



Exploring the World of Science

New York State Science Olympiad
Division B Regional Tournament



Reach For The Stars

School Name: _____

Team #: _____

Student Name(s): _____

Directions:

- Answer the following **70** questions to the best of your ability.
- Sections are marked as multiple choice or short answer.
- All answers must be recorded on the answer sheet to be scored.
- **Please do NOT write on the test or image sheet.**
- Tie Breakers are: 1, 5, 12, 18, 30, 32, 44, 56, 60, 64, 68, 70
- *Try your best and enjoy exploring the universe :)*

Section 1: Answer the following 20 multiple choice questions on general star formation and evolution.

- 1) What color do older stellar populations tend to be? (As seen in visible light)
 - a) More yellow
 - b) More blue
 - c) More red
 - d) More orange
- 2) From what materials do stars form?
 - a) A mix of metals such as iron and nickel
 - b) Organic materials such as carbon and oxygen
 - c) Gaseous and dusty clouds
 - d) Light and hot lava rocks
- 3) What is the name for the diagram that shows evolutionary tracks of stars?
 - a) Hertzsprung-Russell Diagram
 - b) Herbig-Russo Diagram
 - c) Harry-Roger Diagram
 - d) Higgs-Richard Diagram
- 4) At what stage of evolution is our Sun currently at?
 - a) White Dwarf
 - b) Red Giant
 - c) Planetary Nebula
 - d) Main Sequence
- 5) What is another name for a “stellar nursery”?
 - a) Planetary Nebula
 - b) Supernova
 - c) Molecular Cloud
 - d) Baby Star Crib
- 6) Which of the following is NOT generally found in an HII region?
 - a) Old Stars
 - b) Young Stars
 - c) Hydrogen gas
 - d) Molecular clouds
- 7) Which of the following is the primary force that creates stars?
 - a) Electromagnetism
 - b) Gravity
 - c) Strong Force
 - d) Weak Force
- 8) What is the final stage of life for a *very, very, very* massive star?
 - a) Planetary Nebula
 - b) White Dwarf
 - c) Neutron Star
 - d) Black Hole
- 9) What is the most common form of classification for stars?
 - a) By size
 - b) By color
 - c) By brightness
 - d) By position
- 10) What is the correct order for the stellar classification scheme?
 - a) OBAFGKM
 - b) MKGFABO
 - c) GKMOBAF
 - d) BAFKMGO

- 11) What property of a star determines its evolutionary track?
- Mass
 - Color
 - Brightness
 - Position
- 12) Based on the answer for #11 and your own knowledge, what will the last evolutionary stage of our sun be?
- White Dwarf
 - Black Hole
 - Neutron Star
 - It is already there
- 13) What is the most important mechanism to make stars shine?
- Nuclear fusion
 - Magic
 - Electricity
 - A HUGE lightbulb
- 14) If a star suddenly went supernova, would we be able to see it right away?
- Yes, right away
 - No, because light takes time to travel through space
- 15) How long does the average star live?
- Billions of years
 - A few million years
 - Thousands of years
 - Hundreds of years
- 16) What is the most important thing holding stars together?
- Glue
 - Electrical forces
 - Gravity
 - Scientists don't know yet
- 17) What part of the evolutionary track does a star spend most of its life on?
- Red giant branch
 - Main sequence
 - Asymptotic giant branch
 - Supergiant branch
- 18) What is the closest star to Earth?
- Proxima Centauri
 - The Sun
 - Betelgeuse
 - Polaris
- 19) The study of light used to study stars is called...
- Botany
 - Paleontology
 - Spectroscopy
 - Geology
- 20) What is the name for a star that just formed?
- Baby Star
 - Protostar
 - Protoplanet
 - Neutron Star

Section 2: Use the image sheet A-G provided to answer the following 20 identification/short answer and multiple choice questions.

- 21) Identify the object in Image A.
- 22) Identify the object in Image B.
- 23) Identify the object in Image C.
- 24) Identify the object in Image D.
- 25) Identify the object in Image E.
- 26) Identify the object in Image F.
- 27) Identify the object in Image G.
- 28) Identify the object in Image H.
- 29) Identify the object in Image I.
- 30) Image D contains a nebula, which nebula is it?
- 31) What special type of nebula is it (in Image D)?
- 32) In what constellation is the object in Image E found?
- 33) Which famous telescope took Image G?
- 34) What type of galaxy is shown in Image G?
- 35) Which Image contains Stefan's Quintet?
- 36) Which Image contains V0157 Cygni?
- 37) What kind of system is V0157 Cygni thought to be?
- 38) Which of the Images is also called a Bok Globule?
- 39) Image H has a very bright star in it. Which star is it?
- 40) Image I is found in which constellation?
- 41) What does Image I have to do with stellar formation?

Section 3: Use the Image Sheet J-O and your knowledge to answer the following 18 short answer questions.

- 42) Identify the telescope in Image J.
- 43) Which part of the telescope in Image J protects it from the sun?
- 44) What does ISIM stand for in Image J?
- 45) What wavelengths does the telescope in Image J specialize in?
- 46) Image K is showing a light curve for what type of star?
- 47) Is the light curve in Image K showing a constant visual magnitude or is it changing?
- 48) Identify the telescope in Image L.
- 49) What is the wavelength the telescope in Image L is known for?
- 50) Is the telescope in Image L still operational?
- 51) Identify the telescope in Image M.
- 52) What wavelength does the telescope in Image M specialize in?
- 53) Identify the telescope in Image N.
- 54) What wavelength does the telescope in Image N "see" in?
- 55) Why is the telescope in Image N on Earth's surface? (Why not in space?)
- 56) Where on Earth is the telescope in Image N located?
- 57) Identify the deep sky object in Image O.
- 58) What wavelength is Image O shown in?
- 59) Based on your answer from #58, what telescope may have taken this image?

Section 4: Use your astronomy knowledge to answer these 5 multiple choice questions on orbital mechanics.

60) Which of the following best describes the relationship between stellar temperature and luminosity?

- a) $L = 4\pi R^2 \sigma T^4$
- b) $L = 184\pi R^{22} \sigma T^{44}$
- c) $L = R^2 \sigma$
- d) $L = 4\pi T^{100000004}$

61) Which of the following best describes Kepler's First Law?

- a) Orbits are perfect circles
- b) Orbits are elliptical
- c) Orbits are not real
- d) Orbits contain one object only at all times

62) Which of the following best describes Kepler's Third Law?

- a) Orbital circumference is related to the number of objects
- b) Orbital period is related to the length of the semimajor axis
- c) Orbital size is related to the mass
- d) Orbital motion is not related to anything

63) Is there a clear relationship between stellar luminosity and stellar distance?

- a) Yes, the closer a star is the brighter it is
- b) Yes, the further a star is the brighter it is
- c) No, brightness and distance are not directly related. Closer stars can be dimmer and farther stars can be brighter
- d) No, stars are not bright nor far

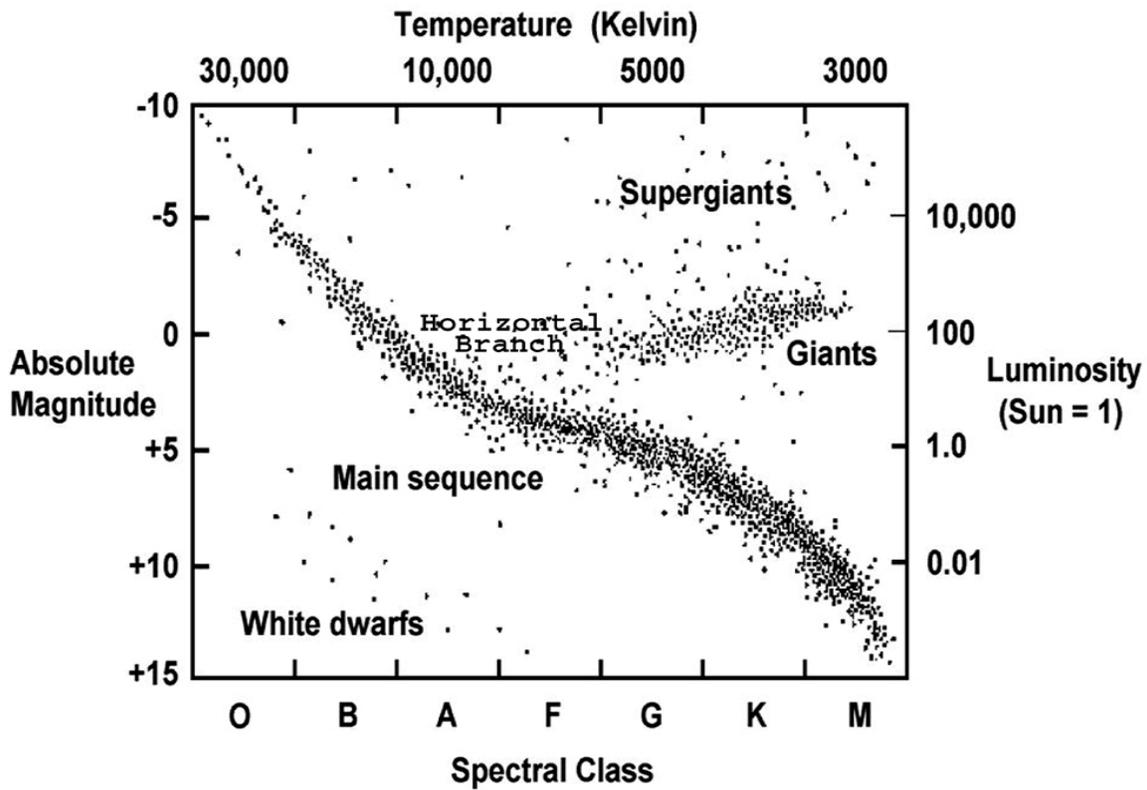
64) Which of the following best describes Newton's Universal Law of Gravitation?

- a) $F = \frac{m_1 m_2}{r^{70}}$
- b) $F = G \frac{m_1 m_2}{r^2}$
- c) $F = \frac{m_1}{r}$
- d) $F = \frac{m_1 m_2}{r^2}$

65) What does Newton's Universal Law of Gravitation mean in words?

- a) Every mass repels each other
- b) Every mass attracts each other
- c) Mass and gravity never interact
- d) Gravity is not a force

Section 5: Use the HR Diagram below to answer the following 5 short answer questions.



66) How much more luminous are supergiants compared to the sun?

67) Are white dwarfs hotter or cooler than giants?

68) According to the absolute magnitude, are white dwarfs brighter or dimmer than supergiants?

69) If the Luminosity of the Sun is 1, what is the approximate Absolute Magnitude, as seen on the diagram?

70) Which of the spectral classes listed on bottom X-axis is our Sun a part of?

A



B



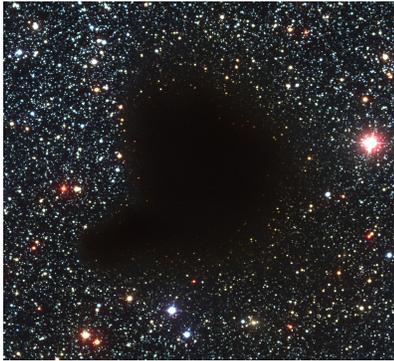
C



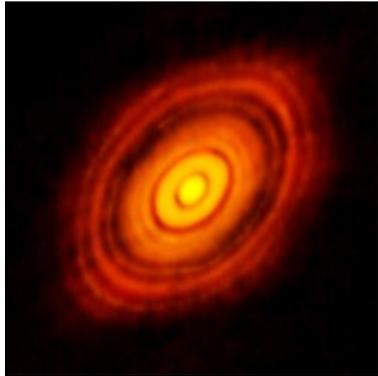
D



E



F



G



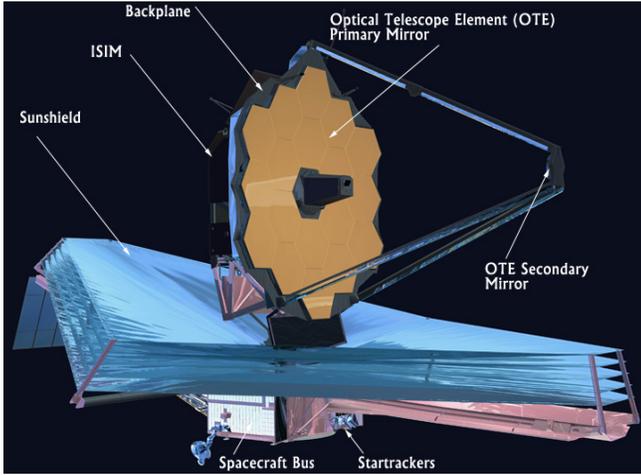
H



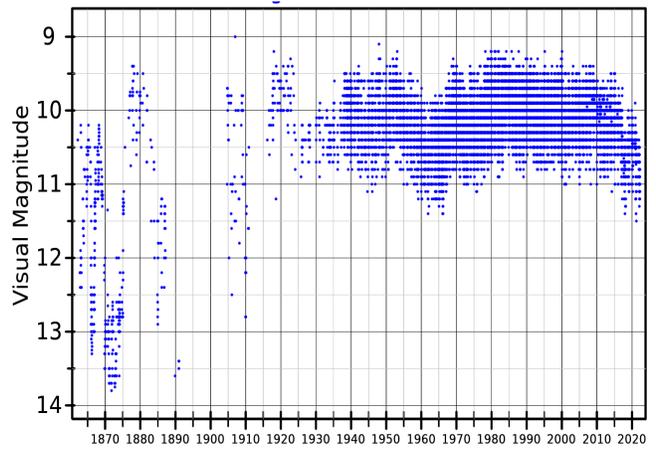
I



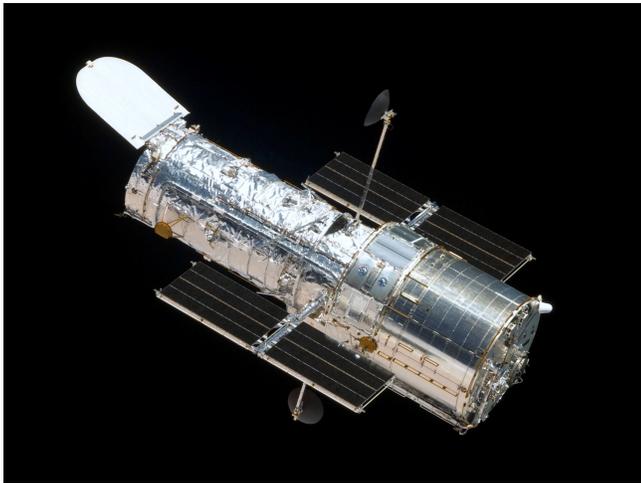
J



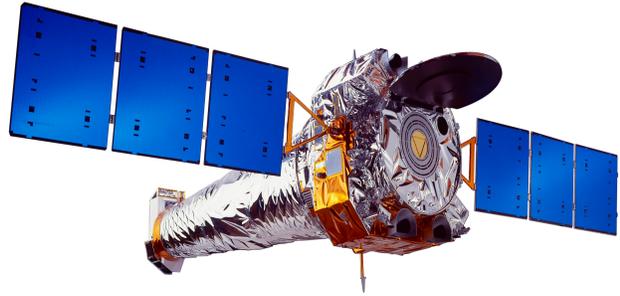
K



L



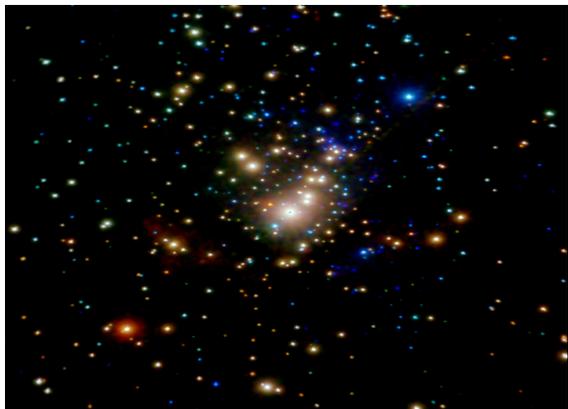
M



N



O



Reach For The Stars Regional 2024 ANSWER SHEET

TEAM NAME:	SCORE: / 70
TEAM NUMBER:	PLACE: /

Section 1: Multiple Choice

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Section 2: Short Answer/Identification
USE IMAGE SHEET A-G

21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____
36. _____
37. _____
38. _____

39. _____

40. _____

41. _____

Section 3: Short Answer/More Identification
USE IMAGE SHEET J-O

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

51. _____

52. _____

53. _____

54. _____

55. _____

56. _____

57. _____

58. _____

59. _____

Section 4: Multiple Choice

60. _____

61. _____

62. _____

63. _____

64. _____

65. _____

Section 5: Short Answer/HR Diagram

66. _____

67. _____

68. _____

69. _____

70. _____

Reach For The Stars Regional 2024 ANSWER SHEET

TEAM NAME:	SCORE: / 70
TEAM NUMBER:	PLACE: /

Section 1: Multiple Choice

1. __B__
2. __C__
3. __A__
4. __D__
5. __C__
6. __A__
7. __B__
8. __D__
9. __B__
10. __A__
11. __A__
12. __A__
13. __A__
14. __B__
15. __A__
16. __C__
17. __B__
18. __B__
19. __C__
20. __B__

Section 2: Short Answer/Identification
USE *IMAGE SHEET A-G*

21. _____ Cygnus _____
22. _____ Pegasus _____
23. _____ Orion _____
24. _____ Perseus _____
25. _____ Barnard 68 _____
26. _____ HL Tauri _____
27. _____ JJ122051+491255 _____
28. _____ NGC 1555 -OR- T Tauri _____
29. __ Messier 42/M42/Orion Nebula _____
30. _____ NGC 1333 _____
31. _____ Reflection Nebula _____
32. _____ Ophiuchus _____
33. _____ JWST _____
34. _____ Green Pea _____
35. _____ Image B / Pegasus _____
36. _____ Image A / Cygnus _____
37. _____ Binary Star System _____
38. __ Image E / Barnard68 _____

39. _____ T Tauri _____
 40. _____ Orion _____
 41. _It is a nebula / has young stars / has
 molecular clouds _____

Section 3: Short Answer/More Identification
USE IMAGE SHEET J-O

42. _____ JWST _____
 43. _____ Sun Shield _____
 44. _Integrated Science Instrument Module _____
 45. ___ Near/Mid Infrared _____
 46. _____ T Tauri Star _____
 47. _____ Changing magnitude _____
 48. _____ Hubble / HST _____
 49. _____ Optical _____
 50. _____ Yes, still operational _____
 51. _____ Chandra _____
 52. _____ X-Ray _____
 53. _____ VLA _____
 54. _____ Radio _____
 55. ___ Radio waves make it to the Earth's surface ___
 56. _New Mexico/The desert_
 57. ___ M42/Orion Nebula/Messier42 _____
 58. _____ X-Ray _____
 59. _____ Chandra _____

Section 4: Multiple Choice

60. ___ A ___
 61. ___ B ___
 62. ___ B ___
 63. ___ C ___
 64. ___ B ___
 65. ___ B ___

Section 5: Short Answer/HR Diagram

66. ___ 10,000 times _____
 67. _____ Hotter _____
 68. _____ Dimmer _____
 69. _ +4.5 // range +6 to +1 _____
 70. ___ G or F _____