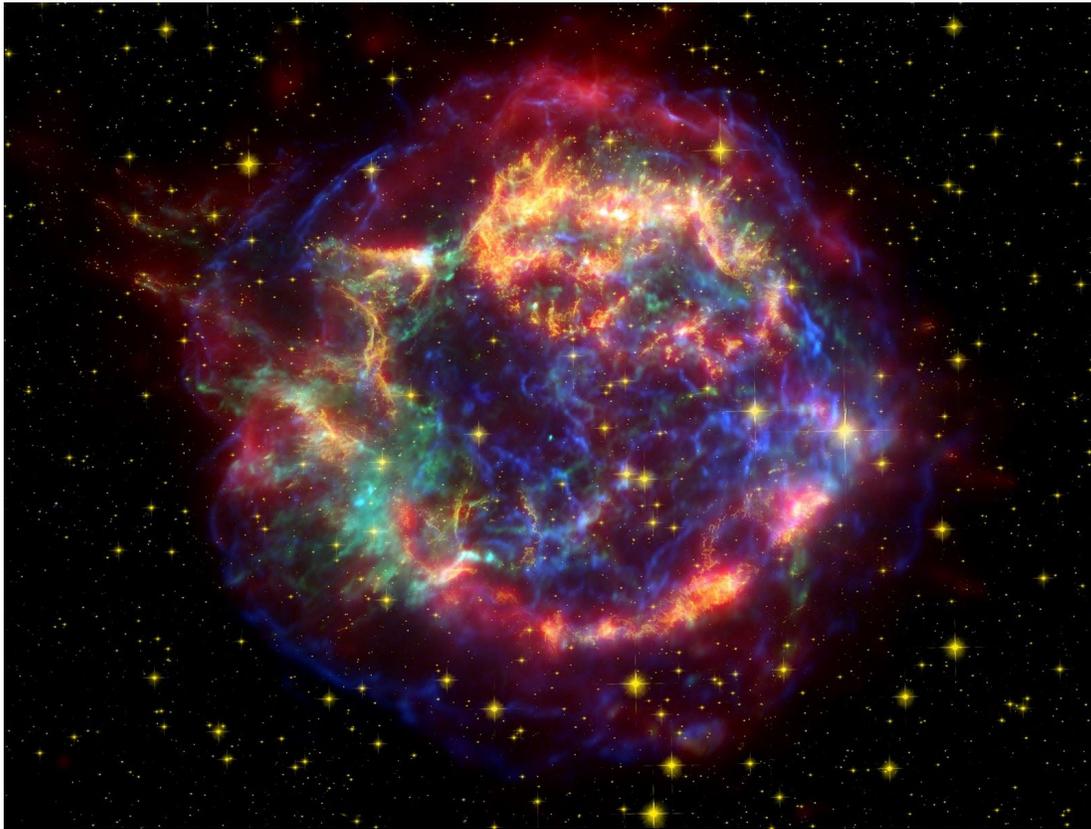


Astronomy

Stellar Evolution & Type II Supernovae

raxu

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This test is designed to be around a Regional test in difficulty.

There are $30+60+50=140$ points total. Answer all questions on the answer sheet.

If you have any questions, email shsscioly23@gmail.com.

The 2013 list of DSO's is used:

Cas A, IGR J17091, NGC 6888/WR 136, PSR J0108-1431, Cygnus X-1, SXP 1062, M1, V838 Mon, Delta Cep, Betelgeuse, Antares, SN 2010JL, NGC 3582, LHa115-N19, Rho Ophiuchi cloud complex, IC 1396.

Tiebreakers: 1) Best Section B score, 2) Best Section C score.

Good luck!

Section A. Stellar Evolutions (30 points)

Each question is worth 2 points. No partial credit is awarded.

1. What is the upper bound for the mass of a neutron star called?
2. Arrange following stages/processes in chronological order:
Red supergiant, O/B star, protostar, supernova remnant.
3. Arrange following stages/processes in chronological order:
Supernova event, stellar nursery, pulsar, Cepheid.
4. Arrange the following objects in increasing average periods:
 - A. RR Lyrae
 - B. Pulsar
 - C. Semiregular Variable (only consider regular period)
 - D. Cepheid
5. During Carbon Burning, what does the core of the star consists of?
6. What is the name of the catalytic cycle in a star that converts Hydrogen into Helium?
7. What is the name of the track sun-like stars follow before they reach Main Sequence?
8. What is different in the spectra of a Type I and Type II Cepheid?
9. For a given period, what is the approximate difference in absolute magnitude between a Type I and Type II Cepheid?
10. Why are Cepheids only useful for measuring distances within ~ 25 Mpc?

Star A and star B are each blackbodies.

11. If A, B have the same volume, and A has twice the luminosity of B, what is the ratio between the temperature of A and B?
12. If A, B have the same temperature, and A has twice the luminosity of B, what is the ratio between the volume of A and B?
13. If A, B have the same luminosity, and A has twice the radius of B, what is the ratio between the temperature of A and B?
14. If A, B have the same luminosity, and A have twice the temperature as B, what is the ratio between the radii of A and B?
15. If A, B are main sequence stars, and A has twice the mass of B, what is the ratio of the time they would spend on the main sequence between A and B?

Section B. Calculations without Calculus (60 points)

Grading: A correct answer with error $\pm 10\%$ for each part gets full credit. Otherwise, see answer sheet for partial credits.

16. Star A has a mass of 12 solar masses. What is its Schwarzschild radius in meters? (6 points)
17. Image M is the light curve of a Type I Cepheid. (12 points)
- What is another name for a Type I Cepheid?
 - What is its mean apparent magnitude?
 - What is its mean absolute magnitude?
 - What is its distance from Earth in kiloparsecs?
18. Star B has a parallax of $7.54 \cdot 10^{-3}$ arcseconds when seen from Earth. It has apparent magnitude 2. (8 points)
- What is its distance from the sun in light years?
 - What is its absolute magnitude?
 - Star B is a Type I Cepheid. What is its period in days?
19. A binary system has a period of 30.0 days. Star C has velocity 80 km/s and star D has velocity 100 km/s. Let O be their center of mass. (10 points)
- What is the mean distance between C and O in AU?
 - What is the mean separation between C and D in AU?
 - What is the mass of the system in solar masses?
20. Star E has temperature 10,000. K and luminosity $10^5 L_{\odot}$. It has apparent magnitude 0.13. (16 points)
- In meters, at what wavelength does star E emit most radiation?
 - What is the radius of star E in solar radii?
 - What is its distance from Earth in parsecs?
 - What is the spectral class of star E? (For example, the sun has spectral class G2V.)
21. Star F is a 1.5 solar mass red giant with a radius of 400 solar radii and a temperature of 3500K. Star F has an extended atmosphere and at 2000 solar radii, it is cool enough for dusts to form. (8 points)
- In W/m^2 , what is the flux from the star at the region where dusts form?
 - What is the luminosity of Star F in solar luminosities?

Section C. 20,000 light-years into space (50 points)

Each problem or part is worth 2 points. No partial credit is awarded.

22. a) Which three images refer to the Type IIb Supernova remnant that occurred approximately 11 kly away and was discovered by astronomer John Flamsteed?
b) Arrange the images in increasing frequency.
23. a) What is the name of the object depicted by image G?
b) What is the DSO contained inside the object referenced in part a?
24. Which image depicts IGR J17091?
25. What are two names of image C?
26. What is the name of the youngest supernova remnant in the Milky Way?
27. Which images depict the first suspected black hole?
28. Which image shows the Crab Nebula?
29. List all images that show Stellar Nurseries.
30. Which image depicts a red supergiant?
31. What type of supernova will the object referenced in 30 undergo?
32. Arrange the following DSOs from youngest to oldest:
Taurus A, α Scorpii, α Orionis
33. What is the prototype of all classical cepheids?
34. Name another star from the same constellation as Betelgeuse.
35. Which DSOs are located in the Small Magellanic Cloud?

Image N is the spectra of several supernovae, one week after B-band maximum/core collapse.

36. Which spectrum comes from a Type Ic Supernova?
37. Which spectrum comes from a Type II Supernova?
38. In (c) and (d), the absorption line of which element, currently not present, is expected to develop as the supernovae age?

Image O is an H-R Diagram. If your answer is not close to any letter, write "None".

39. Which letter is Rigel, a blue-white supergiant?
40. Which letter represents a red supergiant?
41. Which letter represents the behavior of red supergiants before core collapse?
42. Which letters represent Main-Sequence stars that will not evolve into a Type II supernova?
43. Which letter represents Cepheid variable stars?
44. Which letters represent the two objects in Image F?

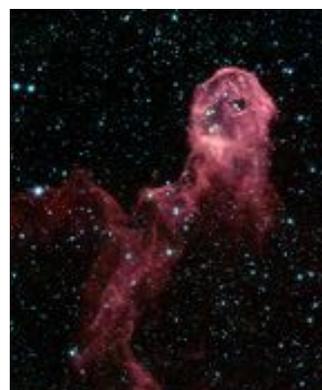
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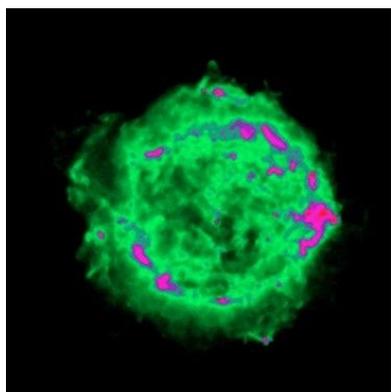
A



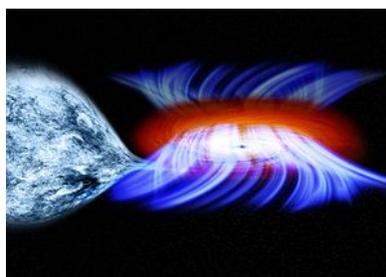
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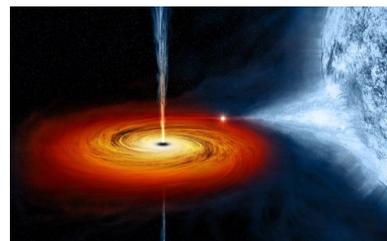
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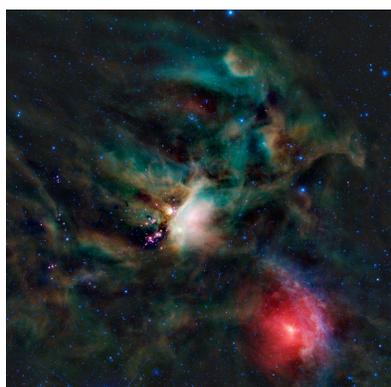
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E



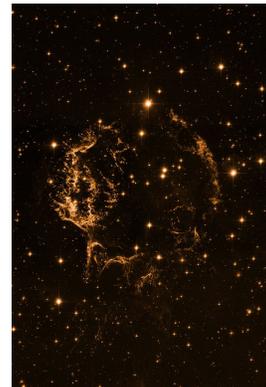
F



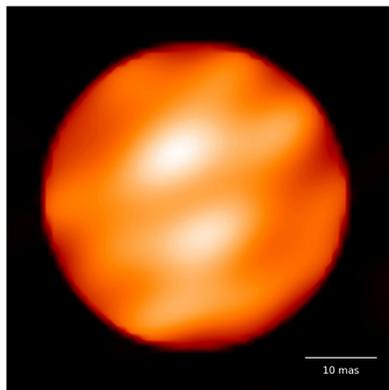
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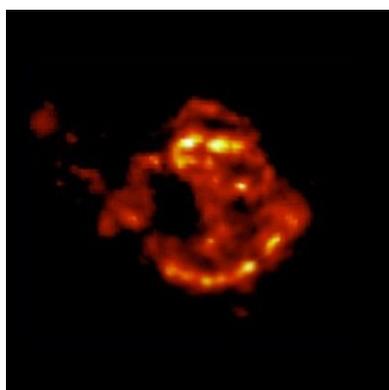
H



I



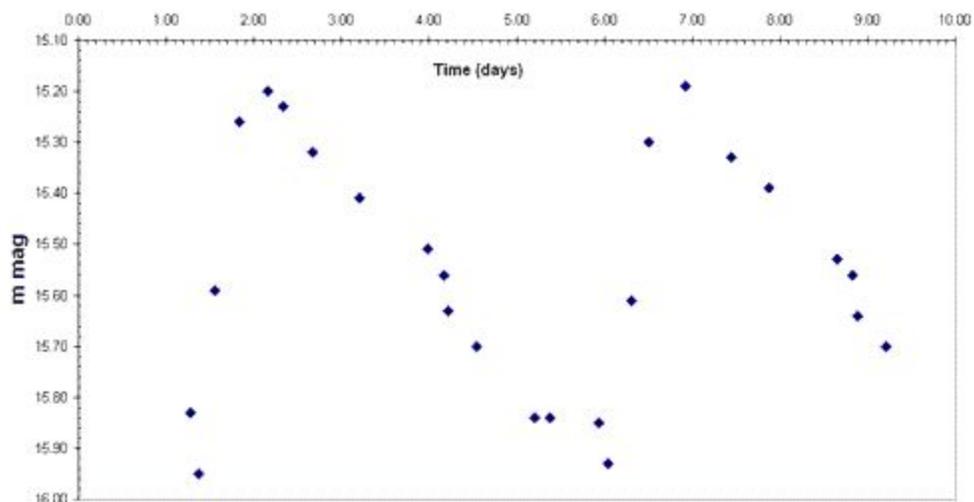
J



K



L



M

