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AQA

A Level

A Level Physics

ASTROPHYSICS: Stars 2

Name:

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Total Marks: /30

1. Whilst classification by temperature and luminosity are both effective schemes, being able to assign a star to a class based on its measurable spectra is particularly useful.

Total for Question 1: 9

(a) Hydrogen absorption lines are most prominent at approximately 10,000 K; above and below this temperature, their prominence diminishes rapidly. Why is this? [2]

(b) Fill in the blanks in the table below. [7]

Class	Colour	Temperature / K	Absorption lines
		25000 - 50000	He^+, He, H
B	blue		
	blue - white		H, ionised metals
F	white	6000 - 7500	
G	yellow - white	5000 - 6000	ionised & neutral metals
K	orange	3500 - 5000	neutral metals
		≤ 3500	

2. Amongst all that you see in the night sky, there exist a variety of stars. Yet, it is thought that all stars originate from clouds of dust and gas. Understanding how stars are formed and how they evolve is an important aspect of our understanding of the universe.

Total for Question 2: 21

(a) A protostar is an extremely hot, dense sphere of dust and gas. Why don't all protostars evolve to form stars? [2]

(b) The majority of most stars' lives are spent in the main sequence phase. During this time they are stable and maintain an approximately constant size. Therefore, since gravitational forces act to compress the star, other forces must resist this compression. Give an example of one and state what causes it and where it originates. [2]

(c) As the nuclear fuel inside a main sequence star is exhausted, gravitational forces cause it collapse very rapidly. Explain how this results in the formation of a neutron star. [5]

(d) A Hertzsprung-Russell diagram is a graph showing the relationship between stellar luminosity and temperature.

i. Explain why, when a red giant becomes a white dwarf, it moves towards the lower left of the diagram. [2]

ii. Black holes are not usually plotted on Hertzsprung-Russell diagrams. Explain why this is the case. [2]

(e) Why do astronomers draw the conclusion that our sun and its solar system must have originated from the remnants of a supernova? [2]

(f) By equating the kinetic energy of a spaceship with the gravitational potential energy of a black hole, show that the spaceship can go no closer than $\frac{2GM}{c^2}$ if it wishes to return. M is the black hole's mass, G is the gravitational constant and c is the speed of light in a vacuum. [4]

(g) Estimate the radius of the event horizon of a black hole with a mass equal to precisely twenty solar masses. [2]