INDIAN ASSOCIATION OF PHYSICS TEACHERS

National Standard Examination in Astronomy - 2025

Date of Examination: November 22, 2025

Time: 2:30 PM to 4:30 PM

Question Paper Code: 41

Student's Roll No:											

Write the Question Paper code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the Question Paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, and iPad during examination is STRICTLY **PROHIBITED.**
2. In addition to this Question Paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the Answer Sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Eleven-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials (means login id and password respectively) for accessing your performance / result in National Standard Examination in Astronomy – 2025.
6. Question paper has two parts. In part A-1 (Q. No.1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.22 

In part A-2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative (s) (1, 2, 3, or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q.No.54 

7. Attempt all sixty questions. For **Part A-1,** each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A-2,** you get 6 marks if all the correct alternatives are marked. No negative marks in this part.
8. Rough work may be done in the space provided. There are **13** printed pages in this question paper
9. Use of **Non - programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting Answer Paper, take away the Question Paper & candidate's copy of OMR sheet for your future reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR Answer Sheet.

Answer Sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in wrong score.

DO NOT WRITE ON THE BACK OF THE ANSWER SHEET.

Instructions to Candidates (Continued) :
You may read the following instructions after submitting the Answer Sheet.

12. **Comments/Inquiries/Grievances regarding this Question Paper, if any, can be shared on the Inquiry/Grievance column on www.iapt.org.in on the specified format till December 1, 2025**

13. **The answers/solutions to this Question Paper will be available on the website: www.iapt.org.in by November 29, 2025.** The score card may be downloaded after Dec 24, 2025

14. **CERTIFICATES and AWARDS:**
Following certificates shall be awarded by IAPT to the students, successful in the NATIONAL STANDARD EXAMINATION IN ASTRONOMY – 2025
(i) "CENTRE TOP 10 %" To be downloaded from iapt.org.in after 30.01.26
(ii) "STATE TOP 1 %" Will be dispatched to the examinee
(iii) "NATIONAL TOP 1 %" Will be dispatched to the examinee
(iv) "GOLD MEDAL & MERIT CERTIFICATE" to all students who attend OCSC – 2026 at HBCSE Mumbai
Certificate for centre toppers shall be uploaded on iapt.org.in

15. List of students (with centre number and roll number only) having a score equal and above **Minimum Admissible Score (MAS)** will be displayed on the website: **www.iapt.org.in** by **December 25, 2025. See the MAS clause** on the Student's brochure on the web.

16. List of students eligible to appear for Indian National Astronomy Olympiad (INAO – 2026) shall be displayed on **www.iapt.org.in** by December 30, 2025.

Physical constants you may need….

Magnitude of charge on electron $e = 1.60 \times 10^{-19}\,C$	Speed of light in free space $c = 3 \times 10^{8}\,ms^{-1}$
Mass of electron $m_e = 9.11 \times 10^{-31}\,kg$	Speed of sound in dry air at 0°C $v = 332\ ms^{-1}$
Mass of proton $m_p = 1.67 \times 10^{-27}\,kg$	Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}\,C^2/Nm^2$
Mass of neutron $m_n = 1.67 \times 10^{-27}\,kg$	Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\,H/m$
Acceleration due to gravity $g = 9.80\,ms^{-2}$	Planck's constant $h = 6.626 \times 10^{-34}\,Js$
Universal gravitational constant $G = 6.67 \times 10^{-11}\,Nm^2/kg^2$	Rydberg constant $R = 1.097 \times 10^{7}\,m^{-1}$
Universal gas constant $R = 8.31\,J/mol\,K$	Astronomical unit $= 1.50 \times 10^{11}\,m$
Boltzmann constant $k = 1.38 \times 10^{-23}\,J/K$	Radius of Sun $R = 6.96 \times 10^{8}\,m$
Stefan's constant $\sigma = 5.67 \times 10^{-8}\,W/m^2K^4$	Mass of Sun $M = 2.0 \times 10^{30}\,kg$
Avogadro's constant $A = 6.022 \times 10^{23}\,mol^{-1}$	Radius of the Earth = 6371 km
Faraday constant $= 96,500\ C/mol$	Mass of the Earth = 5.97×10^{24} kg

INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN ASTRONOMY
(NSEA - 2025)

Time: 120 minute **Max. Marks: 216**

Attempt All Sixty Questions

A – 1

ONLY ONE OUT OF THE FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

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1. In a hypothetical scenario the force experienced by a particle is given by $F = A\,e^{\frac{px}{t^2}} + BV_t^2$, where $V_t = \sqrt{\frac{2mg}{\rho\eta S}}$ is the expression for terminal velocity. Where m is the mass, g is the acceleration due to gravity, ρ is the density of the medium, S is the surface area of the particle, and η is the coefficient of viscosity of the medium. The possible units of *A*, *B* and *p* are

   (a) *A*: newton, *B*: newton kg m^{-1}, *p*: m s^2 (b) *A*: no units, *B*: newton kg m^{-1}, *p*: m^{-1} s^2

   (c) *A*: newton, *B*: kg m^{-1}, *p*: no units (d) *A*: newton, *B*: newton s^2 m^{-2}, *p*: m^{-1} s^2

2. Gravity on the surface of Ganymede, a satellite of Jupiter, is $\left(\frac{1}{7^{th}}\right)$ of that on the Earth, while the gravity on the surface of the Moon is $\left(\frac{1}{6^{th}}\right)$ of that on the Earth. Two identical pendulums are taken one on Ganymede and the other on the Moon. The two pendulums start oscillating together, after how many oscillations on Moon will they come again in the same phase with approximately 1% uncertainty?

   (a) 24 (b) 25 (c) 26 (d) 27

3. Consider two telescopes having equal apertures of 400 mm. One has a focal ratio of $\frac{f}{5}$, the other has the focal ratio of $\frac{f}{10}$. What is the relation between their focal lengths?

   (a) Focal length of the telescope with $\frac{f}{5}$ ratio is twice as compared to the focal length of telescope with $\frac{f}{10}$ ratio.

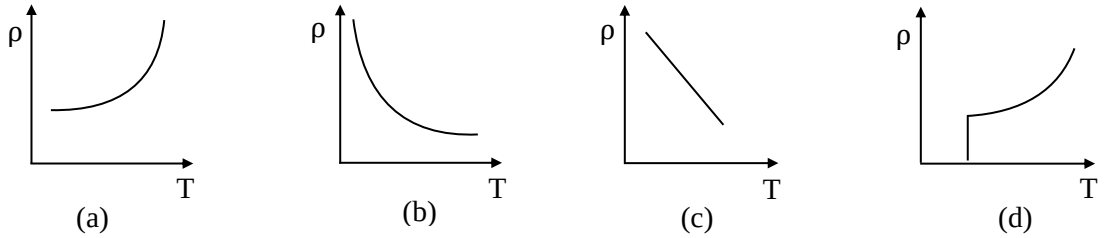
   (b) Focal length of the telescope with $\frac{f}{10}$ ratio is twice as compared to the focal length of telescope with $\frac{f}{5}$ ratio.

   (c) Focal length of the telescope with $\frac{f}{10}$ ratio is four times smaller as compared to the focal length of telescope with $\frac{f}{5}$ ratio.

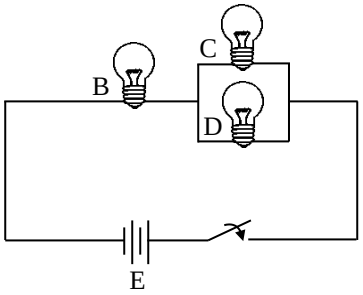
   (d) Focal lengths of both telescopes are the same

4. Statement I:The radius vector of a planet sweeps equal area in equal time while revolving around the Sun.
Statement II: Gravitational force between the Sun and the planet is along the line joining the two.
   (a) Both the Statements are true, and Statement II is correct reason of Statement I.
   (b) Both the Statements are true, but Statement II is not the correct reason of Statement I.
   (c) The Statement I is true and the Statement II is false.
   (d) The Statement I is false and the Statement II is true.

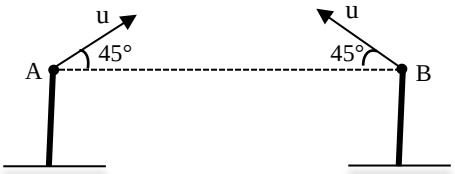
5. Which of the following graphs qualitatively depicts the variation in resistivity of a semiconductor with respect to temperature correctly?



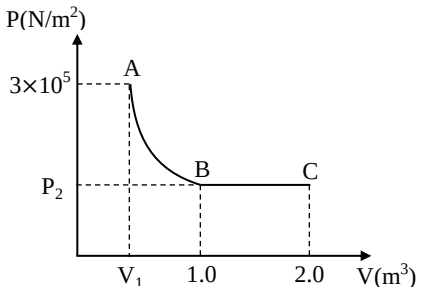
6. Three identical bulbs, B, C and D are connected in a circuit as shown below. By connecting one more identical bulb
   (a) in series with bulb B, the intensity of bulb B will decrease but that of bulb C and D will increase.
   (b) in parallel with bulb B, the intensities of all the three bulbs B, C and D will decrease.
   (c) in parallel with bulbs C and D, the intensities of all the three bulbs B, C and D will increase.
   (d) in series with bulb C, the intensity of bulb B will decrease and that of bulb D will increase.



7. Two cannons are placed on 1000 m high towers at a horizontal distance of 400 m between them along *x*-axis. Ball A is fired at an angle of 45° to the +ve *x*-axis whereas Ball B is fired at an angle of 45^0 to the −ve *x*-axis. Initial velocity of projection given to each ball is u = 40 m/s in magnitude. The point P (*x*, y) at which the two balls collide is
   (a) $x = 200$ m, $y = -45$ m
   (b) $x = 200$ m, $y = 0$
   (c) $x = 100$ m, $y = -200$ m
   (d) the two balls will not collide



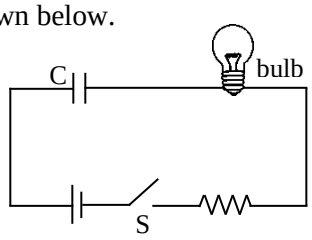
8. Sixty moles of Helium gas are initially at 28°C (at A). It undergoes an isothermal process from A to B and then an isobaric process from B to C. Total change in the internal energy of the gas in the complete process from A to C would be approximately,
   (a) 206 kJ
   (b) 450 kJ
   (c) 431 kJ
   (d) 225 kJ



9. In an atom, the nucleus consists of 2 protons and 2 neutrons and one electron is revolving around the nucleus. According to Bohr's atomic model, the only visible wavelength corresponds to the transition

(a) 2^{nd} to 1^{st} orbit (b) 4^{th} to 2^{nd} orbit (c) 4^{th} to 3^{rd} orbit (d) 5^{th} to 3^{rd} orbit

10. Select the statement describing correctly the functioning of the circuit, shown below.



(a) From the time the switch S is closed, the bulb will start glowing with intensity increasing uniformly to a maximum value and will turn off after some time.

(b) As soon as the switch S is closed, the bulb will glow with maximum intensity which will then slowly decrease to zero.

(c) From the time the switch S is closed, the bulb will start glowing with intensity increasing uniformly to a maximum value and will continue glowing thereafter.

(d) If distance between the parallel plates of the capacitor is increased, bulb intensity will attain maximum value in shorter time after the switch is closed.

11. A mechanical spring deviates from Hooke's law as $F \propto -k(e^x - 1)$, where x is the strain. At what value of the strain x, the force deviates from the one obeying Hooke's law with same k and unit length, just by 1% ?

(a) $x = 1\%$ (b) $x = 2\%$ (c) $x = 5\%$ (d) $x = 20\%$

12. Three lenses with focal lengths f, f' and f respectively are kept with common principal axis in that order with successive separation of $\frac{f}{2}$ between each pair. If the point object is placed on the common principal axis to the left of 1^{st} lens at $2f$ distance from it. What should be the value of focal length f' so as to form the final image at distance of $2f$ from 3^{rd} lens on the right of it?

(a) $-\frac{4f}{3}$ (b) $+\frac{4f}{3}$ (c) $-\frac{3f}{4}$ (d) $-\frac{3f}{5}$

13. A negatively charged small ball with charge $-$ 20 pC and mass 1.00 mg is placed at the centre of a uniformly charged ring of radius 5.00 cm. The negatively charged ball is allowed to move only along the axis of the ring. The ball executes SHM with frequency of 1.00 kHz. The charge on the ring is

(a) 27.4 mC (b) 0.55 mC (c) 13.9 μC (d) 0.69 μC

14. Two hunters approach a prey from opposite directions. One hunter has a probability of $\frac{1}{3}$ for hitting the prey, the other has a probability of $\frac{2}{3}$ for hitting the prey. Both fires a burst of 3 shots each simultaneously. Assume that both the hunters fire one shot each at the same time simultaneously, followed by another shot each at the same time, followed by the third shot each at the same time, each round of shots have negligible time gap between them. The probability that the prey, in question, is hit

(a) after the three rounds is 1 (b) in the first round of shots is 1

(c) after the three rounds is $\frac{7}{9}$ (d) after the three rounds is $\frac{721}{729}$

15. A particle moving with constant velocity along X-axis has angular momentum p = 120 units about a reference point in XY plane. Which of the following statements is correct?
    (a) If the reference point is shifted parallel to Y axis, angular momentum need not change necessarily.
    (b) If the reference point is taken to double the present distance from origin, instantaneous angular velocity become half the present value.
    (c) It is always possible to increase instantaneous angular velocity to double the present value by shifting reference point parallel to X axis.
    (d) If the reference point is shifted parallel to X axis, angular momentum will surely not change about it.

16. An electron moving with speed of 0.1% speed of light, enters a uniform magnetic field of strength 2.5 gauss at 60° angle. Calculate the number of helical turns it takes in moving 1 km distance.
    (a) 20000 to 22000 (b) 22000 to 25000 (c) 30000 to 32000 (d) 45000 to 47000

17. If $a + \frac{1}{a} = \sqrt{3}$ then $a^6 + \frac{1}{a^6}$ is
    (a) 27 (b) 0 (c) – 2 (d) 81

18. If $\sin x + \cos x = \sqrt{2}$ then $\sin^4 x + \cos^4 x$ is
    (a) 4 (b) -1 (c) 1 (d) $\frac{1}{2}$

19. If a, b, c are in arithmetic progression and a^2, b^2, c^2 are in geometric progression, then the common ratio is
    (a) 0 (b) 1 (c) 2 (d) 3

20. $\sum_{n=1}^{\infty} \frac{1}{n(n+3)} =$
    (a) $\frac{1}{3}$ (b) $\frac{11}{18}$ (c) $\frac{1}{2}$ (d) $\frac{4}{17}$

21. Let $f: \mathbb{R} \to \mathbb{R}$ be defined as $f(x) = \max\{x^2, 1\}$. Then
    (a) f is differentiable everywhere
    (b) f is continuous everywhere but not differentiable at $x = \pm 1$
    (c) f is not continuous at $x = \pm 1$
    (d) f is neither continuous nor differentiable.

22. Let T_1 denote an equilateral triangle of side length a, T_2 be the triangle whose vertices are midpoints of sides of T_1, T_3 be the triangle whose vertices are midpoints of sides of T_2. We continue in similar manner to obtain the triangles $T_4, T_5, \ldots$. For each natural number n, let P_n denote the perimeter of the triangle T_n. Then $\sum_{n=1}^{\infty} P_n =$
    (a) 12a (b) 8a (c) 6a (d) 3a

23. $\sqrt{i} + \sqrt[3]{i^2} = x + iy$, where $i = \sqrt{-1}$. $(x, y) = ?$
    (a) $(-0.293, 1.573)$ (b) $(-0.293, 0.707)$ (c) $(-0.207, 1.573)$ (d) (1.207, 1.573)

24. A standard parabola $x^2 = 36y$ is approximated as an arc of a circle for small values of x. What will be the radius of that circle?

(a) 72 (b) 36 (c) 18 (d) 9

25. $\int_0^{\frac{\pi}{2}} \frac{\sin x}{\sin x+\cos x} dx =$

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) 0 (d) π

26. Let $f(x)$ be continuous on $[0, \pi]$ and $f(x) + f(\pi - x) = \pi$. Then $\int_0^{\pi} f(x)dx =$

(a) π^2 b) $\frac{\pi}{2}$ c) $\frac{\pi^2}{2}$ d) $\frac{\pi^2}{4}$

27. $\lim_{x\to 3} \frac{\sqrt{1-\cos 2(x-3)}}{x-3}$

(a) Exists and it equals $\sqrt{2}$
(b) Exists and it equals $-\sqrt{2}$
(c) Does not exist because $(x - 1) \to 0$
(d) Does not exist because left hand limit is not equal to right hand limit.

28. A water tank has the shape of an inverted right circular cone, whose semi-vertical angle is $\tan^{-1}\left(\frac{3}{4}\right)$. Water is poured into it at a constant rate of 5 m^3/min. Then, the rate (in m/min) at which the water surface moves along the slant surface at the instant when the depth of water in the tank is 10 m is

(a) $\frac{1}{9\pi}$ (b) $\frac{9}{192\pi}$ (c) $\frac{1875}{4\pi}$ (d) $\frac{4}{27\pi}$

29. How many people should there be in a group such that there is more than half the probability, that two people from the group have their birthdays with the same date, irrespective of in which months they were born.

(a) 3 or more (b) 4 or more (c) 7 or more (d) 23 or more

30. A and B alternatively toss a coin. The one who gets a head first wins. If A starts the game, then what is the probability that A wins?

(a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{3}{5}$

31. Consider the expression $Z = 1 + 2^2 + (3^3)^3 + ((4^4)^4)^4 + \cdots$. From which term onwards, the total value of the expression Z exceeds 10^{1000}?

(a) 4 (b) 6 (c) 8 (d) 10

32. Let $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$. Which of the following statements is <u>not</u> true?

(a) A is symmetric (b) If $a + b + c = 0$ then $det\ A = 0$
(c) $det\ A = a^3 + b^3 + c^3 - 3abc$ (d) $det\ A = det\ A^T$

33. It has been four hours since Regulus ($10h\ 08m, +11°58'$) has crossed the local meridian at Mumbai ($19°2'11.11''N, 72°51'34.09''\ E$). Which of the following stars will be closest to the meridian now?
    (a) Arcturus ($14h\ 16m\ 50.74s, 19°02'8"$)
    (b) Sirius ($6h\ 46m\ 15.1s, -16°44'.6"$)
    (c) Betelgeuse ($5h\ 56m\ 31.86s, 19°02'8"$)
    (d) Spica ($13h\ 26m\ 32.96s, -11°17'44.7"$)

34. A star has an apparent magnitude of 10, and an Absolute magnitude of 10. How many parsecs away from the Earth is it?
    (a) 100 (b) 10 (c) 1 (d) 0.1

35. Which of the following statement or statements about stars are true?
    (a) Among all one solar mass stars, the one with the largest radius is also the hottest.
    (b) Type I supernovae are characterized by the absence of Hydrogen in the spectrum.
    (c) Cooler stars show less absorption lines in their spectra.
    (d) The stars are spectrally classified as O, B, A, F, G, K, M; with O type stars showing dense hydrogen line while M type stars having very less hydrogen lines.

36. As seen from Earth, angular separation between Proxima Centauri and Alpha Centauri is 2.2°. What is the physical separation between the two stars?
    (a) 4.25 light years (b) 0.16 light years (c) 2.2 light years (d) 0.33 light years

37. Two stars in a binary system are separated by 3.0 AU and have mass ratio of 2 : 1. Their orbital period is 6.0 years. What are the masses of the stars in terms of solar mass?
    (a) 2.0, 1.0 (b) 0.50, 0.25 (c) 2.25, 1.125 (d) 1.78, 0.88

38. A comet's closest approach to Sun is at 1 AU. What is the radial component of its velocity at this position?
    (a) 0 km/s (b) 21.2 km/s (c) 30 km/s (d) 42.4 km/s

39. A new space station orbits the sun every four and a half years. In a particular year, it is seen on the local meridian at 1:00 am of the 21st of June, 2020. It will be again seen on the local meridian from the Earth, approximately, on
    (a) 21 June, 2024, at 1:00 am
    (b) 20 December, 2024, at 4:00 pm
    (c) 3 October, 2021, 4:00 pm
    (d) 21 March, 2021, 9:00 pm

40. What is the advantage of an equatorial telescope mount over an alt-azimuth mount?
    (a) Reduced vibrations and provides a more stable viewing platform.
    (b) It allows tracking celestial objects using only one axis of motion.
    (c) It eliminates the need for polar alignment before observing.
    (d) It is easier to carry and transport due to its lightweight design.

41. Which of the following statements is correct about constellations?
    (a) Any star cannot belong to two constellations simultaneously.
    (b) Only the bright stars which are imagined as some figure in the sky make constellations.
    (c) Brightest star in any constellation has magnitude 1.
    (d) There are only 12 constellations along the Ecliptic belt.

42. What would be the speed of a comet, on a parabolic orbit around the sun, whose point of closest approach is 1AU, when at a distance of 4.0 AU?
    (a) 42.1 km/s (b) 29.8 km/s (c) 21.1 km/s (d) 84.4 km/s

43. Globular clusters are typically found in the halo of Milky Way. In which of the following constellation, there are higher chances of seeing globular cluster?
    (a) Orion (b) Sagittarius (c) Ursa Minor (d) Virgo

44. Ecliptic plane makes approximately $60°$ with the Milky Way plane. One point of intersection lies in the constellation of Sagittarius, in which constellation does the other intersection point lie?
    (a) Aquarius (b) Libra (c) Pieces (d) Gemini

45. Which of the following places will have minimum duration between the two zero shadow days in a given calendar year.
    (a) Manila $(14° 36' N, 120° 59' E)$ (b) Monteiro $(7° 53' S, 37° 7' W)$
    (c) Kansanshi $(12° 6' S, 26° 26' W)$ (d) Barah $(13° 42' N, 30° 22' E)$

46. An observer from Delhi, will see the Sun on the local meridian 365 times in the year 2025. A star, located on the celestial equator, will be seen how many times on the local meridian by the same observer in 2025?
    (a) 364 (b) 365 (c) 366 (d) 367

47. Considering the nuclear reactions that power the energy output of the stars, the correct statements is:
    (a) the p-p chain is the dominant process that creates He in very massive stars.
    (b) the fusion of H into He is an exothermic process.
    (c) the CNO (Carbon-Nitrogen-Oxygen) cycle results in the creation of the elements like Si, S and P following the fusion of the lighter elements.
    (d) the fusion process is replaced by the fission process in heavier stars.

48. Which of the following constellations is broken in two disjoint parts in the sky?
    (a) Draco (b) Ursa (c) Serpens (d) Eridanus

A – 2

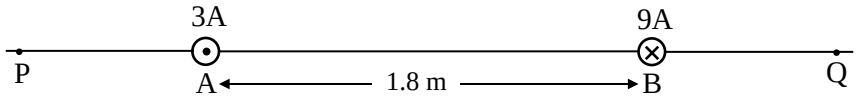
ANY NUMBER OF OPTIONS (4, 3, 2 or 1) MAY BE CORRECT

MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED AND NO INCORRECT.

49. Inside a cylindrical well, at the bottom and touching the wall, a red ball is thrown at an angle of 45^o to the horizontal towards the diametrically opposite end of the wall, and it hits the wall after a time interval of $\frac{v\sqrt{2}}{g}$, where v is the magnitude of velocity of the red ball and g is acceleration due to gravity. A black ball identical in shape and mass to the red ball is thrown vertically upwards from the bottom of the well with a kinetic energy half of that of the red ball. A green ball having a mass half of the red ball is thrown from the bottom of the well but diametrically opposite to the red ball with a kinetic energy half of that of the red ball. All the balls, if and when they hit the wall, undergo completely elastic collision.
    (a) The red ball bounces off the bottom of the well for the first time when it hits the wall the third time.
    (b) The black ball will take double the time to hit the bottom of the well to that of the red ball.
    (c) The green ball hits the bottom of the well at the same spot as the red ball.
    (d) The green ball will take the same time as the red ball to hit the bottom of the well the first time.

50. Read the two statements, I and II, about a RLC series circuit driven by an AC voltage source using an inductor having internal resistance r. Assume that the maximum amplitude of ac signal is v_m and frequency is *F:*
    I: when frequency *F* is equal to the resonance frequency of the circuit, potential difference across the series combination of L and C has a non-zero amplitude.
    II: when frequency *F* is equal to the resonance frequency of the circuit, current in the circuit has amplitude less than v_m/R.
    Select correct statement(s) from the following:
    (a) If statement I is correct, statement II has to be correct.
    (b) If statement II is false, statement I cannot be false.
    (c) Statement II is false for most of the RLC series circuits with ac voltage source.
    (d) Statement I is correct for most of the RLC series circuits with ac voltage source.

51. Two current carrying wires A and B are held fixed, parallel to each other, at a distance of 1.8 m. A current of 3A flows through wire A in a direction, coming out of the plane of paper and that through the wire B is 9A going in to the plane of paper as shown.



    Which of the following statement(s) is/are true with reference to the given situation?
    (a) There can be a point on the left of wire A (PA side) where net magnetic field is zero.
    (b) There can be a point on the right of wire B (BQ side) where net magnetic field is zero.
    (c) There can be a point between the wires A and B, closer to A, where magnetic field produced by the two wires will be in the same direction having equal magnitude.
    (d) There can be a point Q on the right of wire B (BQ side) where net magnetic field is in the upward direction parallel to the plane of paper.

52. Two black bodies A and B are emitting in the approximate ratio 2:5. Which of the following statements may be correct from the given information?
    (a) Body B is 20% hotter and 10% larger in diameter than body A.
    (b) Body B is 50% hotter but half in diameter than body A.
    (c) Body B is 10% hotter and 30% larger in diameter than body A.
    (d) Body B has double the temperature of A and only 40% diameter of body A.

53. Let $\delta = \begin{vmatrix} x & x^2 & 1 \\ 1 & x & x^2 \\ x^2 & 1 & x \end{vmatrix}$. Which of the following statements is <u>not</u> true?
    (a) δ is an even function
    (b) $\delta = 0$ for all real x
    (c) δ is a polynomial of degree 6
    (d) If $x = \sqrt[3]{1}$, $\delta = 0$ for all roots

54. Which of the following functions are periodic?
    (a) $\sin x + \cos x$ (b) $\tan x$ (c) $x \sin x$ (d) $\sin x + \sin \sqrt{2}x$

55. If $x + \frac{1}{x} = 2$ then which of the following are true?
    (a) $x^2 + \frac{1}{x^2} = 2$ (b) $x^3 + \frac{1}{x^3} = 2$ (c) $x = 1$ (d) $x^4 + \frac{1}{x^4} = 2$

56. Which of the following series are not convergent?
    (a) $\sum_{n=1}^{\infty} \left(1 + \frac{1}{n}\right)$ (b) $\sum_{n=1}^{\infty} \left(3 + \left(\frac{2}{3}\right)^n\right)$ (c) $\sum_{n=1}^{\infty} n^{\frac{1}{n}}$ (d) $\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$

57. The Pole star
    (a) can be seen at night from all locations on the Earth.
    (b) will be visible during a solar eclipse from nearly the whole of the northern hemisphere.
    (c) will be visible during a solar eclipse from the equator.
    (d) can, in principle, be observed from India anytime during the day and night.

58. An observer measures the location of the Sun, moon, planets, and bright stars like Sirius, very diligently. The correct conclusions that she may reach is/are:
    (a) Planets rise and set at the same time as per the sidereal clock but not as per the solar clock for all days of the year.
    (b) The Sun rises and sets at the same time as per the solar clock and not as per the sidereal clock for all days of the year.
    (c) The stars rise and set at the same time as per the sidereal clock but not as per the solar clock for all days of the year.
    (d) The moon rises and sets at different times as per the sidereal clock and also as per the solar clock for all days of the month.

59. Which of the following stars is/are circumpolar in Warsaw (52°14'N 21°01'E)
    (a) α Cygni (16h 41m, $+31°36'$)
    (b) β Böotis (15h 01m, $+40°23'$)
    (c) θ Aurigae (5h 59m, $+37°12'$)
    (d) γ Draconis ($17h\ 56m$, $+51°26'$)

60. Star A rises half an hour before star B and it sets half an hour after star B from a particular location. Which of the following statement(s) is/are correct?

(a) The location is on equator.
(b) The location is in southern hemisphere and star A is more south than star B.
(c) The location is in northern hemisphere and star A is more north than star B.
(d) Both stars have the same right ascension.

Rough Work