# Astronomy – Huntley Invitational 2017

Please write neatly!

High School: _____

Team #: _____ Varsity or JV? _____

Competitors' Names: _____

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Part I: Image Identification… (2 pts each)

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Part II: Multiple Choice… (1 pt each)

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# Astronomy Test – Huntley Invitational 2017

**Team Name:** _____ **Varsity /JV?** _____ **Team Number:** _____

1. The temperature of stars in the universe varies with the type of star and the age of the star among other things. By looking at the shape of the spectrum of light emitted by a star, we can tell something about its average surface temperature. If we observe a star's spectrum and find that the peak power occurs at the border between red and infrared light, what is the approximate surface temperature of the star? (in degrees C)

A. 200

B. 2000

C. 4000

D. 8000

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2. If we observe a stars spectrum and find that the peak power occurs at the border between blue and ultraviolet light, what is the surface temperature of the star? (in degrees C)

A. 200

B. 2000

C. 3000

D. 7000

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3. Which way does the light ray bend when it passes obliquely (i.e., at an angle to the surface) through the flat surface and into a block of glass?

A. Away from the perpendicular to the surface, bending toward the surface, making a smaller angle to the surface

B. A light ray does not change direction when it passes into the surface of the glass because the surface is flat.

Light rays only change their directions through curved glass surfaces.

C. Toward the perpendicular to the surface, making a greater angle to the surface

D. Parallel to the focal plane

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4. Which of the following aberrations causes problems in image quality at the prime focus (where light is first focused by the objective element, lens or mirror) ONLY in refracting telescopes?

A. Spherical aberration

B. Poor seeing or twinkling of star images

C. Light of different colors not coming to a focus at the same point

D. Chromatic inclusion

5. Which of the following sentences CORRECTLY describes an advantage that a large refracting telescope has over a large reflecting telescope?

A. A refracting telescope has no obstruction that blocks part of the light entering the telescope.

B. A refracting telescope is not subject to as many aberrations as a reflecting telescope.

C. The lens in a refracting telescope can be made larger than the mirror in a reflecting telescope.

D. The objective eyepiece can be made larger in a reflecting telescope

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6. Spherical aberration in the primary mirror of a reflecting telescope is GENERALLY avoided by

A. making the mirror surface a parabolic shape.

B. using adaptive optics.

C. putting extra lenses in the light beam to correct for the shape of the primary mirror.

D. using techniques from the refracting telescope

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7. Which of the following techniques have now produced the sharpest images of sources in the universe?

A. Electronic imaging on the new 10-m diameter Keck telescope on the high volcanic mountain Mauna Kea on Hawaii

B. Cameras on board the 2.4-m Hubble Space Telescope from above the atmosphere, in space

C. Binocular lenses at the VLA in New Mexico

D. Combination of many radio telescopes into an interferometer

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8. What is the greatest obstacle to observing the universe in the infrared region of the spectrum from an observatory on the ground?

A. The longer wavelengths of infrared radiation compared to those of visible light

B. Macular degeneration of refracting mirrors

C. Water vapor in the Earth's atmosphere

D. Seeing, i.e., the twinkling of objects seen through the Earth's atmosphere

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9. To which of the following radiations is the Earth's atmosphere most transparent?

A. X rays and gamma rays

B. Radio and visible light

C. Ultraviolet and Microwave

D. Ultraviolet radiation

10. When a piece of steel is heated, the wavelength of peak intensity of the emitted electromagnetic radiation will

A. change from ultraviolet, through visible light, to infrared radiation.

B. change from infrared, through visible, to ultraviolet.

C. change from visible through radio

D. not change at all. The intensity of radiation increases at all wavelengths, but the peak wavelength does not change.

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11. A perfect blackbody is so-called by scientists because

A. it will only allow the capture of visible spectrum

B.it absorbs all energy falling on it and emits no energy at all, hence its name.

C. it absorbs all energy falling upon it and emits a characteristic spectrum of radiation whose intensity as a function of wavelength depends only on the blackbody's temperature.

D. the spectrum of energy absorbed and emitted by it has a fixed shape as a function of wavelength, the emitted intensity alone depending on the blackbody's temperature.

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12. If the temperature of a blackbody increases, the intensity of emitted energy becomes

A. greater at all wavelengths.

B. greater near the wavelength of peak emission, but unchanged at other wavelengths.

C. less at longer wavelengths and greater at shorter wavelengths

D. less at all wavelengths

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13. Cepheid variable stars pulsate regularly in size. During the contraction part of the cycle, when the star's temperature is increasing, the peak wavelength of the emitted radiation will

A. Shift from the UV to the visible part of the spectrum.

B. Remain unchanged.

C. Shift from the visible to the UV part of the spectrum.

D. Change will only be seen during the inflation part of the cycle.

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14. A small particle of interplanetary material is heated by friction from a temperature of 400 K to 4000 K as it falls into the atmosphere of the Earth and produces a meteor or a shooting star in our sky. If this object behaves like a perfect blackbody over this short time, how will its emitted radiation change as it is heated?

A. Its total intensity will rise by a factor of 10 while its peak wavelength will become shorter by a factor of 10, moving from the infrared to red visible light.

B. Its total emitted intensity will rise by a factor of 10,000 while its peak wavelength will become shorter by a factor of 10, moving from the infrared to red visible light.

C. Its total intensity will rise by a factor of 10,000 while its peak wavelength will become longer by a factor of 10, moving from visible light to the infrared or heat radiation.

D. The total intensity is not associated outside the peak radiation

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15. The person who originated the idea that light is emitted and absorbed in packets of energy (later called photons by Albert Einstein) was

A. Max Planck, who explained the shape of the blackbody curve.

B. Ernest Rutherford, who discovered the atomic nucleus.

C. Niels Bohr, who explained the spectrum of emission or absorption lines of hydrogen in terms of electron transitions in atoms.

D. Karl Jansky, who pioneered the radio telescope.

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16. In a beam of radiation from a blackbody, the amounts of energy per second at an ultraviolet wavelength of 300 nm and at an infrared wavelength of 800 nm are found to be equal. In this beam, how do the numbers of photons per second at each of these wavelengths compare?

A. There will be equal number of UV and XRay photons.

B. There will be a greater number of IR photons than UV photons.

C. There will be equal numbers of photons at each of these wavelengths.

D. There will be a greater number of UV photons than IR photons.

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17. Suppose an astronomical satellite observes the Orion Nebula at a wavelength of 1250 nm. In what wavelength range is this satellite observing?

A. X rays

B. Infrared

C. Ultraviolet

D. Microwave

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18. Spectral lines were first discovered

A. by Balmer, by passing an electric current through rarified hydrogen gas and breaking the resulting light into colors using a prism.

B. by Fraunhofer, by passing the light from the Sun through a prism and magnifying the resulting spectrum.

C. by Kirchhoff, by dropping chemicals in the form of powder into a very hot flame and looking at the resulting light through a prism.

D. by Maxwell, by demonstrating that electricity, magnetism and light are all permutations of electromagnetism

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19. In 1868, astronomers observed a spectral line in the Sun at a wavelength where they had never seen a spectral line before, even in laboratory sources, although other solar spectral lines were where they were expected to be. The logical conclusion that they reached based on this observation was that

A. the temperature of this portion of the Sun was much higher, or possibly much lower, than anyone had ever expected.

B. temperature extremes are caused by fluctuations from the coronal holes

C. gas in that part of the Sun was moving very rapidly toward or away from them, causing that spectral line to become Doppler-shifted to a new wavelength.

D. they had found a previously undiscovered element.

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20. An astronomer wants to use a spectrograph to disperse the light from a star into its component colors. She has a choice between using a prism or a diffraction grating to disperse the light. Which of the following statements correctly describes an advantage of one of these choices over the other?

A. The prism disperses the light evenly across the spectrum, whereas the diffraction grating disperses it unevenly.

B. The diffraction grating disperses the light evenly at all colors, whereas the prism disperses it unevenly.

C. The prism reflects the light poorly, whereas the diffraction grating reflects light far better and over a wider wavelength range.

D, The differencing wavelengths in the spectrum makes the diffraction grating the best choice.

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21. Suppose that we take the spectrum of a distant galaxy, we measure its redshift, and we find that it is receding from us with a velocity of 42,000 km/s. If we suppose that the Hubble constant is 70 km/s/Mpc (just for the sake of argument), how distant is the galaxy?

A. 200 Mpc

B. 400 Mpc

C. 600 Mpc

D. 800 Mpc

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22. A nearby galaxy has a radius of 4000milliion AU and rotates every 800 million years. What is it's mass in solar masses?

A. $10^9$ solar masses

B. $10^{10}$ solar masses

C. $10^{11}$ solar masses

D. $10^{12}$ solar masses

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23. The Hydra cluster is at a distance of 1,200 Mpc. Suppose that the Hubble constant has a value of 70 km/s/Mpc. At what speed are galaxies in the Hydra cluster moving away from us?

A. 84,000 km/s

B. 86,000 km/s

C. 92,000 km/s

D. 98,000 km/s

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24. A large spiral galaxy with a probable absolute magnitude -20 appears on a photographic plate at an apparent magnitude of +20. How far away is it?

A. $10^6$ parsecs

B. $10^7$ parsecs

C. $10^8$ parsecs

D. $10^9$ parsecs

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25. Hipparcos observations have given us good data on stars to about:

A. 200 parsecs

B. 300 parsecs

C. 400 parsecs

D. 500 parsecs

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26. Which statement about stellar notion is incorrect?

A. The radical velocity is measured by the Doppler shift.

B. The transverse velocity is measured by the proper motion.

C. Proper motion is measured over intervals of six months.

D. The Pythagorean theorem relates space,, transverse, and radial velocities.

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27. What is the typical main sequence lifetime of a B-type star?

A. 20 million years

B. 80 million years

C. 10 billion years

D. 100 billion years

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28. Upon what data do measurements of eclipsing binaries depend?

A. their masses and their absolute magnitudes

B. their Doppler shifts and the duration of stages of the eclipse

C. their total periods and separations in orbit

D. their spectral classification and luminosities

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29. Procyon lies about 13 Light Years away- thus it's parallax is about:

A. 0.1"

B. 0.25"

C. 0.5"

D. 1.3"

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30. In order to turn a star's proper motion into its space velocity, we must also know:

A. its temperature and mass

B. its distance and radial velocity

C. its distance and mass

D. its spectral type and period

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31. Why is 21-cm radiation so important to the study of interstellar matter and the galaxy?

A. emitted by hydrogen, it passes through interstellar dust and lets us to map the entire galaxy

B. emitted by carbon monoxide, it passes through interstellar gas and lets us see the galaxy

C. it is emitted by most stars, enabling astronomers to map the entire galaxy

D. it is emitted in the hot regions of star formation so the spiral arms can be mapped

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32. If one star of a binary fills its Roche lobe and is spilling matter onto the other, then the system is a:

A. potential type II supernova

B. contact binary

C. spectroscopy binary

D. mass-transfer binary

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33. Which of these is least likely to happen?

A. low mass starts producing planetary nebulae

B. red giants exploding as type II supernova

C. recurrent supernovae of type I

D. contact binaries becoming novae

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34. Which of the following is not an argument for Cygnus X-1's being a true black hole?

A. Spectroscopic data suggests hot gas is flowing from the companion B star onto Cygnus X-1

B. Cygnus X-1's mass is estimated to be between 5 and 10 solar masses.

C. The mass of the visible B star is even greater than Cygnus X-1, at around 30 solar masses.

D. X-rays from Cygnus X-1 vary on time scales as short as a millisecond.

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35. Which statement about Population I is incorrect?

A. Its oldest members may be over ten billion years old.

B. Its brightest star are evolved red giants.

C. Its most notable groupings are the globular star clusters.

D. These older stars are richer in heavier elements they have made in their cores.

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36. Which sequence by formation by age is correct, oldest to youngest?

A. Halo, spiral arms, globular clusters

B. globular clusters, open clusters, emission nebulae

C. planetary nebulae, RR Lyrae variables, Population II stars

D. Population I stars, Population II stars, Population III stars

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37. A redshift of seven implies a galaxy is receding at .96c; use $H_o = 65$ km/s/Mpc to find its distance.

A. 3.2 billion Light Years

B. 4.4 billion Light Years

C. 14.4 billion Light Years

D. 18.9 billion Light Years

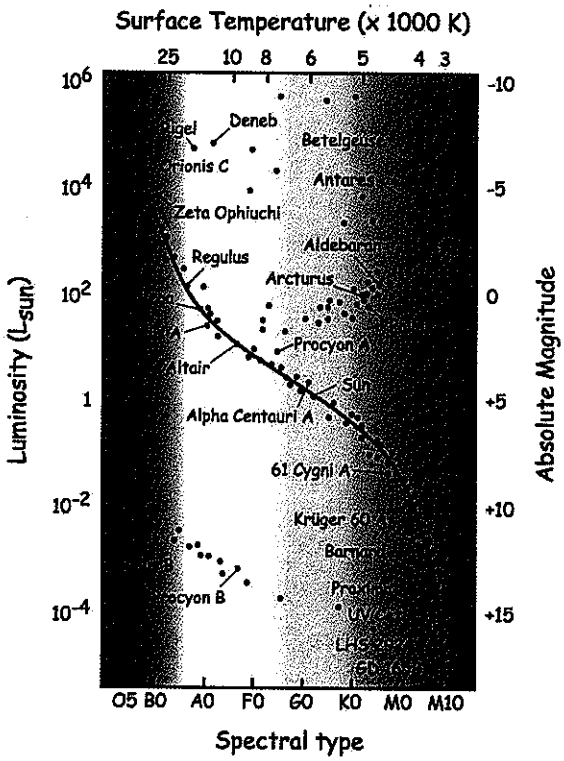
38. For a Hubble constant of 65 km/s/Mpc, the critical density is about:

A. $2 \times 10^{-14}$ g/cc

B. $4 \times 10^{-36}$ g/cc

C. $8 \times 10^{-27}$ kg/m$^3$

D. $6 \times 10^{-80}$ g/cc




39. Sirius A is a star on the main sequence according to the Hertzsprung-Russell Diagram. Compared to our sun, Sirius A is

A. brighter and hotter.

B. dimmer and cooler.

C. dimmer and hotter.

D. brighter and cooler

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40. Which star in the Hertzsprung-Russell Diagram above has the greatest surface temperature?

A. Regulus

B. Aldebaran

C. Vega

D. Deneb

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41. Tycho's SNR is located in the constellation

A. Cassiopeia

B. Pisces

C. Lyra

D. Orion

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| Star | $m_v$ | $M_v$ | d (pc) | Parallax (sec of arc) | Spectral Type |
|---|---|---|---|---|---|
| 65 Tau | 4.2 | | | 0.025 | A7 IV |
| HR 4621 | 2.6 | -0.3 | | | B2 IV |
| $\alpha$ Pic | | 1.8 | 20 | | A7 V |
| 58 Ori | | -6.0 | | 0.005 | M2 I |
| HR 2491 | -1.5 | | 2.5 | | A1 V |

42. Which star in the Star Table above would appear the faintest in the night sky?

A. 65 Tau

B. HR 4621

C. 58 Ori

D. HR 2491

43. Which star in the Star Table above is the closest to Earth?

A. 65 Tau

B. HR 4621

C. 58 Ori

D. HR 2491

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44. The star Sadir has an absolute bolometric magnitude of -5.3 and the absolute bolometric magnitude of the sun is +4.7. Based on this information, which of the following statements is true.

A. Sadir has a greater surface temperature than the sun.

B. Sadir has a larger diameter than the sun.

C. Sadir is 10,000 times more luminous than the sun.

D. Sadir is 100 parsecs from Earth.

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45. SS Cygni is a variable star in the northern constellation Cygnus (the Swan). It is perhaps the prototype dwarf nova, due to:

A. meaning that it undergoes frequent and regular brightness outbursts - every 7 or 8 weeks

B. SS Cygni is often classified as a U Geminorum type supernova

C. one of the components is a red dwarf-type star, cooler than the Sun, while the other is a Red Giant

D. the fact that the stars in the SS Cyg system are separated 1 million miles or more.