

- Describe what is meant by *gravitational field*.
- One of the moons of Mars is called Phobos.
  - mass of Phobos =  $1.06 \times 10^{16}$  kg
  - mass of Mars =  $6.39 \times 10^{23}$  kg
  - mean distance from the centre of Mars to the centre of Phobos =  $9.4 \times 10^6$  m
 Calculate the mean force holding Phobos in orbit.
- The value of  $g$  at the surface of the Moon is  $1.63 \text{ N kg}^{-1}$ .
  - Sketch a graph of how  $g$  varies with increasing distance,  $r$  from the surface of the Moon.
  - Describe how to calculate the work done in raising a mass through a distance of 100 m from the Moon.
- The relationship between the time period,  $T$ , and the radius,  $r$ , of an artificial satellite in a circular orbit is given by  $T^2 \propto r^3$ .
  - State the factor by which the time period changes when the radius is doubled.
  - State the factor by which the radius must change in order to halve the time period.
  - State the name given to an artificial satellite of Earth that has a constant orbital height above the Earth's surface and an equatorial orbit.
- Some information about the Sun is provided:
  - mass of the Sun =  $1.99 \times 10^{30}$  kg
  - radius of the Sun =  $6.96 \times 10^8$  m
  - surface temperature of the Sun =  $5750$  K
  - time for the Sun to rotate once on its axis =  $2.33 \times 10^6$  s
 The equation for escape velocity,  $v$  is 
$$v = \sqrt{\frac{2GM}{R}}$$
 Calculate the escape velocity from the surface of the Sun.  
 You may not have to use all of the information given above.
- Outline the stages that a low mass star such as the Sun passes through before it becomes a red giant. Which stages no longer occur in its core.
- Explain why stars can emit radiation, such as ultraviolet.
- Use Stefan's law to predict what would happen to the luminosity of a star if its surface temperature and radius change separately, in a star.
  - The surface temperature is halved.
  - The radius is doubled.
- One astronomical unit (AU) =  $1.5 \times 10^{11}$  m.  
 Use this value to calculate the value of 1 parsec in m.
- When the galaxy GN-z11 is observed from Earth, the spectrum of the galaxy shows a large red shift. Explain what causes this red shift.
- Describe what is meant by *dark matter*.

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