

ASTROCHALLENGE 2022 JUNIOR MCQ ROUND

Saturday 4^{th} June 2022

PLEASE READ THESE INSTRUCTIONS CAREFULLY.

- 1. This paper consists of **24** printed pages, including this cover page.
- 2. You are required to keep your microphone and camera on at all times throughout the round.
- 3. You are not allowed to use your keyboard at all times, but you may use your mouse to scroll through the question paper as well as switch to the formula booklet.
- 4. Any materials other than the Question Paper and Formula Booklet are strictly prohibited.
- 5. 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.
- 6. Write your answers on a piece of A4 paper. Write your **Name**, **School**, and **Team Number** at the **bottom right corner** before taking a photo to submit. Failure to conform to this may result in us being unable to find the owner of the script.
- 7. It is *your* responsibility to ensure that your answer script has been submitted.

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- 1. The location is Singapore. If Scorpius crosses the meridian at 9 p.m., what season are we in?
 - (A) Spring
 - (B) Summer
 - (C) Autumn
 - (D) Winter
 - (E) Season of love
- 2. What is one possible reason why Johannes Kepler realised that the orbits of planets are not circular, but elliptical?
 - (A) He was not convinced by the then popular mystical belief that the circle is the Universe's perfect shape.
 - (B) He observed that Uranus appeared to suddenly reverse course.
 - (C) He realised that the radial line drawn from the Sun to a planet sweeps out equal areas in equal intervals of time and the planet travelled faster near the Sun.
 - (D) He realised that the arc lengths travelled by a planet in equal intervals of time are equal.
 - (E) Trick question. The orbit of any planet is circular because the planet must be at a constant radius away from the Sun in order to maintain a stable orbit.
- 3. Which set of stars will all be observable in the evening of 12 July 2022 in Singapore?
 - (A) Pollux, Betelgeuse, Regulus
 - (B) Deneb, Procyon, Vega
 - (C) Antares, Spica, Rigil Kentaurus
 - (D) Options A, B and C are all correct
 - (E) None of the options above

- 4. Below are listed several telescopes.
 - I Hubble Space Telescope (191 nm, D = 2.4 m, f/24)
 - II James Webb Telescope (600 nm, D = 6.5 m, f/20)
 - III Parkes Radio Observatory (1 mm, D = 18 m, f/16)
 - IV X-Ray household telescopes (10 nm, D = 10 cm, f/12)

Which one of these telescopes can theoretically resolve Olympus Mons (21.9 km) anytime in their respective wavelengths? Assume circular orbits for the solar system planets.

- (A) I only
- (B) I and II only
- (C) I, II and III only
- (D) I, II, III and IV
- (E) None of the telescopes
- 5. What is a pulsar?
 - (A) It is a supermassive blackhole with an accretion disc. As matter in the accretion disc falls into the black hole, energy is emitted as electromagnetic radiation and detected.
 - (B) It is a star undergoing stellar nucleosynthesis. Its luminosity varies with a fixed period caused by processes within the star.
 - (C) It is a neutron star rotating rapidly. Beams of electromagnetic radiation are emitted from its magnetic poles.
 - (D) It is a radio pulse lasting around milliseconds. Its origin is unknown.
 - (E) It is a strong pulse of gravitational wave produced when two compact objects merge.

- 6. Which of the following could be a possible cause of blurred image in a telescope?
 - I Magnification is too high
 - II Environmental factors
 - III Collimation
 - (A) Statements I and II only
 - (B) Statements II and III only
 - (C) Statements I, II and III
 - (D) Statement II only
 - (E) None of the statements
- 7. Why is each cycle of meteor showers about a year? Example: the Geminid meteor shower occurs around December every year.
 - (A) The meteors come from the ice and dust of a comet/celestial body at the constellation the meteor shower is named after. Hence, every year when the specific constellation rises into view at night, the meteor shower occurs.
 - (B) The meteors come from the ice and dust of a comet/celestial body. After passing through our solar system, the body results in meteors which are stationary at the same location on the Earth's orbit around the Sun. Hence, every year when the Earth passes the specific region, the meteor shower occurs.
 - (C) The meteors come from the ice and dust of a comet/celestial body. The ice and dust form an orbit similar to the body's original path around the sun. This orbital path coincides with the Earth's orbit at a particular point. Hence, every year when the Earth reaches this point, the meteor shower occurs.
 - (D) There is a physical reason, but it is none of the reasons given above.
 - (E) There is no physical reason, it is purely coincidental.
- 8. Water vapour has been observed on the surface of Europa, leading scientists to believe that there is a subsurface ocean on this Julian moon. How does liquid water exist so far away from the Sun?
 - (A) The volcanic activity of Io heats up Europa and hence allowing for the presence of an ocean on Europa.
 - (B) Tidal heating of Europa by the gravitational pull of Jupiter heats up the interior of the moon and allows the ocean to remain as a liquid.
 - (C) Frequent asteroid impacts on Europa influenced by the gravitational pull of Jupiter heats up the surface of Europa, causing its icy surface to melt and form an ocean.
 - (D) Europa has a thick atmosphere which traps radiation from the Sun, allowing for heating of its surface.
 - (E) Microbial lifeforms are present under this subsurface ocean, which undergo exothermic processes, therefore generating heat and keeping the ocean warm.

- 9. Arrange the following spectral classes from highest to lowest surface temperature:
 - (A) A,F,G,K,M
 - (B) F,A,G,M,K
 - C F,A,G,K,M
 - (D) A,F,K,G,M
 - (E) K,A,F,M,G

10. Which of the following definitions best describes a brown dwarf?

- (A) A very young star that is still accreting gas from its parent molecular cloud.
- (B) A stellar remnant that is supported by electron degeneracy.
- (C) The smallest and coolest type of star that also lies on the main sequence.
- (D) A sub-stellar object that is unable to fuse ordinary hydrogen into helium, but is massive enough to undergo deuterium fusion at some point in its lifespan.
- (E) An astronomical object orbiting a star, that is massive enough to be rounded by its own gravity (but not massive enough to undergo fusion) and has cleared its surrounding orbital region.

11. Identify objects X and Y.

Object X	Object X consists of a group of stars who were apparently named
	after Atlas's daughters. Object X is quite spread out in the night
	sky due to its closeness with the Earth. In fact, it has an apparent
	diameter of 330'. It can be seen with the naked eye in Singapore
	and can be easily located in northern hemisphere winter.
Object Y	Object Y is named after the constellation which it is in. Assuming
	that you are in a reasonably suburban site, it is the furthest object
	you can expect to see. Because of its size of more than a degree
	across, it is best observed with a pair of binoculars instead of a
	telescope.

- (A) The Double Cluster and Omega Centauri
- (B) The Hyades and Omega Centauri
- (C) The Double Cluster and Andromeda Galaxy
- (D) The Hyades and 47 Tucana
- (E) The Hyades and Andromeda Galaxy
- 12. Suppose I tracked Lambda Orionis (also known as Meissa, the "head" star of Orion) throughout the year. Due to systematic and random errors, the parallax obtained for the star was 2.700 milliarcseconds. The literature value of the distance of Lambda Orionis from the Earth is about 1108 light years. What is the percentage error of my measurement?
 - (A) -93.46%(B) -8.23%
 - (C) +162.79%
 - (D) -8.96%
 - (E) +292.30%

JUNIOR MCQ ROUND

QUESTION VOIDED

[Turn over]

14. The theoretical and experimental rotational curves of galaxies can be seen in the figure below (source: Wikipedia). Curve A is the predicted rotational curve. As the distance from the galactic core increases, Kepler's third law predicts the rotational velocity to decrease. However, observational results show that this does not hold true as seen in curve B. Currently, what is the most popular answer for this problem?



- (A) Modifying Newtonian Gravity by modelling the gravitational force experienced by a star in the edges of a galaxy to be proportional to its centripetal acceleration.
- (B) The redshift of the galaxies is not completely accounted for when measuring the rotational velocity of galaxies, hence leading to larger than expected measurements.
- (C) The difference in rotational curves is theorised to be explained using gravitoelectromagnetism.
- (D) Theorising the presence of large amounts of dark matter to account for the apparent discrepancy in mass required for such high velocities at the edges of the galaxy.
- (E) None of the above.

15. A sextant is an instrument commonly used in navigation. It works by measuring the angle between an astronomical object and the horizon. One typical example of use is to measure the angle between the sun and the horizon at local solar noon to calculate the latitude of the observer.



Basically, the angle between the 2 objects (in the example, the Sun and the Horizon) is read directly off the scale. The sextant scale is typically one-sixth of a circle, thereby giving the instrument its name of "Sextant".

Clarence decided one day to go on a voyage to nowhere, taking into account pandemic restrictions and all. He chartered a sailboat but discovered that they do not have a GPS onboard. Luckily, Clarence brought along his handy Sundial and a sextant similar to the one as depicted above.

On a day close to the summer solstice, Clarence decides to use the sextant for celestial measurements at local midnight. He has managed to locate Altair in Aquila close to the local meridian. He only remembers the declination of the Altair to be around 9°. He sees another star and measures the angle between the 2 objects to be around 35°. What can this star be?

- (A) Trick Question: Not enough information is provided.
- (B) Capella (5h 18m, $+46^{\circ}01m$)
- (C) Castor (7h $36m, +31^{\circ}50m$)
- (D) Polaris (2h 56m, $+89^{\circ}15m$)
- (E) Vega (18h $38m, +38^{\circ}48m$)

16. Which of the following statements about the planets in our solar system are true?

- I Neptune and Uranus are named ice giants because they are made of frozen water.
- II Venus is the second brightest object in the night sky after the Moon.
- III Mercury is not tidally locked with the Sun in a 1:1 ratio.
- IV Saturn's rings are purely made of ice.
- (A) II and III only
- (B) I and IV only
- (C) I, II and III only
- (D) II, III and IV only
- (E) All statements are true

17. The following graph (Meadows *et al.*, 2018) shows the spectral flux across different wavelengths for Proxima Centauri.



What is the approximate surface temperature of Proxima Centauri?



18. Which of these stars cannot be observed by an observer at Toronto, Canada (43.6532° N)?

- (A) Vega
- (B) Rigil Kentaurus
- (C) Sirius
- (D) Arcturus
- (E) None of the above.

- 19. The Sun's analemma shows the apparent change in the Sun's position. It is captured on a fixed location on Earth at the same mean solar time throughout the year. In a composite photo, the sun's movement will form a somewhat asymmetrical 'number 8' shape. Below are some proposed contributing factors for the shape of the Sun's analemma:
 - I Eccentricity of the Earth's orbit around the Sun
 - II Difference between the Earth's synodical and sidereal day
 - III The Earth's axis tilt relative to the ecliptic plane

Which of them are valid contributing factors?

- (A) I and II only
- (B) I and III only
- (C) II and III only
- (D) I, II and III
- (E) None of the above

20. A Saros cycle is a period of exactly 223 synodic months (approximately 18 years, 10 days and 8 hours) and can be used to predict future solar and lunar eclipses. After each Saros cycle the Sun-Earth-Moon geometry will almost be identical, with the only difference being the Earth rotating an extra 120° to account for the 8 hours. Here is a table of solar eclipses of the past three years.

Year	Date	Eclipse type	Magnitude	Region of maximal phase
2019	6 Jan	Partial	0.7145	Sakha, Russia
2019	2 Jul	Total	1.0459	Southern Pacific Ocean
2019	26 Dec	Annular	0.9701	Riau, Indonesia
2020	21 Jun	Annular	0.994	Uttarakhand, India
2020	14 Dec	Total	1.0254	Río Negro, Argentina
2021	10 Jun	Annular	0.9435	Nunavut, Canada
2021	4 Dec	Total	1.0367	Weddell Sea, Antarctica

The red path in the figure below shows the eclipse path for 26 December 2019 solar eclipse.



Where will the 5 January 2038 solar eclipse occur?

- (A) Option A
- (B) Option B
- (C) Option C
- (D) Option D
- (E) None of the above.

- 21. On Oct. 19, 2017, Robert Weryck, a researcher at the University of Hawaii, discovered a strange object with unknown origins, which Astronomers later named Oumuamua. Oumuamua had an orbit around the Sun with eccentricity 1.20 and had a non-gravitational acceleration. There was also no observable out-gassing. Below are some statements about Oumuamua:
 - I An orbital eccentricity of 1.20 suggests that Oumuamua is a comet from the Oort Cloud.
 - II An orbital eccentricity of 1.20 suggests that Oumuamua is an interstellar object.
 - III Non-gravitational acceleration with no observable out-gassing suggest that Oumuamua contains water ice.
 - IV Non-gravitational acceleration with no observable out-gassing suggest that Oumuamua contains hydrogen ice or nitrogen ice, but not water ice.
 - V It is more likely for Oumuamua to contain nitrogen ice than hydrogen ice because if it had hydrogen ice, they would have evaporated on its journey to the solar system.
 - VI It is more likely for Oumuamua to contain nitrogen ice than hydrogen ice because nitrogen is more abundant in its parent stellar system.

Which statement(s) is/are well-reasoned and supported by observation?

- (A) I and III only
- (B) I, IV and V only
- (C) II and III only
- (D) II, IV and V only
- (E) II, IV and VI only
- 22. What is a planet?
 - I It must orbit at least one star.
 - II It can be in any shape.
 - III It must have cleared the neighborhood around its orbital path.
 - (A) I only
 - (B) I and II only
 - (C) II and III only
 - (D) I and III only
 - (E) I, II and III

23. Which is the best reason why water is regarded as being essential for life to occur?

- (A) Water has strong surface tension.
- (B) Water can exist in all three matter states simultaneously under certain conditions.
- (C) All chemical reactions require water to occur.
- (D) Water molecules can form extensive hydrogen bonds.
- (E) Water is a strong infrared absorber.
- 24. On a cloudless night in Singapore, you observe the moon setting in the West and notice that it has a crescent shape that smiles upon you. What phase is the moon currently in?
 - (A) Waning gibbous
 - (B) Waxing gibbous
 - (C) Waning crescent
 - (D) Waxing crescent
 - (E) Not enough information to determine
- 25. Southern Pleiades rose from the horizon at 9.12 p.m. on 1 February 2022 in Singapore. What time did it rise on 1 March 2022?
 - A 17 22
 - (B) 19 22
 - (C) 21 12
 - (D) $23\ 02$
 - (E) 23 20

	1)	SATURN	URANUS	2)	3)	VENUS	EARTH	NEPTUNE
4)	5427	687	1271	3933	1326	5243	5514	1638
Gravity (m/s2)	3.7	9	8.7	3.7	23.1	8.9	9.8	11
5)	4.3	35.5	21.3	5	59.5	10.4	11.2	23.5
Rotation Period (hours)	1407.6	10.7	-17.2	24.6	9.9	-5832.5	23.9	16.1
Length of Day (hours)	4222.6	10.7	17.2	24.7	9.9	2802	24	16.1
Orbital Inclination (degrees)	7	2.5	0.8	1.9	1.3	3.4	0	1.8
Obliquity to Orbit (degrees)	0.034	26.7	97.8	25.2	3.1	177.4	23.4	28.3
Mean Temperature (C)	167	-140	-195	-65	-110	464	15	-200

26. Refer to the chart below.

Choose the correct answer:

A	1) Mercury	2) Mars	3) Jupiter	4) Mass (10^{24} kg)	5) Radius (10^8 m)
B	1) Mercury	2) Mars	3) Jupiter	4) Density (kg \cdot m ⁻³)	5) Escape velocity (km \cdot s^{-1})
\bigcirc	1) Mars	2) Jupiter	3) Mercury	4) Radius (10^8 m)	5) Mass (10^{24} kg)
\bigcirc	1) Mars	2) Jupiter	3) Mercury	4) Radius (10^8 m)	5) Escape velocity (km \cdot s^{-1})
E	1) Jupiter	2) Mars	3) Mercury	4) Density (kg \cdot m ⁻³)	5) Escape velocity (km \cdot s^{-1})

27. Which of the following statements about the possibility of extra-terrestrial life is/are true?

I Population II stars are less likely to have exoplanets that harbour life than Population I stars.

- II The Drake Equation is not a good indicator of the possibility of extra-terrestrial life because it is more concerned with intelligent life than microbial life.
- III It is not possible for an exoplanet outside its parent star's habitable zone to harbour life.
- (A) II only
- (B) III only
- (C) II and III only
- (D) I and II only
- (E) I, II and III

- 28. Given that the total energy of an object orbiting around the Sun is calculated to be exactly 0. What orbit can the object achieve?
 - (A) Circular(B) Elliptic(C) Parabolic
 - (D) Hyperbolic
 - (E) Trick question: The energy of an object orbiting the Sun cannot be 0.
- 29. Identify the object circled red in the image below.



- (A) Betelgeuse
 (B) Fomalhaut
 (C) Regulus
 (D) Vega
 (E) None of the above
- 30. A star of absolute magnitude 0.5 is observed to have an apparent magnitude of 5. How far is the star away from Earth?
 - (A) 1.25 pc
 (B) 10.0 pc
 (C) 79.4 pc
 - (D) 86.2 pc
 - (E) 126 pc

31. Ganymede, the largest moon of Jupiter, has a mean orbital radius of 1.07×10^9 m. The orbital period of Ganymede is 172 hours. Europa, another moon of Jupiter, orbits at a mean radius of 6.70×10^8 m. How much time does it take for Europa to orbit Jupiter?



- (B) 75 hours
- (C) 65 hours
- (D) 55 hours
- (E) None of the above

32. "It is a beautiful winter night. Perseus is visible in the North. With a pair of binoculars aimed at the brightest star in Perseus, you would be able to see the Alpha Persei Cluster. Looking further East, the red dwarf Capella is bright and visible. Tracing the stars nearby in an irregular hexagonal shape, the constellation Auriga takes shape. Looking upwards from Auriga and Perseus towards the South, the brighter stars of Sagittarius form the distinct teapot asterism."

Which sentence in this paragraph is wrong if the rest of the paragraph is correct?

- (\mathbf{A}) "It is a beautiful winter night."
- (B)"Perseus is visible in the North."
- (C)"Tracing the stars nearby in an irregular hexagonal shape, the constellation Auriga takes shape."
- (D)"Looking upwards from Auriga and Perseus towards the South, the brighter stars of Sagittarius form the distinct teapot asterism."
- (E)Trick question: All sentences in the paragraph are correct.
- 33. Mr Loh is an archeologist studying the writing of ancient civilisations. Someone claims to have found a 5000-year-old inscription that describes how an ancient tribe navigated. Based on the descriptions of the sky in the inscription, it seems that the tribe used the star Polaris as a way to indicate the northern direction, thus aiding in navigation. Mr Loh immediately identifies the inscription as a forgery. Why?
 - (\mathbf{A})
 - Writing was not invented until 2000 BC.
 - (B)Polaris was not the north star 5000 years ago.
 - (C)Polaris was not visible to the naked eye 5000 years ago.
 - (D)None of the reasons above
 - (E)Mr Loh is mistaken and the inscription cannot be identified as a forgery with the information given.
- 34. The distance between the Sun and Venus at aphelion and perihelion is 108.9 million km and 107 million km respectively. Calculate the orbital eccentricity.
 - (A) 7.2830×10^{-3}
 - (B) 8.8004×10^{-3}
 - (C) 7.2830×10^{-2}
 - (D) 8.8004×10^{-2}
 - (E) 9.8255×10^{-1}

35. We do not expect to find life on planets orbiting around high-mass stars because

- (A) the stars are too hot for life to form.
- (B) the stars are too bright.
- (C) the lifetime of a high-mass star is too short.
- (D) planets cannot have stable orbits around high-mass stars.
- (E) extraterrestrial life does not exist.
- 36. Many ancient monuments were built to align to equinoxes, solstices, or stars. Which of the following alignments would still be accurate today?
 - I Stonehenge was built around 3000 BC such that during the summer solstice, the sun rises directly above the Heel Stone.
 - II The Mnajdra temples on Malta consist of three structures built over a period of a thousand years beginning around 3600 BC. It was built such that the spring equinox sunrise bisects the entrance to the Lower Temple, shining light through the main passageway and into a small shrine.
 - III Great Pyramids of Sneferu, Khufu and Khafre built about 4700 years ago was hypothesised to be built such that they directly pointed to the star Thuban.
 - (A) I only
 - (B) III only
 - (C) I and II only
 - (D) I, II and III
 - (E) None of the alignments
- 37. Blackholes are given their name as their gravitational pull is so strong that even light cannot escape from within. Which of the following is not a way whereby blackholes can be identified?
 - (A) Accretion of neighbouring stellar materials
 - (B) Gravitational waves
 - (C) Type II supernova
 - (D) Gravitational influence on nearby stars
 - (E) Hawking radiation

- 38. The following statements describe the life stages of certain stars. Which of the following statements (arranged in chronological order) describe the major life stages of a solar mass star?
 - I Helium starts to run out in the core of the star.
 - II The star expels its outer layers, forming a planetary nebula with a white dwarf in its center.
 - III Hydrogen fusion begins and the star lies on the main sequence.
 - IV Carbon fusion begins, creating a carbon star.
 - V The core of the star undergoes a helium flash, commencing helium fusion.
 - VI A nebula begins to contract under its own gravity, forming a protostar at its center.
 - VII Hydrogen in the core begins to run out, and the star evolves into a red giant.
 - (A) III, VI, V, I, II
 - (B) III, VI, VII, IV, II
 - (C) VI, III, VII, V, I, IV, II
 - (D) VI, III, VII, I, II,IV
 - (E) VI, III, VII, V, I, II
- 39. Which of the following statements is true and can be accounted for by the Cosmological Principle?
 - (A) The observable universe is finite in size.
 - (B) Every observable galaxy is moving away from us.
 - (C) The cosmic microwave background radiation is highly isotropic.
 - (D) The distribution of the stars in a suitably dark night sky is roughly uniform.
 - (E) Galaxies exist in filaments separated by voids, in a structure also known as the Cosmic Web.
- 40. During a conversation at 12 a.m. local solar time in Singapore, your crush said that it was her birthday month and she wants to see her zodiac sign, Taurus in the night sky. Trying to impress her, you took up the challenge and tried to look for her zodiac constellation in the night sky. Will you be able to succeed?
 - (A) Yes. The zodiac constellation is visible by naked eye.
 - (B) Yes. The zodiac constellation is visible but only with a pair of binoculars or telescope.
 - (C) No. The zodiac constellation is below the horizon.
 - (D) No. Zodiac constellations are fake and you should leave her immediately.
 - (E) No. The zodiac is near the horizon and blocked by buildings and atmosphere.

41. You asked your crush out for another stargazing session but she said she will only come out when the two brightest superior wandering stars align. Assuming the previous time these two wandering stars aligned was yesterday, how long will you need to wait to finally meet her again?

(Hint: Synodic period formula is $\frac{1}{P} = \frac{1}{E} - \frac{1}{S}$, where P is the period between conjunction, E is the orbital period of the inner planet and S is the period of the outer planet.)

- (A) About 2 days :)
- (B) About 2 weeks :
- (C) About 2 months :(
- (D) About 2 years :'(
- (E) About 20 years T.T
- 42. A rock is dropped from rest into a crevasse on the moon. What is the speed of the rock just before it hits bottom 10 seconds later?



- (B) $9.81 \text{ m} \cdot \text{s}^{-1}$
- (C) 5.15 m $\cdot s^{-1}$
- (D) 16.0 m \cdot s⁻¹
- (E) 98.1 m \cdot s⁻¹
- 43. Isabel is setting up the telescope for a private viewing session with her friends. She wants to show them Saturn (currently at an altitude of 70°) and determines that a magnification of 300 times would be the ideal. Given that she owns a Schmidt-Cassegrain NexStar 6SE telescope with a focal length of 1500 mm, and that she has the following items with her:

Eyepiece: 4 mm, 10 mm, 12 mm, 26 mm and 32 mm

Barlow: $2\times$ and $5\times$

1 Star Diagonal

What combination of the accessories should she use for the best viewing experience?

- (A) 10 mm eyepiece, $2 \times$ barlow
- (B) 12 mm eyepiece, $2 \times$ barlow
- (C) 4 mm eyepiece, star diagonal
- (D) 12 mm eyepiece, $2 \times$ barlow, star diagonal
- (E) 26 mm eyepiece, $5 \times$ barlow, star diagonal

44. Which one of the following stars is not a part of the winter hexagon?

- (A) Aldebaran
- (B) Betelgeuse
- (C) Capella
- (D) Pollux
- (E) Rigel
- 45. In 1924, Edwin Hubble measured the distance to the Andromeda nebula, which firmly established it as a separate galaxy outside our own Milky Way. What did he measure to allow him to calculate the distance of Andromeda?
 - (A) Cepheid variables
 - (B) Galactic redshift
 - (C) Gamma-ray bursts
 - (D) Parallax
 - (E) Rotational Doppler shift (Tully-Fisher relation)
- 46. How many of the following statements are True?
 - I The declination of the star at your local zenith will be equals to your latitude.
 - II Stars with the same Right Ascension (R.A.) will rise and set at the same time.
 - III The R.A. of the stars on your local Meridian will tell you your civil time.
 - IV At least 1 zodiacal constellation lies above the horizon within a 24 hr period.
 - $(A) \quad 0$
 - (B) 1
 - (C) 2
 - (D) 3
 - (E) 4

- 47. What magnification would a refractor telescope give if the main objective lens has an aperture of 150 mm and a focal ratio of f/10, and the eyepiece a focal length of 25 mm?
 - $(A) \quad 6 \times$
 - (B) 17×
 - (C) 60×
 - (D) 170×
 - $(E) \quad 600 \times$

48. Which of the following stars does not belong to the constellation?

- (A) Arcturus, Leo
- (B) Rigel, Orion
- (C) Sirius, Canis Major
- (D) Spica, Virgo
- (E) Vega, Lyra

49. Which of the following statements is generally **false** about globular and open clusters?

- (A) Open clusters have irregular shapes.
- (B) Globular clusters are older than open clusters.
- (C) Open clusters normally appear in the disk of the galaxy.
- (D) Globular clusters contain more stars than open clusters.
- (E) None of the above
- 50. You would like to maximise your view of the Pleiades star cluster (110') in your eyepiece. Given the following details of your telescope, which eyepiece should you choose? (1 inch = 2.54cm)

Telescope: 5-inch aperture, f/6

- (A) 35 mm focal length, 40° apparent field-of-view
- (B) 30 mm focal length, 50° apparent field-of-view
- (C) 25 mm focal length, 60° apparent field-of-view
- (D) 20 mm focal length, 50° apparent field-of-view
- (E) 15 mm focal length, 60° apparent field-of-view