ASTROCHALLENGE 2025
JUNIOR MCQ ROUND

Wednesday 4th June 2025

PLEASE READ THESE INSTRUCTIONS CAREFULLY.

1. This paper consists of a total of **19** printed pages, including this cover page.

2. Any materials other than the Question Paper and Formula Booklet are strictly prohibited.

3. Do **NOT** turn over this page until instructed to do so.

4. You have **2 hours** to attempt **ALL** questions in this paper. If you think there is more than one correct answer, choose the *most* correct answer.

5. At the end of the paper, submit the Optical Answer Sheet. You do not need to submit this booklet.

6. Please ensure that you have shaded the correct course code and matriculation number, and have written your name, school, and team number clearly on the Optical Answer Sheet.

7. It is *your* responsibility to ensure that your Optical Answer Sheet has been submitted.

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1. In August 2023, India became the fourth country to successfully land a spacecraft on the Moon. The Pragyan rover was part of the mission and was fully dependent on its small solar panel to provide it with the 50 Watts of power necessary to move around the lunar surface and carry out experiments. Assuming that the solar panels were always facing the Sun perpendicularly and had 100% efficiency, and that the solar irradiance at the Moon was the same as the average solar irradiance on the Earth, what was the minimum solar panel area required?

   (A) $290\,cm^2$

   (B) $370\,cm^2$

   (C) $180\,cm^2$

   (D) $460\,cm^2$

   (E) $530\,cm^2$

2. One of the closest and brightest supernovae in recent times, SN 2023ixf reached an apparent magnitude of 10.8 in the galaxy M101 (Pinwheel Galaxy), about 21 million light years away. What was the absolute magnitude of this supernova?

   (A) -18.2

   (B) -19.5

   (C) -17.2

   (D) -20.3

   (E) -21.5

3. Which of the following nuclear reactions correctly describe Helium fusion in evolved high-mass stars?

   (A) P-P Chain

   (B) CNO Cycle

   (C) Triple-alpha Process

   (D) Alpha-ladder

   (E) Slow neutron capture (s-process)

4. I was staring at the night sky on a cold night near the equator. Close to sunrise, I noticed an increased number of bright moving dots in the sky, each taking anywhere from 15 seconds to a minute to go across the whole night sky. What could they have been?

   (A) Meteors

   (B) Stars

   (C) Planets

   (D) Satellites

   (E) Pulsars

5. Someone told George that Flat Frames in astrophotography will allow him to remove artifacts such as dust particles from his images. George, being the smart guy he is, decides to create his own software to process his images. In his software, he decided to subtract the Flat Frame from his main picture. Is this the correct way to remove artifacts?

(A) Yes, he is correct. Subtracting the flat frame will subtract the dust particles artifacts.

(B) No, he is incorrect. Subtracting the flat frame will instead enhance the dust particles artifacts as they are of a lower intensity to begin with.

(C) Yes, he is correct. Subtracting the frame will reduce the intensity of the region where the dust particles artifacts are present, and thus remove them.

(D) No, he is incorrect. You need to use dark frames to remove the artifacts from dust particles.

(E) George is tricking us; flat frames are used to flatten the image by merging multiple images taken into one singular image.

6. Cornelius was looking at velocity dispersion data for various elliptical galaxies. To fulfill his research requirements, he performs the following steps in order:

I   He used the Tully-Fisher relation to calculate the Luminosity of each galaxy.

II   He converted the Luminosity to Absolute Magnitude of each galaxy.

III He then sourced the Apparent Magnitude of each galaxy, ensuring that it was measured in the same wavelength range used to calculate the Absolute Magnitude.

IV   Using the distance modulus, he calculated the distance to each galaxy.

Which one of the above steps is wrong?

(A) Step I

(B) Step II

(C) Step III

(D) Step IV

(E) None of the above. All steps are correct.

7. Betelgeuse (α Orionis) is located in the red-giant branch in a Hertzsprung-Russell diagram. This is the first of the giant star branches that a star encounters after moving off the main sequence. Which of the following best describes the fusion process happening in or around the centre/core of Betelgeuse?

(A) Core Hydrogen Burning

(B) Shell Hydrogen Burning

(C) Helium Flash

(D) Helium Core Burning

(E) Helium Shell Burning

8. The Eddington limit describes the mass limit at which:

A The core of a star becomes supported by electron degeneracy pressure.

B A white dwarf can no longer be supported by electron degeneracy pressure and explodes in a Type Ia supernova.

C A neutron star can no longer be supported by neutron degeneracy pressure and collapses into a black hole.

D A high-mass star no longer becomes gravitationally bound due to radiation pressure.

E A giant molecular cloud begins to undergo Jeans collapse into a protostar.

9. Which of the following elements/isotopes were NOT produced during the primordial (Big Bang) nucleosynthesis?

I   Hydrogen-1

II   Deuterium (Hydrogen-2)

III Helium-4

IV   Lithium-7

V   Carbon-12

A Option V only

B Options IV and V

C Options III, IV and V

D Options II, IV and V

E Options II, III, IV, V

10. Which one of the following properties of a star can be studied using techniques in stellar spectroscopy?

A Chemical Composition

B Temperature

C Mass

D Relative velocity of motion towards or away from the observer

E All of the above

11. Which one of the following statements about equinoxes and solstices is correct?

A At vernal and autumnal equinox, the declination of the sun is 0 degrees.

B At summer and winter solstices, the right ascension of the sun is 0 hrs.

C The equinoxes represent the days where the day is exactly as long as the night, as observed by a person at 40°N.

D In the Gregorian calendar, leap years are determined by setting winter solstice on 21st December.

E The moon phase at each equinox and solstices is always a new moon.

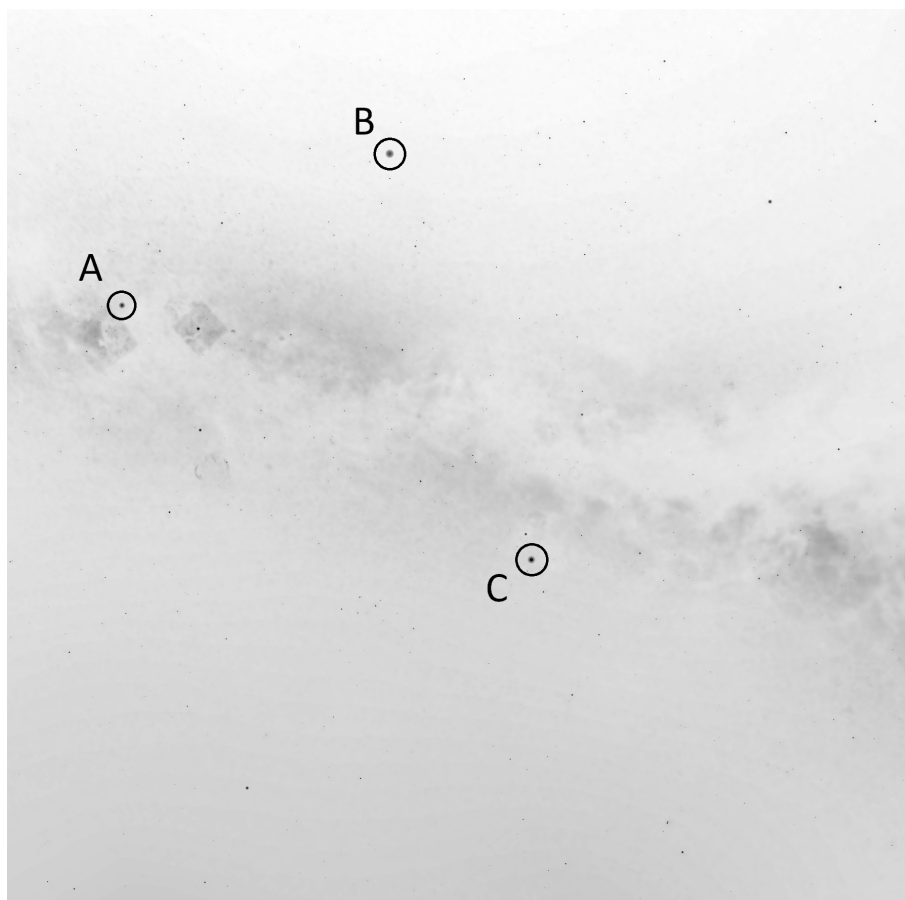**Use the following information to answer Questions 12 to 14.**

Figure 1: Question 12 to 14.

Star name	Right Ascension	Declination
A	20h41min	+45°17′
B	18h36min	+38°47′
C	19h50min	+8°52′
Alpheratz	0h8min	+29°5′

Table 1: Question 12 to 14

12. On a beautiful cloudless night, Michael was looking up at the night sky. He was delighted to see many stars. Suddenly, his friend Cheryl pointed out three stars (A, B and C) that seemingly resembled a triangle, and claimed that it is a famous asterism. What is this asterism?

Ⓐ   Spring triangle

Ⓑ   Summer triangle

Ⓒ   Autumn triangle

Ⓓ   Winter triangle

Ⓔ   This is not a famous asterism

13. Based on your Question 12 answer or otherwise, which of the following names belong to either of stars A, B or C?

   I   Acrux

   II   Antares

   III Denebola

   IV Spica

   V   Vega

   Ⓐ   I and II only

   Ⓑ   III and IV only

   Ⓒ   IV only

   Ⓓ   V only

   Ⓔ   None of the above

14. Assume that we are on the equator at 6pm, and all stars in Table 1 are below the horizon. Which of the stars will rise first?

   Ⓐ   Star A

   Ⓑ   Star B

   Ⓒ   Star C

   Ⓓ   Alpheratz

   Ⓔ   Not enough information

15. If a star rises with an azimuth 30 degrees, what is the azimuth it sets at?

   Ⓐ   120 degrees

   Ⓑ   150 degrees

   Ⓒ   240 degrees

   Ⓓ   300 degrees

   Ⓔ   330 degrees

16. Bob sees a half moon on the western horizon at 12am today. What will he see at 12am 7 days later?

   Ⓐ   A new moon not in the night sky.

   Ⓑ   A half moon at the eastern horizon.

   Ⓒ   Full moon at local meridian.

   Ⓓ   A half moon at the western horizon.

   Ⓔ   A gibbous moon in the eastern sky.

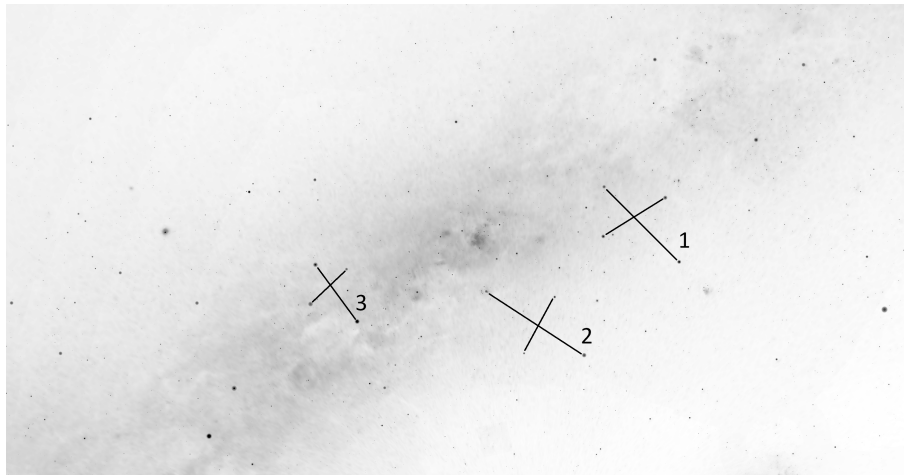**Use the following information to answer Questions 17 to 18.**

Figure 2: Questions 17 to 18.

17. Michael sees three cross-shaped patterns (1, 2, 3) in the sky. Which of the following contains the correct labellings of the patterns shown in Figure 2?

Ⓐ 1: Diamond Cross; 2: False Cross; 3: Southern Cross

Ⓑ 1: Diamond Cross; 2: Northern Cross; 3: False Cross

Ⓒ 1: False Cross; 2: Diamond Cross; 3: Southern Cross

Ⓓ 1: Northern Cross; 2: Diamond Cross; 3: Southern Cross

Ⓔ 1: Southern Cross; 2: Diamond Cross; 3: False Cross

18. Which of the crosses does not have all its vertex stars lying in the same constellation?

Ⓐ Diamond Cross

Ⓑ False Cross

Ⓒ Northern Cross

Ⓓ Southern Cross

Ⓔ None of the crosses

19. On October 14 2024, NASA launched Europa Clipper, to investigate Europa and study the nature of its ice shell, the subsurface ocean, and the moon's geology. Why did NASA choose to study this moon of Jupiter?

Ⓐ Europa shows volcanic activity likely caused by tidal friction with Jupiter, which heats the interior of the moon. Hence, the need to learn the intricacies of this process.

Ⓑ Europa has the largest body of water of any body of the solar system other than Earth, and hence may serve as an additional source of water for humans on earth.

Ⓒ Europa has a subsurface ocean and may potentially host life. Hence the possibility of signs of life.

Ⓓ Europa is found to have cryogeysers with traces of iron compounds and hence may turn into a red moon.

Ⓔ Europa is one of the biggest moons in the solar system that still hasn't been explored.

20. Why are most earth-based visual telescopes located at high altitudes?

   (A)   The closer distance to celestial objects makes them brighter.

   (B)   Less atmospheric turbulence at high altitudes.

   (C)   Less blackbody radiation from sources on the ground.

   (D)   Moon does not rise as high on higher altitudes and hence does not contribute to light pollution.

   (E)   Astronomers are lonely creatures whom prefer to be away from civilisation.

21. Identify the optical tube assembly design and mount in Figure 3.

Figure 3: Question 21. [1]

   (A)   Schmidt-Cassegrain, alt-azimuth mount

   (B)   Maksutov-Cassegrain, equatorial mount

   (C)   Galilean refractor, equatorial mount

   (D)   Newtonian reflector, alt-azimuth mount

   (E)   Korsch reflector, equatorial mount

22. Which one of the following is NOT evidence for dark matter?

   (A)   The unexpected plateau of galaxies' rotation curves - orbital velocity plateaus even when measuring speeds of objects further from the galactic centre.

   (B)   Doppler wobbling of stars caused by external mass shifting the barycentre (centre of mass) of the system outside of the centre of the star.

   (C)   Mass distribution of galactic collision in the bullet cluster.

   (D)   Higher than expected orbital velocities of galaxies in the Coma galactic cluster.

   (E)   Gravitational lensing caused by large masses bending spacetime.

23. Which of the following correctly states the position and phase of Venus when the arrangement of Venus, the Earth and the Sun are as shown in Figure 4? (diagram not to scale)
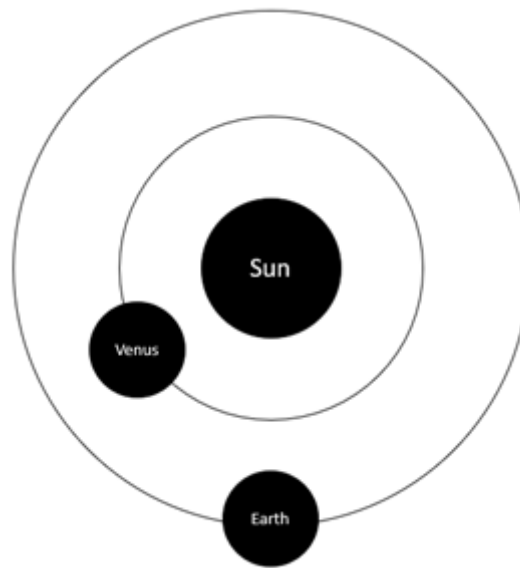

Figure 4: Question 23.

(A) Superior conjunction, full phase

(B) Eastern elongation, half phase

(C) Inferior conjunction, full phase

(D) Western elongation, gibbous phase

(E) Eastern elongation, full phase

24. Figure I-1 on the Insert is a picture of the Pillars of Creation in Eagle Nebula (M16). The image on the left is taken by Hubble Space Telescope (HST) in 2014 and the one on the right is taken by the James Webb Space Telescope (JWST) in 2022.

Which of the following best explains why the image on the right reveals more stars and shows less dust?

(A) The newborn stars have dispersed most of the dust that previously obscured them after 6 years.

(B) Since the relative position of earth with respect to M16 has changed in the past 6 years, we have a different view of M16 revealing more stars and having less dust.

(C) Dark matter, which the dust is made of, has moved to other parts of the Milky Way due to gravitational interactions.

(D) JWST's image was taken in infrared light, which can penetrate through the dust better while HST's image was taken in visible light.

(E) JWST and HST had different microchips with different capabilities of on-board processing.

25. Sampson has two telescope setups. The specifications of his setups are as shown in Table 2. On Valentine's Day, he is going out with his date to do deep sky photography throughout the night.

	Telescope 1	Telescope 2
OTA type	Refractor	Newtonian
Aperture	70mm	254mm
Focal Ratio	f/13	F/4.7
Mount type	Alt Azimuth	Equitorial

Table 2: Question 25.

Which is the better setup for him to bring and what is the best explanation?

(A) Both telescopes are equally good as the difference in their aperture is not large enough to show a significant difference.

(B) Both telescopes are equally good as they both use excellent quality mirrors and lenses.

(C) Telescope 1. It has a large focal length and hence can produce a higher magnification. The alt azimuth mount also allows for easy slewing to the same target throughout the night.

(D) Telescope 2. It only has mirrors which are less prone to collimation errors as compared to lenses.

(E) Telescope 2. It has a large aperture to collect more light and has an equatorial mount which is superior for tracking an object throughout the night.

26. Which of the following properties must be observed/measured in order to calculate the distance to a Cepheid variable?

I Period of pulsation

II Absolute magnitude

III Apparent magnitude

IV Mass of the star

(A) I and II only

(B) I and III only

(C) II and III only

(D) II and IV only

(E) III and IV only

27. A comet is observed to have a highly elliptical orbit around the Sun. At its perihelion, it is 0.5 AU from the Sun. At its aphelion, it is 5 AU from the Sun. At which of the following positions does the comet move fastest?

(A) At perihelion.

(B) At aphelion.

(C) At a point midway between perihelion and aphelion.

(D) The comet moves at a constant speed.

(E) Not enough information to determine.

28. Which of the following are possible theories for the origin of planetary rings?

   I   Material originating from the protoplanetary disk that is within the Roche limit of the planet.

   II Material hurled into orbit originating from the collision of micrometeorites and the planet's inner moons.

   III Material from the collision of two moons, scattering debris.

   IV Material originated from debris of moons being torn apart by a planet's tidal forces.

   (A) I and III only

   (B) II and IV only

   (C) I, II and III only

   (D) II, III and IV only

   (E) I, II, III and IV

29. Consider an arbitrary star. Timothy and Wertz are observing the same star at the same time from different latitudes but the same longitude on Earth. Will Timothy and Wertz **always** observe the star at different altitudes relative to their local horizon?

   (A) Yes, as they are at different latitudes.

   (B) Yes, as the time since the stars have risen are different between Timothy and Wertz.

   (C) No, as Timothy and Wertz are looking at the same star.

   (D) No, as Timothy and Wertz are on the same longitude, and thus the star will have the same hour angle, hence the same time since their last meridian transit thus the same altitude.

   (E) No, as it is possible that coincidentally, that the same star appears at the same altitude for Timothy and Wertz, despite that the star might have different azimuth to both of them.

30. What is the main purpose of using standard candles in astronomy?

   (A) To calculate the temperature of stars.

   (B) To identify the composition of a galaxy.

   (C) To determine the age of the universe.

   (D) To measure distances to celestial objects.

   (E) To measure black hole masses.

31. The star Manchun is 8×10^4 times more luminous than the Sun and 25 times more massive than the Sun. What type of star is Manchun most likely to be?

   (A) White dwarf

   (B) Red giant

   (C) Red supergiant

   (D) T-Tauri star

   (E) Main sequence

[Turn over]

32. The Stratospheric Observatory for Infrared Astronomy (SOFIA) was an airborne observatory which is created as a result of a joint project between the National Aeronautics and Space Administration (NASA) and German Aerospace Centre. As an airborne observatory, SOFIA consists of a Boeing 747SP plane carrying a 2.5m reflector telescope and mainly made observations through infrared light, as shown in Figure 5.

Figure 5: Question 32.

Which of the following is NOT a potential advantage that SOFIA has over other ground based infrared observatories?

(A) SOFIA operates at high altitudes which results in higher quality data being retrieved due to less seeing.

(B) SOFIA can operate over a larger infrared spectrum due to its high operating altitude.

(C) SOFIA may be rapidly redeployed at different locations allowing for flexibility when observation various regions of the sky.

(D) SOFIA can operate at any time of the day or night, unlike ground-based observatories that can only operate at night.

(E) None of the above.

33. During its evolution, a (hypothetical) star called Zimmerman is likely to be a red giant of surface temperature 4000 K and luminosity $10^3 L_\odot$. Later it is likely to be a white dwarf of surface temperature 16,000 K and luminosity $10^{-2} L_\odot$. Calculate $\dfrac{R_D}{R_G}$ where R_D is the radius of the star Zimmerman as a white dwarf and R_G is the radius of the star Zimmerman as a red giant.

(A) 3.91×10^{-8}

(B) 2.50×10^{-6}

(C) 1.98×10^{-4}

(D) 5.06×10^{-2}

(E) 5060

34. What is the closest distance an asteroid can come to Earth, measured from the centre of the Earth, before being disintegrated by Earth's gravity? Assume both the asteroid and the Earth are spherical, and the asteroid's density is 1000 kg/m^3. Ignore the effects of Earth's atmosphere.

A It will not disintegrate; the calculated distance is smaller than Earth's radius.

B 14000 km

C 44000 km

D 1800000 km

E 490000000 km

35. Why are pulsars observed to spin so rapidly after their formation in a supernova?

A Because radiation pressure from the supernova blast pushes the neutron star into a spin.

B Because neutron stars inherit orbital momentum from the progenitor star.

C The collapse of the stellar core drastically reduces its size, increasing its rate of rotation due to conservation of angular momentum.

D Because the magnetic field lines twist and accelerate the star's spin.

E Because neutron stars must spin quickly to prevent collapse into black holes.

36. Astronomers use space telescopes such as the James Webb Space Telescope (JWST) to analyse the atmospheres of exoplanets for potential signs of life. One strategy is to look for gases like oxygen and methane in a planet's atmosphere using transit spectroscopy.

Why is the simultaneous detection of both oxygen and methane considered a strong indicator of possible biological activity?

A Oxygen and methane are both inert gases that do not interact, so their joint presence indicates stable atmospheric conditions for life.

B Oxygen and methane react with each other and should not co-exist unless they are continuously replenished, possibly by biological processes.

C Methane stabilizes oxygen molecules at high altitudes, preventing them from being lost to space.

D Oxygen is a greenhouse gas that protects methane from photodissociation, allowing both gases to accumulate.

E Both gases are typically produced only through artificial industrial processes, making them reliable signs of intelligent life.
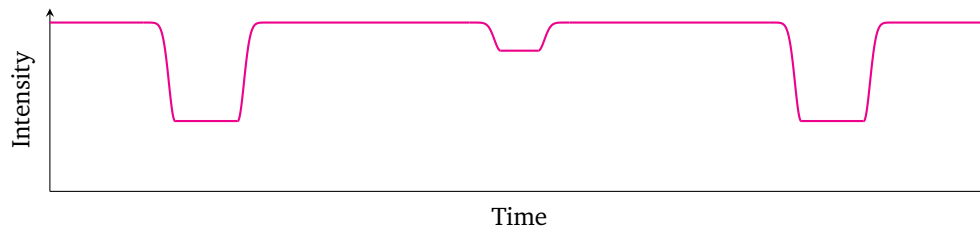
37. Figure 6 shown below is a light curve of a star.

Figure 6: Question 37.

Which of the following statements are plausible explanations for the shape of the light curve?

I   The star is a T-Tauri Star which are young and unstable stars which results in their periodic swelling and contraction causing this light curve.

II   The curve is likely caused by two massive exoplanets eclipsing a dwarf star.

III   The star is a Cepheid variable with its characteristic periodic dimming.

IV   This curve is a result of eclipses of a binary star system.

(A)   I and II

(B)   II only

(C)   II and IV

(D)   III only

(E)   I, II, III and IV

38. Where and how are stable beryllium isotopes synthesised?

(A)   Inside the cores of low mass stars, due to the proton-proton chain.

(B)   During a supernova, due to the s-process.

(C)   Inside brown dwarves, as a product of Lithium Burning.

(D)   During neutron star mergers, due to the rp-process.

(E)   In interstellar medium, from break-up of heavier elements under cosmic ray bombardment.

39. A sun-synchronous orbit ensures that a satellite in the orbit passes over the same point on Earth at the same local solar time each day. Which of the following is a characteristic of a sun-synchronous orbit?

(A)   It has a low inclination.

(B)   Satellites in sun-synchronous orbit stays stationary above a fixed point of Earth as its orbital period is 24 hours.

(C)   It generally takes less Δv for a satellite to reach sun-synchronous orbit compared to the International Space Station on low Earth orbit, when launched from the equator.

(D)   Sun-synchronous orbit has a nodal precession period of 1 solar year.

(E)   It is a hoax, sun-synchronous orbit is impossible in real life.

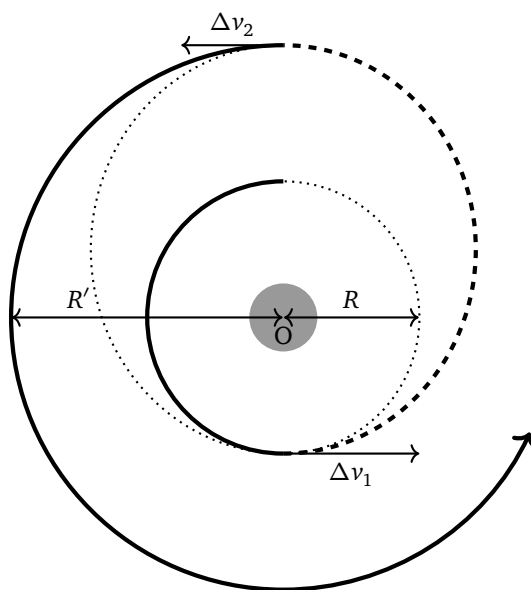**40.** Figure 7 shown below is a diagram of the Hohmann transfer orbit.

Figure 7: Question 40.

Which of the following is/are true about the Hohmann transfer orbit?

I   It is often the most fuel-efficient way to accomplish the transfer because it requires the lowest impulse.

II   It is usually the fastest way to transfer orbits.

III It is suitable for interplanetary travel without adjustments for relative motion of planets.

IV   The time required for a Hohmann transfer orbit depends on the semi-major axis of the transfer ellipse.

(A)   I and IV only

(B)   II only

(C)   II and III only

(D)   IV only

(E)   I, II, III and IV

41. Jupiter's Moons, Io, Europa and Ganymede exhibit Laplace resonance, a special type of orbital resonance between 3 bodies where the ratio of the orbital periods of the moons is 4:2:1. Which of the following explanations best describes why Laplace resonance occurs in the Jovian system?

(A)   The gravitational influence of other Jovian Moons, especially Callisto, "shepherds" the 3 moons into the Laplace resonance ratio.

(B)   The 3 moons exert regular, periodic gravitational influences on each other, resulting in the Laplace resonance structure.

(C)   Resonances in the proto-satellite disk (akin to the Huygens gap in Saturn's rings), where the 3 moons formed, resulted in the 3 moons following similar periodic ratios as the debris which they were formed from, thus resulting in the Laplace resonance structure observed today.

(D)   Jupiter's Trojan asteroids exert gravitational influences on the 3 moons, locking them into a Laplace resonance structure.

(E)   None of the above.

42. While learning astronomy, Xixun encounters that white dwarfs will cool to form black dwarfs, however we have not found any so far because,

  Ⓐ   They radiate in ultraviolet wavelengths, which are very hard to detect.

  Ⓑ   The electron degeneracy pressure causes a black dwarf to immediately turn back into a white dwarf; black dwarf is an unstable state.

  Ⓒ   The universe is not old enough to host black dwarfs.

  Ⓓ   Black dwarfs cannot exist for a long time because low energy causes them to collapse and undergo supernova.

  Ⓔ   Black dwarfs are repelled by interstellar gas, which keeps them from forming in any known galaxy.

43. Why is there a notable absence of ground-based observatories operating in the gamma, X-ray and ultraviolet bands of the electromagnetic (EM) spectrum?

  Ⓐ   Due to light pollution, it is difficult to detect shorter wavelengths of EM radiation in ground-based observatories.

  Ⓑ   Earth's atmosphere absorbs most of these shorter wavelengths of EM radiation, making them difficult to observe from ground-based observatories.

  Ⓒ   Current technology to detect these wavelengths of EM radiation are simply too expensive to be feasible for astronomy research.

  Ⓓ   Current observatories that operate in the visible spectrum, near-infrared and radio wavelengths are more than sufficient to conduct astronomy research.

  Ⓔ   Actually, there are ground-based observatories that operate in the gamma, X-ray and ultraviolet bands of the EM spectrum.

44. KY is an eccentric astronomer. He only looks at funny DSOs. Table 3 shows information about some DSOs KY wishes to observe.

Name	Right Ascension	Declination	Apparent Magnitude
Heart Nebula	2h32m44.07s	+61°27′13.4″	6.50
Jolly Roger Cluster	4h07m52.71s	+62°20′02.2″	6.90

Table 3: Question 44.

If KY observes the Heart Nebula culminating in Singapore at 22:08:19 local time, when will KY observe the Jolly Roger Cluster culminating at the same location?

  Ⓐ   Same time as Heart Nebula, because their Declination is very close.

  Ⓑ   23:43:28 local time

  Ⓒ   20:33:10 local time

  Ⓓ   21:37:19 local time

  Ⓔ   It will never culminate.

45. The wavelength of the Lyman-alpha line in the hydrogen spectrum is measured in the laboratory to be 122 nm. In the hydrogen spectrum of a galaxy, the Lyman-alpha line is measured to be 129 nm. Determine the distance of this galaxy from the Earth.

(A) 227 Mpc

(B) 240 Mpc

(C) 254 Mpc

(D) 262 Mpc

(E) 275 Mpc

46. The cosmic microwave background was produced during the epoch of recombination, when light decoupled from matter and could travel freely through the universe. This decoupling happened because:

(A) The density of matter in the universe has decreased sufficiently so that the mean free path of photons becomes much larger than the width of a proton.

(B) The electroweak interaction underwent symmetry breaking and separated into the electromagnetic and weak interactions.

(C) The temperature has cooled enough for neutral hydrogens to form from an ionized plasma of electrons and protons.

(D) The temperature has cooled enough for gas clouds to collapse and heat up, resulting in the reionization of hydrogen and production of h-alpha radiation.

(E) The temperature has cooled sufficiently so that matter in the universe is no longer emitting blackbody radiation at high intensities.

47. In 1588, Tycho Brahe published the Tychonic system, which is a geoheliocentric model in which the Sun, the Moon and stars revolve around the Earth, and other five planets (Uranus and Neptune were not yet discovered) revolve around the sun.

Back when it was proposed, it was a major competitor, along with the Copernican heliocentric model, as an alternative to the Ptolemy's geocentric model.

However, the scientific community eventually replaced the Tychonic model with the Copernican model. Which one of the following observations could have contributed to the support for Copernicus' heliocentric model **over the Tychonic model**?

(A) The observed seasonal change of the declination of the Sun on the celestial sphere.

(B) The observation of the retrograde motion of Mars.

(C) The observation of the phases of Venus in 1610.

(D) The observation of stellar parallax of 61 Cygni in 1838.

(E) All of the above.

48. It is common advice to look away from the radiant point while observing a meteor shower. Is this true and why?

$\;$ (A)   True. Meteors will appear to have longer streaks away from the radiant point; an observer should be looking away.

$\;$ (B)   True. In order to best protect oneself from meteorites that fall to the ground, an observer should be looking away.

$\;$ (C)   Not true. Since the meteor shower originates from the radiant point, most meteors can be easily seen at that point.

$\;$ (D)   Not true. Since meteors can penetrate through a thick layer of clouds, the meteor shower will be clearest at the radiation point - even on a cloudy night.

$\;$ (E)   It does not matter if one looks towards or away from the radiant point.

49. Which of the following is true about the Hayashi Track?

$\;$ (A)   Stars along this track are continuously expanding, until the temperature cools down and gravity pulls it inwards, starting nuclear fusion and entering the Main Sequence.

$\;$ (B)   Stars along this track are continuously decreasing in temperature, but at a constant luminosity.

$\;$ (C)   Stars along this track are continuously contracting, but at the same temperature, resulting in a decrease in luminosity.

$\;$ (D)   Stars along this track are called the Main Sequence stars, and have started fusing hydrogen into helium (e.g., our Sun).

$\;$ (E)   Stars who ride along this track include Max Verstappen.

Use the following information to answer Question 50.

SKA - Low is a radio telescope being built in Western Australia and is set to be the biggest radio telescope in the world when it is completed in 2028. It uses 131,072 log-periodic antennas spread between 512 stations at a length around 75km. The antennas are arranged in an interesting shape as shown in Figure 8.

Figure 8: Question 50. [3]

50. Which of the following best explains why the antennas are in a Christmas tree shape?

(A) Antennas are stacked vertically on top of each other to filter out unnecessary wavelengths of light for higher sensitivity.

(B) Antennas of different lengths are able to capture different frequencies - longer antennas for lower frequencies and shorter antennas for higher frequencies. This allows scientists to study the universe in a range of frequencies.

(C) Some antennae are used for communication between 'trees' while only some are used in observing the night sky.

(D) The Christmas tree shape provides the best structural stability against weather conditions such as sandstorms and rain.

(E) The engineers who designed SKA - Low proposed their plan on Christmas day.

References

[1] Sky-Watcher Global. *DOB 6" Traditional*. n.d. URL: https://skywatcher.com/product/dob-6-traditional/ (visited on 19/05/2025).

[2] NASA, ESA, CSA, STScI, J. DePasquale, A. Koekemoer, A. Pagan, ESA/Hubble, and The Hubble Heritage Team. *Hubble and Webb Showcase the Pillars of Creation (Slider Tool)*. Accessed: 2025-05-19. ESA/Webb. 2022. URL: https://esawebb.org/images/comparisons/weic2216/.

[3] SKA Observatory. *SKA-Low*. Accessed: 2025-05-19. SKA Observatory. n.d. URL: https://www.skao.int/en/explore/telescopes/ska-low.