

SPACE SCIENCE

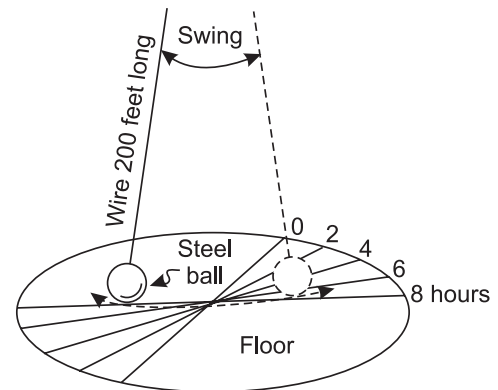
Direction: Base your answers to questions 1 through 4 in the table below, which shows eight inferred stages describing the formation of the universe from its beginning to the present time.

Data Table

	Description of the Universe	Temperature	Time From the Beginning of Universe
1	the size of an atom	?	0 second
2	the size of a grapefruit	?	10^{-43} seconds
3	“hot soup” of electrons	10^{27}	10^{-32} seconds
4	Cooling allows protons and neutrons to form.	10^{13}	10^{-6} seconds
5	Still too hot to allow the forming of atoms	10^8	3 minutes
6	Electrons combine with protons and neutrons, forming hydrogen and helium atoms. Light emission begins.	10,000	300,000 years
7	Hydrogen and helium form giant clouds (nebulae) that will become galaxies. First stars form	-200	1 billion years
8	Galaxy clusters form and first stars die. Heavy elements are thrown into space, forming new stars and planets.	-270	13.7 billion years

- How soon did protons and neutrons form after the beginning of the universe?
 - 10^{-43} second
 - 10^{-32} second
 - 10^{-6} second
 - 13.7 billion years
- What is the most appropriate title for this table?
 - The Big Bang Theory
 - The Theory of Plate Tectonics
 - The Law of Superposition
 - The Laws of Planetary Motion

- According to this table, the average temperature of the universe since stage 3 has
 - decreased, only
 - increased, only
 - remained the same
 - increased, then decreased
- Between which two stages did our solar system form?
 - 1 and 3
 - 3 and 5
 - 6 and 7
 - 7 and 8
- The diagram below represents a Foucault pendulum swinging freely for 8 hours.



The Foucault pendulum appears to gradually change its direction of swing due to Earth's

- orbit around the Sun
 - curved surface
 - tilted axis
 - spin on its axis
- During nighttime cooling, most of the energy radiated by Earth's oceans into space is
 - ultraviolet rays
 - gamma rays
 - visible light rays
 - infrared rays

7. Which observation provides the best evidence that Earth revolves around the Sun?
- (1) Stars seen from Earth appear to circle Polaris.
 - (2) Earth's planetary winds are deflected by the Coriolis effect.
 - (3) The change from high ocean tide to low ocean tide is a repeating pattern.
 - (4) Different star constellations are seen from Earth at different times of the year.
8. The Sun's position in space is best described as the approximate center of
- (1) a constellation
 - (2) the universe
 - (3) the Milky Way galaxy
 - (4) our solar system
9. Compared to Pluto, Mercury moves more rapidly in its orbit because Mercury
- (1) is larger
 - (2) is more dense
 - (3) is closer to the Sun
 - (4) has a more elliptical orbit
10. One factor responsible for the strength of gravitational attraction between a planet and the Sun is the
- (1) degree of tilt of the planet's axis
 - (2) distance between the planet and the Sun
 - (3) planet's period of rotation
 - (4) amount of insolation given off by the Sun
11. When astronomers look at distant galaxies, what sort of motion do they see?
- (1) The galaxies are all spinning rapidly.
 - (2) The galaxies are all moving rapidly toward us.
 - (3) The galaxies are all moving rapidly away from us.
 - (4) Galaxies are falling toward three centres in opposite parts of the sky.
12. What is meant by the redshift?
- (1) The galaxies are growing redder as we watch.
 - (2) The galaxies are cooling off.
 - (3) The spectrum lines of the galaxies are shifted to redder wavelengths.
 - (4) Only (1) and (2)
13. What do astronomers infer from the motion of the distant galaxies?
- (1) The Universe is contracting.
 - (2) The Universe is expanding.
 - (3) The Universe is imploding.
 - (4) The Universe is spinning.
14. Astronomers have found the cosmic microwave background (CMB) radiation. What is the nature of this radiation?
- (1) It is a bright, uniform, X-ray glow.
 - (2) It is a faint, uniform, radio signal.
 - (3) It is a faint, uniform, X-ray glow.
 - (4) It is a weak and very patchy glow at visible wavelengths.
15. How was the cosmic microwave background created?
- (1) The fusion of H into He by the first stars.
 - (2) The radioactive decay of uranium.
 - (3) The formation of quarks in the big bang.
 - (4) The burst of radiation from the big bang as it cooled toward 10,000 K.

24. A distant quasar is detected to have a redshift of value = 5.6.

Calculate the speed at which the quasar is currently moving relative to the Earth.

- (1) 8.6 c (2) 5.6 c
(3) 4.6 c (4) 2.6 c

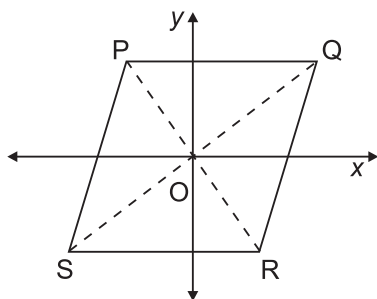
25. Nuclear fusion processes inside stars can only synthesize elements with a nucleon number less than

- (1) 73 (2) 83
(3) 63 (4) 93

26. A star of known luminosity that, when compared with its apparent brightness, can be used to calculate its distance is known as

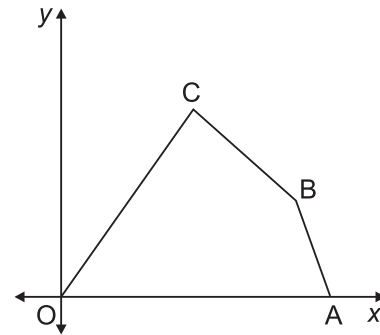
- (1) Apparent brightness
(2) Stellar parallax
(3) Standard candle
(4) Cosmological redshift

27. PQRS is a parallelogram. Coordinates of Q and R are Q(8, 2) and R(4, -2). What would be the coordinates of P, Q, R and S if the parallelogram is shifted so that SR is placed on the x-axis with S as the origin?



- (1) (-4, 4), (-16, -4), (-12, 0) and (0, 0)
(2) (4, -4), (8, 2), (4, -2) and (0, 0)
(3) (4, 4), (16, 4), (12, 0) and (0, 0)
(4) (-4, 2), (16, 4), (12, 0) and (-8, -2)

28. The vertices of quadrilateral OABC are O(0, 0), A(28, 0), B(24, 8) and C(8, 24). Find the midpoint of the line joining the midpoints of \overline{OA} and \overline{BC} .



- (1) (15, 8)
(2) (14, 0)
(3) (16, 16)
(4) (20, 24)
29. Which star's surface temperature is closest to the temperature at the boundary between Earth's mantle and core?
- (1) Sirius
(2) Rigel
(3) the Sun
(4) Betelgeuse
30. Maxwell's equations relate to _____.
- (1) law of gravitation
(2) basic laws of electromagnetism
(3) laws of electrostatics
(4) nuclear model of an atom
31. To measure the distance of a planet from the earth _____ method is used.
- (1) echo
(2) direct
(3) parallax
(4) paradox

32. A _____ is the interval from one noon to the next noon.
- (1) mean solar day
 - (2) solar day
 - (3) lunar day
 - (4) none of these
33. The moon subtends an angle of 57 minute at the base-line equal to the radius of the earth. What is the distance of the moon from the earth? [Radius of the earth = 6.4×10^6 m]
- (1) 11.22×10^8 m
 - (2) 3.86×10^8 m
 - (3) 3.68×10^{-3} km
 - (4) 3.68×10^8 km
34. How many times will the Sun's perpendicular rays cross Earth's Equator between March 1 of one year and March 1 of the next year?
- (1) 1
 - (2) 2
 - (3) 3
 - (4) 4
35. The value of acceleration due to gravity is 980 cm s^{-2} . If the unit of length is kilometre and that of time is minute then value of acceleration due to gravity is
- (1) 980 km min^{-2}
 - (2) 98 km min^{-2}
 - (3) $35.28 \text{ km min}^{-2}$
 - (4) $28.35 \text{ km min}^{-2}$
36. If an artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of the escape velocity from the earth, the height of the satellite above the surface of the earth is
- (1) $2R$
 - (2) $R/2$
 - (3) R
 - (4) $R/4$
37. A satellite is orbiting very close to planet. Its time period depends only upon:
- (1) density of the planet
 - (2) mass of the planet
 - (3) radius of the planet
 - (4) mass of the satellite
38. If suddenly the gravitational force of attraction between Earth and a satellite revolving around it becomes zero, then the satellite will
- (1) continue to move in its orbit with same velocity
 - (2) move tangentially to the original orbit with the same velocity
 - (3) become stationary in its orbit
 - (4) move towards the Earth
39. The escape velocity on the surface of the Earth is 11.2 km/s . If mass and radius of a planet are 4 and 2 times respectively than that of Earth, the escape velocity from the planet will be
- (1) 11.2 km/s
 - (2) 1.112 km/s
 - (3) 15.8 km/s
 - (4) None of these
40. The ratio of the energy required to raise a satellite upto a height R (radius of earth) from the surface of Earth to that required to put it into orbit is
- (1) 1:1
 - (2) 8:1
 - (3) 4:1
 - (4) None of these

INTERACTIVE SECTION

41. If you could travel in a spaceship at the speed of light away from the solar system, how long could you see the Sun?
- (1) 3 years
 - (2) 30 years
 - (3) 300 years
 - (4) 3000 years
42. How far have spacecraft from Earth traveled into space?
- (1) Well over 10 Light-years
 - (2) Well over 1 Light-year
 - (3) Somewhat less than one Light-day
 - (4) A bit less than two Light-years
43. The experimental satellite SROSS abbreviation means
- (1) Stretched Rohini Satellite Series
 - (2) Super Rohini Satellite Series
 - (3) Subsystem Rohini Satellite Series
 - (4) Subcontracted Rohini Satellite Series
44. A particle hanging from a massless spring stretches it by 2 cm at earth's surface. How much will the same particle stretch the spring at height 2624 km from the surface of earth? (Radius of earth = 6400 km)
- (1) 1 cm
 - (2) 2 cm
 - (3) 3 cm
 - (4) 4 cm
45. The gravitational potential difference between the surface of a planet and a point 20 m above it is 16 J/kg. Then the work done in moving a 2 kg mass by 8 m on a slope 60 degree from the horizontal, is
- (1) 11.1 J
 - (2) 5.55 J
 - (3) 16 J
 - (4) 27.7 J
46. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius $1.01 R$. The time period of the second satellite is larger than that of the first one by approximately
- (1) 0.5%
 - (2) 1.5%
 - (3) 1%
 - (4) 3.0%
47. Two spherical bodies having the mass M and $5M$ and radii R and $2R$ respectively are released in free space with initial separation between their centres equal to $12 R$. If they attract each other due to gravitational force only, then the distance covered by the smaller body just before collision is
- (1) 2.5 R
 - (2) 4.5 R
 - (3) 7.5 R
 - (4) 1.5 R
48. The earth is an approximate sphere. If the interior contained matter which is not of the same density everywhere, then on the surface of the earth, the acceleration due to gravity
- (1) will be directed towards the centre but not the same everywhere
 - (2) will have the same value everywhere but not directed towards the centre
 - (3) will be same everywhere in magnitude directed towards the centre
 - (4) cannot be zero at any point

49. As observed from earth, the sun appears to move in an approximate circular orbit. For the motion of another planet like mercury as observed from earth, this would

- (1) be similarly true
- (2) not be true because the force between earth and mercury is not inverse square law
- (3) not be true because the major gravitational force on mercury is due to sun
- (4) not be true because mercury is influenced by forces other than gravitational forces

50. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because

- (1) the solar cells and batteries in satellites run out
- (2) the laws of gravitation predict a trajectory spiralling inwards
- (3) of viscous forces causing the speed of satellite and hence height to gradually decrease
- (4) of collisions with other satellites

51. Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon

- (1) will be elliptical
- (2) will not be strictly elliptical because the total gravitational force on it is not central
- (3) is not elliptical but will necessarily be a closed curve
- (4) deviates considerably from being elliptical due to influence of planets other than earth

52. If the law of gravitation, instead of being inverse-square law, becomes an inverse-cube law

- (1) planets will not have elliptic orbits

- (2) circular orbits of planets is not possible
- (3) there will be no gravitational force inside a spherical shell of uniform density
- (4) both (1) and (2)

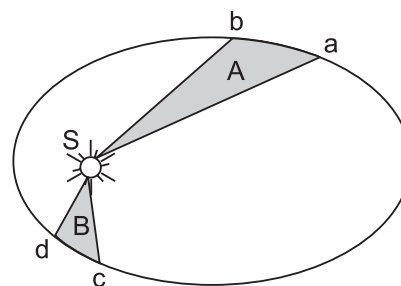
53. Which of the following are true?

- (1) A polar satellite goes around the earth's pole in east-west direction.
- (2) A geostationary satellite goes around the earth in east-west direction.
- (3) A geostationary satellite goes around the earth in west-east direction.
- (4) A polar satellite goes around the earth in east-west direction.

54. Which of these is not a launch vehicle of the Indian Space Research Organisation (ISRO)?

- (1) ASLV
- (2) GSLV
- (3) HSLV
- (4) PSLV

55. The figure shows the motion of a planet around the sun in an elliptical orbit with sun at the focus. The shaded areas A and B are also shown in the figure which can be assumed to be equal. If t_1 and t_2 represent the time for the planet to move from a to b and d to c respectively, then



- (1) $t_1 < t_2$
- (2) $t_1 > t_2$
- (3) $t_1 = t_2$
- (4) $t_1 \leq t_2$

56. Whereas latitude and longitude are the coordinates of places on earth, the coordinates used for star locations are

- (1) ascension and altitude
- (2) right ascension and declination
- (3) declination and altitude
- (4) polar angle and ascension

57. The 2.7 kelvin cosmic background radiation is concentrated in the:

- (1) radio wavelengths
- (2) infrared
- (3) visible
- (4) ultraviolet

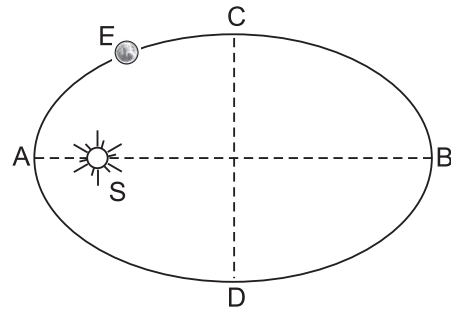
58. Galileo discovered something about Venus with his telescope that shook the old theories. Which of the following was Galileo's discovery?

- (1) Venus was covered in clouds.
- (2) Venus had phases like the moon.
- (3) Venus' surface was similar to the earth's.
- (4) Venus had retrograde motion.

59. In order to derive the law of gravitation, Newton assume that the moon's orbit is

- (1) Circular
- (2) Parabolic
- (3) Uniform
- (4) Straight

60. The earth E moves in an elliptical orbit with the sun S at one of the foci as shown in figure. Its speed of motion will be maximum at the point



- (1) C
- (2) A
- (3) B
- (4) D



END OF THE EXAM