


**INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN ASTRONOMY 2011 - 2012**

Date of examination: 27th November 2011

Time 15.00 to 17.00 Hrs.

Instructions to Candidates

1. In addition to this question paper, you are given a separate answer sheet.
2. On the answer sheet fill up all the entries carefully in the space provided, **ONLY IN BLOCK CAPITALS.**
Incomplete / incorrect / carelessly filled information may disqualify your candidature.
3. On the answer sheet, use only **BLUE or BLACK BALL PEN** for making entries and marking answers.
4. The question paper contains 80 multiple-choice questions. Each question has 4 options, out of which only one is correct. Choose the correct answer and mark a **cross** in the corresponding box on the answer sheet as shown below :

Q.	a	b	c	d
22				

5. Any rough work should be done only on the sheet provided at the end of question paper.
6. A correct answer carries 3 marks and 1 mark will be deducted for each wrong answer.
7. Use of nonprogrammable calculator is allowed.
8. No candidate should leave the examination hall before the completion of the examination.
9. The answers / solutions to this question paper will be available on our website - www.iapt.org.in by 3 rd December 2011.
10. Result sheets and the "centre top 10%" certificates of NSEA are dispatched to the Professor in charge of the centre. Thus you will get your marks from the Professor in charge of your centre by January 2012 end.
11. TOP 300 (or so) students are called for the next examination-Indian National Astronomy Olympiads (INAO). Individual letters are sent to these students ONLY.
12. No queries will be entertained in this regard.

PLEASE DO NOT MAKE ANY MARK OTHER THAN (X) IN THE SPACE PROVIDED ON THE ANSWER SHEET.

Answer sheets are evaluated with the help of a machine. Due to this, **CHANGE OF ENTRY IS NOT ALLOWED.**

Scratching or overwriting may result in wrong score.

DO NOT WRITE ANYTHING ON BACK SIDE OF ANSWER SHEET.

CERTIFICATES & AWARDS

Following certificates are awarded by the I.A.P.T. to students successful in NSEA.

- i) Certificate for "Centre Top 10%" students.
- ii) Merit certificates to statewise Top 1% students.
- iii) Merit certificate and a prize in the form of a book to Nationwide Top 1% students.

TO TAKE THIS EXAMINATION YOU HAVE TO BE BORN ON OR AFTER JANUARY 1, 1993

INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN ASTRONOMY 2011 – 2012

Total time: 120 minutes

Marks: 240

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT

N.B. : Physical constants are given at the end.

- 1) Total solar eclipse can be observed from the moon
- (a) when total lunar eclipse is seen from the earth.
 - (b) when total solar eclipse is seen from the earth.
 - (c) on every full moon day.
 - (d) on every new moon day.
- 2) A point mass is subjected to two simultaneous sinusoidal displacements in X direction, $x_1(t) = A \sin(\omega t)$ and $x_2(t) = A \sin\left(\omega t + \frac{2\pi}{3}\right)$. Adding a third sinusoidal displacement $x_3(t) = B \sin(\omega t + \phi)$ brings the mass to a complete rest. The values of B and ϕ are
- (a) $A\sqrt{2}, \frac{3\pi}{4}$.
 - (b) $A, \frac{4\pi}{3}$.
 - (c) $A\sqrt{3}, \frac{5\pi}{6}$.
 - (d) $A, \frac{\pi}{3}$.
- 3) Consider the equation $\tan^2 \theta + 3 = 3 \sec \theta$. Then, the given equation
- (a) is an identity.
 - (b) has no solution for $0 \leq \theta \leq 90^\circ$.
 - (c) has only one solution for $0 \leq \theta \leq 90^\circ$.
 - (d) has two solutions for $0 \leq \theta \leq 90^\circ$.
- 4) The radiant of Quadrantids meteor shower lies in
- (a) Pegasus.
 - (b) Carina.
 - (c) Orion.
 - (d) Bootes.

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5) Vectors \vec{p} and \vec{q} include an angle θ between them. If $(\vec{p} + \vec{q})$ and $(\vec{p} - \vec{q})$ respectively include angles α and β with \vec{p} , then $(\tan \alpha + \tan \beta)$ is

(a) $\frac{pq \sin \theta}{p^2 + q^2 \cos^2 \theta}$.

(b) $\frac{2pq \sin \theta}{p^2 - q^2 \cos^2 \theta}$.

(c) $\frac{p^2 \sin^2 \theta}{p^2 + q^2 \cos^2 \theta}$.

(d) $\frac{q^2 \sin^2 \theta}{p^2 - q^2 \cos^2 \theta}$.

6) An alternating current of frequency ω flows through a conductor with conductivity σ . The material of the conductor has a magnetic permeability μ . The quantity $(\omega\sigma\mu)^{-\frac{1}{2}}$ has the dimensions same as those of

- (a) charge.
- (b) current.
- (c) time.
- (d) length.

7) What is the position of the Red supergiant stars on the Hertzsprung-Russell diagram?

- (a) upper left.
- (b) upper right.
- (c) lower left.
- (d) lower right.

8) 'The dirty ice ball' theory of comets was formulated by

- (a) Encke.
- (b) Fred Whipple.
- (c) Halley.
- (d) Brian Marsden.

9) The value of the expression $\frac{7 \cos 70^\circ}{2 \sin 20^\circ} + \frac{3 \cos 55^\circ \operatorname{cosec} 35^\circ}{2 \tan 25^\circ \tan 45^\circ \tan 65^\circ}$ is

- (a) 2
- (b) 5
- (c) $\frac{7}{2}$
- (d) $\frac{3}{2}$

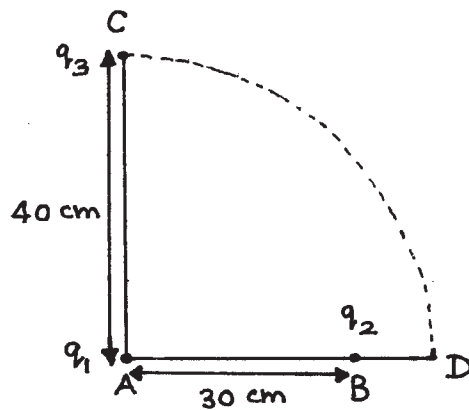
10) The quantity $\sqrt{\frac{\mu_0}{\epsilon_0}}$ has the units same as those of

- (a) frequency.
- (b) speed.
- (c) resistance.
- (d) conductance

11) The spectrum of the sun belongs to spectral class

- (a) A.
- (b) K.
- (c) G.
- (d) B.

12) Two charges q_1 and q_2 are placed 30 cm apart as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius 40 cm from C to D. The change in potential energy of the system is $\left(\frac{q_3}{4\pi\epsilon_0}\right)k$, where k is



- (a) $8 q_2$.
- (b) $6 q_2$.
- (c) $8 q_1$.
- (d) $6 q_1$.

13) The maximum number of solar eclipses in a year is

- (a) three.
- (b) four.
- (c) five.
- (d) seven.

14) If $A = \{2,4,6,8,\dots,400\}$, so that $n(A) = 200$ and $B = \{3,6,9,12,\dots,750\}$, so that $n(B) = 250$, then

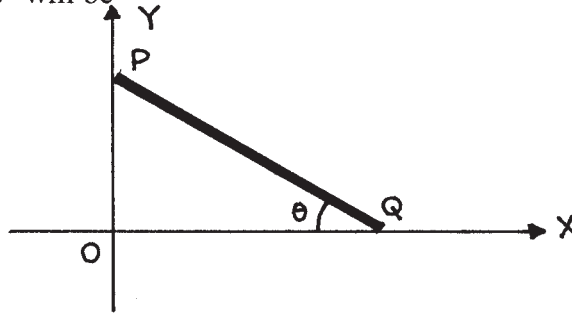
- (a) $n(A \cap B) = 125$ and $n(A \cup B) = 325$
- (b) $n(A \cap B) = 124$ and $n(A \cup B) = 326$
- (c) $n(A \cap B) = 66$ and $n(A \cup B) = 384$
- (d) $n(A \cap B) = 65$ and $n(A \cup B) = 385$

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15) The type of Andromeda galaxy is

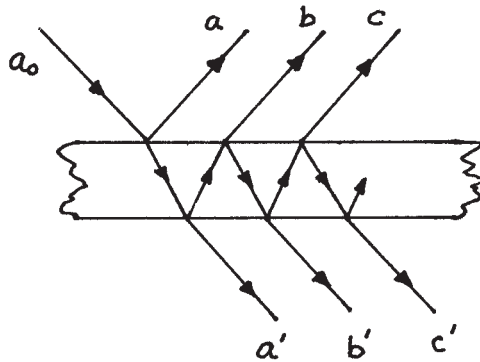
- (a) spiral.
- (b) barred spiral.
- (c) elliptical.
- (d) irregular.

16) A rod PQ of length l is resting on two mutually perpendicular axes as shown in the figure. If the tip P begins to slide down with a constant speed of $\sqrt{3}$ m/s, the speed of tip Q when $\theta = 30^\circ$ will be



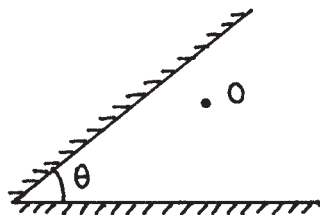
- (a) $\sqrt{3}$ m/s.
- (b) 1 m/s.
- (c) 3 m/s.
- (d) 2 m/s.

17) The figure shows beams of light incident on a thin film and subsequently emerging from it. Here each beam is represented by a single ray. Let r be the ratio of amplitude of the reflected beam to that of the incident beam. Amplitude of the incident beam a_0 is assumed to be unity. Neglecting absorption in the film, amplitude of beam a' will be



- (a) $1 - r^2$.
- (b) $(1 - r)^2$.
- (c) r^2 .
- (d) $\sqrt{1 - r^2}$.

18) Two plane mirrors are inclined at an angle θ as shown. The number of images formed of an object O is n . Then, the angle θ



- (a) must be $\frac{2\pi}{n}$.
- (b) must be $\frac{2\pi}{n+1}$.
- (c) lies between $\frac{2\pi}{n}$ and $\frac{2\pi}{n+1}$.
- (d) must be $\frac{2\pi}{n-1}$.

19) The sum of the third and the seventh terms of an A.P. is 6 and their product is 8. The sum of the first 16 terms of this A.P. will be

- (a) 20 only.
- (b) 76 only.
- (c) 20 or 76.
- (d) 8.5 or -2.5

20) A window is 50 cm in height. A stone falling from a height of 40 cm above the window crosses the window in time t equal to

- (a) $\frac{1}{7}$ s.
- (b) $\frac{3}{7}$ s.
- (c) $\frac{5}{7}$ s.
- (d) $\frac{4}{7}$ s.

21) The number of points on the circle $2x^2 + 2y^2 - 3x = 0$ having distance 2 units from the point $(-2, 1)$ is

- (a) zero.
- (b) 1
- (c) 2
- (d) 4

22) Outer planet becomes retrograde

- (a) before conjunction.
- (b) before opposition.
- (c) after conjunction.
- (d) after opposition.

23) A conical vessel of radius 6 cm and height 8 cm is completely filled with water. A metal sphere is now lowered into the water. The size of the sphere is such that when it touches the inner surface, it just gets immersed. The fraction of water that overflows from the conical vessel is

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- (a) $\frac{3}{8}$.
- (b) $\frac{5}{8}$.
- (c) $\frac{7}{8}$.
- (d) $\frac{5}{16}$.

24) To determine the absolute magnitude of a star, it is considered to be at a distance of

- (a) 10 AU.
- (b) 10 parsec.
- (c) 1 parsec.
- (d) 1 light year.

25) Which one of the following never moves in retrograde motion?

- (a) Mars.
- (b) Venus.
- (c) the moon.
- (d) the moon's nodes.

26) $\lim_{x \rightarrow \infty} \left(\frac{x-3}{x+2} \right)^x$ is equal to

- (a) e^5 .
- (b) e .
- (c) e^{-1} .
- (d) e^{-5} .

27) The zero shadow days CANNOT be observed in the city of

- (a) Amritsar.
- (b) Nagpur.
- (c) Chennai.
- (d) Sriharikota.

28) If $a^2 + b^2 + c^2 + d^2 = 45$, out of the following statements the correct one is

- (a) $ab + bc + cd + da \leq 45$.
- (b) $ab + bc + cd + da \geq 45$.
- (c) $ab + bc + cd + da \leq \frac{45}{2}$.
- (d) $ab + bc + cd + da \geq \frac{45}{2}$.

29) An ellipse has foci (3,1) and (1,1). It passes through the point P(1,3). Therefore, the eccentricity of the ellipse is

- (a) $\sqrt{2} - 1$.
- (b) $\sqrt{3} - 1$.
- (c) $\frac{\sqrt{2} - 1}{2}$.
- (d) $\frac{\sqrt{3} - 1}{2}$.

30) Apart from the twelve constellations, the sun passes through the constellation of

- (a) Orion.
- (b) Ursa Major.
- (c) Ophiuchus.
- (d) Perseus.

31) For the quadratic equation $3x^2 + px + 3 = 0$, where $p > 0$, one of the roots is square of the other. Hence, the value of p is

- (a) $\frac{1}{3}$.
- (b) 1.
- (c) 3
- (d) $\frac{2}{3}$.

32) Two vectors $(\vec{a} + 2\vec{b})$ and $(5\vec{a} - 4\vec{b})$, where \vec{a} and \vec{b} are unit vectors, are perpendicular to each other. Therefore, the angle between \vec{a} and \vec{b} is

- (a) 45°
- (b) 60°
- (c) $\cos^{-1}\left(\frac{1}{3}\right)$
- (d) $\cos^{-1}\left(\frac{1}{6}\right)$

33) The north galactic pole lies in the constellation of

- (a) Ursa Minor.
- (b) Ursa Major.
- (c) Coma Berenices.
- (d) Draco.

34) The transits of Mercury occur in the months of

- (a) January and July.
- (b) March and September
- (c) May and November
- (d) June and December

35) If the sun is rising in Gemini, the zodiacal constellation on the meridian will be

- (a) Virgo.
- (b) Sagittarius.
- (c) Pisces.
- (d) Libra.

36) If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, out of the following statements the correct one is

- (a) $A^3 = 27 A$
- (b) $A^3 = 3 A$
- (c) $A^3 = A$
- (d) $A + A + A = A^2$

37) In the spectrum of a quasar, the observed wavelength of an element (having rest wavelength of 1216 Å) is found to be 2432 Å. Therefore, the value of red shift (z) of that quasar is

- (a) - 1
- (b) - 0.5
- (c) 0.5
- (d) 1

38) Which of the following is the cube root of 64?

- (a) $2\sqrt{3}i + 2$
- (b) $2\sqrt{3}i - 2$
- (c) $2 - 3\sqrt{2}i$
- (d) $3 - 2\sqrt{3}i$

39) The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 Å. Therefore, the wavelength of the second spectral line in the Balmer series of singly ionized helium atom is

- (a) 1215 Å.
- (b) 1640 Å.
- (c) 2430 Å.
- (d) 4687 Å.

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40) If $x \neq 0, x \neq 1$ and $x^{x\sqrt{x}} - (x\sqrt{x})^x = 0$, the value of x is

- (a) 0.444---
- (b) 2.25
- (c) 4
- (d) 9

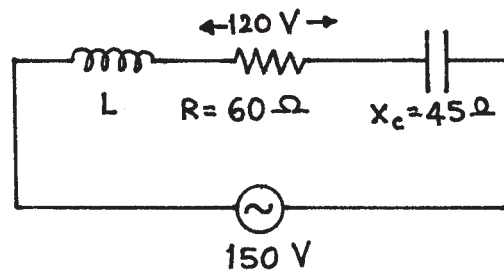
41) An alpha particle of 10 MeV energy collides head on with a copper nucleus ($Z = 29$) and is deflected back. The distance of closest approach of the alpha particle is about

- (a) 4.2×10^{-15} m.
- (b) 8.3×10^{-15} m.
- (c) 1.6×10^{-14} m.
- (d) 2.1×10^{-14} m.

42) A non-conducting ring charged uniformly is rotating about its axis (passing through its centre and perpendicular to its plane) with a constant angular velocity. Let E, V and B be respectively the electrostatic field, electrostatic potential and magnetic field produced at the centre of the ring. Then,

- (a) $E = 0, V \neq 0, B = 0$
- (b) $E = 0, V \neq 0, B \neq 0$
- (c) $E \neq 0, V = 0, B \neq 0$
- (d) $E \neq 0, V = 0, B = 0$

43) In the circuit given below the voltage across the inductor



- (a) is 90 volt.
- (b) is zero volt.
- (c) cannot be greater than 150 volt.
- (d) is 180 volt.

44) The successive resonance frequencies of a pipe are 425 Hz, 595 Hz and 765 Hz respectively. If the speed of sound in air is 340 m/s, the length of the pipe is

- (a) 0.85 m.
- (b) 1.0 m.
- (c) 0.5 m.
- (d) 1.7 m.

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45) If $m = 6 + \sqrt{35}$ and $n = 6 - \sqrt{35}$, the value of $(\sqrt{m} - \sqrt{n})$ is

- (a) $\sqrt{14}$.
- (b) $\sqrt{21}$.
- (c) $\sqrt{18}$.
- (d) $\sqrt{10}$.

46) Mercury stands at a height h in a barometer. A small hole is made at a height h' (less than h). The mercury comes out of the hole with a speed v equal to

- (a) $\sqrt{2gh'}$.
- (b) $\sqrt{2g(h-h')}$.
- (c) $\sqrt{2gh}$.
- (d) zero.

47) Let α and β be the cube roots of unity. If $A = \begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix}$ and $B = \begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix}$, then the product AB is

- (a) $\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$
- (b) $\begin{bmatrix} -1 & -1 \\ -1 & -2 \end{bmatrix}$
- (c) $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$
- (d) $\begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$

48) A uniform wire of length l and mass m is bent in the form of a rectangle PQRS such that $PQ : QR = 2 : 1$. The moment of inertia of this rectangle about side QR is

- (a) $\frac{11}{243} ml^2$
- (b) $\frac{7}{216} ml^2$
- (c) $\frac{5}{136} ml^2$
- (d) $\frac{7}{162} ml^2$

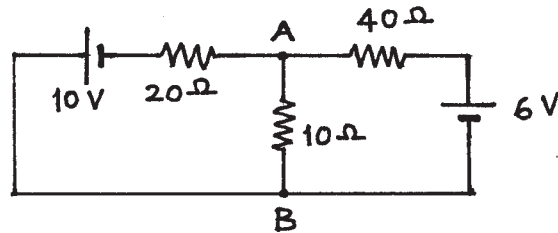
49) A planoconvex lens forms a lens combination with a planoconcave lens such that their curved surfaces have equal radii of curvature and are in contact with each other.

If μ_1 and μ_2 are the refractive indices of the materials of the two lenses, the focal length of the combination is proportional to

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- (a) $|\mu_1 - \mu_2|$
 (b) $\frac{2}{\mu_1 + \mu_2}$
 (c) $\frac{1}{|\mu_1 - \mu_2|}$
 (d) none of the above as it is infinite.

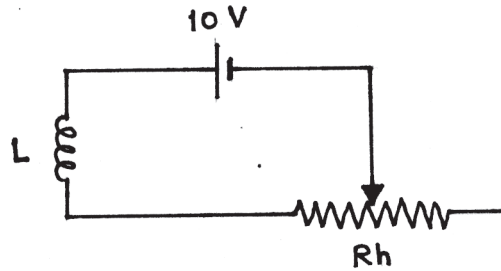
50) Refer to the circuit. The current through 10 ohm resistance is



- (a) 371 mA from B to A.
 (b) 371 mA from A to B.
 (c) 200 mA from B to A.
 (d) 200 mA from A to B.
- 51) Given that $1 + x^2 = 2x \cos \theta$, the value of $\frac{x^6 + 1}{x^3}$ is
- (a) $2 \cos 3\theta$
 (b) $3 \cos 2\theta$
 (c) $2 \cos 2\theta$
 (d) $3 \cos 3\theta$
- 52) The weight of a metal sphere when immersed in water at 0°C is W_1 and that at 50°C is W_2 . If the coefficient of cubical expansion of the metal is less than that of water, then
- (a) $W_1 = W_2$
 (b) $W_1 < W_2$
 (c) $W_1 > W_2$
 (d) nothing can be said as the data are insufficient.
- 53) An organ pipe of length l (open at both ends) is sounded together with another organ pipe of length $(l + x)$ where $x \ll l$, to produce their fundamental notes. If speed of sound in air is v , the beat frequency is
- (a) $\frac{vx}{l^2}$
 (b) $\frac{vx}{2l^2}$
 (c) $\frac{v}{2\sqrt{x}l}$
 (d) $\frac{vx}{4l^2}$

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- 54) A circuit connects a pure inductor (L) to a dc source through a rheostat as shown. The sliding contact of the rheostat is pulled to the right so as to increase the resistance. At an instant when the resistance is 20 ohm, the current in the circuit is



- (a) 0.5 A.
 (b) less than 0.5 A.
 (c) more than 0.5 A.
 (d) less than or more than 0.5 A depending on the value of L .
- 55) Two angles of a triangle are $\frac{\pi}{6}$ and $\frac{\pi}{4}$. The longest side of this triangle has length $(1 + \sqrt{3})$. Therefore, the area of the triangle is
- (a) $\frac{1}{\sqrt{3} - 1}$
 (b) $\frac{1}{\sqrt{3} + 1}$
 (c) $\sqrt{3} + 1$
 (d) $\sqrt{3} - 1$
- 56) A given mass of an ideal gas expands to 2.5 times its initial volume (V) at a constant pressure (p). If γ is the ratio of specific heats, the change in internal energy of the gas is
- (a) $\frac{5pV}{2(\gamma - 1)}$
 (b) $\frac{3pV}{2(\gamma - 1)}$
 (c) $\frac{pV}{2(\gamma - 1)}$
 (d) $\frac{2pV}{(\gamma - 1)}$
- 57) Let the energy, the magnitude of linear momentum and the angular frequency of an electron revolving in an orbit with quantum number n be E , p and ω respectively then

- (a) $\left(\frac{E}{\omega}\right)$ varies as n^2 .
- (b) $\left(\frac{Ep}{\omega}\right)$ is independent of n .
- (c) $(p\omega)$ varies as \sqrt{n} .
- (d) $(Ep\omega)$ is independent of n .

58) Which of the following corresponds to $(\sin^{-1} x + \sin^{-1} y)$?

- (a) $\sin^{-1}(x\sqrt{1-y^2} - y\sqrt{1-x^2})$
- (b) $\sin^{-1}(x\sqrt{1-y^2} + y\sqrt{1-x^2})$
- (c) $\sin^{-1}(x\sqrt{1-x^2} - y\sqrt{1-y^2})$
- (d) $\sin^{-1}(x\sqrt{1-x^2} + y\sqrt{1-y^2})$

59) Given $\vec{A} + \vec{B} = \vec{C}$. If \vec{B} is reversed, the resultant is \vec{D} . Then, we have

- (a) $C^2 - D^2 = A^2 - B^2$.
- (b) $C^2 - D^2 = 2(A^2 - B^2)$.
- (c) $C^2 + D^2 = A^2 + B^2$.
- (d) $C^2 + D^2 = 2(A^2 + B^2)$

60) $\left[1 + \cot \theta - \sec\left(\theta + \frac{\pi}{2}\right)\right] \left[1 + \cot \theta + \sec\left(\theta + \frac{\pi}{2}\right)\right]$ equals

- (a) $\cot \theta$
- (b) $2 \cot \theta$
- (c) $3 \cot \theta$
- (d) $4 \cot \theta$

61) Which of the following is INCORRECT?

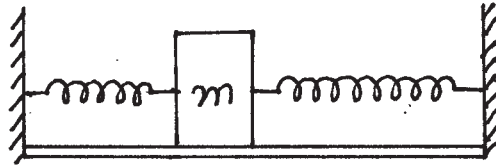
- (a) Electric field exerts a force on a stationary charge.
- (b) Electric field exerts a force on a moving charge.
- (c) Magnetic field exerts a force on a stationary charge.
- (d) Magnetic field exerts a force on a moving charge.

62) Consider the two circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 6x - 8y = 24$. The number of common tangents to these circles is

- (a) 1
- (b) 2
- (c) 3
- (d) 4

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- 63) A body of mass m suspended from a spring of length l and force constant k oscillates with periodic time T . Now, the spring is cut into two pieces of lengths in the ratio 2:3. The same mass is attached to the two pieces as shown and set into oscillations on a smooth surface. The periodic time of oscillations T' is



- (a) $\frac{T}{\sqrt{2}}$.
- (b) $\frac{2\sqrt{3}T}{5}$.
- (c) $\frac{\sqrt{6}T}{5}$.
- (d) $\frac{T}{\sqrt{5}}$.
- 64) The polar equation $\frac{8}{r} = \cos\theta - 1$ represents
- (a) a parabola.
 (b) an ellipse.
 (c) a hyperbola.
 (d) a pair of straight lines.
- 65) A non-uniform rod of length l is placed along positive X axis with one of its ends at $(0,0)$. Linear mass density of the rod varies as $(l-x)$. Its centre of mass is at
- (a) $\left(\frac{l}{6}, 0\right)$
 (b) $\left(\frac{l}{3}, 0\right)$
 (c) $\left(\frac{2l}{3}, 0\right)$
 (d) $\left(\frac{5l}{6}, 0\right)$
- 66) A satellite revolves round the earth along an elliptical orbit of eccentricity e . If T is the periodic time of revolution, the time taken by the satellite to travel from one extreme of the minor axis to the other through perigee is

(a) $\frac{T}{2} \left(1 - \frac{e}{2\pi} \right)$

(b) $\frac{T}{2} \left(1 - \frac{\pi}{2e} \right)$

(c) $\frac{T}{2} \left(1 - \frac{e}{\pi} \right)$

(d) $\frac{T}{2} \left(1 - \frac{1}{e} \right)$

67) Consider the points A(a, b + c), B(b, c + a) and C(c, a + b). The area of Δ ABC is

(a) $2(a^2 + b^2 + c^2)$.

(b) $\frac{a^2 + b^2 + c^2}{6}$.

(c) $2(ab + bc + ca)$.

(d) none of the above.

68) In a certain village of Maharashtra everybody knows Marathi language. However, 52% people can understand only Marathi, 35% are able to understand Hindi while 23% can understand English. The number of people who can understand Marathi, Hindi as well as English is 1500. Hence the population of this village is

(a) 13750.

(b) 15000.

(c) 16250.

(d) 18125.

69) The value of $\left[1.5 + 0.5 + 0.25 + 0.15 + 0.1 + \dots + \frac{1}{850} \right]$ is

(a) $1\frac{15}{17}$

(b) $2\frac{8}{17}$

(c) $2\frac{16}{17}$

(d) $3\frac{1}{17}$

70) If $(12!)^{-1} - (14!)^{-1} = x (15!)^{-1}$, the value of x is

(a) 2565.

(b) 2645.

(c) 2715.

(d) 2875.

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71) Consider the curve given by $y = x^4 + 8x^3 + 26x^2 + 32x - 73$. The number of points on this curve at which tangent to the curve is parallel to X axis is

- (a) 1.
- (b) 2.
- (c) 3.
- (d) 4.

72) If $5^{3x-4} + 5^{4-3x} = 2$, the value of x is

- (a) $\frac{4}{3}$.
- (b) $-\frac{4}{3}$.
- (c) $\frac{3}{4}$.
- (d) $\log(2)$.

73) The function $f(x) = \sin x \cos x$ is increasing in the interval

- (a) $\left(0, \frac{\pi}{2}\right)$.
- (b) $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$.
- (c) $\left(\frac{\pi}{2}, \frac{3\pi}{4}\right)$.
- (d) $\left(\frac{3\pi}{4}, \pi\right)$.

74) The last three terms in the expansion of $(a + b)^n$ are 54880, 48020 and 16807 respectively. Therefore, the values of a , b and n respectively are

- (a) 5, 7, 4
- (b) 2, 7, 7
- (c) 4, 7, 5
- (d) 7, 4, 5

75) Two soap bubbles A and B respectively of radii 2mm and 5 mm stick to each other to form a double bubble. Then,

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- (a) the radius of curvature of common surface is $\frac{10}{3}$ mm and concave on the side of bubble A.
- (b) the radius of curvature of common surface is $\frac{7}{2}$ mm and convex on the side of bubble A.
- (c) the radius of curvature of common surface is $\frac{10}{3}$ mm and convex on the side of bubble A.
- (d) the radius of curvature of common surface is $\frac{7}{2}$ mm and concave on the side of bubble A.

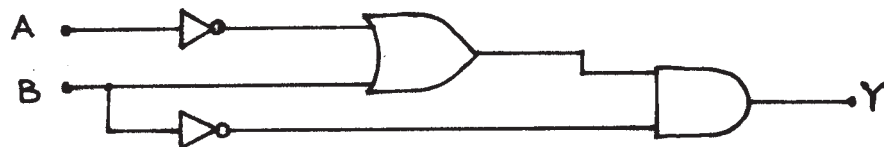
76) A body of mass 50 g performs simple harmonic motion with amplitude 20 cm. If the total energy of the body is 2 J, the periodic time is

- (a) 1.4 ms.
 (b) 1.4 s.
 (c) 14 ms.
 (d) 140 ms.

77) The integral $\int_0^{\frac{\pi}{6}} \frac{\cos^4(3x)}{\sin^4(3x) + \cos^4(3x)} dx$ equals

- (a) $\frac{\pi}{12}$
 (b) $\frac{\pi}{6}$
 (c) $\frac{\pi}{3}$
 (d) $\frac{\pi}{2}$

78) Refer to the arrangement of logic gates given below. The outputs Y for A = 0, B = 0 and A = 1, B = 1 respectively are



- (a) 0 and 1.
 (b) 1 and 0.
 (c) 0 and 0.
 (d) 1 and 1.

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79) An electron in the second excited state of a hydrogen atom has an associated de Broglie wavelength of about

- (a) 0.32 nm.
- (b) 0.66 nm.
- (c) 3.2 nm.
- (d) 1.0 nm.

80) $\int \frac{x^4 + \log 5(5^{x-1})}{5^x + x^5} dx$ gives

- (a) $5^x - x^5$
- (b) $(5^x - x^5)^{-1}$
- (c) $\log(5^x + x^5)$
- (d) $\frac{1}{5} \log(5^x + x^5)$

-X-X-X-X-X-X-X-X-X-X-X-X-X-

Physical constants you may need –

- 1) Charge on electron $e = 1.6 \times 10^{-19} \text{ C}$
- 2) Mass of an electron $m_e = 9.1 \times 10^{-31} \text{ kg}$
- 3) Universal gravitational constant $G = 6.67 \times 10^{-11} \text{ N m}^2 / \text{kg}^2$
- 4) Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{N m}^2$
- 5) Gas constant $R = 8.31 \text{ J / K mol}$
- 6) Planck constant $h = 6.62 \times 10^{-34} \text{ J s}$
- 7) Stefan constant $\sigma = 5.67 \times 10^{-8} \text{ W / m}^2 \text{ K}^4$
- 8) Boltzmann constant $k = 1.38 \times 10^{-23} \text{ J / K}$

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Rough Sheet