MSc Geophysics

Set No. 1

Question Booklet No. 00076

15P/204/30 (2/9)

(To be filled up by the candidate by blue/black ball-point pen)

Roll No. | | | | | | | | | |

Serial No. of OMR Answer Sheet ....

Day and Date ....

....
(Signature of Invigilator)

INSTRUCTIONS TO CANDIDATES

(Use only ***blue/black ball-point pen*** in the space above and on both sides of the **Answer Sheet**)

1. Within 10 minutes of the issue of the Question Booklet, check the Question Booklet to ensure that it contains all the pages in correct sequence and that no page/question is missing. In case of faulty Question Booklet bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall ***except the Admit Card without its envelope***.
3. ***A separate Answer Sheet is given. It should not be folded or mutilated. A second Answer Sheet shall not be provided. Only the Answer Sheet will be evaluated.***
4. Write your Roll Number and Serial Number of the Answer Sheet by pen in the space provided above.
5. ***On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.***
6. ***No overwriting is allowed in the entries of Roll No., Question Booklet no. and Set no. (if any) on OMR sheet and Roll No. and OMR sheet no. on the Question Booklet.***
7. ***Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfairmeans.***
8. ***Each question in this Booklet is followed by four alternative answers. For each question, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by pen as mentioned in the guidelines given on the first page of the Answer Sheet.***
9. For each question, darken only one circle on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed. If you do not wish to attempt a question, leave all the circles in the corresponding row blank (such question will be awarded zero marks).*
11. For rough work, use the inner back page of the title cover and the blank page at the end of this Booklet.
12. Deposit only **OMR** ***Answer Sheet*** at the end of the Test.
13. You are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

Total No. of Printed Pages : 40

[उपर्युक्त निर्देश हिन्दी में अन्तिम आवरण पृष्ठ पर दिये गए हैं।]

ROUGH WORK
रफ़ कार्य

15P/204/30

No. of Questions : 150

प्रश्नों की संख्या : 150

Time : $2\frac{1}{2}$ Hours | ***Full Marks : 450***

समय : $2\frac{1}{2}$ घण्टे | ***पूर्णाङ्क : 450***

Note : (1) Attempt as many questions as you can. Each question carries **3 (Three)** marks. ***One mark will be deducted for each incorrect answer.*** **Zero** mark will be awarded for each unattempted question.

अधिकाधिक प्रश्नों को हल करने का प्रयत्न करें। प्रत्येक प्रश्न **3** (तीन) अंकों का है। *प्रत्येक गलत उत्तर के लिए एक अंक काटा जायेगा।* प्रत्येक अनुत्तरित प्रश्न का प्राप्तांक *शून्य* होगा।

(2) If more than one alternative answers seem to be approximate to the correct answer, choose the closest one.

यदि एकाधिक वैकल्पिक उत्तर सही उत्तर के निकट प्रतीत हों, तो निकटतम सही उत्तर दें।

01. A 50 gm bullet moving with velocity 10m/sec strikes a block of 950 gm at rest and gets embedded in it. The loss in kinetic energy will be :

(1) 100% (2) 95% (3) 5% (4) Zero

02. The escape velocity on the surface of the earth is v_0. If M and R are the mass and radius of the earth, then the escape velocity on another planet of mass 2M and radius R/2 will be :

(1) $4v_0$ (2) $2\ v_0$ (3) v_0 (4) $v_{0/2}$

03. The geostationary satellite moves in a circular orbit of radius about :

(1) 42000 Km. (2) 36000 Km.

(3) 30000 Km. (4) 24000 Km.

04. If the total energy of a particle is thrice its rest mass energy then the velocity of the particle in terms of velocity of light is :

(1) $\frac{C}{3}$ (2) $\frac{2C}{3}$ (3) $\frac{2\sqrt{2}}{3}C$ (4) $\frac{\sqrt{2}}{3}C$

05. The half life of certain particle in its own frame at rest is 36 μsec. Its half life for an observer moving at constant velocity 0.8c with respect to the particle will be :

(1) 36 μsec (2) 50 μsec

(3) 60 μsec (4) 121.6 μsec

06. If $\vec{F}$ is a c conservative force then :

(1) $\vec{\nabla}.\vec{F}=0$ (2) $\vec{\nabla}\times\vec{F}=0$

(3) $\vec{\nabla}\vec{F}$ (4) $\vec{\nabla}\times\vec{\nabla}\times\vec{F}=0$

07. Width of any resonance curve :

(1) is directly proportional to quality factor

(2) is inversely proportional to quality factor

(3) is independent of quality factor

(4) is independent of resonance frequency

08. A perfect mcanoatomic gas undergoes reversible adiabatic expansion. The relationship between its volume v and internal energy u at any stage of expansion is given by :

(1) $uv^{1/3}$ = const (2) uv = constant

(3) $uv^{2/3}$ = const (4) $uv^{4/3}$ = constant

09. A system A interacting with a restrain R undergoes a reversible transformatican of its thermodynamic state . If ∇S_A is the change in the entropy of A and ∇S_R that of R during this transformation, then in general

(1) $\nabla S_A = \nabla S_R$ (2) $\nabla S_A = -\nabla S_R$

(3) $\nabla S_A = 0, \nabla S_R > 0$ (4) $\nabla S_A > 0, \nabla S_R = 0$

10. When some work is done by heat energy there will be some wastage of energy, this is in accordance with :

(1) First law of thermodynamics

(2) Second law of thermodynamics

(3) Third law of thermodynamics

(4) Zeroth law of thermodynamics

11. The work done in moving an object of mass m through distance $\vec{S} = (2\vec{i} + 6\vec{j} + 2\vec{k})$ meter on application of a force $\vec{F} = (3\vec{i} + \vec{j} - \vec{k})$ Newton is given by :

(1) 29 Joules (2) 8 Joules

(3) 10 Joules (4) 25 Joules

12. Two masses connected by an inextensible string over a fixed frictionless pulley. The sum of the masses of two boxes in M and difference in their masses is m. If we ignore the masses of the pulley and string then the downward acceleration of heavier lose is :

(1) $\frac{M}{m}g$ (2) $\frac{m}{M}g$ (3) $\frac{M^2 - m^2}{2m}g$ (4) $\frac{M^2 - m^2}{2M}g$

13. An ideal gas undergoes a process during which U constant, where P is the pressure and v is the volume of the gas. If the volume of the gas decreases the temperature will :

(1) increase

(2) decrease

(3) remain constant

(4) first increases their decreases

14. If 100 gm of steam at 150°C is cooled and frozen into 100 gm of ice at °C. Specific heat of steam is 2.01 kJ/kg °K and specific heat of water is 4.18 kj/kg°K. The total heat removed during the process is (Given Latent heat of ice 80Cal/gm Latent heat of vapour = 536 Cal/gm) :

(1) 211 kJ (2) 311 kJ (3) 351 kJ (4) 401 kJ

15. The width of interference fringes in young's double slit experiment increases.

(1) on increasing the slit width

(2) on decreasing the wavelength of interring light

(3) on decreasing the distance between the slit and the screen

(4) on decreasing the distance between two slits.

16. On placing a thin sheet of mica of thickness 12×10^{-5} cm in the path of the one of the two interfering beams in Fresnel's liprism arrangement it is found that the central fring was shifted by a distance equal to the width of the bright fringe of $\lambda = 6 \times 10^{-5}$ cm then find the refractive index of the mica :

(1) 1.33 (2) 1.4 (3) 1.5 (4) 1.45

17. A Newton's ring arrangement is used with a source of light emitting two wavelengths $\lambda_1 = 6 \times 10^{-5}$ cm and $\lambda_2 = 4.5 \times 10^{-5}$ cm. It is found that the nth dark ring due to λ_1 coincides with the (n + 1)th darkring due to λ_2. Find the value of n :

(1) 4 (2) 3 (3) 2 (4) 5

18. In Michelson interferometer white light fringes are formed. It is found that on introducing a glass plate $(\mu = 1.5)$ of thickness 0.5 mm the central fring shifts. By what distance the mirror M_1 must be moved to bring the central dark fringe to its initial position on the cross wires :

(1) 0.16 mm (2) 0.25 mm (3) 0.50 mm (4) 0.08 mm

19. We wish to use a plate of glass (μ = 1.5) as polarizer. What must be the angle of incidence so that the reflected light is completely polarized :

(1) 56.3° (2) 65.4° (3) 36.5° (4) 45.6°

20. What requirement must be met for the envelope of the central maxima of double slit Fraunal offer diffraction pattern to contain exactly eleven fringes if it is given that the slit width is a and the separation between the two slits is of :

(1) $\frac{d}{a}=\frac{9}{2}$ (2) $\frac{d}{a}=\frac{13}{2}$ (3) $\frac{d}{a}=\frac{11}{2}$ (4) $\frac{d}{a}=\frac{7}{2}$

21. The sodium source of light has a doublet whose components are 5890A° and 5896A°, Find the minimum number of lines in a grating to resolve this doublet in the first order :

(1) 796 (2) 982 (3) 856 (4) 490

22. Find the thickness of the quarter wave plate for light of wavelength 6000A°, given that μ_0 = 1.544 and μ_e = 1.553 :

(1) 16.6×10^{-4} cm (2) 33.2×10^{-4} cm

(3) 8.3×10^{-4} cm (4) 66.4×10^{-4} cm

23. A beam of light is analysed by a Nical prism after passing through quarter wave plate. Two position of maximum intensity and two positions of zero intensity are found on one complete rotation of Nicalprism. The light is :

(1) unpolarized (2) plane polarized

(3) circularly polarized (4) Elliptically polarized

24. The plane of polarization is rotated by 6° by a tube 20cm long containing a solution made by dissolving 100 gm of Rochelle salt in a liter of water. How many grams of salt must there be in a liter of a solution which relates the plane of polarization through 6.75° when placed in a tube 15cm long :

(1) 120gm (2) 150gm (3) 80gm (4) 140gm

25. Indicate the false statement about the dispersive power of a diffraction grating :

(1) It increases with the order of the spectrum

(2) It increases with the grating element

(3) It increases with the number of rulings per unit length the grating

(4) It decreases with grating element

26. If the width of the transparent position is equal to hall the width of opaque portion in a diffraction grating then the missing order of spectrum will be :

(1) 1st, 3rd, 5th etc (2) 2nd, 4th, 6th etc

(3) 3rd, 6th, 9th etc (4) 5th, 10th, 15th etc

27. If υ_1 and υ_2 denote the specific volumes of liquid and vapour respectively and L be the latent heat of evaporation of liquid at temperature T then the rate of change of pressure P with temperature is given by :

(1) $\frac{dP}{dT}=\frac{L}{T(\upsilon_2-\upsilon_1)}$ (2) $\frac{dP}{dT}=\frac{L}{T(\upsilon_1-\upsilon_2)}$

(3) $\frac{dP}{dT}=\frac{T}{L(\upsilon_2-\upsilon_1)}$ (4) $\frac{dP}{dT}=\frac{T}{L(\upsilon_1-\upsilon_2)}$

28. Indicate the wrong relation among the four Maxwell's relations given below :

(1) $\left(\frac{\partial S}{\partial V}\right)_T=\left(\frac{\partial P}{\partial T}\right)_V$ (2) $\left(\frac{\partial S}{\partial P}\right)_T=\left(\frac{\partial V}{\partial T}\right)_P$

(3) $\left(\frac{\partial T}{\partial V}\right)_S=-\left(\frac{\partial P}{\partial S}\right)_V$ (4) $\left(\frac{\partial T}{\partial P}\right)_S=\left(\frac{\partial V}{\partial S}\right)_P$

29. The first TdS equation is given by :

(1) $TdS = C_v dT - T\left(\frac{\partial P}{\partial T}\right)_V dV$

(2) $TdS = C_p dT - T\left(\frac{\partial V}{\partial T}\right)_P dP$

(3) $TdS = C_v dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$

(4) $TdS = C_p dT + T\left(\frac{\partial V}{\partial T}\right)_P dP$

30. The first energy equation is given by :

(1) $\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_P + P$

(2) $\left(\frac{\partial u}{\partial P}\right)_T = T\left(\frac{\partial V}{\partial T}\right)_P - P\left(\frac{\partial V}{\partial P}\right)_T$

(3) $\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_P - P$

(4) $\left(\frac{\partial u}{\partial p}\right)_T = T\left(\frac{\partial V}{\partial T}\right)_P + P\left(\frac{\partial V}{\partial P}\right)_T$

31. The heat capacity equation

$$C_P - C_V = T\left(\frac{\partial V}{\partial T}\right)_P\left(\frac{\partial P}{\partial T}\right)_V$$

can be rewritten as :

(1) $C_P - C_V = T\left(\frac{\partial V}{\partial T}\right)_P^2\left(\frac{\partial V}{\partial P}\right)_T$

(2) $C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V^2\left(\frac{\partial V}{\partial P}\right)_T$

(3) $C_P - C_V = -T\left(\frac{\partial p}{\partial T}\right)_P^2\left(\frac{\partial P}{\partial V}\right)_T$

(4) $C_P - C_V = -T\left(\frac{\partial V}{\partial T}\right)_P^2\left(\frac{\partial P}{\partial V}\right)_T$

32. In thermodynamics Gibb's function G is defined as :

(1) $G = u + PV + TS$ (2) $u + PV - TS = G$

(3) $G = u - PV + TS$ (4) $G = u - PV - TS$

33. From the third law of thermodynamic we can not directly prove that :

(1) Heat capacity vanishes at absolute zero

(2) Coefficent of volume expansion vanishes at absolute zero

(3) Cp = Cv at absolute zero

(4) Absolute zero is unattainable by a finite change of parameters

34. If for any thermodynamic system $\oint dx = 0$ for all cyclic processes then the variable be can not be :

(1) Internal energy (2) Pressure

(3) Temperature (4) Volume

35. If 1 kg of water at 0^0C is mixed with 1 kg of water at 100^0C. The change in the entropy of the system after mixing is :

(1) 24 cal/°k (2) 144 cal/°k

(3) 168 cal/°k (4) 48 cal/°k

36. "The ratio of the emissive power to the absorptive power for radiation of a given wavelength is the same for all bodies at the same temperature". is called :

(1) Stefan's law (2) Newton's law

(3) Kirownoff's law (4) Rayleigh Jean's law

37. If S_σ is the salar constant, σ is the Stefan's constant, r is the radius of the sun and R_0 is the mean distance of the earth from the center of the sun then the temperature of the sun is given by :

(1) $T=\left(\frac{R_0^2}{\sigma r^2}\times S_0\right)^{1/4}$

(2) $T=\left(\frac{\sigma r^2}{R_0^2}\times \frac{S_0}{60}\right)^{1/4}$

(3) $T=\left(\frac{R_0^2}{\sigma r^2}\times \frac{S_0}{60}\right)^{1/4}$

(4) $T=\left(\frac{\sigma r^2}{R_0^2}\times S_0\right)$

38. The heat required for the reversible isothermal expansion of 1 mol of a van-der-waal's gas from volume v_1 to v_2 is given by :

(1) $RT\ ln\left(\frac{v_2-le}{v_1-le}\right)$

(2) $RT\ ln\ \{(v_2 - le)\ (v_1 - le)\}$

(3) $RT\ ln\left(\frac{v_1-le}{v_2-le}\right)$

(4) $RT\ ln\ \frac{v_2}{v_1}$

39. a body is rotating with a constant angular velocity $\vec{\omega}$ about an axis passing through the origin of coordinates. If $\vec{r}$ is the position vector for a point fixed in the rotating body then the linear vetocity $\vec{v}$ of that point is related with $\vec{\omega}$ and $\vec{r}$ by the relation :

(1) $\vec{\omega}=\vec{v}\times\vec{r}$

(2) $\vec{v}=\vec{\omega}\times\vec{r}$

(3) $\vec{v}=\vec{\omega}\cdot\vec{r}$

(4) $\vec{\omega}=\vec{v}\cdot\vec{r}$

40. Find the centripetal force acting on a satellite orbiting around the earth in a circular orbit of radius r with its center at the center of earth given that the mass of earth is Me and mass of the satellite in Ms and angular velocity of the satellite is w.

(1) $-\frac{G\,Me\,Ms}{r^3}\vec{r}$ (2) $Ms\,w^2\,\vec{r}$

(3) $\frac{G\,Me\,Ms}{r^3}\vec{r}$ (4) $-Ms\,w^2\,\vec{r}$

41. An object fixed with respect to the surface of a planet identical in mass and radius to the earth experiences zero gravitational acceleration at the equator. What is the length of the day on that planet :

(1) 13 hrs (2) 1.3 hrs (3) 12 hrs (4) 1.2 hrs

42 A cylinder of mass M and radius R is rolling down an inclined plane without slipping. If the height of the inclined plane from the surface of the earth is h. Find the speed v of the center of mass of the cylinder when it reaches the bottom of the inclined plane :

(1) $v = \sqrt{2gh}$ (2) $v = \sqrt{\frac{4}{3}gh}$ (3) $v = \sqrt{\frac{gh}{2}}$ (4) $v = \sqrt{\frac{3}{4}gh}$

43. A small object of mass m is attached to a light string which passes through a hallow tube the tube is held vertically by one hand and the strong by the other. The object is set into rotation in a circle of radius r_1 with a speed v_1. The string is then pulled down shortening the path of the radius to r_2 the new leaner speed v_2 will be :

(1) $v_2 = v_1\left(\frac{r_1}{r_2}\right)$ (2) $v_2 = \left(\frac{r_1^2}{r_2}\right) v_1$

(3) $v_2 = \sqrt{\frac{r_1}{r_2}}\, v_1$ (4) $v_2 = \sqrt{\frac{r_2}{r_1}}\, v_1$

44. In a playground there is a small marry ground of radius 4m and mass 12 kg. The radius of gyration of the merry- go-round is 3m. A child of mass 3 kg runs at a speed of 10m/sec tangent to the rein of the merry go round when it is at rest and then jumps on it Find the angular velocity of the merry-ground and the child neglecting the friction :

(1) 0.58 rad/sec
(2) 0.69 rad/sec
(3) 0.77 rad/sec
(4) 0.83 rad/sec

45. If two 1gm masses moving with equal and opposite velocities of 10 cm/sec collide and stick together after collision then the additional rest mass of the joined pair will be :

(1) 2×10^{-10} gm
(2) 2×10^{-11} gm
(3) 1×10^{-11} gm
(4) 1×10^{-10} gm

46. For shorter wavelengths the Planck's radiation formula can easily Explain :

(1) Wien's law
(2) Rayleigh-Jean's law
(3) Stefan's law
(4) Newton's law

47. If the proper mean life time of π^+ meson is $\tau = 2.5 \times 10^{-8}$ sec. then the distance travelled by a burst of π^+ mesons travelling with speed $v = 0.73$ C will be about :

(1) 500 meter
(2) 350 meter
(3) 800 meter
(4) 450 meter

48. A satellite stationary with respect to the surface of a planet identical in mass and radius to the earth experiences zero gravitational acceleration at the equator. What is the length of the day at the planet :

(1) 1.2 hr (2) 12 hr (3) 1.3 hr (4) 15 hr

49. The dominant mode in a rectangular waveguide is :

(1) TE_{01} (2) TE_{10} (3) TM_{01} (4) TM_{10}

50. A lossless transmission line has characteristic impedance 70 Ω and phase constant 3 rad/m at a frequency 100 MHz. Find the capacitance per meter :

(1) 68.2 pF/m (2) 82.6 pF/m (3) 56.3 pF/m (4) 47.9 pF/m

51. The concept of displacement current was given by :

(1) Faraday (2) Ampere (3) Lorentz (4) Maxwell

52. A medium is characterized by $\sigma = \nu, \mu = \mu_0$ and $\epsilon = \epsilon_0$ and electric field of an E.M. wave is given by $\vec{E} = 20 \sin (10^8 t + \frac{2}{3} z)\, \hat{a}y$ volt/m calculate $\vec{H}$

(1) $\vec{H} = \frac{1}{6\pi} \sin(10^8 t + \frac{2}{3} z)\, \hat{a}x$ Amp/m

(2) $\vec{H} = \frac{1}{6\pi} \cos(10^8 t + \frac{2}{3} z)\, \hat{a}y$ Amp/m

(3) $\vec{H} = \frac{1}{6\pi} \cos(10^8 1 + \frac{2}{3} z)\, \hat{a}x$ Amp/m

(4) $\vec{H} = \frac{1}{6\pi} \sin(10^8 t + \frac{2}{3} z)\, \hat{a}y$ Amp/m

53. If $\vec{A}$ is the vector Potential and V is the scalar potential at any point then the electric field of an E.M. wave at that point is :

(1) $\vec{E} = -\vec{\nabla} V + \frac{\partial \vec{A}}{\partial t}$

(2) $\vec{E} = -\vec{\nabla} V - \frac{\partial \vec{A}}{\partial t}$

(3) $\vec{E} = -\vec{\nabla} V$

(4) $\vec{E} = -\vec{\nabla} V + \frac{\partial \vec{A}}{\partial t}$

54. In a certain medium the electric field of an E.M. wave is given by $\vec{E} = 10\cos(10^8 t - 3y)\,\hat{a}x$ V/m what type of medium is it ?

(1) Free space
(2) Perfect conductor
(3) Perfect dielectric
(4) Lossless dielectric

55. A uniform plane wave in a lossy medium has a phase constant 1.6 rad/m at a frequency of 10^7 Hz and its magnitude is reduced by 60% for every 2 meter travelled. Find the skin depth.

(1) 2.18 m
(2) 4.36 m
(3) 11.09 m
(4) 3.56 m

56. In a full wave rectifier the output DC voltage for input A.C. Voltage V = Vp sin wt is given by :

(1) $\frac{2Vp}{\pi}$
(2) $\frac{Vp}{\pi}$
(3) Vp
(4) $\frac{Vp}{2}$

57. For a transistor the value of h_{fe} is 49 then the value of h_{fb} will be :

(1) 0.99
(2) 0.98
(3) 50
(4) 0.2

58. In the frequency response of R.C. coupled CE amplifier the upper cutoff frequency is obtained due to :

(1) Blocking capacitor
(2) Bypass capacitor
(3) Junction capacitor
(4) Coupling capacitor

59. If a P-N junction diode is reverse baised then its depletion width :

(1) Increases
(2) Decreases
(3) Remains unchanged
(4) Diminishes to almost zero width

60. If silicon chip doped with As is heated and its temperature is start increasing from room temperature then its resistance :

(1) decreases

(2) increases

(3) remains unchanged

(4) first increases and then decreases

61. In multistage amplifiers C.E. amplifier is used at intermediate stages because :

(1) Its voltage gain is high

(2) Its power gain is high

(3) Its input impedance is very high

(4) Its output impedance is very low

62. Find the concentration of donor atoms to be added to an intrinsic Si sample to produce N type material of conductivity 480 s/m. The electron molulety in Ntype silicon is 0.38 m^2/ v.sec. :

(1) $7.9 \times 10^{21}/m^3$

(2) $8.7 \times 10^{20}/m^3$

(3) $5.7 \times 10^{21}/m^3$

(4) $6.3 \times 10^{20}/m^3$

63. Indicate the false statement about the advantages of full wave rectifier over a half wave rectifier :

(1) Smaller ripple voltage

(2) Larger peak inverse voltage

(3) Larger rectification efficiency

(4) Smaller transformer losses

64. Indicate the false statement about the π section filter :

(1) D.C. output voltage is larger

(2) R.M.S. current in the transformer is large

(3) It has a very good regulation

(4) Smaller value of inductor is required

65. Indicate the wrong statement about the Raman effect :

(1) In the scattered light waves of lower as well as higher frequencies than the freq. of original wave is found

(2) Sheft in frequency depends on the frequency of original wave

(3) The extra frequencies are $v \pm v_1, v \pm v_2, v \pm v_3$ where v is original frequency

(4) It is due to the effect of interaction between light and matter

66. The lines of hydrogen spectrum in Paschen series are given by : (assume that n is an integer)

(1) $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

(2) $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

(3) $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$

(4) $\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$

67. The work function of tangston is 5.4 ev when the surface is illuminated by the light of 175 nm the maximum energy of the photoelectrons will be given by (Take $h = 6.626 \times 10^{-34}$ joule-sec) :

(1) 1.4 ev (2) 1.3 ev (3) 1.5 ev (4) 1.7 ev

68. If we plot a graph between the mase K.E. the photoelectrons and the frequency of the light incident on the photoelectrode then the intercept on the axis gives the value of :

(1) Threshold frequency

(2) Stopping potential

(3) Planck's constant

(4) Electron charge

69. Find the shortest wavelength present in the radiation from an X ray machine when accelerating potential is 50.000 V ($e= 1.6 \times 10^{-19}$ caul)

(1) 0.05 nm

(2) 0.0156 nm

(3) 0.0248 nm

(4) 0.03 nm

70. X rays of wavelength 10.0 pm are scattered from a target. Find the maximum kinetic energy of the recoil electrons :

(1) 6.54×10^{-15} J

(2) 3.27×10^{-15} J

(3) 8.54×10^{-12} J

(4) 4.27×10^{-12} J

71. Find the de Broglic wavelength of an electron with a velocity of $V = 10^7$ m/sec (mass of the electron = 9.1×10^{-31} kg) :

(1) 5.3×10^{-11}m

(2) 7.3×10^{-11}m

(3) 3.65×10^{-11}m

(4) 9.6×10^{-11}m

72. Indicate the false conclusion given below derived from the Michelson-Morley experiment :

(1) All motion is relative to a specified frame of reference

(2) All motion is relative to a universal frame of reference

(3) The ether does not exist

(4) The light waves does not require a material medium for its propagation

73. Two concentric oncentric cylinders form a coaxial transmission line. If a and b are the diameters of inner and outer conductor respectviely then the capacitance per unit length of this coaxial line (Assume that ϵ is the permitunity of the material between the conductors is given by :

(1) $\frac{2\pi \epsilon}{ln\,(b/a)}$

(2) $2\pi \epsilon\, ln \left(\frac{b}{a}\right)$

(3) $\frac{2\pi \epsilon}{b^2 - a^2}$

(4) $2\pi \epsilon \left(\frac{1}{a^2} - \frac{1}{b^2}\right)$

74. If the input to the full wave rectifier is V(t) = Sin wt then the Fourier series for the output f(t) is given by :

(1) $f(t) = \frac{2}{\pi} - \frac{4}{\pi} \sum_{n=2,4,6....}^{\infty} \frac{\sin n w t}{(n^2-1)}$

(2) $f(t) = \frac{2}{\pi} - \frac{4}{\pi} \sum_{n=2,4,6....}^{\infty} \frac{\cos n w t}{(n^2-1)}$

(3) $f(t) = \frac{4}{\pi} - \frac{2}{\pi} \sum_{n=2,4,6....}^{\infty} \frac{\sin n w t}{(n^2-1)}$

(4) $f(t) = \frac{4}{\pi} - \frac{2}{\pi} \sum_{n=2,4,6....}^{\infty} \frac{\cos n w t}{(n^2-1)}$

75. Indicate the false statement about the construction of Ballistic galvanometer :

(1) its coil is bound on a non con conducting frame

(2) its coil is made of thin copper wire

(3) number of turns in the coil is large

(4) moment of inertia of the coil should be small

76. If $\frac{d^2\vec{A}}{dt^2} = 6t\hat{i} - 24t^2\hat{j} + 4\sin t\hat{k}$ and $\vec{A}(0) = 2\hat{i} - \hat{j}, \frac{d\vec{A}}{dt}(0) = -\hat{i} - 3\hat{k}$, then $\vec{A}$ is given by :

(1) $\vec{A} = 6\hat{i} - 48\,t\hat{j} + 4\cos t\,\hat{k}$

(2) $\vec{A} = 3t\,\hat{i} - 8\,t^3\hat{j} + 4\cos t\,\hat{k}$

(3) $\vec{A} = (t^3 - t + 2)\,\hat{i} + (1 - 2t^4)\,\hat{j} + (t - 4\sin t)\,\hat{k}$

(4) $\vec{A} = (6 + 3t^2)\,\hat{i} - (8t^3 + 48t)\,\hat{j}$

77. In cylindrical coordinate system (δ, ϕ, z), divergence of a vector field $\vec{A} = (A_\delta, A_\phi, A_z) = A_\delta \vec{e}_\delta + A\varphi \vec{e}\varphi + A_z \vec{e}_z$ is :

(1) $\nabla.\vec{A} = \left(\frac{\partial A_\delta}{\partial_\delta}, \frac{\partial A_\phi}{\partial_\phi}, \frac{\partial A_z}{\partial_z} \right)$

(2) $\nabla.\vec{A} = \frac{\partial A_\delta}{\partial_\delta} + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial A_z}{\partial_z}$

(3) $\nabla.\vec{A} = \frac{1}{\delta\phi z}\left[\frac{\partial}{\partial_\delta}(\delta A_\delta) + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial}{\partial_z}(\delta Az \right]$

(4) $\nabla.\vec{A} = \frac{1}{\delta}\left[\frac{\partial}{\partial_\delta}(\delta A_\delta) + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial}{\partial_z}(\delta Az) \right]$

78. In spherical coordinates (r, θ, ϕ) curl of a field $\vec{A} = (A_r, A_\theta, A_\phi) = A_r \vec{e}_r + A_\theta \vec{e}_\theta + A_\phi \vec{e}_\phi$ is :

(1) $\frac{1}{r^2 \sin\phi} \left\{ \left(\frac{\partial}{\partial\theta} (r\cos\theta A_\phi) - \frac{\partial}{\partial\phi}(rA_\theta) \right) \vec{e}_r - \left(\frac{\partial Ar}{\partial\phi} + \frac{\partial}{r}(r\sin\theta A_\phi) \right) r\vec{e}_\theta + \left(\frac{\partial}{\partial r}(rA_\theta) + \frac{\partial Ar}{\partial\theta} \right) r\sin\theta\, \vec{e}_\phi \right\}$

(2) $\frac{1}{r^2 \text{ Sin } \theta} \left\{ \left(\frac{\partial}{\partial \theta} \left(r \sin \theta \, A_\phi \right) - \frac{\partial}{\partial \phi} (r A_\theta) \right) \vec{e}_r + \left(\frac{\partial Ar}{\partial \phi} - \frac{\partial}{\partial r} \left(r \sin \theta \, A_\phi \right) \right) r \vec{e}_\theta + \left(\frac{\partial}{\partial r} (r A_\theta) - \frac{\partial Ar}{\partial \theta} \right) r \sin \theta \, \vec{e}_\phi \right\}$

(3) $\frac{1}{r \theta \phi} \left\{ \left(\frac{\partial}{\partial \theta} (A\phi) - \frac{\partial}{\partial \phi} (A_\theta) \right) \vec{e}_r + \left(\frac{\partial}{\partial r} (A_\theta) - \frac{\partial}{\partial \theta} (A_r) \right) \vec{e}_\theta + \left(\frac{\partial}{\partial \phi} (r A_r) - \frac{\partial}{\partial \theta} \right) \left(r \sin \phi \, A_r \right) \vec{e}_\phi \right\}$

(4) $\frac{1}{r \sin \theta \sin \phi} \left\{ \left(\frac{\partial A\phi}{\partial \theta} - \frac{\partial A\theta}{\partial \phi} \right) \vec{e}_r + \left(\frac{\partial Ar}{\partial \phi} - \frac{\partial A\phi}{\partial \theta} \right) \vec{e}_\theta + \left(\frac{\partial A_\theta}{\partial r} - \frac{\partial Ar}{\partial \theta} \right) \vec{e}_\phi \right\}$

79. The curl of cross product of two fields $\vec{A}$ and $\vec{B}$ is given by :

(1) $\nabla \times \left(\vec{A} \times \vec{B} \right) = \left(\vec{B} . \nabla \right) \vec{A} - \vec{B} \left(\nabla . \vec{A} \right) - \left(\vec{A} . \nabla \right) \vec{B} + \vec{A} \left(\nabla . \vec{B} \right)$

(2) $\nabla \times \left(\vec{A} \times \vec{B} \right) = \left(\vec{A} . \nabla \right) \vec{B} + \left(\vec{B} . \nabla \right) \vec{A} - \vec{A} \left(\nabla . \vec{B} \right) - \vec{B} \left(\nabla . \vec{A} \right)$

(3) $\nabla \times \left(\vec{A} \times \vec{B} \right) = \left(\vec{A} . \nabla \right) \vec{B} - \vec{A} \left(\nabla . \vec{B} \right) - \left(\vec{B} . \nabla \right) \vec{A} + \vec{B} \left(\nabla . \vec{A} \right)$

(4) $\nabla \left(\vec{A} \times \vec{B} \right) = \vec{B} \left(\nabla \times \vec{A} \right) - \vec{A} \left(\nabla \times \vec{B} \right)$

P.T.O.

80. Green's first identity is given by :

(1) $\iiint\limits_V \left[\phi \nabla^2 \Psi + (\nabla \phi)(\nabla \Psi)\right] dV = \iint\limits_S (\phi \nabla \Psi) dS$

(2) $\iiint\limits_V \left[\phi \nabla^2 \Psi - (\nabla \phi)(\nabla \Psi)\right] dV = \iint\limits_S (\phi \nabla \Psi) dS$

(3) $\iiint\limits_V \left[\phi \nabla^2 \Psi + (\nabla \phi)(\nabla \Psi)\right] dV = \iint\limits_S (\phi \nabla \Psi + \Psi \nabla \phi) dS$

(4) $\iiint\limits_V \left[\phi \nabla^2 \Psi + (\nabla \phi)(\nabla \Psi)\right] dV = \iint\limits_S (\nabla(\phi \Psi) + \phi \nabla \Psi) dS$

81. The eccentricity of a hyperbola given by $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is given by :

(1) $e = \sqrt{2}\,ab$

(2) $e^2 = \frac{a^2 + b^2}{a^2}$

(3) $e^2 = \frac{a^2 - b^2}{a^2}$

(4) $e^2 = \frac{a^2 + b^2}{b^2}$

82. If d_1 and d_2 denote the distances of any point on an ellipse from its major and minor axes respectively, which axes have the respective lengths 2a and 2b, then

(1) $\frac{2d_1}{a^2} + \frac{2d_2}{b^2} = 1$

(2) $\frac{d_1^2}{a^2} - \frac{d_2^2}{b^2} = 1$

(3) $\frac{d_1^2}{a^2} + \frac{d_2^2}{b^2} = 1$

(4) $\frac{d_1^2}{a^2} + \frac{d_2^2}{b^2} = -1$

83. Let P, Q, R be three points on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with centre C. If CP, CQ and CR are inclined equally to each other, then :

(1) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{1}{3}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

(2) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{2}{3}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

(3) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{3}{2}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

(4) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=3\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

84. If PSP' and QSQ' are two mutually orthogonal focal chords of a conic $\frac{l}{r}=1+e\cos\theta$, then value of $\frac{(SP+SP'+SQ+SQ')\,(SP.SP'.SQ.SQ')}{(SP+SP')\,(SQ+SQ')\,(SP.SP'+SQ.SQ')}$ is :

(1) $\frac{e}{l}$ (2) $\frac{l}{e}$ (3) $\frac{l}{2}$ (4) el

85. Locus of centres of conics, passing through four points P $(a_1, 0)$, Q $(0, b_1)$, R $(a_2, 0)$, M$(0, b_2)$, no three of which are collinear, is :

(1) an ellipse
(2) a parabola
(3) a hyperbola
(4) a circle

86. Locus of points of intersection of two perpendicular tangents one to each of two given confocal conics is :

(1) A hyperbola
(2) a circle
(3) a parabola
(4) an ellipse

87. Locus of the points of contact of parallel tangents to a system of confocals is :

(1) a circle
(2) an ellipse
(3) a parabola
(4) a rectangular hyperbola

88. The normals at the points
$t_1 = (at_1^2, 2at_1)$ and $t_2 = (at_2^2, 2at_2)$ to the parabola $y^2 = 4ax$ intersect in the point :

(1) $(a(t_1 + t_2)^2, 2a(t_1 + t_2))$

(2) $t_3 = 2(-(t_1 + \frac{2}{t_2})) = (a(-(t_1 + \frac{2}{t_2}))^2, -2a(t_1 + \frac{2}{t_2}))$

(3) $(0, 0)$

(4) $((2a + a(t_1^2 + t_1t_2 + t_2^2), -at_1t_2(t_1 + t_2))$

89. The shortest distance between the lines passing through the points P_1 (6, 2, 2) and P_2 (-4, 0, -1) in the directions $\hat{i} - 2\hat{j} + 2\hat{k}$ and $3\hat{i} - 2\hat{j} - 2\hat{k}$ respcetively is :

(1) 4 units
(2) 9 units
(3) 16 units
(4) 36 units

90. For the triangle Δ ABC with vertices A(a, 0, 0), B (0, b, 0), C (0, 0, c), the circumcentre of the triangle Δ ABC is :

(1) $\left(\frac{a}{3}, \frac{b}{3}, \frac{c}{3}\right)$

(2) $\left(\frac{ab^2c^2}{b^2c^2 + c^2a^2 + a^2b^2}, \frac{a^2bc^2}{b^2c^2 + c^2a^2 + a^2b^2}, \frac{a^2b^2c}{b^2c^2 + c^2a^2 + a^2b^2}\right)$

(3) $\left(\frac{1}{a(a^{-2} + b^{-2} + c^{-2})}, \frac{1}{b(a^{-2} + b^{-2} + c^{-2})}, \frac{1}{c(a^{-2} + b^{-2} + c^{-2})}\right)$

(4) $\left(\frac{a^3(b^2 + c^2)}{2(b^2c^2 + c^2a^2 + a^2b^2)}, \frac{b^3(c^2 + a^2)}{2(b^2c^2 + c^2a^2 + a^2b^2)}, \frac{c^3(a^2 + b^2)}{2(b^2c^2 + c^2a^2 + a^2b^2)}\right)$

91. If θ is the angle between the pair of planes $ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy = 0$, then

(1) $\tan\theta = \pm\dfrac{\sqrt{a^2+b^2+c^2-gh-hf-fg}}{a+b+c}$

(2) $\tan\theta = \pm\dfrac{\sqrt{f^2+g^2+h^2-bc-ca-ab}}{a+b+c}$

(3) $\tan\theta = \pm\dfrac{\sqrt{a^2+b^2+c^2-gh-hf-fg}}{f+g+h}$

(4) $\tan\theta = \pm\dfrac{\sqrt{f^2+g^2+h^2-bc-ca-ab}}{f+g+h}$

92. Consider four distinct points O (0, 0, 0), A (a, 0, 0), B (0, b, 0), C (0, 0, c). then the surface area of the sphere passing through the points O, A, B and C is :

(1) $\dfrac{\pi}{6}\left(a^2+b^2+c^2\right)^{3/2}$

(2) $\pi\left(a^2+b^2+c^2\right)$

(3) $\pi a^2 b^2 c^2$

(4) $\pi\left(a^2+b^2+c^2\right)^{3/2}$

93. The enveloping cylinder of $ax^2 + by^2 + cz^2 = 1$, whose generators are parallel to the line $\dfrac{x}{l} = \dfrac{y}{m} = \dfrac{z}{n}$ is given by :

(1) $(alx + bmy + cnz)^2 = (al^2 + bm^2 + cn^2)(ax^2 + by^2 + cz^2 - 1)$

(2) $(al^2 + bm^2 + cn^2)^2 = (ax^2 + by^2 + cz^2 - 1)(alx + bmy + cnz)$

(3) $(ax^2 + by^2 + cz^2 - 1)^2 = (alx + bmy + cnz)(al^2 + bm^2 + cn^2)$

(4) $(alx + bmy + cnz)(ax^2 + by^2 + cz^2 - 1) = a^2l^2 + b^2m^2 + c^2n^2$

94. The equation of the C one with its vertex at the origin (0, 0, 0) and with its guiding curve as the circle passig through the points A (a, 0, 0), B (0, b, 0) and C (0, 0, c) is :

(1) $a (b^2 - c^2) yz + b (c^2 - a^2) zx + c (a^2 - b^2) xy = 0$

(2) $\left(\frac{b}{c}-\frac{c}{b}\right)yz+\left(\frac{c}{a}-\frac{a}{c}\right)zx+\left(\frac{a}{b}-\frac{b}{a}\right)xy=0$

(3) $\left(\frac{b}{c}+\frac{c}{b}\right)xy+\left(\frac{c}{a}+\frac{a}{c}\right)yz+\left(\frac{a}{b}+\frac{b}{a}\right)zx=0$

(4) $a (b^2 + c^2) yz + b (c^2 + a^2) zx + c (a^2 + b^2) xy = 0$

95. The maximum number of normals drawn from a point to a central conicoid is :

(1) 3 (2) 4 (3) ∞ (4) 6

96. The general solution of differential equation $x \log x \frac{dy}{dx} + y = \log x$ is :

(1) $y = c + \log x$ (2) $y \log x = c + \frac{1}{2} (\log x)^2$

(3) $y = c + \frac{1}{2} \log x$ (4) $y \log x = c + \log x$

97. The differential equation
$(xy^2 + ax^2y)\, dx + (x^3 + x^2y)\, dy = 0$
is exact when a is equal to :

(1) 2 (2) 4 (3) 1 (4) 3

98. The complementary function of differential equation $\frac{d^4y}{dx^4} - \frac{d^2y}{dx^2} = \tan x$ is :

(1) $(c_1 + c_2) + c_3e^x + c_4 e^{-x}$

(2) $(c_1 + c_2x)e^x + (c_3 + c_4x) e^{-x}$

(3) $(c_1 + c_2)e^x + (c_3 + c_4) e^{-x}$

(4) $(c_1 + c_2x) + c_3e^{-x} + c_4x e^{-x}$

99. The particular integral of the differential equation

$$\frac{d^4y}{dx^4} - a^4y = \cos a x$$

is :

(1) $-\frac{x}{4a^3} \cos a x$ (2) $\frac{x}{4a^3} \cos a x$

(3) $-\frac{x}{4a^3} \sin a x$ (4) $\frac{x}{4a^3} \sin a x$

100. The general solution of the differential equation

$$\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = 8e^{3x}$$

is :

(1) $y = (c_1 + c_2 x + c_3 x^3) e^x + e^{3x}$ (2) $y = (c_1 + c_2 x)e^x + c_3 e^{-x} + e^{3x}$

(3) $y = (c_1 + c_2 x + c_3 x^2) e^x + e^{3x}$ (4) $y = (c_1 + c_2 x + c_3 x^2)e^x + 8 e^{3x}$

101. The general solution of the differential equation $\frac{d^2y}{dx^2} = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{1/2}$ is :

(1) $y = \sin h (x + c_1) + c_2$ (2) $y = -\cos (x + c_1) + c_2$

(3) $y = \cos h (x + c_1) + c_2$ (4) $y = \sin (x + c_1) + c_2$

P.T.O.

102. The general solution of the diffenential equation

$$y\frac{d^2y}{dx^2}-\left(\frac{dy}{dx}\right)^2=y^2\log x \text{ is :}$$

(1) $\log y = c_1 e^x + c_2 e^{-x}$

(2) $\log y = c_1 \sin x + c_2 \cos x$

(3) $y = \log (c_1 e^x + c_2 e^{-x})$

(4) $y = \log (c_1 \sin x + c_2 \cos x)$

103. The differential equation, whose set of independent solution is $\{e^x, \sin x, \cos x\}$ is:

(1) $\frac{d^3y}{dx^3}+\frac{d^2y}{dx^2}+\frac{dy}{dx}+y=0$

(2) $\frac{d^3y}{dx^3}-3\frac{d^2y}{dx^2}+3\frac{dy}{dx}-y=0$

(3) $\frac{d^3y}{dx^3}-\frac{d^2y}{dx^2}+\frac{dy}{dx}-y=0$

(4) $\frac{d^3y}{dx^3}+3\frac{d^2y}{dx^2}+3\frac{dy}{dx}+y=0$

104. The solution of the integral equation

$$\int_0^x e^{x-t}y(t)dt = x$$

is :

(1) $y(x) = 1 + x$

(2) $y(x) = 2 - x$

(3) $y(x) = 1 - x$

(4) $y(x) = 2 + x$

105. The integral equation $y(x)+\lambda\int_0^1 \sin xt\, y(t)dt = x$ is :

(1) volterra integral equation of first kind

(2) Fredholm integral equation of first kind

(3) volterra integral equation of second kind

(4) Fredholm integral equation of second kind

106. If the Laplace transform of f(t) is F (s), then the Laplace transform of f (at) is :

(1) F (a s) (2) $F\left(\frac{s}{a}\right)$

(3) $\frac{1}{a}$ F (s) (4) $\frac{1}{a}F\left(\frac{s}{a}\right)$

107. If the Laplace transform of sin (at) is a | s² +a²), then the Laplace transform of t sin (at) is :

(1) $\frac{as}{(s^2+a^2)^2}$ (2) $\frac{-2as}{(s^2+a^2)^2}$

(3) $\frac{2as}{(s^2+a^2)^2}$ (4) $\frac{2as}{s^2+a^2}$

108. If the Laplace transform of sin 2t is $2/(s^2 + 4)$, then the Laplace transform of $\frac{\sin 2t}{t}$ is :

(1) $\tan^{-1} s$ (2) $\tan^{-1}\frac{s}{2}$ (3) $\cot^{-1}\frac{s}{2}$ (4) $\cot^{-1}s$

109. If u (t -a) is unit step function, then the function f (t) defined as

$$f(t) = \begin{cases} 8 & t < 2 \\ 6 & t > 2 \end{cases}$$

in terms of unit step function can be expressed as :

(1) 8 + 2u (t - 2) (2) 8 + u (t - 2)

(3) 8 - 2u (t - 2) (4) 8 - u (t - 2)

110. If the Laplace transform of y (t) is y (s), then application of Laplace transform in initial value problem y" - y = t, y (0) = y' (0) = 1 results as :

(1) $y(s) = \frac{1}{s^2(s^2-1)}$ (2) $y(s) = \frac{1}{s^2}$

(3) $y(s) = \frac{1}{s-1} + \frac{1}{s^2(s^2-1)}$ (4) $y(s) = \frac{1}{s^2-1}$

111. Forces P, 2P, 3P and 4P act along the sides of AB, BC, AD and DC respectively of a square ABCD. The magnitude of their resultant is :

(1) $3\sqrt{2}$ P (2) $5\sqrt{3}$ P (3) $5\sqrt{2}$ P (4) $3\sqrt{3}$ P

112. If a system of coplanar forces (2, 3) and (4, 5) act at the points (1, 1) and (2, 2) then the equation of the line of action of their resultant is:

(1) 6x - 8y = 3 (2) 8x - 6y = 5

(3) 8x - 6y = 3 (4) 6x - 8y = 5

113. Forces P, Q, R act along the sides BC, CA, AB of a triangle ABC taken in order. If their resultant passes through the centre of the inscribed circle of the triangle ABC then :

(1) P - Q - R = 0 (2) P - Q + R = 0

(3) - P - Q + R = 0 (4) P + Q + R = 0

114. An endless chain of weight w rests in the form of a circular band round a smooth vertical cone which has its vertex upwords. If α is the semi vertical angle of the cone then the tension in the chain due to its weight is :

(1) $\frac{\omega \tan \alpha}{2\pi}$ (2) $\frac{\omega \cot \alpha}{\pi}$ (3) $\frac{\omega \cot \alpha}{2\pi}$ (4) $\frac{\omega \tan \alpha}{\pi}$

115. The work done by the tension T of a string in a small extension of its length from x to x + δx is :

(1) $-T. \delta x$ (2) $T . \delta x$ (3) $-\delta T. \delta x$ (4) $\delta T. \delta x$

116. If a string of lenght 5 units and weight 50 wunits is hanging in the form of a catenary 2y = cosh (2x) then the tension at the lowest point of the catanary is :

(1) 10 units (2) 5 units

(3) 25 units (4) None of these

117. A string hangs between two fixed points in the form of a catenary y = cos hx. If the arc lenght of a point on the catenary from the vertex'is $\sqrt{3}$ then its height above the vertex is :

(1) 4 (2) 3 (3) 2 (4) 1

118. If a body is just on the point of sliding down a rough inclined plane under its own weight then the inclination of the plane is :

(1) less than the angle of friction

(2) equal to the angle of friction

(3) greater then the angle of friction

(4) none of these

119. If a particle is executing a simple harmonic motion about a centre O starting from a point A such that OA = 9 metres and the aceleration of the particle at P towads PO is 4 metres/sec^2, where OP = 1 metre then the maximum speed achieved by the particle during the course of motion is :

(1) 6 metres/sec (2) 9 metres/sec

(3) 12 metres/sec (4) 18 metres/sec

120. If a particle is projected from the lowest point of a smooth vertical circle of radius 10 metres with velocity $\sqrt{(10g)}$ metres/sec and moves along the inside of the circle then the angle through which the particle can oscillate about the lowest point is :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{6}$

121. The sides of a rectangular plate of mass m are formed by four straight lines y = -3 ; y = 4, x =5 ; x = -4 then its moment of inertia about a line through the centre of the plate and parallel to x - axis is :

(1) $\frac{m}{3}\left(\frac{9}{2}\right)^2$ (2) $\frac{m}{3}\left(\frac{7}{2}\right)^2$ (3) $\frac{4m}{3}\left(\frac{9}{2}\right)^2$ (4) $\frac{4m}{3}\left(\frac{7}{2}\right)^2$

122. If a rigid body swing, under graivity, from a fixed horizontal axis then the time of a complete oscillation is :

(1) $2\pi\sqrt{\left(\frac{k^2h}{g}\right)}$ (2) $2\pi\sqrt{\left(\frac{k^2g}{h}\right)}$ (3) $2\pi\sqrt{\left(\frac{hg}{k^2}\right)}$ (4) $2\pi\sqrt{\left(\frac{k^2}{hg}\right)}$

Where k is the radius of gyration of the rigid body about the fixed axis, and h is th distance betwern the fixed axis and the centre of inertia of the rigid body .

123. The specific graivity of a fluid is three times that of a cylinder. If the cylinder floats vertically with 8 cms. of its lenght above the fluid then the whole length of the cylinder is :

(1) 10 cms (2) 12 cms (3) 14 cms (4) 16 cms

124. If the mass of a cube of side 10 cm is 10 gm then its moment of inertia about any axis through its centre is :

(1) $\frac{8}{3}$ (250) gm cm^2 (2) $\frac{4}{3}$ (250) gm cm^2

(3) $\frac{2}{3}$ (250) gm cm^2 (4) $\frac{11}{3}$ (250) gm cm^2

125. A triangle is wholly immersed in a liquid with its centre of gravity at a depth 2cm and its centre of pressure at a depth 3 cm. If the triangle is lowered through a distance 2 cm then the depth of its centre of pressure in the new position is :

(1) $\frac{5}{2}$ cms (2) $\frac{7}{2}$ cms (3) $\frac{9}{2}$ cms (4) $\frac{11}{2}$ cms

126. If $x_r = \cos\frac{\pi}{2^r} + i\sin\frac{\pi}{2^r}, i = \sqrt{-1}, r \geq 1$, then the value of $x_1.x_2.x_3.$ .... ad inf. is :

(1) $\cos\pi$ (2) $\cos 2\pi$ (3) $\sin\pi$ (4) $\cos\frac{\pi}{2}$

127. If $2\cos\phi = x + \frac{1}{x}$ then the value of $2\cos r\phi$ is :

(1) $2\left(x^r + \frac{1}{x^r}\right)$ (2) $x^r - \frac{1}{x^r}$

(3) $x^r + \frac{1}{x^r}$ (4) $2\left(x^r - \frac{1}{x^r}\right)$

128. If $2\cos\theta = x + \frac{1}{x}$ and $2\cos\phi = y + \frac{1}{y}$ then the value of $x^m y^n + \frac{1}{x^m y^n}$ is :

(1) $\cos(m\theta - n\phi)$ (2) $\sin(m\theta + n\phi)$

(3) $\cos(m\theta + n\phi)$ (4) $2\cos(m\theta - n\phi)$

129. If $\cos\alpha + \cos\beta + \cos\gamma = 0$, $\sin\alpha + \sin\beta + \sin\gamma = 0$ then $\cos 3\alpha + \cos 3\beta + \cos 3\gamma$ is :

(1) $2\cos(\alpha + \beta + \gamma)$ (2) $3\cos(\alpha + \beta + \gamma)$

(3) $\cos(\alpha + \beta + \gamma)$ (4) none of these

130. If $(a_1 + ib_1)(a_2 + ib_2) \ldots (a_n + ib_n) = A + iB$ then

$\tan^{-1}\left(\frac{b^1}{a^1}\right) + \tan^{-1}\left(\frac{b^2}{a^2}\right) + \ldots + \tan^{-1}\left(\frac{b_n}{a_n}\right)$ is :

(1) $\tan^{-1}\left(\frac{B}{A}\right)$ (2) $\tan^{-1}\left(\frac{A}{B}\right)$ (3) $\tan^{-1}\left(\frac{B^2}{A^2}\right)$ (4) $\tan^{-1}\left(\frac{A^2}{B^2}\right)$

131. By De Moivre's Theorem, $(\sin x + i\cos x)^n$ is equal to :

(1) $\cos nx + i\sin nx$

(2) $\text{con } n\left(\frac{\pi}{2} + x\right) + i\sin n\left(\frac{\pi}{2} + x\right)$

(3) $\cos n\left(\frac{\pi}{2} - x\right)$

(4) $\cos n\left(\frac{\pi}{2} - x\right)\ i\sin n\left(\frac{\pi}{2} - x\right)$

132. The expression Log sin (x + iy) is resolved into its real and imaginary parts as :

(1) $\frac{1}{2}\log_e\left[\frac{\sin h\, 2y + \cos 2x}{2}\right] + i\,(2n\pi + \tan^{-1}(\cot x \tan hy))$

(2) $\frac{1}{2}\log_e\left[\frac{\sin h\, 2y - \cos 2x}{2}\right] + i\,(2n\pi + \tan^{-1}(\cot x \tan hy))$

(3) $\frac{1}{2}\log_e\left[\frac{\cos h\, 2y + \cos 2x}{2}\right] + i\,(2n\pi + \tan^{-1}(\cot x \tan hy))$

(4) $\frac{1}{2}\log_e\left[\frac{\cos h\, 2y - \cos 2x}{2}\right] + i\,(2n\pi + \tan^{-1}(\cot x \tan hy))$,

$n \in N$ = Set of natural numbers.

133. log (- i) is equal to :

(1) $\frac{\pi}{2}i$

(2) $-\frac{\pi}{2}i$

(3) - i

(4) None of these

134. $\log\left(\frac{\sin(x+iy)}{\sin(x-iy)}\right)$ is equal to :

(1) $2\,i\tan^{-1}(\cot x \tan hy)$

(2) $2\,i\tan^{-1}(\tan x \tan hy)$

(3) $2\,i\tan^{-1}(\tan x \cot hy)$

(4) $2\,i\tan^{-1}(\sin x \tan hy)$

135. $i\log\left(\frac{x-i}{x+i}\right)$ is equal to :

(1) $\pi - \tan^{-1}x$

(2) $\pi - 2\tan^{-1}x$

(3) $\pi - 3\tan^{-1}x$

(4) $\pi - 4\tan^{-1}x$

136. $\frac{23x-11x^2}{(2x-1)(9-x^2)}$ when resolved into partial fractions is equal to :

(1) $\frac{1}{2x-1}+\frac{4}{3+x}-\frac{1}{3-x}$

(2) $\frac{4}{2x-1}+\frac{1}{3+x}-\frac{1}{3-x}$

(3) $\frac{1}{2x-1}-\frac{4}{3+x}+\frac{1}{3-x}$

(4) $-\frac{1}{2x-1}-\frac{1}{3+x}-\frac{4}{3+x}$

137. When x < 1, the sum of the infinite series

$\frac{1}{(1-x)(1-x^3)}+\frac{x^2}{(1-x^3)(1-x^5)}+\frac{x^4}{(1-x^5)(1-x^7)}+......$ is equal to :

(1) $\frac{1}{(1+x)(1+x^2)}$

(2) $\frac{1}{(1+x)(1-x^2)}$

(3) $\frac{1}{(1-x)(1+x^2)}$

(4) $\frac{1}{(1-x)(1-x^2)}$

138. if sum of any two quantities x, y, z be greater than the third, then $(x + y + z)^3 >$

(1) $9 (y + z - x) (z + x - y) (x + y - z)$

(2) $27 (y + z - x) (z + x - y) (x + y - z)$

(3) $\frac{27}{8} (y + z - x) (z + x - y) (x + y - z)$

(4) None of these

139. $x\sqrt{\frac{1+x}{1-x}} > y\sqrt{\frac{1+y}{1-y}}$:

(1) if x and y are integers and positive and x > y

(2) if x and y are fractions and x < y

(3) if x and y are proper fractions and positive and x > y

(4) if x and y are proper fractions and positive and y > x

140. if $\begin{vmatrix} 1 & 3 & 9 \\ 1 & x & x^2 \\ 4 & 6 & 9 \end{vmatrix} = 0$, then

(1) $x = 3$

(2) $x = 3$ or 6

(3) $x = 3$ or $\frac{3}{2}$

(4) None of these

141. If $\omega \neq 1$ is a cube root of unity, then

$$\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2-1 \\ -i & -1+\omega-i & -1 \end{vmatrix}$$

is equal to :

(1) 0 (2) 1 (3) i (4) ω

142. A quadratic equation with rational coefficients can have :

(1) both root equal and irrational

(2) one root rational and other irrational

(3) one root real and other root imaginary

(4) none of these

143. If the equation $x^2 - (2 + m)x + (m^2 - 4m + 4) = 0$ has coincident roots then :

(1) $m = 0, m = 1$

(2) $m = 0, m = 2$

(3) $m = \frac{2}{3}, m = 6$

(4) $m = \frac{2}{3}, m = 1$

P.T.O.

144. The value of 'a' for which the sum of the squares of the roots of the equation $x^2 - (a - 2)x - a - 1 = 0$ assumes the least value is :

(1) 2 (2) 3 (3) 0 (4) 1

145. Equation $x^{10} - 4x^6 + x^4 - 2x - 3 = 0$ has :

(1) at least six imaginary roots (2) at least four imaginary roots

(3) at most six imaginary roots (4) at most four imaginary roots

146. If α, β are the roots of $ax^2 + bx + c = 0$ and $\alpha + h$, $\beta + h$ are the roots of $px^2 + qx + r = 0$, then the value of h is :

(1) $\left(\frac{b}{a} - \frac{a}{b}\right)$ (2) $\frac{1}{2}\left(\frac{b}{a} - \frac{q}{p}\right)$

(3) $-\frac{1}{2}\left(\frac{b}{a} - \frac{q}{p}\right)$ (4) None of these

147. If a square matrix A is such that

$$A^T A = I = AA^T$$

then $|A|$ is equal to :

(1) 0 (2) ± 1

(3) ± 2 (4) None of these

148. If $A^2 - A + I = 0$, then the inverse of A is :

(1) I - A (2) A - I (3) A (4) A + I

149. Let $A = \begin{pmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{pmatrix}$, $10\,(B) = \begin{pmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{pmatrix}$ if B is the inverse of A,

then α is :

(1) - 2 (2) 1 (3) 2 (4) 5

150. The system of equation

$$x + y + z = 1$$
$$3x + 2y + z = 2$$
$$4x + 3y + 2z = 3$$

has :

(1) No solution
(2) A unique solution
(3) Infinitely many solutions
(4) More than one but finitely many solutions

अभ्यर्थियों के लिए निर्देश

(इस पुस्तिका के प्रथम आवरण पृष्ठ पर तथा उत्तर-पत्र के दोनों पृष्ठों पर केवल नीली-काली बाल-प्वाइंट पेन से ही लिखें)

1. प्रश्न पुस्तिका मिलने के 10 मिनट के अन्दर ही देख लें कि प्रश्नपत्र में सभी पृष्ठ मौजूद हैं और कोई प्रश्न छूटा नहीं है। पुस्तिका दोषयुक्त पाये जाने पर इसकी सूचना तत्काल कक्ष-निरीक्षक को देकर सम्पूर्ण प्रश्नपत्र की दूसरी पुस्तिका प्राप्त कर लें।
2. परीक्षा भवन में ***लिफाफा रहित प्रवेश-पत्र के अतिरिक्त***, लिखा या सादा कोई भी खुला कागज साथ में न लायें।
3. ***उत्तर-पत्र अलग से दिया गया है। इसे न तो मोड़ें और न ही विकृत करें। दूसरा उत्तर-पत्र नहीं दिया जायेगा। केवल उत्तर-पत्र का ही मूल्यांकन किया जायेगा।***
4. अपना अनुक्रमांक तथा उत्तर-पत्र का क्रमांक प्रथम आवरण-पृष्ठ पर पेन से निर्धारित स्थान पर लिखें।
5. ***उत्तर-पत्र के प्रथम पृष्ठ पर पेन से अपना अनुक्रमांक निर्धारित स्थान पर लिखें तथा नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक तथा सेट का नम्बर उचित स्थानों पर लिखें।***
6. ***ओ० एम० आर० पत्र पर अनुक्रमांक संख्या, प्रश्नपुस्तिका संख्या व सेट संख्या (यदि कोई हो) तथा प्रश्नपुस्तिका पर अनुक्रमांक और ओ० एम० आर० पत्र संख्या की प्रविष्टियों में उपरिलेखन की अनुमति नहीं है।***
7. ***उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुचित साधन का प्रयोग माना जायेगा।***
8. ***प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। प्रत्येक प्रश्न के वैकल्पिक उत्तर के लिए आपको उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्रथम पृष्ठ पर दिये गये निर्देशों के अनुसार पेन से गाढ़ा करना है।***
9. प्रत्येक प्रश्न के उत्तर के लिए केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा करने पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।
10. ***ध्यान दें कि एक बार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का उत्तर नहीं देना चाहते हैं, तो संबंधित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शून्य अंक दिये जायेंगे।***
11. रफ कार्य के लिए प्रश्न-पुस्तिका के मुखपृष्ठ के अंदर वाला पृष्ठ तथा उत्तर-पुस्तिका के अंतिम पृष्ठ का प्रयोग करें।
12. परीक्षा के उपरान्त ***केवल ओ एम आर उत्तर-पत्र*** परीक्षा भवन में जमा कर दें।
13. परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।
14. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धारित दंड का/की, भागी होगा/होगी।