**Astronomy Assessment and TPS Questions:**

**Doppler Shift**

1. Which is true of Doppler Shifted light from a star?
   1. If the light is redshifted, the star is moving towards you.
   2. If the light is blueshifted, the star is close to you.
   3. If the light is redshifted, the star is moving quickly.
   4. If the light is blueshifted, the star will appear blue.
   5. None of the above is true.
2. You observe two spectra (shown below) that are redshifted relative to that of a stationary source of light. Which of the following statements best describes how the sources of light that produced the two spectra were moving? *Assume that the left end of each spectrum corresponds to shorter wavelengths (blue light) and that the right end of each spectrum corresponds with longer wavelengths (red light).*

Spectrum A

Spectrum B

* 1. Source A is moving faster than source B.
  2. Source B is moving faster than source A.
  3. Both sources are moving with the same speed.
  4. It is impossible to tell from looking at these spectra.

1. A star is moving toward Earth. If you were to look at the spectrum of this star, what would it look like?
   1. an absorption spectrum that is redshifted relative to an unmoving star
   2. an emission spectrum that is redshifted relative to an unmoving star
   3. a continuous spectrum that is blueshifted relative to an unmoving star
   4. an absorption spectrum that is blueshifted relative to an unmoving star
   5. a continuous spectrum that is redshifted relative to an unmoving star
2. A bright star is moving away from Earth. Which of the choices best completes the following statement describing the spectrum of this star?

You would observe a(n) \_\_\_\_\_\_\_\_\_\_\_ spectrum that is \_\_\_\_\_\_\_ relative to a star that is not moving.

1. absorption; blueshifted
2. emission; redshifted
3. continuous; blueshifted
4. absorption; redshifted
5. continuous; redshifted
6. An important line in the absorption spectrum of stars occurs at a wavelength of 656nm for stars at rest. Imagine that you observe five stars (A-E) from Earth and discover that this absorption line is at the wavelength shown in the table below for each of the five stars.

|  |  |
| --- | --- |
| 1. STAR | 2. Wavelength of Absorption line |
| A | 649 nm |
| B | 660 nm |
| C | 656 nm |
| D | 658 nm |
| E | 647 nm |

Based on the information in the table above, which of the following is the most accurate ranking of the speed of the stars from fastest toward the Earth to moving fastest away from Earth.

1. B, D, C, A, E
2. E, D, C, B, A
3. C, E, A, D, B
4. A, B, C, D, E
5. E, A, C, D, B

1. An important line in the absorption spectrum of stars occurs at a wavelength of 656nm for stars at rest. Imagine that you observe four stars (A-E) from Earth and discover that this absorption line is at the wavelength shown in the table below for each of the four stars.

|  |  |
| --- | --- |
| 1. STAR | 2. Wavelength of Absorption line |
| A | 649 nm |
| B | 656 nm |
| C | 658 nm |
| D | 647 nm |

Based on the information in the table above, which of the following is the most accurate ranking of the speed of the stars from moving fastest toward Earth to moving fastest away from Earth.

1. A=B=C=D
2. C, B, A, D
3. D, A, B, C
4. Cannot be determined from the information provided.
5. An important line in the spectrum of a typical cloud of hydrogen gas occurs at 486 nm for a cloud that is not moving relative to an observer. Imagine that you observe four different clouds of gas (A-D) from Earth and discover that this line is at the wavelength shown in the table below for each of the four clouds.

|  |  |
| --- | --- |
| 1. STAR | 2. Wavelength of Absorption line |
| A | 449 nm |
| B | 460 nm |
| C | 458 nm |
| D | 447 nm |

Based on the information in the table above, which of the following is the most accurate ranking of the distance to the clouds (A-E), from closest to farthest from Earth.

1. B, C, A, D
2. D, A, C, B
3. A=B=C=D
4. Cannot be determined from the information provided.
5. An important line in the spectrum of a star occurs at 434 nm for a star that is not moving relative to an observer. Imagine that you observe four different stars (A-D) from Earth and discover that this line is at the wavelength shown in the table below for each of the four stars.

|  |  |
| --- | --- |
| 1. STAR | 2. Wavelength of Absorption line |
| A | 449 nm |
| B | 460 nm |
| C | 456 nm |
| D | 458 nm |

Based on the information in the table above, of these stars, which would appear the most red in color.

1. A
2. B
3. C
4. D
5. Cannot be determined from the information provided.

Use the four spectra for objects A-D, shown below, to answer the next two questions. Note that one of the spectra is from an object at rest (not moving relative to Earth) and the remaining spectra come from objects that are all moving away from the observer. [*Assume that the left end of the spectrum corresponds with short wavelengths and the right end corresponds with long wavelengths*.]

Object D

Object B

Object A

Object C

1. Which object would be at rest?
2. Object A
3. Object B
4. Object C
5. Object D
6. They are moving the same speed, the speed of light
7. Of the objects that are moving, which is moving with the fastest speed?
8. Object A
9. Object B
10. Object C
11. Object D
12. They are moving the same speed, the speed of light.

Use the four spectra shown at right for objects A-D, to answer the next two questions. Note that one of the spectra is from an object at rest (not moving) and the remaining spectra come from objects that are all moving toward the observer.

Object C

Object D

Object A

Object B

1. Which object would be at rest?
2. Object A
3. Object B
4. Object C
5. Object D
6. More than one object is at rest
7. Which two objects appear to be moving with approximately the same speed?
8. Objects A and B
9. Objects B and D
10. Objects C and D
11. Objects A and D
12. They are all moving the same speed, the speed of light.
13. Which of the four objects A-D is moving with the fastest speed?
14. Object A
15. Object B
16. Object C
17. Object D
18. More than one object is moving with the fastest speed.
19. A bright star is moving toward Earth. If you were to look at the spectrum of this star, what would it look like?
    1. an absorption spectrum that is redshifted relative to an unmoving star
    2. an emission spectrum that is redshifted relative to an unmoving star
    3. a continuous spectrum that is blueshifted relative to an unmoving star
    4. an absorption spectrum that is blueshifted relative to an unmoving star
    5. a continuous spectrum that is redshifted relative to an unmoving star
20. According to the Doppler effect,
    1. Sound gets louder as its source approaches and softer as it recedes.
    2. Sound gets higher and higher in pitch as its source approaches and lower and lower as its source recedes.
    3. Sound is of constant higher pitch as it approaches and of constant lower pitch as its source recedes.
    4. Both a and b above.
    5. Both a and c above.
21. The Doppler effect causes light from a source moving away to be
    1. Shifted to shorter wavelengths
    2. Shifted to longer wavelengths
    3. Changes in velocity
    4. Both a and c above
    5. Both b and c above
22. The Doppler effect is used to:
    1. measure the radial velocity of a star
    2. detect and study binary stars
    3. measure the rotation of the Sun
    4. both a and b above
    5. all of the above
23. The picture below shows the motion of four stars including our Sun relative to a “fixed point”, say the center of our galaxy. Looking at the Doppler shifts in stars #1, #2, and #3, from our location near the Sun we would see the spectra of stars #1, #2, and #3 to be .…

Star #1 Our Sun Star #2 Star #3

5 km/s 10 km/s 10 km/s 12 km/s

|  |  |  |  |
| --- | --- | --- | --- |
| Answers | Star #1 | Star #2 | Star #3 |
| a. | redshifted | redshifted | redshifted |
| b. | redshifted | blueshifted | redshifted |
| c. | No Doppler shift | redshifted | No Doppler shift |
| d. | blueshifted | blueshifted | No Doppler shift |
| e. | blueshifted | redshifted | No Doppler shift |

1. A bright blue star is moving away from Earth. Which of the choices best completes the following statement describing the spectrum of this star?

You would observe a(n) \_\_\_\_\_\_\_\_\_\_\_ spectrum that is \_\_\_\_\_\_\_ compared to a star that is not moving.

* 1. absorption; redshifted
  2. emission; redshifted
  3. continuous; blueshifted
  4. absorption; blueshifted
  5. continuous; redshifted

1. Imagine you observe a red nebula of hot, low-density hydrogen gas moving toward Earth. Which of the choices best completes the following statement describing the spectrum of this nebula?

You would observe a(n) \_\_\_\_\_\_\_\_\_\_\_ spectrum that is \_\_\_\_\_\_\_ compared to a nebula that is not moving.

1. absorption; redshifted
2. emission; redshifted
3. continuous; blueshifted
4. emission; blueshifted
5. continuous; redshifted
6. Imagine you observe a bright star that is moving toward Earth. If you were to look at the spectrum of this star, what would it look like?
   1. an absorption spectrum that is redshifted relative to an unmoving star
   2. an emission spectrum that is redshifted relative to an unmoving star
   3. a continuous spectrum that is blueshifted relative to an unmoving star
   4. an absorption spectrum that is blueshifted relative to an unmoving star
   5. a continuous spectrum that is redshifted relative to an unmoving star
7. Which of the following is true of all main sequence stars that appear red to us on Earth:
   * 1. They are hotter than blue main sequence stars.
     2. They will live longer than very bright main sequence stars.
     3. They are moving toward Earth.
     4. They are moving away from Earth.
     5. They are the same size as red giant stars that have the same temperature.
8. A star’s Doppler shift tells you the star’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   1. direction of motion relative to an observer
   2. absolute speed
   3. temperature
   4. color
9. Stars that are red:
   1. Are moving toward Earth.
   2. Are moving away from Earth.
   3. There is not enough information to determine the stars’ movement.
10. When a star is moving toward you, its light would ­­\_\_\_\_\_\_\_\_.
    1. Appear red
    2. Appear blue
    3. Be redshifted
    4. Be blueshifted
11. When comparing a star that is redshifted to a star that is blueshifted, the redshifted star will always be ­­­\_\_\_\_\_\_\_\_.
    1. Closer to you
    2. Father away from you
    3. Moving faster
    4. Moving slower
    5. None of the above
12. When comparing two stars that are blueshifted, the star that is experiencing the most shift will always be ­\_\_\_\_\_\_\_\_.
    1. Traveling the fastest
    2. Traveling the slowest
    3. Closer to you
    4. Farther away from you
    5. More than one of the above are correct
13. What happens when the light of a star is redshifted?
    1. the light is shifting to shorter wavelengths
    2. the star and the observer are moving away from each other
    3. the star is cooling down
    4. the light is shifting to a higher frequency

Stars A, B, C, and D below are moving at equal speeds relative to a stationary observer, in the directions indicated by the arrows. (Diagram)

Earth

A

B

C

D

1. Using the diagram above, which stars’ light will be redshifted?
2. Using the diagram above, which stars’ light will be blueshifted?
3. Using the diagram above, which stars’ light will be neither redshifted nor blueshifted?

Object A at rest

Object A in motion

1. Using the two spectra for Object A shown above, which of the following kinds of information can you infer about Object A?
   1. Its temperature
   2. Its distance from Earth
   3. Its direction of motion
   4. All of the above
2. In which situation will an observer receive light that is shifted to a longer wavelength?
   1. When the observer and the star are moving away from each other
   2. When the observer and the star are moving toward each other
   3. When the observer and the star are moving perpendicular to each other
   4. When the observer and the star are moving in the same direction at the same speed

An important line in the spectrum of a star occurs at 649 nm for a star that is not moving relative to an observer. Imagine that you observe five different stars (A-E) from Earth and discover that this line is at the wavelength shown in the table below for each of the five stars.

|  |  |
| --- | --- |
| STAR | Observed Wavelength of Absorption line |
| A | 658 nm |
| B | 638 nm |
| C | 649 nm |
| D | 642 nm |
| E | 653 nm |

1. Using the information above, which star(s) is/are moving the fastest?
2. Which star(s) is/are moving toward you?
3. Which star(s) is/are moving away from you?
4. The wavelength of a photon from an object that is blueshifted will appear to be \_\_\_\_\_\_\_\_\_\_\_\_ than/as when it was emitted.
   1. Faster
   2. Longer
   3. Shorter
   4. the same length
5. The frequency of light emitted by an object that is redshifted will appear to be \_\_\_\_\_\_\_\_\_\_\_\_ than/as when it was emitted.
   1. Lower
   2. Higher
   3. the same
6. Star X is moving very quickly away from Earth, and Star Y is moving very slowly towards Earth. What will their Doppler Shifts look like?
   1. Star X will show a large blueshift and Star Y will show a small redshift
   2. Star X will show a small blueshift and Star Y will show a large redshift
   3. Star X will show a small redshift and Star Y will show a large blueshift
   4. Star X will show a large redshift and Star Y will show a small blueshift

An important line in the absorption spectrum of stars occurs at a wavelength of 450 nm for stars at rest. You observe Stars A, B, C and D and discover that this important absorption line is measured at the wavelength shown in the table below for each of the four stars.

|  |  |
| --- | --- |
| Star | Wavelength of absorption line |
| A | 445 nm |
| B | 450 nm |
| C | 460 nm |
| D | 455 nm |

1. Using the information above, the star that has this absorption line at the lowest frequency is:
   1. not moving toward or away from Earth.
   2. moving toward Earth.
   3. moving away from Earth.
2. Star X is moving very slowly away from Earth, and Star Y is moving very quickly towards Earth what is true about the stars?
   1. Star X must be closer to Earth than star Y.
   2. Star Y must be closer to Earth than Star X.
   3. Star X will look blue and Star Y will look red.
   4. Star Y will look blue and Star X will look red.
   5. None of the answers above are correct.
3. Shown below, an observer on Earth is moving toward the stationary Stars A, B, and C. Star Stars A and C are red, and Star B is blue. How does the shift of the light from each star compare, from greatest to least shift?
   1. A>B>C
   2. A=B=C
   3. A<B<C
   4. There is insufficient information to answer the question

Earth

A

B

C

1. The diagram below shows an observer on Earth between stars Y and Z, both of which are stationary. Earth is moving toward Star Y. Which of the statements below best compares the Doppler shift of the light of Star Y and Star Z?
   1. The blueshift of Star Y is greater than the redshift of Star Z
   2. The blueshift of Star Y is equal to the redshift of Star Z
   3. The blueshift of Star Y is less than the redshift of Star Z

Y

Z

1. You view a star nightly over the course of six months. The star is moving parallel to your position on Earth. After a few months you notice the star’s light change color from blue to red. Why?
   1. The star has gotten cooler
   2. The star has moved toward you
   3. The light of the star has redshifted
   4. The star has gotten hotter