INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN ASTRONOMY 2015 -16

Date of Examination: 22nd November, 2015

Time: 1500 to 1700 Hrs

Q. Paper Code: A 454

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q. P. Code appears on each page of the question paper.

Instructions to Candidates –

1. Use of mobile phones, smartphones, ipads during examination is **STRICTLY PROHIBITED**.
2. In addition to this question paper, you are given 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 answer sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

6. A correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
7. Any rough work should be done only in the space provided.
8. Use of **non-programmable** calculator is allowed.
9. No candidate should leave the examination hall before the completion of the examination.
10. After submitting your answer paper, take away the Candidate's copy for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.

Answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.

Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.

Instructions to Candidates (continued) –

Read the following instructions after submitting the answer sheet.

11. **Comments regarding this question paper, if any, may be sent by email only to iaptpune@gmail.com till 24th November, 2015.**
12. **The answers/solutions to this question paper will be available on our website – www.iapt.org.in by 2nd December, 2015.**
13. **CERTIFICATES and AWARDS –**
    Following certificates are awarded by the IAPT to students successful in NSEs

    (i)Certificates to "Centre Top 10%" students

    (ii)Merit Certificates to "Statewise Top 1%" students

    (iii)Merit Certificates and a book prize to "National Top 1%" students

14. Result sheets and the "Centre Top 10%" certificates will be dispatched to the Prof-in-charge of the centre by January, 2016.
15. List of students (with centre number and roll number only) having score above MAS will be displayed on our website (www.iapt.org.in) by **22nd December, 2015.** See the **Eligibility Clause** in the Student's brochure on our website.
16. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student's brochure will be informed accordingly.

Indian Association of Physics Teachers

NATIONAL STANDARD EXAMINATION IN ASTRONOMY 2015-2016

Total time: 120 minutes **Marks: 240**

Only one out of four options is correct

1) If high tides are observed on a particular date at a place in India, one may observe
   a) low tides in the United States
   b) low tides in Australia
   c) high tides in both United States and Australia
   d) low tides in India after half a month.

2) What is the value of ***x*** if $x = \begin{vmatrix} 2sin2\theta cos2\theta & sin^2\theta - cos^2\theta \\ cos4\theta & 2sin\theta cos\theta \end{vmatrix}$

   a) $4sin\theta$ b)$2sin2\theta$ c) $cos2\theta$ d) $cos6\theta$

3) If $\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = 0$ then ***x*** is given by

   a) $(a+b+c)$ b)$-(a+b+c)$ c) $(ab+bc+ca)$ d) $-(a^2+b^2+c^2)$

4) A particle of mass 1 kg is moving along a line y = x +2 (here x and y are in metre) with speed 2 ms^{-1}. The magnitude of angular momentum of particle about the origin is
   a) $4\text{kg m}^2\text{s}^{-1}$ b) $2\sqrt{2}\text{kg m}^2\text{s}^{-1}$ c) $4\sqrt{2}\text{kg m}^2\text{s}^{-1}$ d) $2\text{kg m}^2\text{s}^{-1}$

5) If R is the radius of the earth and g is the acceleration due to gravity, the mean density of earth is
   a) $\frac{3\pi R}{4gG}$ b) $\frac{4\pi G}{3gR}$ c) $\frac{4RG}{3gR}$ d) $\frac{3g}{4\pi RG}$

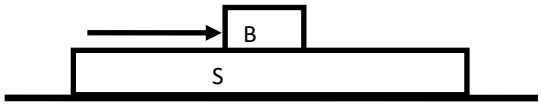
6) Compared with others, the planets Earth and Venus have nearly same size and density. But strength of the magnetic field of Venus is negligibly small compared to that of the Earth. This is due to
   a) larger orbital speed of Venus
   b) the absence of atmosphere around Venus
   c) absence of metallic rocks inside Venus
   d) very slow rotation of Venus

7) The sum of the cubes of three successive integers is always divisible by

   a) 4 b) 8 c) 9 d)12

8) The circles $x^2 + y^2 = 400$ and $x^2 + y^2 - 10x - 24y + 80 = 0$ are in same plane. Which of the following statement is true?
   a) They do not touch each other
   b) They intersect each other in two points.
   b) They touch each other externally
   c) They touch each other internally

9) A 40 Kg slab S rests on frictionless floor and a 10 Kg block B rests on the top of the slab. The coefficient of friction between them is μ_s =0.45 and μ_k=0.4. If the force applied on the block is 75N, the accelerations of the slab and the block respectively are (g= 10 ms^{-2}).



a) 3.5 ms^{-2} , 1.0 ms^{-2} b) 1.0 ms^{-2} , 1.0 ms^{-2} c) 3.5 ms^{-2}, 3.5 ms^{-2} d) 1.0ms^{-2}, 3.5 ms^{-2}

10) Select the wrong one (here N is newton, A is ampere, J is joule, m is meter, s is second and Kg is kilogram).

a) $\frac{stress}{strain} = Nm^{-2}$ b) $Surface\ tension = Jm^{-2}$

c) $\text{Capacitance} = A^2s^4Kg^{-1}m^{-1}$ d) $Force = Kgms^{-2}$

11) If $cos20^0 - sin20^0 = k$ then $cos40^0$is equal to

a) $\sqrt{2k - k^2}$ b) $k(2-k)^2$ c) $k\sqrt{2-k^2}$ d) $k + 2\sqrt{2k-k^2}$

12) Sun spots are used in the study of

a) rotation of the Sun
b) size of the Sun
c) variation in the luminosity of Sun
d) variation in the gravitational field around the Sun.

13) Which of the following statements are correct

(i) $sin2\theta = \frac{2tan\theta}{(1+\tan^2\theta)}$ (ii) $sin2\theta = 2tan\theta\cos^2\theta$

(iii) $\sqrt{\sin^2\theta - \cos^2\theta} = sin2\theta$ (iv) $\frac{tan2\theta}{sec2\theta} = sin2\theta$

a) (i) & (iv) b) (i), (ii) & (iii) c) (i), (ii) & (iv) d) All

14) Five (5) parallel lines in a plane are intersected by set of four (4) parallel lines. The number of parallelogram is

a) 12 b)20 c)25 d)60

15) A horizontal platform at rest starts ascending from the ground with a constant acceleration of $1ms^{-2}$. After 2 seconds a stone is thrown vertically upwards from the platform with a speed of 2ms^{-1} relative to the platform. The maximum height from the ground attained by the stone is (g = 10 ms^{-2})

a) 2.8 m b) 2.2 m c) 2.4 m d) 2.6 m

16) The efficiency of carnot's heat engine is 0.5 when the temperature of the source is T_1 and that of sink is T_2. The efficiency of another carnot's heat engine is also 0.5. The *possible* temperature of the source and sink of the second engine are respectively.

a) $T_1 + 5, T_2 - 5$ b) $T_1 + 10, T_2 - 10$ c) $2T_1 , 2T_2$ d) $2T_1, \frac{T_2}{2}$

17) Two hypothetical stars A and B of same size have apparent magnitudes of - 4.5 and 1.5 and real magnitudes of 1.5 and -4.5 respectively. We conclude that
   a) A is much hotter and closer to earth than B
   b) B is much hotter and closer to earth than A
   c) A is much hotter than B and B is much closer to earth than A
   d) B is much hotter than A and A is much closer to earth than B

18) Find the value of $\begin{vmatrix} 1 & 2 & 3 \\ 1 & 8 & 27 \\ 1 & 32 & 243 \end{vmatrix}$

   a) 36 b) 216 c) 1296 d) 6!

19) Find the value of $\tan^{-1} 2 + \tan^{-1} 3$

   a) $\frac{\pi}{4}$ b) $-\frac{\pi}{4}$ c) $\frac{3\pi}{4}$ d) $\frac{5\pi}{6}$

20) A physical quantity $y = \frac{a^4 b^2}{(cd^4)^{1/3}}$ has four variables a, b, c and d. The percentage error in a, b, c and d are 2%, 3% 4% and 5% respectively. The error in y will be
   a) 6% b) 11% c) 12% d) 22%

21) Two identical drops of water fall through air with a terminal velocity 2 ms^{-1}. If the drops merge to form a single drop, its terminal velocity is
   a) 3.17 ms^{-1} b) 1.58 ms^{-1} c) 2.52 ms^{-1} d) 4 ms^{-1}

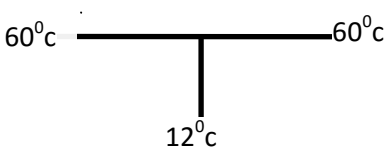
22) Apart from the earth, *Aurora* phenomena is observed on which of the following planet
   a) Venus
   b) Mars
   c) Mercury and
   d) Jupiter

23) The mean of the five numbers is zero. Their variance is 2. If three of these numbers are -1, 1and 2. The remaining numbers are
   a) -5 & 3 b) -4 & 2 c) -3 & 1 d) -2 & 0

24) Find the digit at the unit place of $27^{2015} + 21^{2015} - 23^{2015}$
   a) 7 b)3 c) 5 d) 1

25) A cylindrical tube open at both ends has a fundamental frequency of 390 Hz in air. If $\frac{1}{4}^{th}$ of the tube is immersed, vertically in water, the fundamental frequency of air column is
   a) 130 Hz b) 390 Hz c) 520 Hz d) 260 Hz

26) Three identical rods are joined as shown in the figure. The temperature at the junction is
   a) 48 ^{0}c b) 44 ^{0}c
   c) 40 ^{0}c d) 36 ^{0}c.



27) Sun is at a mean distance of about 27,000 light years from the centre of the Milky way galaxy and completes one revolution about the galactic centre in about 225 million years. The linear speed of Sun is

a) 160 km s^{-1} b) 230 km s^{-1} c) 30 km s^{-1} d) 80 km s^{-1}

28) Find the value of $\tan^{-1}\frac{\cos x}{1+\sin x}$

a) $\frac{x}{4}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{4}-\frac{x}{2}$ d) $\frac{\pi}{4}-\frac{x}{2}$

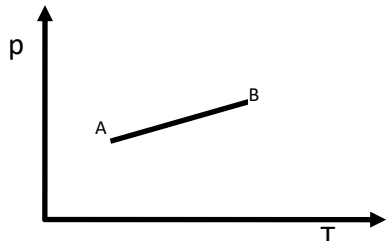
29) If $log30 = 1.4771$, $log40 = 1.6021$, $log50 = 1.6990$, $\log 45 = x$ then find *x*.

a) 1.6542 b) 1.6232 c) 1.6532 d) 1.6832

30) The figure shows a pressure vs temperature (P-T) graph for a given mass of an ideal gas undergoing a process from A toB. In this process, volume of the gas

a) is increasing b)remains constant

c) is decreasing d) cannot be predicted.



31) A window is 50 cm high. A stone starts falling from a height of 40 cm above the window. It crosses the window in

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

32) Light from the nearest star 'proxima centauri' takes 4.24 light years to reach earth. The stellar parallax of this star is about

a) 1.30 sec b) 0.77 sec c) 13.8 sec d) 0.24sec.

33) The equation $\frac{x^2}{25-a}+\frac{y^2}{49-a}=1$ represents

a) an ellipse if $a > 25$ b) a hyperbola if $25 < a < 49$

c) a hyperbola if $a > 49$ d) an ellipse if $25 < a < 49$

34) The value of the determinant $\begin{vmatrix} x & sin\theta & cos\theta \\ -sin\theta & -x & 1 \\ cos\theta & 1 & x \end{vmatrix}$ is

a) Independent of θ b) Independent of x

c) Independent of of θ and x d) none of these is true

35) Two similarly charged spherical conductors are suspended by non conducting threads of length l from a horizontal support. If this is taken to a place of zero gravitational effect , the angle between the threads and the separation between them are

a) 0^0 , 2*l* b) 180^0 , 2*l* c) 120^0 , *l* /2 d) 60^0 , (√3 /2) *l*

36) A cylindrical object of volume 0.4 m^3 floats in water with 20% of its height seen above water. The minimum force required to be applied on the object so that it just gets immersed in water is

(Density of water= 10^3 kg m^{-3} g=10ms^{-2})

a) 3200 N b) 800 N c) 2400 N d) 4800 N.

37) The International Space Station (ISS) launched in 1998 its satellite orbiting earth with perigee at 422 km and apogee at 425 km above mean sea level. Given mean radius of the earth is 6371 km and acceleration due to gravity is 9.8 ms^{-2} , the distance covered by ISS in one hour is about

a) 27500 km b) 766 km c) 4150 km d) 2660km.

38) Find the 99th term of the sequence 7, 23, 47, 79, 119, ……..

a) 35999 b) 379999 c) 37799 d) 39599

39) Forty two cube with 1cm edge each are glued together to form a solid rectangular block. If the perimeter of the base is 20 cm. Find the height of that rectangular block.

a) 2 cm b) 3 cm c) 6 cm d) 7 cm

40) Out of the following expressions

(i) $y = \frac{a}{x-vt}$ (ii) $y = a\sqrt{(x-vt)}$ (iii) $y = a(x-vt)^2$ (iv) $y = a(x^2 - vt^2)$

the expression/s that represent/s progressive waves is/are

a) (i) and (ii) only b) (ii) and (iii) only c) (i), (ii) and (iii) only d) all

41) There are two open organ pipes of exactly the same length and material but of different radii. Then,

a) narrower pipe has lower frequency
b) both the pipes have exactly the same frequency
c) wider pipe has lower frequency
d) either has lower frequency depending on the amplitude of sound waves.

Read the following passage and answer the questions number 42 to 44

A star of mass greater than about 5 times the mass of the Sun (M_0) dies as black hole. When the nuclear burning stops, the star starts collapsing under its own gravity. On attaining a certain radius, its escape velocity becomes equal to the speed of light and it is called the Schwarzschild radius R_s. An 'event' horizon is said to be formed when 'No information' can be obtained by electromagnetic waves from within. For a non-rotating black hole, the Schwarzschild radius itself forms the event horizon. (G= 6.674×10^{-11} **N**·m^2/kg^2, c=$3X10^8 ms^{-1}$, $M_0 \approx 21.6\text{x}\,10^{30}$ kg and $M_{earth} = 5.972X10^{24}kg$)

42) The Schwarzschild radius of a star of mass $8M_0$ is about

a) 3 km [1] b) 256 km c) 140 km d) 480 km s^{-1}

43) After a massive star attains the Schwarzschild radius R_s, on further gravitational contraction , the radius of event horizon of a non rotating black hole

a) decreases b) increases c) remains constant d) becomes infinite

44) Suppose earth starts shrinking to become a black hole then the event horizon wii

a) 8.9km b) 2.35m c) 0.89cm d) 12.45cm

45) $(51^{32} - 15^{32})$ is a multiple of

a) 765 b) 2178 c) 2826 d) 2956

46) $10^{0.6021} = 4$; $10^{0.4771} = 3$ and $10^x = 72$ find x

a) 1.85735 b) 1.75725 c) 1.87525 d) 1.87255

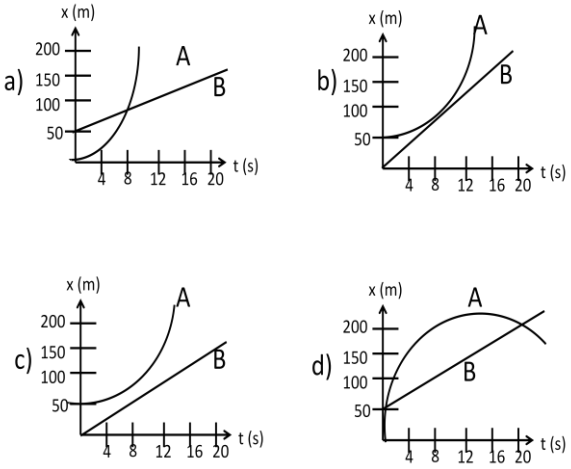
47) Find the smallest natural number 'n' such that $(65n^2 + 1)$ is a perfect square

a) 13 b) 16 c) 17 d) 19

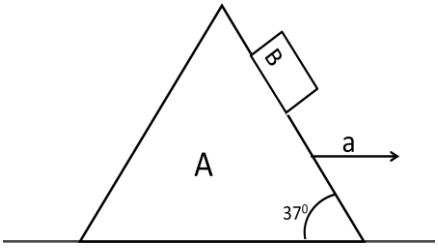
48) Two litres of milk purchased from a vendor, has a density of 1018 kgm^{-3}. If the density of pure milk from that source is 1030 kgm^{-3} and that of water used is 998 kg m$^{-3,}$ the amount of water mixed in the sample is

a) 0.750 litre b) 0.667 litre c) 0.480 litre d) 0.375 litre

49) Particle A starts from origin with a constant acceleration $3ms^{-2}$. Its initial speed is zero. Particle B starts from $x = 48\,m$ and moves with constant speed of $6ms^{-1}$. If both the particles move along $x - axis$ and start at the same instant, then indentify the correct graph which depicts motion of both the particles.



50) In the situation shown in adjacent figure, coefficient of friction between block B and wedge A is 0.5. Wedge A is moved horizontally with uniform acceleration a. Then identify the correct statement (take tan 37^0 = ¾).



a) Friction on the block is zero if $a = g$
b) Friction on the block is upward along the incline if $a > g$
c) Friction on the block is downward along the incline if $a < \frac{g}{2}$
d) Friction on the block is kinetic in nature if $a \geq 2\,g$

51) Find the sum of all three-digit perfect square numbers

a) 9131 b) 10131 c) 10231 d) 11031

52) Which of the following statements are true

(i) $Sin^{-1}\frac{8}{17} + Cos^{-1}\frac{84}{85} = Sin^{-1}(0.6)$ (ii) $Sin^{-1}\frac{8}{17} + Cos^{-1}\frac{84}{85} = \tan^{-1}0.75$

(iii) $Sin^{-1}\frac{8}{17} + Cos^{-1}\frac{84}{85} = Cot^{-1}(0.75)$ (iv) $Sin^{-1}\frac{8}{17} + Cos^{-1}\frac{84}{85} = \mathrm{Cos}^{-1}0.80$

a) (i) &(iv) b) (i), (ii) & (iii) c) (i), (ii) & (iv) d) All

Read the following passage and answer the questions number 53 to 56

The Mars Orbital Mission (MOM) space craft launched on 9th November 2013 reached the expected Martian orbit on 24th September 2014. Now it is revolving the planet Mars in a highly elliptic orbit. At the closest position the space craft is at a height of 421.7 km above the Martian surface, its farthest distance from the planet's surface being 76993.6 km. The mean radius of Mars is about 3390 km.

One of the two natural satellites of Mars is 'Phobos' revolves the planet in a nearly circular orbit with a mean radius of 9377 km once in every 7.66 hours (mass of mars = $6.39X10^{23}$ kg and G = 6.674×10^{-11} **N**·m^2/kg^2).

53) The semi major axis of MOM's orbit is about
a) 42100 km b) 38500 km c) 40000 km d) 36800 km

54) The semi minor axis is about
b) 21008 km b) 17510 km c) 4207 km d) 19503 km

55) The period of revolution of the space craft in hours is about
a) 36.4 b) 26.5 c) 72.8 d) 53.0

56) The maximum speed of the space craft in its orbit is about

a) 2.15 kms^{-1} b) 1.85 kms^{-1} c) 7.89 kms^{-1} d) 1kms^{-1}

57) If $y = \frac{\cos(x)}{\sec(x)}$ then $\frac{dy}{dx}$ is given by
a) $\sin(2x)$ b) $-\sin(2x)$ c) $\sin(x)\,cosec(x)$ d) $\frac{\sin(x)}{cosec(x)}$

58) The owner of a milk store finds that he can sell 980 litres of milk each week at Rs 42/litre and 1220 litres of milk each week at Rs 48/litre. Assuming the linear relationship between the selling price and the demand, how many litres could he sell weekly at Rs 51/litre.
a) 1340 b) 1430 c) 1450 d) 1540

59) Two hypothetical main sequence stars A and B have their radius in the ratio 1:2 and their surface temperature in the ratio 2:1. Then the ratio of their luminosities respectively are in the ratio
a) 4:1 b) 1:1 c) 2:1 d) 1:16.

60) Find the value of θ if $cos3\theta + cos\theta = cos2\theta$
a) π b) $\frac{\pi}{2}$ c) $\frac{2\pi}{3}$ d) $\frac{\pi}{4}$

61) Consider an isolated system of interacting particles. Then indentify the correct statement
(i) Total mechanical energy of the system must be conserved.
(ii) Total linear momentum of the system must be conserved.
a) (i) is true and (ii) is false
b) (i) is false and (ii) is true
c) (i) and (ii) both are true
d) (i) and (ii) both are false

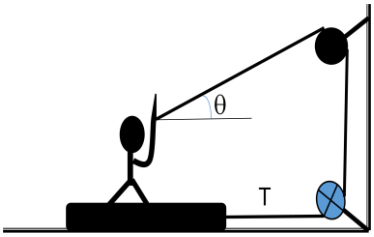
62) A gaint wheel of mass M has a rim on which a person can walk. Consider a case where, in a person of mass m walks on the rim at a constant speed and the wheel rotates in opposite direction with constant angular speed. Further the speed of the person with respect to ground is zero. Then the net force exerted by axle on the wheel.
(i) Is equal to $(m+M)g$
(ii) Is greater than $(m+M)g$
(iii) Depends on angular speed of the wheel
(iv) Depends on radius of the wheel

a) (i) is true b) (i) and (ii) are true
c) (ii) and (iii) are true d) (ii), (iii) and (iv) are true

63) A particle is projected with a velocity, $20ms^{-1}$ at angle of 60^0. Then radius of curvature of its trajectory at a point where its velocity makes an angle of 37^0 with the horizontal is (g = 9.8ms^{-2})

a) 16m b) 19.53m c) 15.62m d) 25m

64) A person standing on a plank is pulling a string as shown in the adjacent figure. Floor is rough and the motion is impending. Tension in the string is denoted by $T$and coefficient of friction between plank and floor is μ. The tension in the string is



a) $T = \frac{\mu mg}{1+cos\theta+\mu sin\theta}$ b) $T = \frac{\mu mg}{1+cos\theta}$
c) $T = \frac{\mu mg}{1+\mu sin\theta}$ d) $T = \frac{\mu mg}{1+\mu}$

65) If α and β are the roots of the equation $x^2 = -(x+1)$. How many of the following statements are true

(i) $\alpha^2 = \beta$ (ii) $\alpha = \beta^2$ (iii) $\alpha\beta = 1$ (iv) $\alpha^3 - \beta^3 = 0$

a) 1 b) 2 c) 3 d) all

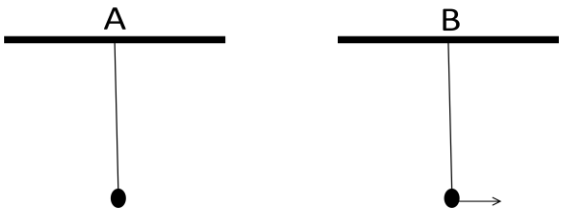
66) The numbers 'a' and 'b' are chosen from the set $\{1,2,3,4,5,6,7,8,9,10\}$ such that $a \leq b$ with replacement. Find the probability that 'a' divides 'b'

a) $\frac{5}{11}$ b) $\frac{29}{45}$ c) $\frac{27}{55}$ d) $\frac{49}{100}$

67) Assuming that straight line works as a plane mirror for a point. Find the image of the point (1,2) in the line $x - 3y + 4 = 0$

a) (-2,-1) b) (-1,-2) c) (1.2,1.4) d) (-1.2, -1.4)

68) There are two pendula as shown in the adjacent figure. Pendulum A is at rest in its equilibrium position while pendulum B is oscillating. When pendulum B passes through the equilibrium position, Consider the following two statements.



(i) The net force experienced the bob at the equilibrium position is zero in both the cases.
(ii) The acceleration of pendulum B in the tangential direction is zero.

a) Statement (i) and (ii) are correct
b) Statement (i) is correct while Statement (ii) is wrong
c) Statement (ii) is correct while Statement (i) is wrong
d) Statement (i) and (ii) are wrong

69) An electrical circuit consisting of three identical bulbs and three switches is shown in the adjacent figure. Let the glowing bulb be presented by one (1) and zero (0) when it is not glowing. The correct table that represent the circuit operation is

Switch			Bulb		
A	B	C	1	2	3
on	On	on	1	1	0
on	On	off	1	1	1
on	Off	off	1	0	0
off	On	on	0	0	0

(a)

Switch			Bulb		
A	B	C	1	2	3
on	on	on	1	1	1
on	on	off	1	1	0
on	off	off	1	0	0
off	on	on	0	0	0

(a)

(b)

Switch			Bulb		
A	B	C	1	2	3
on	On	On	1	1	1
on	On	Off	1	0	0
on	Off	Off	1	0	0
off	On	On	0	0	0

(c)

Switch			Bulb		
A	B	C	1	2	3
on	on	on	1	1	0
on	on	off	0	0	1
on	off	off	1	1	0
off	on	on	0	0	1

(d)

70) In a polarization experiment a plane polarised light is allowed to pass through a mica sheet and then through an analyser. The intensity of light is measured as function of orientation of mica sheet. The intensity attains minimum at a certain angle and then increases. The data obtained for three angles close to minima is given by.

Angle	Intensity
-3.6^0	1.1
0^0	0.2
3.6^0	0.6

Assuming that variation of intensity (I) with respect to angle (θ) is a quadratic function, the angle at which the intensity of light is zero is

a) 0.7 b) 0.9 c) 0.3 d) 0.5

71) A cylinder is closed at both ends and has insulating walls. It is divided into two compartments by an adiabatic (insulating) partition that is perpendicular to the axis of the cylinder. Each compartment contains 1.00 mol of oxygen that behaves as an ideal gas with ratio of specific heat, $\gamma = \frac{7}{5}$. Initially, the compartments one and two have equal volumes and their temperatures are 550K and 250K. The partition is then allowed to move slowly until the pressures on its two sides are equal. The final temperatures in the first and second compartments are respectively

a) 473.5K & 264.5K b) 498.9K & 284.2K
c) 492.9K & 270.2K d) 250K & 550K

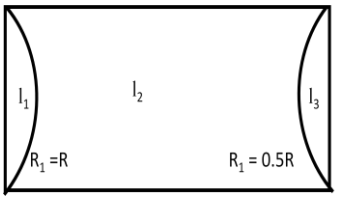
72) The reminder that is obtained, if the number $(100110011001)^2$ is divided by 91 is
a) 0 b) 1 c) 8 d) 9

73) If $3^x = 7^y = 63^z$ then $z(2y + x)$ is given by
a) $x\sqrt{y}$ b) xy c)x^2y d)$none\ of\ these$

74) $\vec{a}$ and $\vec{b}$ are unit vectors. θ is the angle between $\vec{a}$ and $\vec{b}$. Which of the given statement are true.
(i) If $\vec{a} + \vec{b}$ is unit vector then $\theta = \frac{2\pi}{3}$
(ii) If $\vec{a} - \vec{b}$ is unit vector then $\theta = \frac{\pi}{3}$
(iii) If $\vec{a} + \vec{b}$ is unit vector then $\theta = \frac{\pi}{3}$
(iv) If $\vec{a} - \vec{b}$ is unit vector then $\theta = \frac{\pi}{4}$
a) (i) & (ii) b) 2(iii) & (iv) c) (i) & (iii) d) none of the above

75) When the cube root of 13683*0393208 is divided by 3, the remainder is 2. The digit in place of * is
a) 5 b) 6 c) 7 d) 9

76) A glass slab is divided into three lenses $l_1, l_2\ and\ l_3$ as shown in the adjacent figure. If power of lens l_1 is $P_1 = 0.25,$ the power of the lens l_2.
a) -0.5D b) -0.25D
c) -0.75 D c) -0.4 D



77) An object (O) is placed at a distance of 30 cm from a convex lens of focal length 12 cm and real image is caught on a screen. A convex mirror is placed between lens and image screen. It's position, when adjusted forms a final image coincident with O. If the distance between lens and mirror is 10 cm, the focal length of the convex mirror is
a) 30 cm b) 10cm c) 5 cm d) 25cm

78) An electrical heater drawing a current 5 amp is used for melting 5 Kg of ice (at 0^0). The temperature of the melt after 1000 sec (latent heat of melting of ice is 80 $calg^{-1}$, specific heat of water is 1 $calg^{-1}$per degree Celsius and resistance of coil is 40Ω).
a) 10^0C b) 30^0C c) 15^0C d) 0^0C

79) A stone tied to string is whirled in a horizontal plane in a circular path at a rate 5rev s^{-1}. If the same stone is whirled with same force by a string of half its length, the number of revolution for one second now is
a) $\sqrt{80}\ rev\ s^{-1}$ b) $\sqrt{10}\ rev\ s^{-1}$ c) $\sqrt{50}\ rev\ s^{-1}$ d) $\sqrt{40}\ rev\ s^{-1}$

80) Consider a small balloon filled with an ideal gas which is submerged in water. Assuming that the temperature is the same everywhere in the water, the buoyant force on the balloon when it is at a depth *d* below the surface, in terms of its volume at the surface V_o, the atmospheric pressure P_o, the density of water ρ_o, and the acceleration due to gravity *g*.
a) $F_B = \frac{P_0V_0}{d+\frac{P_0}{\rho g}}$ b) $F_B = \frac{P_0V_0}{d\rho g+P_0}$ c) $F_B = \frac{d\rho g+P_0}{P_0V_0}$ d) $F_B = \frac{P_0V_0}{d+\frac{\rho g}{P_0}}$