

Q11 A black hole of mass $10^6 M_\odot$ is surrounded by an accretion disc. Suppose that the material in the accretion disc moves in circular orbits. Consider a small blob of material in this accretion disc with orbital radius $3.0 \times 10^9 \text{ m}$. Find the orbital speed of the blob. [Hint This is a similar exercise to finding the orbital speed of a planet, most recently discussed on page 15 of Block 3.]

Choose from the key the value closest to yours.

KEY for Q11

- A $5 \times 10^{-9} \text{ m s}^{-1}$ D $2 \times 10^{10} \text{ m s}^{-1}$
 B $2 \times 10^4 \text{ m s}^{-1}$ E $5 \times 10^{16} \text{ m s}^{-1}$
 C $0.7c$ F $0.5c^2$

Pencil across one cell in row 11.

Q12 Which *one* statement regarding clusters of galaxies is *false*?

KEY for Q12

- A Giant elliptical galaxies are often found near the centres of rich clusters. ✓
 B Galactic mergers may occur whereby a large galaxy in a rich cluster may grow into a cD galaxy. ✓
 C Rich clusters often contain a higher proportion of spiral galaxies than do sparse clusters. ✓
 D The spatial distribution of clusters adds to our knowledge of the spatial distribution of dark matter. ✓
 E A change in the accepted value of the Hubble constant would *not* change our estimates of the relative distances of different clusters of galaxies. ✓
 F The value of Hubble's constant reflects the rate (on average) at which clusters are receding from each other. ✓

Pencil across one cell in row 12.

$$v^2 = \frac{GM}{r}$$

$$v^2 = \frac{GM}{r} = \frac{6.67 \times 10^{-11} \times 10^6 \times 2 \times 10^30}{3 \times 10^9}$$

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