Section 1

1. .
    a. **M51**
    b. **Infrared**
    c. **NGC 5195, paired x-ray arcs emitted from supermassive black hole in NGC 5195**
2. .
    a. **SN2014J**
    b. **10-11**
    c. **Type 1a SN**
    d. **Light echo**
3. .
    a. **M81**
    b. **M82**
    c. **Stripped hydrogen gas forming filamentary structures.**
    d. **Gravitational interactions between other galaxies cause interstellar gas to funnel into M82**
4. .
    a. **ESO 137-001**
    b. **X-ray**
    c. **Ram pressure strpping**
    d. **16h 13m 27.305s, −60° 45′ 50.59″**
5. .
    a. **IC 10**
    b. **CO (Molecular Gas)**
    c. **Extremely big, extending much further than its visible portions**
    d. **10.3**
6. .
    a. **Sag A***
    b. **X-Ray**
    c. **Stellar dynamics in galaxies cause black holes to slowly drift toward the galactic center**
    d. **SM Blackhole**
7. **11**
8. **2**
9. **10**
    a. **X-Ray**
    b. **Jets of high-energy particles from a supermassive black hole in the central galaxy of the cluster**

c. **Massive molecular gas filaments**

Section 2

1. .
    a. **500,000 solar masses, 9.95E35 kg**
    b. **2.06E18 m, 66.8 pc**
    c. **-1.92E33 J**
    d. **9.62E42 J, -9.62E42 J**
    e. **2950 km**
2. .
    a. **0.3125**
    b. **A: 0.444 solar masses, B: 1.42 solar masses; we assumed 90 degree inclination angle**
    c. **0.938 AU, A: 0.715 AU, B: 0.223 AU**
    d. **4.17E8 m, 0.600 solar radii**
    e. **0.851**
3. .
    a. **Narrow lines, low speeds ~500 km/s**
    b. **Forbidden; low-density environments**
    c. **Seyfert 1's have very broad emission lines**
    d. **X-rays absorbed by intervening material with high hydrogen column densities**
    e. **Hydrogen is relatively abundant, so the strength of the line is stronger**
4. .
    a. **150 km/s, plus or minus 5-7 km/s**
    b. **9.37E40 kg, 4.71E10 solar masses**
    c. **Rotation velocity inversely proportional to radial distance, curve levels off at certain distance**
    d. **2.17E41 kg, 1.09E11 solar masses, mass scales linearly with radius and approximately no dependence on rotational velocity**
    e. **Visible matter can't account for all of the calculated mass, so some invisible matter must account for the extra self-gravity that creates a flat rotation curve**