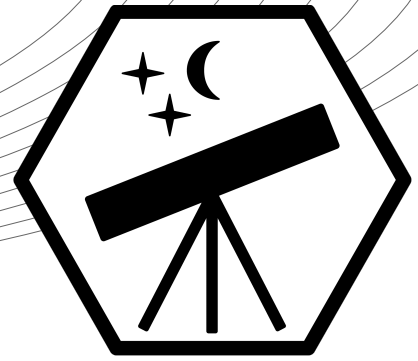# International Astronomy and Astrophysics Competition
Final Round

Final Round Exam 2021

The final round exam was given in the form of an online exam.
Each participant was given a subset of 30 questions in random order.
This paper version is only available for training purposes.

Question 1 : Which intense meteor shower peaks every year in August?

(A) Lyrids   (B) Leonids   (C) Perseids   (D) Geminids

Question 2 : The distance between two objects with equal mass is doubled. By how much does the gravitational force between the objects decrease?

(A) $1/\sqrt{2}$ (B) $1/2$ (C) $1/4$ (D) $1/8$

Question 3 : A spaceship accelerates at 150 m/s^2 from rest. How long does it take to reach a 1.2 km distant asteroid?

(A) 2 Seconds   (B) 3 Seconds   (C) 4 Seconds   (D) 5 Seconds

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Question 4 : What kind of radiation do **pulsars** emit?

(A) Compton radiation   (B) Lyα radiation

(C) Planck radiation   (D) Synchrotron radiation

Question 5 : The gravitational potential energy E between two objects with a distance R to each other can be expressed as ...

(A) $E = -G\frac{M \cdot m}{R}$ (B) $E = -G\frac{M \cdot m}{R^2}$

(C) $E = G\frac{M \cdot m}{R}$ (D) $E = G\frac{M \cdot m}{R^2}$

Question 6 : What instrument is commonly used to observe and study **pulsars**?

(A) Laser interferometer   (B) Radio telescopes

(C) Magnetic spectrometer   (D) Radar telescopes

Question 7 : What type of astronomical object are **pulsars** most commonly?

(A) White dwarfs   (B) Neutron stars   (C) Quasars   (D) Black dwarfs

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Question 8 : The two coordinate axis of the **Equatorial Coordinate System** are called ...

(A) Elevation and azimuth

(B) Declination and right ascension

(C) Azimuth and declination

(D) Ecliptic latitude and longitude

Question 9 : The **Vernal equinox** is the intersection point between ...

(A) the Earth's rotational axis and the horizon

(B) the celestial equator and the horizon

(C) the Earth's rotational axis and the ecliptic

(D) the celestial equator and the ecliptic

Question 10 : The closest star system to the Earth is called Alpha Centauri. How many stars belong to the Alpha Centauri system?

(A) 2   (B) 3   (C) 4   (D) 5

Question 11 : The picture below shows a satellite galaxy of the Milky Way: What is the name of this satellite galaxy?

(A) Sagittarius Dwarf Spheroidal

(B) Triangulum Galaxy

(C) Andromeda Dwarf

(D) Large Magellanic Cloud

Question 12 : Stars from which spectral type have the lowest temperature?

(A) Class O   (B) Class F   (C) Class K   (D) Class M

Question 13 : Which one of the following expressions is the Rankine-Hugoniot jump condition for the conservation of momentum through a shock wave?

(A) $\rho_1 v_1 = \rho_2 v_2$

(B) $\rho_1 v_1^2 + p_1 = \rho_2 v_2^2 + p_2$

(C) $\frac{v_1^2}{2} + h_1 = \frac{v_2^2}{2} + h_2$

(D) $\rho_1 v_1 + h_1 = \rho_1 v_1 + h_2$

Question 14 : Which one of the following expressions is correct for the Lorentz factor γ and $\beta = v/c$?

(A) $\frac{1}{\gamma^2} = 1 + \beta^2$ (B) $\frac{1}{\gamma^2} = \beta\gamma^2$ (C) $\frac{1}{\gamma^2} = 1 - \beta^2$ (D) $\frac{1}{\gamma^2} = \beta\gamma^2$

Question 15 : The intergalactic medium is permeated mainly by ...

(A) neutral heavy elements

(B) ionized heavy elements

(C) neutral hydrogen

(D) ionized hydrogen

Question 16 : In a far-away solar system, a planet circles the main star with an orbital period of 100 days and a semi-major axis of 2 AU. Another planet with a semi-major axis of 8 AU is observed in the same solar system. What is the orbital period of the new planet?

(A) 200 days   (B) 400 days   (C) 800 days   (D) 1000 days

Question 17 : How is the part of a moon's shadow called in which a total solar eclipse is possible?

(A) Umbra   (B) Penumbra   (C) Antumbra   (D) Apex

Question 18 : The diameter of the lens' aperture of your telescope is 5 m and you observe at a wavelength of 1000 nm. What is the resolution of this telescope?

(A) $1.22 \cdot 10^9$ (B) $2.44 \cdot 10^9$ (C) $122 \cdot 10^9$ (D) $244 \cdot 10^9$

Question 19 : A fast travelling spaceship has a Lorentz factor of $\gamma = 3$. This corresponds to a velocity v of ...

(A) $\sqrt{8}/3c$ (B) $3/\sqrt{8}c$ (C) $\sqrt{8}/9c$ (D) $9/\sqrt{8}c$

Question 20 : Imagine that a total solar eclipse happens on the Earth today. What is the phase of the Moon on this day?

(A) New moon

(B) Waxing crescent

(C) Waning gibbous

(D) Full moon

Question 21 : The negative effect of incoming wavefront distortions on telescope images is reduced by using a system called ...

(A) Adaptive spectroscopy

(B) Active spectroscopy

(C) Adaptive optics

(D) Active optics

Question 22 : You are given a list of stars and their apparent magnitude. Which one is the faintest star?

(A) Star A, 5 mag

(B) Star B, 0.3 mag

(C) Star C, -0.2 mag

(D) Star D, -5 mag

Question 23 : The **right ascension** is measured in units of ...

(A) kelvin   (B) meters   (C) hours   (D) declinations
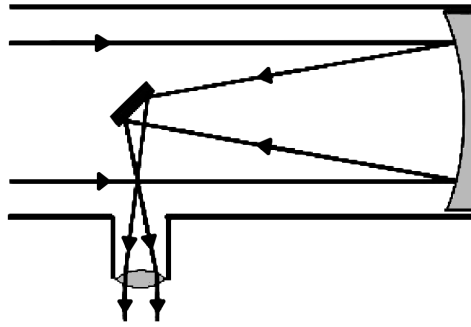
Question 24 : The Lyman-alpha line can be found at a wavelength of around ...

(A) 120 nm   (B) 330 nm   (C) 860 nm   (D) 1100 nm

Question 25 : Which transition is called Lyα lines?

(A) Hydrogen, 1st to 2nd orbit

(B) Helium, 1st to 2nd orbit

(C) Hydrogen, 2nd to 1st orbit

(D) Helium, 2nd to 1st orbit

Question 26 : Below, you can see the rough sketch of a telescope. What type of telescope is drawn?

(A) Newtonian telescope

(B) Refractor telescope

(C) Cassegrain telescope

(D) Catadioptric telescope

Question 27 : An **Analemma** is a diagram showing the position of _____ from a fixed location and the same mean solar time over the course of a year.

(A) the Sun

(B) the Moon

(C) the Vernal equinox

(D) Jupiter

Question 28 : Which astronomical coordinate system uses the observer on Earth as a reference point?

(A) Horizontal Coordinate System

(B) Equatorial Coordinate System

(C) Ecliptic Coordinate System

(D) Galactic Coordinate System

Question 29 : Which type of star is only stable due to the pressure of an electron gas?

(A) Neutron stars

(B) Supergiant stars

(C) Blue dwarfs

(D) White dwarfs

Question 30 : The colour of a star depends on the ...

(A) mass

(B) radius

(C) temperature

(D) orbital velocity

Question 31 : An object is moving with a velocity of $0.6c$ in your line of sight. What is the redshift z of this object?

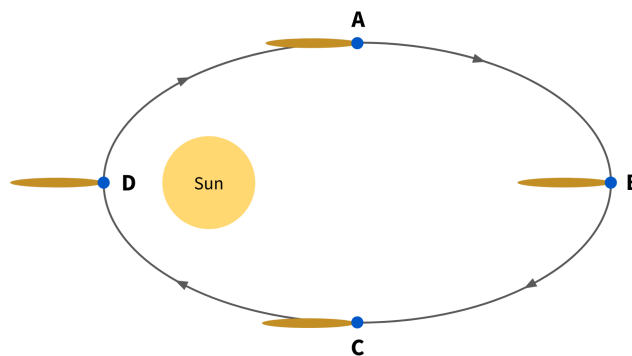   (A) $z = 1$ (B) $z = \sqrt{2}$ (C) $z = 1.5$ (D) $z = 2.5$

Question 32 : In which one of the following time frames after the big bang did the **cosmic reionization process** begin?

    (A) 0 - 999 hundred years   (B) 1 - 999 thousand years

    (C) 1 - 999 million years   (D) 1 - 14 billion years

Question 33 : Massive stars are essential for the universe because they …

    (A) neutralize the intergalactic medium.   (B) emit synchrotron radiation.

    (C) produce quasars for X-ray emission.   (D) create most of the chemical elements.

Question 34 : The drawing below shows a comet in four positions around the Sun. For which position does the comet's tail point in the correct direction?

    (A) Position A   (B) Position B   (C) Position C   (D) Position D

Question 35 : What spectral region can be observed from the Earth even when there are clouds in the sky?

    (A) Gamma wavelengths   (B) Radio wavelengths

    (C) Ultraviolet wavelengths   (D) X-ray wavelengths

Question 36 : What was the last planet visited by **Voyager 1**?

(A) Jupiter   (B) Saturn   (C) Uranus   (D) Neptune

Question 37 : The time between two full moons is approximately ...

(A) 28 days   (B) 28.5 days   (C) 29 days   (D) 29.5 days

Question 38 : Which one of the following objects is called a **black dwarf** in astronomy?

(A) A star that will become a black hole   (B) A cooled white dwarf

(C) A low radiation-emitting star   (D) A high radiation-absorbing star

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Question 39 : Which planet has an axial tilt of 98 degrees?

(A) Saturn   (B) Uranus   (C) Neptune   (D) Pluto

Question 40 : The smallest distance between Pluto and the Sun is about ...

(A) 20 AU   (B) 30 AU   (C) 40 AU   (D) 50 AU