

Volume 28, Number 1, September 2018

Answers

Practice questions

Mary Whitehouse

Proton therapy

1 X-rays and gamma rays are more penetrating than other types of radiation, so can reach deeper into the body, affecting more cells. They also transfer higher energies and hence are able to cause ionisation of atoms and molecules, such as water and DNA, found in cells.

2 The force on a proton moving at right angles to a magnetic field is perpendicular to the path of the proton (and to the field), this force provides the centripetal force to cause a proton to move in a circle.

The force provided by the magnetic field Bqv is proportional to the speed of the proton, so if the speed increases, the magnetic force increases (e.g. doubling the speed doubles the force that the field exerts on the proton). However the force needed to move in a circle depends on mv^2/r e.g. if the proton speed doubles, the centripetal force needed to keep it moving in a circle of the same radius is multiplied by 4, and the force provided by the field is now not large enough. The radius of the circle must increase when v increases, until $Bqv = mv^2/r$, e.g. if the proton speed doubles, it spirals outwards until it is moving in a circle of twice the original radius.

The swinging ponytail

1 The period of the vertical oscillation depends on the spring constant and the mass of the load. The period of the pendulum oscillation depends on the gravitational field strength and the length of the spring.

2 The changing length of the spring causes the effective length of the pendulum to change.

Mathskit: Angles, units and approximations

1 Angular width $\theta = 4.3$ arcmin
 $= 4.3^\circ/60$
 $= (4.3^\circ/60) \times \pi$ radians/ 180°
 $= 0.00125$ radians

2 $\theta = \frac{l}{r}$
 $\theta =$ angular width $= 0.00125$ radians
 $r =$ distance to supernova remnant $= 3$ kpc
 $l = r\theta$
 $= 0.00125$ radians $\times 3$ kpc

= 0.00375 kpc

= 3.75 pc

3 The distance to the supernova remnant is so large that the angle subtended is very small, approximately one fifteenth of a degree. Therefore the length of the chord across the arc is almost equal to the arc length.

Electricity supply

1 **Climate** is a factor: Haiti is much closer to the equator than the UK and Iceland so has a warmer climate; Iceland is further north and has much darker and colder winters than the UK so needs more electricity to maintain a similar standard of living.

Poverty/wealth: Haiti is a less-developed country than the UK and Iceland; people have fewer power-hungry domestic appliances and luxury goods that need electricity.

2 There has been a growing awareness of the contribution burning fossil fuels makes to climate change — and also, perhaps, a growing awareness of the effects climate change may have on our lives.

Fossil fuels are not a sustainable supply and are also used in the petrochemical industry, so burning them is wasteful.

This resource is part of PHYSICS REVIEW, a magazine written for A-level students by subject experts. To subscribe to the full magazine go to www.hoddereducation.co.uk/physicsreview