Science Olympiad
UT Invitational
October 25, 2025

Astronomy C Answer Key

ANSWER KEY ANSWER KEY
ANSWER KEY ANSWER KEY
ANSWER KEY ANSWER KEY
ANSWER KEY ANSWER KEY
ANSWER KEY ANSWER KEY
ANSWER KEY ANSWER KEY

Section A [23 points]

1. [1 pt] ___D___
2. [2 pts] White dwarf : VII, Giant : III, Main sequence : V, Subgiant : IV, Supergiant : I (1 pt for 2/5)
3. [1 pt] White dwarf
4. [1 pt] Neutron star
5. [2 pts] Microwave, Infrared, Visible, Far ultraviolet, Gamma (1 pt for 4 in right order)

---

6. [1 pt] ___B___
7. [1 pt] ___F___
8. [1 pt] ___I___
9. [1 pt] ___A___
10. [1 pt] Main sequence
11. [2 pts] Yes (1 pt), far bottom right (or off the diagram) (1 pt) (Do NOT accept the region around A)
12. [2 pts] x: color/spectral classification, $B-V$ index (1 pt); y: abs./app. magnitude, flux, intensity (1 pt)

---

13. [1 pt] Blackbody
14. [2 pts] Absorption line (1 pt), photons at specific energies are absorbed by an intervening, cool medium (1 pt)
15. [2 pts] Object A (1 pt). Explanation mentions qualitative difference in spectra (e.g., the wavelength at peak intensity of A is shorter than B; OR, the total luminosity of A is greater than B) (0.5 pts) and connects it to a 'law' (e.g., Wien's; OR, Stefan–Boltzmann [resp.]) (0.5 pts)
16. [2 pts] Blackbody spectra should not intersect (1 pt). As a blackbody becomes warmer, it radiates more light at all wavelengths (1 pt). (Do NOT accept any mention of the two spectra having 'different shapes')

Section B [25 points]

17. [1 pt] Orion Molecular Complex

18. [1 pt] Lambda Orionis Ring

19. [1 pt] Barnard's Loop

20. [1 pt] Expansion of ejecta (0.5 pts) from a supernova (0.5 pts)

21. [2 pts] Infrared (1 pt), stellar formation is often obscured by gas and dust in the visible spectrum, but infrared light can shine through (1 pt) (Only half credit for explanation if missing mention of 'dust')

22. [2 pts] 10–30 million years old (1 pt). The stars and gas will disperse into the field (1 pt) (Half credit for explanation mentioning there will be less gas)

---

23. [1 pt] Molecular clouds/stellar nurseries (Do NOT accept cloud complex)

24. [2 pts] Kinetic (or thermal) energy/heat (Also accept rotational energy)

25. [2 pts] Does not have a coherent "core" velocity structure; OR, the stars move at a rapid pace away from each other.

26. [1 pt] CO

27. [1 pt] Radio/millimeter/microwave (Do NOT accept infrared)

---

28. [3 pts] 0.766 (Accept 76.6 %)

29. [3 pts] Cluster B is older (1 pt). Observe that cluster B has a lower ratio of high mass stars (1 pt). Since high-mass stars live shorter lives than low-mass stars, the older cluster would have a lower ratio of high mass stars (1 pts).

---

30. [1 pt] Image 15

31. [1 pt] T Tauri. Half credit for young stellar object (YSO) or pre-main sequence (PMS) star

32. [2 pts] Star/protostar, accretion/protoplanetary disk, bipolar flow/jet, starspot

Section C [41 points]

33. [1 pt] PSR B1509-58

34. [1 pt] Pulsar, pulsar wind nebula, neutron star. Half credit for nebula.

35. [2 pts] 15:13:[30, 80], −59:[06:xx, 09:xx]. Half credit for coordinates slightly outside of the accepted range

36. [2 pts] [1400, 1800] eV

37. [2 pts] [10000, 13500] counts

38. [2 pts] Additional emission lines on the continuous peak

39. [1 pt] Dimmer

40. [2 pts] Material from the outflowing jets (1 pt) is colliding with the interstellar medium (1 pt)

---

41. [1 pt] Helix Nebula

42. [1 pt] 200

43. [2 pts] Giant stars shed their outer layer (1 pt) as radiation pressure overcomes the weakened gravity. This stellar wind glows because it is eventually ionized (1 pt) by the exposed core of the star.

44. [2 pts] White dwarf (1 pt); carbon-oxygen (or oxygen-neon) (1 pt)

Section C continued...

45. [1 pt] ___B___

46. [1 pt] Crab Nebula/M1/Crab Pulsar

47. [2 pts] Chandra, Hubble, and Spitzer (1 pt for 1/3)

48. [1 pt] It was created by a supernova in 1054 (which was observed by astronomers of that time!), which makes it 971 years old today.

49. [2 pts] It has a rotational period of 33.4 milliseconds, meaning that it completes 29.94 revolutions per second.

50. [3 pts] These pulsars are called millisecond pulsars (or recycled pulsars) (1 pt), and they spin much faster because they are accreting material from a companion star (1 pt) in a close binary system (point given for anything mentioning the two stars orbiting closely, e.g. Roche lobe overflow) (1 pt)

---

51. [1 pt] Image 14

52. [1 pt] Type IIb

53. [1 pt] Observation of a scattered light echo

54. [1 pt] Hydrogen absorption lines

---

55. [5 pts] (0.5 pts for each valid/invalid)
    A: Invalid, the stars must move in an elliptical orbit with the center of mass at one focus (1 pt)
    B: Valid, 1:1 (1.5 pts)
    C: Invalid, the stars are in the wrong phase or center of mass at wrong location (1 pt)

56. [1 pt] Kepler's third law

57. [1 pt] WDJ181058.67+311940.94

58. [1 pt] Gravitational wave radiation

Section D [16 points]

59. [2 pts] 5800 [5250, 6450]. Use Wien's law

60. [3 pts] 6.96×10^5 [5.62, 8.70]. Use magnitude to luminosity (notice it is equal to the Sun) and Stefan–Boltzmann

---

61. [2 pts] 5 (Exact). Use $d = 1/p$. (Half credit for not converting mas to arcsec)

62. [3 pts] Use dist. modulus (1 pt) (half credit for attempt). Correct M (1.5 pts) and $\log_{10} P$ (1.5 pts)

Star	M	$\log_{10} P$
Jeff	-4.1	0.699
Britta	-2.9	1.30
Abed	-2.1	1.74
Troy	-1.2	2.28

63. [2 pts] Plotted correctly (1 pt), axes labels (0.5 pts), tick marks (0.5 pts)

64. [3 pts] Draw a best fit line (1 pt), $\alpha = 1.84$ [1.65, 2.03] (1.5 pts), $\beta = -5.34$ $[-5.87, -4.81]$ (1.5 pts)

65. [1 pt] Type Ia supernova