forces) (1) **Area 3: Max 2** (1) Idea that outer layers of Sun are ejected into space (1) The temperature doesn't rise enough for further fusion to begin (1) The core/Sun becomes a (white) dwarf star	6

Q17.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• All the stars are in the main sequence (1) • In an older cluster there would be red giant stars (1)		2
(ii)	**MAX 4** • The most massive stars experience much greater gravitational forces (1) • So core temperature and density is greatest (1) • The rate of fusion in the core is greatest (1) **Or** the power generated in the core is greatest (1) • The (surface) temperature is greatest • The surface area of these stars is greatest • So according to Stefan's Law the power radiated from these massive stars is greatest		4