Stellar Black Holes True or False Quiz

Answers

1 **TRUE** – A black hole is black because it absorbs all wavelengths of light, which makes a black hole virtually invisible. We can't see black holes, but we can detect them by the effect they have on objects around them. For instance, black holes can be detected by X-ray telescopes. The X-ray emission is caused by material from a visible star close to the black hole being pulled towards the black hole and forming an accretion disk. Material closer to the black hole is spinning faster than the material at the edge of the accretion disk. This generates friction, heating the disk to temperatures over 100 million degrees C. Matter this hot emits X-ray radiation.

Black holes can also be found if a star is discovered to be orbiting an invisible object that is greater than three solar masses. The invisible object is a likely candidate for a black hole.

2 **FALSE –** Black holes are like stars in that they are in fixed orbits. They don't 'roam around'.

3 **TRUE** – The speed of light is 300 000 km/s, which is the speed limit of the Universe. Even at this speed, light is not fast enough to escape the enormous force of gravity of black holes.

4 **FALSE** – This is extremely unlikely.

5 **FALSE** – Black holes are formed by the complete gravitational collapse of massive stars with core masses of at least eight times the mass of the Sun.

6 **TRUE** – Check the diagram showing the life cycle of stars included in this kit. Red supergiants have enough mass to eventually become black holes.

7 **TRUE** – Yes, it is possible for an object to cross the event horizon and survive, if the black hole is weak. If the black hole is weak, its gravitational gradient is weak and it is this gradient that pulls objects apart after they cross the event horizon. However, nothing can survive all the way to the centre (the 'singularity'). It would inevitably be destroyed and become part of the mass of the black hole.

8 **FALSE** – There would be no reason why two black holes could not collide. This is a major area of research involving very complicated computations. The research aims to define what sort of gravitational wave output two colliding black holes would create, so that this could be searched for and detected.

9 **FALSE** – Our Sun is not massive enough to become a black hole. A star needs to be at least eight times the mass of the Sun to form a black hole.

10 **TRUE** – For a long-time astronomers thought that black holes could only grow, as they swallow up matter in their path. The work of Stephen Hawking and others has shown, however, that black holes can radiate energy and lose mass (by quantum processes). It would, however, take longer than the lifetime of the universe for a stellar black hole to evaporate.

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12 **TRUE** – There is no direct evidence that black holes rotate. However, the stars from which they form rotate and there is no reason to believe that they don't (due to the conservation of angular momentum).

13 **TRUE** – If you were to fall into a black hole feet first, you would be stretched by the strong gravitational gradient. Your feet, being closer to the centre of the black hole, would feel stronger gravity than your head, while the left part of your body would be pulled towards the right and vice versa. The result is that you would be stretched lengthways and squeezed sideways to form a long thin string of spaghetti before your very atoms were ripped completely apart.

14 **FALSE** – The planet Jupiter does have the right ingredients to form a star but is not heavy enough or massive enough to induce the necessary reactions for a star to form. If the gaseous planet Jupiter had been about 60 times more massive than it actually is, it would have become a small star. Since it is not massive enough to form a star, it certainly isn't massive enough to eventually form a black hole.

15 **FALSE** – Sirius is not massive enough to form a black hole.

16 **FALSE** – The existence of black holes is inferred by the effect on their environment. The accretion disk circling the event horizon can be detected at all wavelengths. See the solution to question one (above).

17 **FALSE** – It is highly unlikely. The equations of Einstein's Theory of General Relativity indicate that it is virtually impossible, but who knows?

18 **TRUE** – The strength of an object's gravity depends on its mass and radius. The larger its mass and the smaller its radius, the stronger its gravity.

19 **TRUE** – Eta Carinae is the most luminous star in our galaxy, radiating 5 million times more brightly than our Sun. It is probably the most massive star in our galaxy, being 120 solar masses. Eta Carinae may become the next supernova (explosion in the life cycle of very massive stars) in our galaxy. It is definitely massive enough to eventually be a black hole.

20 **TRUE** – There is increasing evidence to suggest that super massive black holes are found in the centres of galaxies (even our own Milky Way Galaxy). Unlike stellar black holes, these black holes have masses around 100 million solar masses. Their origins are still unknown.