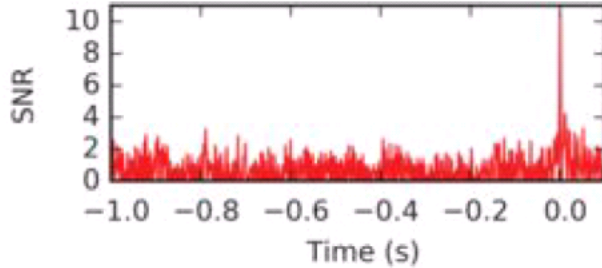


Answer the questions in the best way possible.

1. (1.00 pts) The following is an image of what object?



- A) The standard normalized radiation profile for a Type II supernova.
- B) The strong nuclear resonance simulation for white dwarf formation.
- C) A binary black hole merger
- D) A binary neutron star merger.

2. (1.00 pts) Black holes occur when all the mass of an object is compressed past the:

- A) Tolman-Oppenheimer-Volkoff Limit
- B) Eddington Limit
- C) Laplace Limit
- D) Chandrasekhar limit

Questions #3-5 are about a certain star has a peak emission wavelength at 321.97477 nm:

3. (1.00 pts) What is the absolute surface temperature of this star?

- A) 2.7 kK
- B) 9.0 kK
- C) 5.5 kK
- D) 7.1 kK

4. (1.00 pts) What is the most likely spectral class of this star?

- A) A8
- B) F6
- C) G2
- D) M3

5. (1.00 pts) What is the most probable approximate luminosity of this star in L_{\odot} to the nearest power of ten?

- A) 10^{-3}

- B) 10^{-1}
- C) 10^1
- D) 10^3

Questions #6-8 pertain to a certain black hole with a mass of $3 \times 10^{10} M_{\odot}$.

6. (1.00 pts) How does this mass compare to the average mass for other black holes we know of?

- A) Smallest
- B) Smaller
- C) Larger
- D) Largest

7. (1.00 pts) What is the radius of this black hole in km?

- A) 8.85×10^{13} km
- B) 8.85×10^{10} km
- C) 8.85×10^7 km
- D) 8.85×10^4 km

8. (1.00 pts) Which item has a density closest to that of this black hole?

- A) Air at STP
- B) Water at the deepest part of the ocean (11 km deep)
- C) Rock at the center of the Earth
- D) Metallic Hydrogen at the core of a gas giant like Jupiter

Questions #9-11 are about a two galaxy clusters which collided, and even though most of the visible matter was left behind observations suggest the majority of the mass is still present in each cluster which suggests that Dark Matter is real.

9. (1.00 pts) This result is taken as a disproof of which cosmological hypothesis?

- A) Modified Newtonian Dynamics
- B) 11-Dimensional String Theory
- C) Particle Supersymmetry
- D) Inflationary Dark Energy

10. (1.00 pts) Which object is this?

- A) MACS J1149.5+2233 Cluster
- B) NGC 2623
- C) MACS J0717.5+3745 Cluster
- D) The Bullet Cluster

11. (1.00 pts) What distinction does this object hold?

- A) The most clusters colliding at once
- B) One of the slowest cluster collisions
- C) One of the hottest cluster collisions
- D) The most repeats of collisions between the same clusters

12. (1.00 pts) Which nucleosynthesis process involves Lithium as an intermediate step?

- A) C-N-O Cycle
- B) Primordial Nucleosynthesis
- C) Proton-Proton 2
- D) Triple-Alpha

13. (1.00 pts) The Sun is an example of what type of star?

- A) Main sequence
- B) M-dwarf
- C) Goldilocks
- D) Flare

14. (1.00 pts) What is the Sun's stellar classification?

- A) G2V
- B) G7
- C) F9
- D) F1V

15. (1.00 pts) What type of star fuses the highest percentage of its original hydrogen?

- A) Blue Hypergiant
- B) Red Giant
- C) White Dwarf
- D) Red Dwarf

16. (1.00 pts) What is the lightest metallic element when referring to a star's metallicity ?

- A) Hydrogen
- B) Helium
- C) Lithium
- D) Carbon

17. (1.00 pts) The primary difference between a reflection nebula and a dark nebula is:

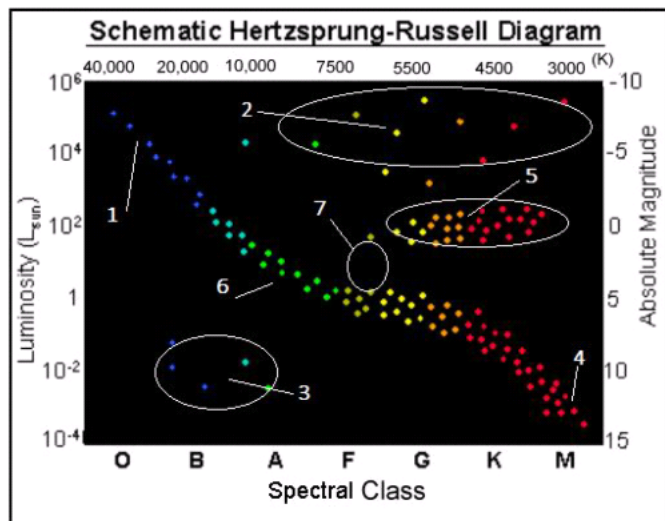
- A) Reflection nebulae have ionized Hydrogen
- B) Dark nebulae have more mass
- C) Reflection nebulae scatter bluer light, and dark nebulae scatter redder light.
- D) Dark are in front of, and reflection are behind, other stars

18. (1.00 pts) Accretion disks release gravitational potential energy as heat as they collapse: how efficient is this energy-release process?

- A) 0.70%
- B) 6.2%
- C) 10%

- D) 42%

For questions #19-21 use the HR diagram provided:



19. (1.00 pts) How do the masses of a star in numbered region 1 compare to those in region 4?

- A) Greater Than
 B) Less Than
 C) Equal To
 D) HR Diagrams don't provide information about mass

20. (1.00 pts) If placed randomly on the diagram, in which numbered region would a star remain stable for the longest period of time?

- A) 2
 B) 3
 C) 4
 D) 6

21. (1.00 pts) What is the event called that affects medium-mass stars in region 5 where the core suddenly burns in a runaway fusion reaction that produces carbon and oxygen?

- A) Helium Flash
 B) Core Collapse Supernova
 C) Stellar Ignition
 D) Hypervelocity Shedding

Thanks for being part of Science Olympiad!