Neutron Stars

I. Physical Characteristics

1. **Define the term neutron star.**

Neutron Star - Collapsed core of a massive supergiant star

2. **Identify the following physical characteristics of a neutron star.**

Diameter : 6 miles (smallest stars in the universe)

Chemical Composition : Iron surface (made of neutrons)

Matter : 1 teaspoon = 1 billion tons

Gravity : 100 billion times greater than Earth

3. **Identify the following about pulsars.**

Definition : spinning neutron stars that flash light

Number Discovered : 3,200 (2023)

Rate : 43,000 spins / minute

(Eject X-ray jets)

II. Discovery of Neutron Stars

1. **What event occurred in each year that advanced the understanding of neutron stars?**

1934 : Idea of neutron star proposed (Walter Baade + Fritz Zwicky)

1965 : 1st neutron star discovered (Anthony Hewish + Samuel Okoye)

1967 : 1st pulsar discovered (Jocelyn Bell + Anthony Hewish)

1974 : 1st binary pulsars (Joseph Taylor + Russell Hulse)

1982 : 1st millisecond pulsar (Don Backer) 642 times/sec.

III. Existence Of Neutron Stars

1. **How long do Neutron Stars typically exist?**

100,000 - 300,000 years

2. **What is the name of the closest Neutron Star to Earth?**

J0108-1431 (326 light years)

3. **What stage of stellar evolution do Neutron Stars exist?**

End of High-Mass star life

4. **What is the future of a Neutron Star after its existence?**

Q-Star (Gray Hole) - Compact, heavy exotic matter?

Black Holes

II. Physical Characteristics

1. **Define the term black hole.**

Black Hole - region whose gravity is so strong that nothing can escape (not even light)

2. **Identify properties of each characteristic of a Black Hole.**

Radius: -Only 4x size of Sun

Event Horizon : Site of infalling matter (No escape)

Singularity : "Center of Black Hole" (Matter compressed infinitely)

3. **Black holes can be directly observed.**

Circle One : True (False)

- Gravitational Effects
- X-Ray Emissions

4. **Define the term supermassive black hole.**

Supermassive Black Hole - black hole with masses millions to billions of times the mass of the Sun

5. **List three characteristics of supermassive black holes.**

1. Center of most galaxies 2. Consumes the entire galaxy 3. Grows as it absorbs stars

II. Discovery of Black Holes

1. **What event occurred in each year that advanced the understanding of black holes?**

1783 : Idea of black holes (John Mitchell)

1915 : Theory of General Relativity (Albert Einstein) - Singularity

1915 : Event Horizon (Karl Schwarzchild) - Schwarzchild Radius

1972 : 1st Discovered Black Hole (Cygnus X-1) (- Charles Bolton - Louise Webster - Paul Murdin)

III. Existence Of Black Holes

1. **How long do Black Holes typically exist?**

Unknown (Depends on matter consumed)

2. **What is the name of the closest Black Hole to Earth?**

V 4641 (Sagittarius)

3. **What stage of stellar evolution do Black Holes exist?**

End of High-Mass star life

4. **What is the future of a Black Hole after its existence?**

- Cannibalistic? / - Evaporate over time?

5. **Define the term gamma ray burst.**

Gamma Ray Burst - collision of black holes or neutron stars (EXTREMELY Energetic)