CfE Advanced Higher Physics

Rotational Motion & Astrophysics Homework

5. General Relativity

1. A satellite is in orbit around the Earth at an altitude of 750km. Calculate the satellite's escape velocity. **3**

2. How does the equivalence principal link the effects of gravity with acceleration? **3**

3. A star which is approximately the same size as our Sun has an average density of 2.7×10^3 kg m^{-3}.

If this star collapsed to form a Black Hole, calculate the Schwarzschild radius of the Black Hole. **9**

4. A star with a radius of 8.7×10^9m and a surface temperature of 6100K is 42 ly from Earth.

Calculate the apparent brightness of the star. **6**

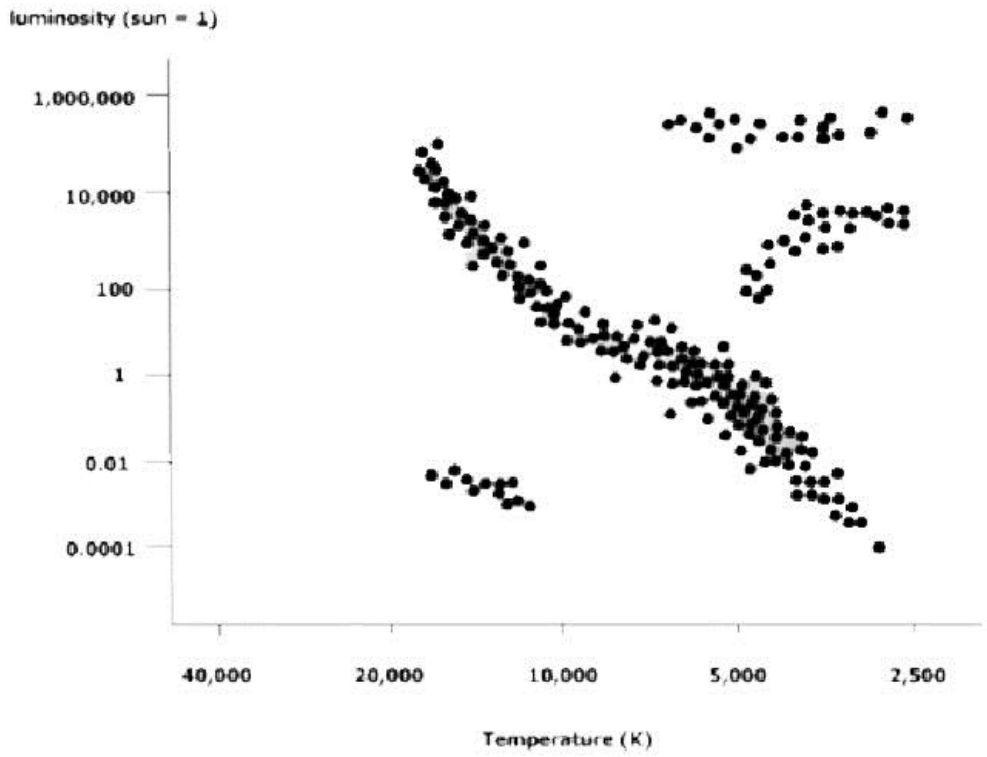
5. Explain what is meant by the term *geodesic*. **2**

6. What effect does mass have on spacetime? **2**

7. Mercury's orbit around the Sun could not be predicted accurately using classical mechanics. General relativity was able to predict Mercury's orbit accurately. Investigate this using a suitable search engine and write a short paragraph summarising your results.

3

8. The diagram below shows one way of classifying stars. Each dot on the diagram represents a star.



The stars are arranged into 4 main groups; the main sequence, giants, super giants and white dwarfs.

(a) In which of the regions on the diagram is the Sun? **1**

(b) The surface temperature of the Sun is approximately 5800K. Explain why the scale on the temperature axis makes it difficult to Identify which dot represents the Sun. **1**

(c) In time, the Sun's nuclear fuel will be used up. Explain what will then happen to the Sun's position in the above diagram and why. **3**

Total Marks 33