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KEAM 2020 Question Paper with Solution

Kerala Engineering Architecture Medical Entrance Exam

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PAPER – I PHYSICS & CHEMISTRY-2020			
Version Code	A05 A1	Question Booklet Serial Number :	8133655
Time: 150 Minutes		Number of Questions: 120	Maximum Marks: 480
Name of the Candidate			
Roll Number			
Signature of the Candidate			
INSTRUCTIONS TO CANDIDATES			
<p>1. Please ensure that the VERSION CODE shown at the top of this Question Booklet is same as that shown in the Admit Card issued to you. If you have received a Question Booklet with a different Version Code please get it replaced with a Question Booklet with the same Version Code as in the Admit Card. THIS IS VERY IMPORTANT.</p>			
<p>2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial Number given at the top of this page against item 3 in the OMR Answer Sheet.</p>			
<p>3. This Question Booklet contains 120 questions. For each question five answers are suggested and given against (A), (B), (C), (D) and (E) of which only one will be the 'Most Appropriate Answer.' Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either Blue or Black Ball Point Pen only.</p>			
<p>4. Negative Marking: In order to discourage wild guessing the score will be subjected to penalization formula based on the number of right answers actually marked and the number of wrong answer marked. Each correct answer will be awarded FOUR marks. ONE mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.</p>			
<p>5. Please read the instructions in the OMR Answer Sheet for marking the answers. Candidates are advised to strictly follow the instruction contained in the OMR Answer Sheet.</p>			
<p>IMMEDIATELY AFTER OPENING THE QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.</p>			
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SEAL

PAPER - 1 PHYSICS & CHEMISTRY

Question Booklet	Serial Number
Number of Questions 110	Maximum Marks 100

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SEAL

**PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS
120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120
PRINTED PAGES 32.**

1. If ϵ_0 and μ_0 are respectively the electrical permittivity and magnetic permeability of vacuum, the dimensional formula for $\frac{1}{\sqrt{\mu_0\epsilon_0}}$ is
(A) MLT (B) MLT^{-2} (C) $ML^{-1}T^{-1}$ (D) M^0LT^{-1} (E) $M^0L^{-2}T$
2. The power in an electrical circuit for a current of $5 \pm 0.4A$ and voltage $10 \pm 0.2 V$ is measured at 10% error. To measure the power at 5% error the current should be measured at an error of
(A) 5% (B) 2% (C) 10% (D) 3% (E) 4%
3. The angular diameter of a planet measured from earth is $90''$. If the diameter of the planet is $\pi \times 10^6 m$, then its distance from the earth is
(A) $3.6 \times 10^9 m$ (B) $7.2 \times 10^9 m$ (C) $3.6 \times 10^6 m$
(D) $7.2 \times 10^6 m$ (E) $1.8 \times 10^8 m$
4. The angle between \vec{A} and the resultant of $2\vec{A} + 3\vec{B}$ and $4\vec{A} - 3\vec{B}$ is
(A) 90° (B) $\tan^{-1}\left(\frac{A}{B}\right)$ (C) $\tan^{-1}\left(\frac{B}{A}\right)$
(D) $\tan^{-1}\left(\frac{A-B}{A+B}\right)$ (E) 0°

Space for rough work

5. A particle is moved in a semi-circular path of radius R . Then
- (A) its average velocity is zero
 - (B) its average acceleration is zero
 - (C) its magnitude of displacement is $2R$
 - (D) its average velocity and average speed are equal
 - (E) its distance travelled is equal to displacement
6. Two projectiles P and Q thrown with velocities v and $\frac{v}{2}$ respectively have the same range. If Q is thrown at an angle of 15° to the horizontal, P must be thrown at an angle of
- (A) 30°
 - (B) $\frac{1}{2} \sin^{-1}\left(\frac{1}{8}\right)$
 - (C) $\frac{1}{4} \sin^{-1}\left(\frac{1}{2}\right)$
 - (D) 60°
 - (E) 45°
7. An object is thrown vertically with a velocity u . The velocity with which it strikes the ground on its return is
- (A) $\frac{u}{2}$
 - (B) $\frac{-u}{2}$
 - (C) $-u$
 - (D) u
 - (E) $2u$
8. Pick out the **correct** statement
- (A) Second law of motion is a vector equation
 - (B) Second law of motion is applicable to a particle and not to the system of particles
 - (C) Force is always in the direction of motion
 - (D) If external force on a body is zero, it does not mean the acceleration is zero
 - (E) Acceleration at an instant depends on the history of the motion of the particle

Space for rough work

9. A boy is standing on a weighing machine inside a lift. When the lift goes upwards with acceleration $\frac{g}{4}$, the machine shows the reading 50 kg. wt. When the lift goes downward with acceleration $\frac{g}{4}$, the reading of the machine in kg. wt. would be
 (A) 50 (B) 30 (C) 45.5 (D) 62.5 (E) 14
10. A ship of mass 2×10^7 kg initially at rest is pulled by a force of 5×10^5 N through a distance of 2 m. Assuming that the resistance due to water is negligible, the speed of the ship is
 (A) 2 ms^{-1} (B) 0.01 ms^{-1} (C) 0.1 ms^{-1} (D) 1 ms^{-1} (E) 5 ms^{-1}
11. A force of $(2\hat{i} + 3\hat{j})$ N acts on a body of mass 1 kg which is at rest initially. The acceleration of the body is
 (A) $(4\hat{i} + 6\hat{j}) \text{ ms}^{-2}$ (B) $(2\hat{i} + 3\hat{j}) \text{ ms}^{-2}$ (C) $(3\hat{i} + 5\hat{j}) \text{ ms}^{-2}$
 (D) $(6\hat{i} + 2\hat{j}) \text{ ms}^{-2}$ (E) $(\hat{i} + \hat{j}) \text{ ms}^{-2}$
12. The Work - Energy theorem
 (A) does not hold in all inertial frames
 (B) is independent of Newton's second law
 (C) may be viewed as a scalar form of Newton's second law
 (D) cannot be extended to non-inertial frames
 (E) is independent of Newton's third law

Space for rough work

13. A running boy has the same kinetic energy as that of a man of twice his mass. If the speed of the boy is 14.14 ms^{-1} , the speed of the man is
 (A) 1.414 ms^{-1} (B) 0.25 ms^{-1} (C) 10 ms^{-1}
 (D) $3\sqrt{2} \text{ ms}^{-1}$ (E) 0.5 ms^{-1}
14. A body of mass 2 kg is moving with a momentum of 10 kg ms^{-1} . The force needed to increase its kinetic energy by four times in 10 seconds is
 (A) 2 N (B) 4 N (C) 1 N (D) 0.5 N (E) 8 N
15. If a force $\vec{F} = \hat{i} - 2\hat{j} - 4\hat{k}$ acting on a particle displaces it from $(1, 1, 1)$ to $(2, -1, 0)$, then the work done by the force (in units of work) is
 (A) 2 (B) 1 (C) 5 (D) 4 (E) 9
16. A disc spinning at the rate 27.5 rad s^{-1} is slowed at the rate 10 rad s^{-2} . The time after which it will come to rest is
 (A) 2.75 s (B) 5.5 s (C) 1.25 s (D) 3.5 s (E) 6.2 s
17. Four particles of masses $m_1 = 1 \text{ kg}$, $m_2 = 2 \text{ kg}$, $m_3 = 1 \text{ kg}$ and m_4 are placed at the four corners of a square. The mass m_4 required, so that the centre of mass of all the four particles is exactly at the centre of the square is
 (A) 3 kg (B) 4 kg (C) 1.5 kg (D) 0.5 kg (E) 2 kg

Space for rough work

18. A solid sphere of radius r is revolving about one of its diameters with an angular velocity ω . If it suddenly expands uniformly so that its radius increases to n times its original value, then its angular velocity becomes
- (A) $n^2\omega$ (B) $\frac{\omega}{n^2}$ (C) $n\omega$ (D) $\frac{\omega}{n}$ (E) $2n\omega$
19. If a ring rolls down from top to bottom of an inclined plane, it takes time t_1 . If it slides, it takes time t_2 . Then the ratio $\frac{t_2^2}{t_1^2}$ is
- (A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{1}{4}$ (D) $\frac{1}{2}$ (E) $\frac{2}{5}$
20. If the distance between sun and earth is d , then the angular momentum of earth around the sun is proportional to
- (A) \sqrt{d} (B) d^2 (C) $d^{1/3}$ (D) d (E) $d^{3/2}$
21. Two identical objects each of mass 50 kg are kept at a distance of separation of 50 cm apart on a horizontal table. The net gravitational force at the mid-point of the line joining their centres is
- (A) zero (B) 6.6733×10^{-9} N (C) 13.346×10^{-9} N
 (D) 3.336×10^{-9} N (E) 6.673×10^6 N
22. The ratio of the weight of a body at a height of $\frac{R}{10}$ from the surface of the earth to that at a depth of $\frac{R}{10}$ is (R is radius of earth)
- (A) 4 : 5 (B) 1 : 1 (C) 9 : 8 (D) 2 : 3 (E) 8 : 9

Space for rough work

23. Three thin wires of equal length are suspended from the top of a roof. The respective ratio of their area of cross section is 1 : 2 : 4 and Young's moduli is 4 : 2 : 1, then the ratio of their weights to be attached at the other ends to obtain same elongation in them is
 (A) 1 : 1 : 1 (B) 1 : 2 : 4 (C) 4 : 2 : 1 (D) $2 : \sqrt{2} : 1$ (E) $1 : \sqrt{2} : 2$
24. Water flows through a horizontal pipe of diameter 2 cm at a speed of 3 cm s^{-1} . The pipe has a nozzle of diameter 0.5 cm at its end. The speed of water emerging from the nozzle is
 (A) 6 cm s^{-1} (B) 48 cm s^{-1} (C) 16 cm s^{-1}
 (D) 12 cm s^{-1} (E) 36 cm s^{-1}
25. The density of kerosene is 800 kg m^{-3} . Its relative density is
 (A) 1.6 (B) 3.2 (C) 1 (D) 0.8 (E) 0.4
26. A solid sphere of volume V experiences a viscous force F when descending with a speed v in a liquid. If another solid sphere of volume $27V$ descends with the same speed v in the same liquid, it experiences a viscous force
 (A) $12F$ (B) $6F$ (C) $9F$ (D) F (E) $3F$
27. Two taps supply water to a container, one at the temperature of 20°C at the rate of 2 kg/minute and another at 80°C at the rate of 1 kg/minute . If the container gets water from the two taps simultaneously for 10 minutes, then the temperature of water in the container is
 (A) 35°C (B) 30°C (C) 50°C (D) 40°C (E) 45°C

Space for rough work

28. If a monoatomic gas is compressed adiabatically to $(1/27)$ th of its initial volume, then its pressure becomes
(A) 27 times (B) 125 times (C) 243 times (D) 81 times (E) 64 times
29. The values of C_p and C_v for a diatomic gas are respectively (R =gas constant)
(A) $\frac{5}{2}R, \frac{7}{2}R$ (B) $\frac{3}{2}R, \frac{5}{2}R$ (C) $3R, 4R$
(D) $\frac{5}{2}R, \frac{3}{2}R$ (E) $\frac{7}{2}R, \frac{5}{2}R$
30. Three moles of an ideal gas are in a rigid cubical box with sides of length 0.170 m. The ratio of the forces that the gas exerts on each of the six sides of the box when the gas temperature are 27°C and 127°C is
(A) 6 : 1 (B) 1 : 2 (C) 3 : 1 (D) 3 : 4 (E) 1 : 3
31. The average kinetic energy of a monoatomic gas molecule kept at temperature 27°C is (Boltzmann constant $k = 1.3 \times 10^{-23} \text{ JK}^{-1}$)
(A) $5.85 \times 10^{-21} \text{ J}$ (B) $4.12 \times 10^{-21} \text{ J}$ (C) $3.75 \times 10^{-21} \text{ J}$
(D) $2.85 \times 10^{-21} \text{ J}$ (E) $7.55 \times 10^{-21} \text{ J}$

Space for rough work

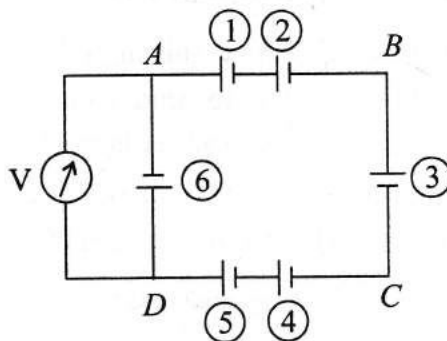
32. A travelling wave in a medium is given by the equation $y = a \sin (\omega t - kx)$. The maximum acceleration of the particle in the medium is
 (A) $a\omega$ (B) $a\omega^2$ (C) $\frac{\omega}{k}$ (D) $\frac{x}{t}$ (E) $k\omega$
33. Two simple harmonic motions with the same amplitude and same frequency acting in the same direction are impressed on a particle. If the resultant amplitude of the particle is equal to the amplitude of individual S.H.M.s, the phase difference between the two simple harmonic motions is
 (A) $\frac{2\pi}{\sqrt{3}}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{4}$ (D) $\frac{2\pi}{3}$ (E) $\frac{\pi}{3}$
34. Two nearest harmonics of an organ pipe open at both the ends are 200 Hz and 240 Hz. The fundamental frequency is
 (A) 40 Hz (B) 20 Hz (C) 30 Hz (D) 80 Hz (E) 50 Hz
35. Two strings of the same material and same length are given equal tension. If they are vibrating with fundamental frequencies 1600 Hz and 900 Hz, then the ratio of their respective diameters is
 (A) 16 : 9 (B) 4 : 3 (C) 81 : 256 (D) 3 : 4 (E) 9 : 16
36. An object, moving in a straight line with velocity 100 ms^{-1} , goes past a stationary observer. If the object emits note of 400 Hz while moving, the change in the frequency noted by the observer as the object goes past him is (speed of sound in air = 300 ms^{-1})
 (A) 350 Hz (B) 300 Hz (C) 200 Hz (D) 100 Hz (E) 150 Hz

Space for rough work

37. The electric flux (in SI units) through any face of a cube due to a positive charge Q situated at the centre of a cube is
- (A) $\frac{Q}{4\pi\epsilon_0}$ (B) $4\pi\epsilon_0 Q$ (C) $\frac{Q}{6\epsilon_0}$ (D) $\frac{Q}{6\pi\epsilon_0}$ (E) $6\pi\epsilon_0 Q$
38. A capacitance of a parallel plate air capacitor is $10\mu\text{F}$. Dielectric constant of the medium to be introduced in between its plates to double its capacitance is
- (A) 2 (B) 3 (C) 4 (D) 2.5 (E) 1.5
39. The electric potential V at any point (x, y, z) in space is given by $V = 4z^2$ volt, where x, y, z are all in metre. The electric field at that point $(1\text{m}, 0, 2\text{m})$ in Vm^{-1} is
- (A) 16 along the positive z axis (B) 16 along the negative z axis
(C) 4 along the positive z axis (D) 4 along the negative z axis
(E) 8 along the negative z axis
40. The work done in moving a point charge of $10\mu\text{C}$ through a distance of 3 cm along the equatorial axis of an electric dipole is
- (A) $10 \times 10^{-6} \text{ J}$ (B) $30 \times 10^{-6} \text{ J}$ (C) $20 \times 10^{-6} \text{ J}$
(D) $5 \times 10^{-6} \text{ J}$ (E) zero

Space for rough work

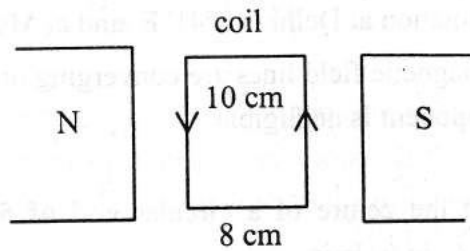
41. A steady current flows in a metallic conductor of non-uniform cross section. The quantity/quantities that remains/remains constant along the length of the conductor is/are
- (A) current, electric field and drift speed (B) drift speed only
 (C) current and drift speed only (D) current and electric field only
 (E) current only
42. In a platinum resistance thermometer, the resistances of the wire at ice point and steam point are of 4Ω and 4.25Ω respectively. When the thermometer is kept in a hot water bath, whose temperature is not known, the resistance of the wire is found to be 4.5Ω . The temperature of the hot water bath is
- (A) 150°C (B) 100°C (C) 300°C (D) 350°C (E) 200°C
43. Internal resistance of a cell is independent of
- (A) the circuit elements connected to it (B) surface area of the electrode
 (C) distance between the electrode (D) concentration of the electrolytes
 (E) temperature of the electrolytes
44. Six cells, each of emf 5 V and internal resistance 0.1Ω are connected as shown in Figure. The reading of the ideal voltmeter V is



- (A) 30 V (B) 5 V (C) 15 V (D) zero (E) 0.5 V

Space for rough work

45. Which one of the following characteristics is not associated with a paramagnetic material?
- (A) It is weakly magnetised in the direction of the magnetising field, in which it is placed
- (B) Its magnetic permeability is greater than one
- (C) Its magnetic susceptibility is positive
- (D) Its magnetic susceptibility increases with rise in temperature
- (E) Its individual atom/molecule/ion has a net non-zero magnetic moment of its own
46. A coil of 50 turns carrying a current of 2A in a magnetic field of 0.5T. The torque acting on the coil is



- (A) 0.4 Nm clockwise (B) 0.2 Nm anticlockwise
- (C) 0.4 Nm anticlockwise (D) 0.2 Nm clockwise
- (E) 0.8 Nm anticlockwise

Space for rough work

47. A long solenoid with 500 turns per unit length carries a current of 1.5 A. The magnetic induction at one of the ends of the solenoid on its axis is nearly
- (A) $32 \times 10^{-4} \text{T}$ (B) $4 \times 10^{-5} \text{T}$ (C) $47 \times 10^{-5} \text{T}$
(D) $16 \times 10^{-4} \text{T}$ (E) $8 \times 10^{-5} \text{T}$
48. Choose the **wrong** statement.
- (A) The magnetic declination is greater at higher latitudes and smaller near the equator.
- (B) In most of the northern hemisphere, the south pole of the dip needle tilts downwards.
- (C) Circulating electron in an atom has a magnetic moment.
- (D) The magnetic declination at Delhi is $0^\circ 41' \text{ E}$ and at Mumbai is $0^\circ 58' \text{ W}$.
- (E) At the poles, the magnetic field lines are converging or diverging vertically so that the horizontal component is negligible
49. The magnetic field at the centre of a circular coil of 50 turns and radius 10 cm carrying a current of 1A, in tesla is
- (A) $\pi \times 10^{-4}$ (B) $\pi \times 10^{-2}$ (C) $2\pi \times 10^{-3}$ (D) $\frac{\pi}{4} \times 10^{-5}$ (E) $\frac{\pi}{2} \times 10^{-4}$

Space for rough work

50. Choose the **wrong** statement for the pure inductive circuit.
- (A) The inductive reactance limits the current in a purely inductive circuit.
 (B) The average power supplied to an inductor over one complete cycle is zero.
 (C) The inductive reactance is directly proportional to the frequency of the current.
 (D) The emf of the source and current oscillates symmetrically about zero value.
 (E) The current leads the voltage by $\frac{\pi}{2}$.
51. A train is running at a speed of 72 km hr^{-1} on the rails separated by a distance of 150 cm. If the vertical component of earth's magnetic field at the place is $4.0 \times 10^{-5} \text{ T}$. The induced emf on the rails is
- (A) 1.2 mV (B) 3 mV (C) 2.5 mV (D) 0.5 mV (E) 4.2 mV
52. A transformer operates at $V_p = 6 \text{ kV}$ on the primary side and supplies electric energy at $V_s = 220 \text{ V}$ to a number of houses in a town. If the total power consumption of the town is 7.2 kW, the current (in amperes) in the primary is
- (A) 2 (B) 1.2 (C) 2.5 (D) 3 (E) 1
53. The relation between the charge flow ΔQ through the circuit of resistance r and the change in the magnetic flux $\Delta\phi_B$ is
- (A) $\Delta Q = \frac{\Delta\phi_B}{r}$ (B) $\Delta\phi_B = \frac{\Delta Q}{r}$ (C) $\Delta\phi_B = \Delta Q$
 (D) $\Delta\phi_B = \frac{\Delta Q}{r^2}$ (E) $\Delta Q = \frac{r}{\phi_B}$

Space for rough work

54. If an electromagnetic wave of frequency 5 MHz travels from vacuum into a dielectric medium of electrical permittivity $\epsilon_r = 4$, then its (take $\mu_r = 1$)
- (A) wavelength is halved and the frequency remains unchanged
 - (B) wavelength and frequency are both doubled
 - (C) wavelength and frequency both remain unchanged
 - (D) wavelength is doubled but the frequency remains unchanged
 - (E) wavelength remains unchanged but the frequency is doubled
55. Among the following, which is **not** true for ultraviolet light?
- (A) induces the production of more melanin, causing tanning of the skin
 - (B) can be focused into very narrow beams
 - (C) kills germs in water purifiers
 - (D) used in eye surgery
 - (E) treatment for certain forms of cancer
56. Choose the **wrong** statement.
- (A) A ray entering a material of larger index of refraction bends toward the normal.
 - (B) A ray entering a material of smaller index of refraction bends away from the normal.
 - (C) A ray oriented along the normal does not bend, regardless of the materials.
 - (D) Light rays from any submerged object bend away from the normal when they emerge into the air.
 - (E) When a wave passes from one material into a second material with larger index of refraction, the wave speed increases.

Space for rough work

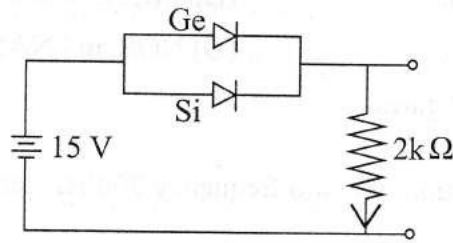
57. Angular width of the first minimum on either side of the central maximum due to a single slit of width a , illuminated by a light of wave length λ is
- (A) $\frac{\lambda}{a}$ (B) $\frac{\lambda}{2a}$ (C) $\frac{2\lambda}{a}$ (D) $\frac{\lambda}{4a}$ (E) $\frac{4\lambda}{a}$
58. The reflected ray is completely polarized for certain angle of incidence in a transparent medium. If the angle of refraction is 30° , then the refractive index of the medium is
- (A) 1.5 (B) 1.732 (C) 1.33 (D) 1.414 (E) 1.6
59. A certain prism produces a minimum deviation of 42° . It produces a deviation of 45° when the angle of incidence is either 43° or 62° . The angle of incidence when the prism undergoes minimum deviation is
- (A) 60° (B) 30° (C) 49° (D) 51° (E) 40°
60. If two waves of intensities I and $4I$ superpose, the ratio between maximum and minimum intensities is
- (A) 9:1 (B) 5:2 (C) 4:3 (D) 3:1 (E) 6:1
61. Among the following photosensitive substances, the one which emits electrons when it is illuminated by visible light is
- (A) magnesium (B) zinc (C) sodium
(D) cadmium (E) platinum

Space for rough work

62. The de Broglie wavelength of the matter wave associated with an object dropped from a height x , when it reaches the ground is proportional to
(A) x^2 (B) $\frac{1}{\sqrt{x}}$ (C) \sqrt{x} (D) $x^{3/2}$ (E) x
63. The number of α -particles emitted during the radioactive decay chain from ${}^{226}_{88}\text{Ra}$ and ending at ${}^{206}_{82}\text{Pb}$ is
(A) 5 (B) 4 (C) 6 (D) 3 (E) 2
64. The shortest wavelength of Paschen series in hydrogen spectrum is 8182 Å. The first member of the Paschen series is nearly
(A) 15400 Å (B) 12200 Å (C) 13400 Å
(D) 18700 Å (E) 16700 Å
65. A nucleus, initially at rest, breaks up into two nuclear fragments with their radii in the ratio 2 : 1. Then their velocities will be in the ratio
(A) 3 : 2 (B) 1 : 5 (C) 1 : 8 (D) 2 : 1 (E) 1 : 4
66. The ratio of the energy released by 4 kg of hydrogen at sun by fusion process to 23.5 kg of ${}^{235}\text{U}$ in the nuclear reactor by fission process is (Assume energy released per fusion is 26 MeV and that per fission is 200 MeV)
(A) 5 : 13 (B) 1 : 26 (C) 13 : 10 (D) 10 : 13 (E) 26 : 1

Space for rough work

67. If the Ge diode in the circuit is reverse biased, the current through $2\text{ k}\Omega$ resistor



- (A) increases by 0.2 mA (B) decreases by 0.4 mA
(C) increases by 0.4 mA (D) decreases by 0.25 mA
(E) does not change
68. The contribution to the total current in a semiconductor, due to electrons and holes are 0.75 and 0.25 respectively. The drift velocity of electrons is $\frac{3}{2}$ times that of holes at this temperature. Then the ratio between electron concentration and hole concentration is
(A) $1 : 3$ (B) $3 : 2$ (C) $6 : 5$ (D) $4 : 1$ (E) $2 : 1$
69. In a common emitter amplifier, the input resistance and output resistance are $200\ \Omega$ and $500\ \Omega$ respectively. If the voltage gain of the amplifier is 50 , then the power gain is
(A) 1250 (B) 1000 (C) 750 (D) 100 (E) 500

Space for rough work

70. The gates that give output $Y = 0$ for the two inputs $A = 1$ and $B = 1$ are
(A) AND and OR gates (B) OR, AND and NAND gates
(C) NOR and OR gates (D) NOR and NAND gates
(E) NAND and AND gates
71. In amplitude modulation of audio frequency 700 Hz, the appropriate carrier frequency to be used is
(A) 5 MHz (B) 50 MHz (C) 1000 kHz (D) 350 kHz (E) 1000 MHz
72. The maximum line-of-sight distance d_M between the transmitting antenna of height h_T and receiving antenna of height h_R in LOS communication is (R = radius of the earth)
(A) $h_T + h_R$ (B) $\sqrt{h_T + h_R}$ (C) $\frac{h_T + h_R}{2}$
(D) $\sqrt{h_T} + \sqrt{h_R}$ (E) $\sqrt{2Rh_T} + \sqrt{2Rh_R}$

Space for rough work

73. Which one of the following will have the largest number of atoms?
(A) 1g Au(s) (B) 1g Na(s) (C) 1g Li(s)
(D) 1g of Cl₂(g) (E) 1g of O₂(g)
74. An organic compound contains 24% carbon, 4% hydrogen and remaining chlorine. Its empirical formula is
(A) CHCl (B) CH₂Cl (C) CHCl₂
(D) CH₃Cl (E) CH₂Cl₂
75. The IUPAC name of an element is Unbinilium. Its atomic number is
(A) 102 (B) 110 (C) 120
(D) 106 (E) 100
76. The number of electrons, protons and neutrons in a species are equal to 10, 11 and 12 respectively. The proper symbol of the species is
(A) ${}_{11}^{22}\text{Na}^+$ (B) ${}_{11}^{23}\text{Na}$ (C) ${}_{10}^{23}\text{Ne}$ (D) ${}_{11}^{23}\text{Na}^+$ (E) ${}_{11}^{23}\text{Na}^{2+}$

Space for rough work

77. Which one of the following element is represented as Eka-Silicon in Mendeleev's periodic table?
 (A) Gallium (B) Germanium (C) Aluminium
 (D) Tin (E) Arsenic
78. The **correct** match among the following is
 (a) Lithium, Sodium, Potassium (i) Alkaline earth metals
 (b) Beryllium, Magnesium, Calcium (ii) Semi-metals
 (c) Oxygen, Sulphur, Selenium (iii) Alkali metals
 (d) Silicon, Germanium, Arsenic (iv) Chalcogens
 (A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
 (B) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
 (C) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
 (D) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
 (E) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
79. Which one of the following molecules is formed by sp^3d hybridisation?
 (A) BrF_5 (B) PF_5 (C) SF_6 (D) $[Co(NH_3)_6]^{3+}$ (E) $[Pt(Cl)_4]^{2-}$
80. The correct order of bond energy (in kJ/mol) of the following molecules is
 (A) $O_2 < B_2 < C_2 < N_2$ (B) $B_2 < C_2 < O_2 < N_2$ (C) $C_2 < O_2 < B_2 < N_2$
 (D) $B_2 < O_2 < C_2 < N_2$ (E) $B_2 < O_2 < N_2 < C_2$
81. The type of attractive forces that operate between gaseous HCl molecules is
 (A) dipole-dipole forces (B) dispersion forces
 (C) ion-dipole forces (D) dipole-induced dipole forces
 (E) electrostatic forces

Space for rough work

82. Schottky defect is shown by
- (A) ionic substances in which the size of the cation is smaller than that of the anion
 - (B) ionic substances in which the cation and anion are of almost similar sizes
 - (C) ionic substances in which the size of the cation is larger than that of the anion
 - (D) non-stoichiometric inorganic solids
 - (E) non-ionic substances
83. In which one of the following reactions, entropy decreases?
- (A) Sodium chloride is dissolved in water
 - (B) Water is heated from 303K to 353K
 - (C) Sodium bicarbonate is decomposed to $\text{Na}_2\text{CO}_3(\text{s})$, $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{g})$
 - (D) Water crystallizes into ice
 - (E) Dihydrogen molecule is decomposed into hydrogen atoms
84. The standard enthalpies of formation of $\text{H}_2\text{O}(\text{l})$ and $\text{CO}_2(\text{g})$ are respectively -286 kJ mol^{-1} and -394 kJ mol^{-1} . If the standard heat of combustion of $\text{CH}_4(\text{g})$ is -891 kJ mol^{-1} , then the standard enthalpy of formation of $\text{CH}_4(\text{g})$ is
- | | | |
|--------------------------------|---------------------------------|--------------------------------|
| (A) -75 kJ mol^{-1} | (B) $+75 \text{ kJ mol}^{-1}$ | (C) -211 kJ mol^{-1} |
| (D) $+211 \text{ kJ mol}^{-1}$ | (E) $-1571 \text{ kJ mol}^{-1}$ | |

Space for rough work

85. The equilibrium constant for the equilibrium $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ at a particular temperature is $2 \times 10^{-2} \text{ mol dm}^{-3}$. The number of moles of PCl_5 that must be taken in a one-litre flask at the same temperature to obtain a concentration of 0.20 mol of chlorine at equilibrium is
(A) 2.0 (B) 2.2 (C) 1.8 (D) 0.2 (E) 0.1
86. The pH of the resultant solution obtained by mixing 20mL of 0.01M HCl and 20mL of 0.005M $\text{Ca}(\text{OH})_2$ is
(A) 2 (B) 0 (C) 1 (D) 7 (E) 5
87. $\text{CH}_4(\text{g}) + 4\text{Cl}_2(\text{g}) \rightarrow \text{CCl}_4(\text{l}) + 4\text{HCl}(\text{g})$
In the above reaction, the change of oxidation state of carbon is
(A) from +4 to -4 (B) from +1 to +4 (C) from -4 to +4
(D) from -1 to +1 (E) from -4 to -1
88. How many moles of platinum will be deposited on the cathode when 0.40 F of electricity is passed through a 1.0 M solution of Pt^{4+} ?
(A) 0.60 mol (B) 1.0 mol (C) 0.40 mol
(D) 0.45 mol (E) 0.10 mol

Space for rough work

89. When the same amount of the solute 'P' and 'Q' are separately dissolved in 500g water, the ΔT_f values are 0.15K and 0.30K respectively. If the molecular weight of 'P' is 80 g mol^{-1} , then the molecular weight of 'Q' is
- (A) 30 g mol^{-1} (B) 60 g mol^{-1} (C) 40 g mol^{-1}
(D) 45 g mol^{-1} (E) 160 g mol^{-1}
90. A solution is prepared by dissolving 20g NaOH in 1250 mL of a solvent of density 0.8 g/mL. Then the molality of the solution is
- (A) 0.2 mol kg^{-1} (B) 0.08 mol kg^{-1} (C) 0.25 mol kg^{-1}
(D) $0.0064 \text{ mol kg}^{-1}$ (E) 0.5 mol kg^{-1}
91. The rate constant of a first order reaction is $231 \times 10^{-5} \text{ s}^{-1}$. How long will 4 g of this reactant reduce to 2 g?
- (A) 310 s (B) 300 s (C) 210 s (D) 30.1 s (E) 230.3 s
92. An endothermic reaction $A \rightarrow B$ has an activation energy of 13 kJ mol^{-1} and the enthalpy change for the reaction is 2 kJ mol^{-1} . The activation energy of the reaction $B \rightarrow A$ is
- (A) 15 kJ mol^{-1} (B) 11 kJ mol^{-1} (C) 2 kJ mol^{-1}
(D) -15 kJ mol^{-1} (E) 26 kJ mol^{-1}

Space for rough work

93. Adsorption is accompanied by
- (A) decrease in enthalpy and decrease in entropy
 - (B) increase in enthalpy and decrease in entropy
 - (C) decrease in enthalpy and increase in entropy
 - (D) increase in enthalpy and increase in entropy
 - (E) no change in enthalpy and entropy
94. In the coagulation of a positive sol, the flocculating power of the ions PO_4^{3-} , SO_4^{2-} and Cl^- decreases in the order
- (A) $\text{PO}_4^{3-} > \text{Cl}^- > \text{SO}_4^{2-}$
 - (B) $\text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$
 - (C) $\text{Cl}^- > \text{SO}_4^{2-} > \text{PO}_4^{3-}$
 - (D) $\text{Cl}^- > \text{PO}_4^{3-} > \text{SO}_4^{2-}$
 - (E) $\text{SO}_4^{2-} > \text{PO}_4^{3-} > \text{Cl}^-$
95. Which one of the following nitrates does not give the corresponding metallic oxide, nitrogen dioxide and oxygen on heating?
- (A) Lithium nitrate
 - (B) Beryllium nitrate
 - (C) Magnesium nitrate
 - (D) Calcium nitrate
 - (E) Potassium nitrate

Space for rough work

96. Which of the following statement is **incorrect** about beryllium?
(A) Beryllium hydroxide is amphoteric.
(B) Beryllium compounds are largely covalent.
(C) Beryllium is not easily attacked by acids.
(D) Beryllium exhibit coordination number of six.
(E) Beryllium hydroxide dissolves in excess of alkali to give a beryllate ion.
97. The oxyacid of phosphorus that contains one P–OH, two P–H and one P=O bonds is
(A) Phosphinic acid (B) Phosphoric acid
(C) Pyrophosphoric acid (D) Hypophosphoric acid
(E) Pyrophosphorous acid
98. Choose the **correct** statements about diborane
I. It is prepared by the oxidation of sodium borohydride with iodine.
II. It undergoes cleavage reactions with Lewis bases to give borane adducts.
III. It is produced on an industrial scale by the reaction of BF_3 with LiAlH_4 .
IV. It is readily hydrolysed by water to give borazine.
V. It burns in oxygen and gives boron trioxide.
(A) I, II, III (B) I, II, V (C) I, II, IV (D) II, III, IV (E) I, III, V
99. Which one of the following actinoid has no electron in 6d orbital?
(A) Pa (B) Np (C) Lr (D) Cm (E) Pu

Space for rough work

100. The catalyst used in the Wacker process of oxidation of ethyne to ethanal is
 (A) Silver (B) Nickel (C) PdCl₂
 (D) V₂O₅ (E) Ziegler catalyst
101. The correct formula of dichlorobis (triphenylphosphine) nickel(II) is
 (A) [NiCl₂(PPh₃)₂]Cl (B) [NiCl₂(PPh₃)] (C) [NiCl₂(PPh₂)₃]
 (D) [NiCl(PPh₃)₂]Cl (E) [NiCl₂(PPh₃)₂]
102. Which one of the following is an ambidentate ligand?
 (A) Cl⁻ (B) H₂O (C) H₂NCH₂CH₂NH₂
 (D) SCN⁻ (E) C₂O₄²⁻
103. Which one is not correctly matched?
- | Ore | Composition |
|----------------|---|
| (A) Siderite | - FeCO ₃ |
| (B) Calamine | - ZnCO ₃ |
| (C) Sphalerite | - ZnS |
| (D) Kaolinite | - [Al ₂ (OH) ₄ Si ₂ O ₅] |
| (E) Cuprite | - CuCO ₃ .Cu(OH) ₂ |
104. Which one of the following is a benzenoid aromatic compound?
 (A) Cyclooctatetraene (B) Hexyne (C) Cyclohexane
 (D) Toluene (E) Cyclopentadiene
105. The products obtained by the ozonolysis of 2-methylbut-1-ene are
 (A) propanone and ethanal (B) propanone and methanal
 (C) butanone and methanal (D) ethanal and propanal
 (E) butanone and methanol

Space for rough work

106. Which one of the following is not an isomer of 3-methylbut-1-yne?
(A) 2,3-Dimethylbuta-1,3-diene (B) Pent-1-yne (C) Pent-2-yne
(D) Penta-1,3-diene (E) 2-Methylbuta-1,3-diene
107. The compound that does not undergo hydrolysis by S_N1 mechanism is
(A) $C_6H_5CH_2Cl$ (B) $C_6H_5CH(CH_3)Cl$ (C) C_6H_5Cl
(D) CH_3CH_2Cl (E) $C_6H_5CH(C_6H_5)Cl$
108. Which one of the following is a secondary alcohol?
(A) 2-methylbutan-2-ol (B) 3-methylbutan-1-ol (C) 2-methylbutan-1-ol
(D) 3-methylbutan-2-ol (E) 2,2-dimethylbutan-1-ol
109. An organic compound 'A' with molecular formula C_7H_6O forms 2,4-DNP derivative and reduces Tollens' reagent. When 'A' is heated with conc. KOH, it gives sodium benzoate and compound 'B'. The compound 'B' is
(A) Benzene (B) Toluene (C) Acetophenone
(D) Benzaldehyde (E) Benzyl alcohol

Space for rough work

110. Which one of the following compounds would undergo Cannizaro reaction?
(A) 2-Methylpentanal (B) Cyclohexanone (C) 2,2-Dimethylbutanal
(D) 1-Phenylpropanone (E) Phenylacetaldehyde
111. Which one of the following can be prepared by Gabriel phthalimide synthesis?
(A) 2-Aminotoluene (B) Aniline (C) 4-Bromoaniline
(D) Allylamine (E) N-Methylethanamine
112. The reagent that is used to distinguish between a secondary amine and a tertiary amine is
(A) p-toluenesulphonyl chloride (B) dil. HCl (C) dil. NaOH
(D) CHCl_3 and alc. KOH (E) bromine water
113. Choose the **correct** statement of the following
(A) Cellulose is also known as animal starch.
(B) A linkage between two monosaccharide units through oxygen atom is called oxide linkage.
(C) Glucose on oxidation with bromine water gives n-hexane.
(D) Carbohydrates are used as storage molecules as starch in animals.
(E) Water insoluble component of starch is amylopectin.
114. Among the following which one is a non-reducing sugar?
(A) Lactose (B) Glucose (C) Sucrose (D) Maltose (E) Fructose

Space for rough work

115. Which one of the following polymer is a copolymer formed by condensation polymerisation?
(A) Buna-S (B) Neoprene (C) Polythene
(D) Melamine-formaldehyde (E) Buna-N
116. Which one of the following sets forms the biodegradable polymer?
(A) 3-Hydroxybutanoic acid and 3-hydroxypentanoic acid.
(B) Acrylonitrile and 1,3-butadiene.
(C) Urea and formaldehyde.
(D) Ethylene glycol and terephthalic acid.
(E) Adipic acid and hexamethylene diamine.
117. The antimicrobial drug that contains arsenic is
(A) Prontosil (B) Salvarsan (C) Sulphapyridine
(D) Ofloxacin (E) Sulphanilamide
118. Which one of the following statements is **not** correct?
(A) All monosaccharides are reducing sugars.
(B) Lactose is commonly known as milk sugar.
(C) Glucose pentaacetate does not react with hydroxylamine.
(D) Glucose does not give 2,4- DNP test.
(E) Glucose on oxidation with bromine water, gives saccharic acid.
119. Which one of the following is an antifertility drug?
(A) Bithionol (B) Ofloxacin (C) Norethindrone
(D) Aspartame (E) Terpeneol
120. Which one of the following is a greenhouse gas?
(A) Methane (B) Ethane (C) Hydrogen sulphide
(D) Acetylene (E) Ethylene

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SEAL

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KEY**PAPER I - PHYSICS & CHEMISTRYVersion-A1**

1	D	21	A	41	E	61	C	81	A	101	E
2	D	22	E	42	E	62	B	82	B	102	D
3	B	23	A	43	A	63	A	83	D	103	E
4	E	24	B	44	D	64	D	84	A	104	D
5	C	25	D	45	D	65	C	85	B	105	C
6	B	26	E	46	A	66	C	86	D	106	A
7	C	27	D	47	C	67	D	87	C	107	C
8	A	28	C	48	B	68	E	88	E	108	D
9	B	29	E	49	A	69	B	89	C	109	E
10	D	30	D	50	E	70	D	90	E	110	C
11	B	31	A	51	A	71	C	91	B	111	D
12	C	32	B	52	B	72	E	92	B	112	A
13	C	33	D	53	A	73	C	93	A	113	E
14	C	34	A	54	A	74	B	94	B	114	C
15	E	35	E	55	E	75	C	95	E	115	D
16	A	36	B	56	E	76	D	96	D	116	A
17	E	37	C	57	C	77	B	97	A	117	B
18	B	38	A	58	B	78	C	98	B	118	E
19	D	39	B	59	D	79	B	99	E	119	C
20	A	40	E	60	A	80	D	100	C	120	A

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PAPER – II MATHEMATICS-2020			
Version Code	B1	Question Booklet Serial Number :	9126960
Time: 150 Minutes	Number of Questions: 120	Maximum Marks: 480	
Name of the Candidate			
Roll Number			
Signature of the Candidate			
INSTRUCTIONS TO CANDIDATES			
<p>1. Please ensure that the VERSION CODE shown at the top of this Question Booklet is same as that shown in the Admit Card issued to you. If you have received a Question Booklet with a different Version Code please get it replaced with a Question Booklet with the same Version Code as in the Admit Card from the Invigilator. THIS IS VERY IMPORTANT.</p>			
<p>2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial Number given at the top of this page against item 3 in the OMR Answer Sheet.</p>			
<p>3. This Question Booklet contains 120 questions. For each question five answers are suggested and given against (A), (B), (C), (D) and (E) of which only one will be the 'Most Appropriate Answer.' Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either Blue or Black Ball Point Pen only.</p>			
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<p>5. Please read the instructions in the OMR Answer Sheet for marking the answers. Candidates are advised to strictly follow the instruction contained in the OMR Answer Sheet.</p>			
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MATHS - II - MATHEMATICS - 2020

Version Number: **81**

Question Booklet Serial Number: **0258880**

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There is no negative marking. It is encouraged to attempt all the questions. The marks for each correct answer will be 1. There is no partial marking. The correct answer will be marked as 'ONE' mark and the incorrect answer will be marked as 'ZERO' mark. There is no marking for a question against which a question mark is marked.

Please read the instructions in the OMR Answer Sheet carefully and follow the instructions advised to you. Follow the instructions contained in the OMR Answer Sheet.

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**PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS
120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120
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1. The domain of the function f given by $f(x) = \sqrt{x-1}$ is
(A) $(-\infty, \infty)$ (B) $(1, \infty)$ (C) $[1, \infty)$ (D) $[0, \infty)$ (E) $(0, \infty)$

2. Let $f(x) = -2x^2 + 1$ and $g(x) = 4x - 3$, then $(g \circ f)(-1)$ is equal to
(A) 9 (B) -9 (C) 7 (D) -7 (E) -8

3. Let A and B be finite sets such that $n(A-B) = 18$, $n(A \cap B) = 25$ and $n(A \cup B) = 70$.
Then $n(B)$ is equal to
(A) 52 (B) 25 (C) 27 (D) 43 (E) 45

4. In a group of 100 persons, 80 people can speak Malayalam and 60 can speak English.
Then the number of people who speak English only is
(A) 40 (B) 30 (C) 20 (D) 25 (E) 35

Space for rough work

5. If $*$ is a binary operation defined by $a * b = \frac{a}{b} + \frac{b}{a} + \frac{1}{ab}$ for positive integers a and b , then $2 * 5$ is equal to
 (A) 4 (B) 3 (C) 2 (D) 1 (E) 5
6. If $A = \{1, 2, 3, 4, 5\}$ and $B = \{2, 4, 6\}$, then $A - B =$
 (A) $\{1, 3, 5, 6\}$ (B) $\{0, 1, 3, 5, 6\}$ (C) $\{1, 3, 5\}$
 (D) $\{1, 2, 3, 4, 5, 6\}$ (E) $\{2, 4\}$
7. Let $A = \{2, 3, 4, 5\}$, $B = \{36, 45, 49, 60, 77, 90\}$ and let R be the relation 'is factor of' from A to B . Then the range of R is the set
 (A) $\{60\}$ (B) $\{36, 45, 60, 90\}$ (C) $\{49, 77\}$
 (D) $\{49, 60, 77\}$ (E) $\{36, 45, 49, 60, 77, 90\}$
8. The real part of $e^{(3+4i)x}$ is
 (A) e^{3x} (B) $\cos 7x$ (C) $e^{3x} \cos 4x$
 (D) $e^{3x} \sin 4x$ (E) 0
9. If $z = x - iy$ and $z^{1/3} = p + iq$, then $\frac{1}{p^2 + q^2} \left(\frac{x}{p} + \frac{y}{q} \right)$ is equal to
 (A) -2 (B) -1 (C) 1 (D) 2 (E) 0

Space for rough work

10. Let $z = x + iy$ be a complex number such that $|z + i| = 2$. Then the locus of z is a circle whose centre and radius are

- (A) $(0, -1); 2$ (B) $(0, 2); 2$ (C) $(1, -1); 2$
(D) $(0, -1); \sqrt{3}$ (E) $(0, 2); \sqrt{3}$

11. If $2 + i$ is a root of $x^2 - 4x + c = 0$, where c is a real number, then the value of c is
(A) 2 (B) 3 (C) 4 (D) 5 (E) 0

12. Let z_1 and z_2 be complex numbers satisfying $|z_1| = |z_2| = 2$ and $|z_1 + z_2| = 3$.

Then $\left| \frac{1}{z_1} + \frac{1}{z_2} \right| =$

- (A) $\frac{3}{2}$ (B) 2 (C) $\frac{3}{4}$ (D) $\frac{1}{2}$ (E) 4

13. The principal argument of the complex number $z = \frac{1 + \sin \pi - i \cos \pi}{1 + \sin \pi + i \cos \pi}$ is

- (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{5}$ (D) $\frac{\pi}{2}$ (E) $\frac{\pi}{4}$

Space for rough work

14. If $z_1 = 2 + 3i$ and $z_2 = 3 + 2i$, then $|z_1 + z_2|$ is equal to
(A) 50 (B) 10 (C) $5\sqrt{2}$ (D) 25 (E) $2\sqrt{5}$
15. $\frac{10i}{1+2i}$ is equal to
(A) $-2i$ (B) $2i$ (C) $-4 + 2i$ (D) $4 + 2i$ (E) $6i$
16. The value of $\sum_{k=1}^{10} (3k^2 + 2k - 1)$ is
(A) 1120 (B) 1200 (C) 1230 (D) 1265 (E) 1255
17. The numbers a_1, a_2, a_3, \dots form an arithmetic sequence with $a_1 \neq a_2$. The three numbers a_1, a_2 and a_6 form a geometric sequence in that order. Then the common difference of the arithmetic sequence is
(A) a_1 (B) $2a_1$ (C) $3a_1$ (D) $4a_1$ (E) $5a_1$
18. In an arithmetic sequence, the sum of first and third terms is 6 and the sum of second and fourth terms is 20. Then the 11th term is
(A) 67 (B) 62 (C) 57 (D) 73 (E) 66

Space for rough work

19. In an A.P., the first term is 3 and the last term is 17. The sum of all the terms in the sequence is 70. Then the number of terms in the arithmetic sequence is
(A) 7 (B) 5 (C) 9 (D) 6 (E) 8
20. Consider the set of all positive rational numbers that are less than 1 and that have denominators as 30 in their lowest terms. Their sum is equal to
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
21. If p , q and 23 is an increasing arithmetic sequence and p and q are prime numbers, then $p + q =$
(A) 22 (B) 24 (C) 26 (D) 28 (E) 30
22. The 5th and 7th terms of a G.P. are 12 and 48 respectively. Then the 9th term is
(A) 162 (B) 96 (C) 192 (D) 144 (E) 182
23. The number of positive integers less than 1000 having only odd digits is
(A) 155 (B) 177 (C) 55 (D) 205 (E) 85

Space for rough work

24. Five points are marked on a circle. The number of distinct polygons of three or more sides can be drawn using some (or all) of the five points as vertices is
 (A) 10 (B) 12 (C) 14 (D) 16 (E) 18
25. The middle term in the expansion of $\left(1 + \frac{1}{5}\right)^{20}$ is
 (A) $\left(\frac{1}{5}\right)^{10}$ (B) $\left(\frac{1}{5}\right)^{11}$ (C) ${}^{20}C_{11}\left(\frac{1}{5}\right)^{11}$ (D) ${}^{20}C_9\left(\frac{1}{5}\right)^9$ (E) ${}^{20}C_{10}\left(\frac{1}{5}\right)^{10}$
26. ${}^{11}C_0 + {}^{11}C_1 + {}^{11}C_2 + {}^{11}C_3 + {}^{11}C_4 + {}^{11}C_5 =$
 (A) 2^6 (B) 2^8 (C) 2^{10} (D) 2^{11} (E) 2^9
27. If ${}^nP_r = 840$ and ${}^nC_r = 35$, then the value of r is equal to
 (A) 2 (B) 4 (C) 6 (D) 3 (E) 5
28. The sum of the coefficients in the expansion of $(1 + 2x - x^2)^{20}$ is
 (A) 2^{20} (B) 2^{21} (C) 2^{19} (D) 2^{40} (E) 2

Space for rough work

29. The number of ways a committee of 4 people can be chosen from a panel of 10 people is

- (A) 315 (B) 240 (C) 210 (D) 720 (E) 120

30. If $A = \begin{pmatrix} 6 & 2 \\ 7 & -5 \end{pmatrix}$ and $A - B = \begin{pmatrix} -2 & 1 \\ 4 & -9 \end{pmatrix}$, then $B =$

- (A) $\begin{pmatrix} -8 & -1 \\ 3 & 4 \end{pmatrix}$ (B) $\begin{pmatrix} 8 & 1 \\ -3 & -4 \end{pmatrix}$ (C) $\begin{pmatrix} 4 & 3 \\ 11 & -14 \end{pmatrix}$ (D) $\begin{pmatrix} 8 & 1 \\ 3 & 4 \end{pmatrix}$ (E) $\begin{pmatrix} 4 & 1 \\ 3 & 2 \end{pmatrix}$

31. The value of the determinant $\begin{vmatrix} bc & ca & ab \\ a^3 & b^3 & c^3 \\ \frac{1}{a} & \frac{1}{b} & \frac{1}{c} \end{vmatrix}$ is

- (A) $a^5 - 1$ (B) $a^2bc + ab^2c + abc^2$ (C) $ab(a+b+c)$
(D) $a^4b^4c^4(a+b+c)$ (E) 0

32. If the matrix $\begin{bmatrix} 1 & 2 & -1 \\ -3 & 4 & k \\ -4 & 2 & 6 \end{bmatrix}$ is singular, then the value of k is equal to

- (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

Space for rough work

33. If $\begin{bmatrix} -1 & 3 \\ 4 & -5 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 0 & 7 \end{bmatrix} = \begin{bmatrix} -1 & 19 \\ \alpha & -27 \\ 0 & 14 \end{bmatrix}$, then the value of α is

(A) 5 (B) 4 (C) 7 (D) -14 (E) -5

34. If $A^{-1} = \frac{1}{11} \begin{pmatrix} -3 & 4 \\ 5 & -3 \end{pmatrix}$, then $A =$

(A) $\frac{-1}{11} \begin{pmatrix} 3 & 4 \\ 5 & 3 \end{pmatrix}$ (B) $\frac{1}{11} \begin{pmatrix} 3 & 4 \\ 5 & 3 \end{pmatrix}$ (C) $\begin{pmatrix} 3 & -4 \\ -5 & 3 \end{pmatrix}$

(D) $\begin{pmatrix} 3 & 4 \\ 5 & 3 \end{pmatrix}$ (E) $\begin{pmatrix} -3 & 4 \\ 5 & -3 \end{pmatrix}$

35. The system of equations

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

$$3x + 3y + 6z = 17$$

$$5x - 3y + 2z = 27$$

has

- (A) no solution (B) finitely many solutions
 (C) infinitely many solutions (D) unique and trivial solution
 (E) unique and non-trivial solution

Space for rough work

36. The smallest prime number satisfying the inequality $\frac{2n-3}{3} \geq \frac{n-1}{6} + 1$ is
(A) 2 (B) 3 (C) 5 (D) 7 (E) 11
37. The number of integers satisfying the inequality $|n^2 - 100| < 50$ is
(A) 5 (B) 6 (C) 12 (D) 8 (E) 10
38. The solution set of the rational inequality $\frac{x+9}{x-6} \leq 0$ is
(A) $(-\infty, 9) \cup (6, \infty)$ (B) $(-\infty, 9] \cup (6, \infty)$ (C) $(-\infty, 9] \cup [6, \infty)$
(D) $[-9, 6)$ (E) $(-9, 6]$
39. Which of the following sentences is/are statement(s)?
(i) 10 is less than 5.
(ii) All rational numbers are real numbers.
(iii) Today is a sunny day.
(A) (i), (ii) and (iii) (B) (i) and (ii) only (C) (i) and (iii) only
(D) (ii) and (iii) only (E) (i) only

Space for rough work

40. The value of θ with $0 \leq \theta \leq 90^\circ$ and $\sin^2 \theta + 2 \cos^2 \theta = \frac{7}{4}$ is equal to
(A) 15° (B) 30° (C) 45° (D) 60° (E) 75°
41. The value of $\sin^2 1^\circ + \sin^2 2^\circ + \sin^2 3^\circ + \dots + \sin^2 88^\circ + \sin^2 89^\circ$ is equal to
(A) $\frac{45}{2}$ (B) $\frac{49}{2}$ (C) $\frac{89}{2}$ (D) 45 (E) 89
42. The value of $\sin^4 \frac{\pi}{8} + \sin^4 \frac{3\pi}{8}$ is equal to
(A) $\frac{5}{8}$ (B) $\frac{3}{4}$ (C) $\frac{3}{\sqrt{2}}$ (D) $\frac{3}{8}$ (E) $\frac{5}{4}$
43. The value of $\sin(45^\circ + \theta) - \cos(45^\circ - \theta)$ is equal to
(A) 1 (B) $\cos \theta$ (C) $\sin \theta$ (D) $2 \cos \theta$ (E) 0
44. The values of x in $0 \leq x \leq \pi$ such that $\cos 2x = \cos x$ are
(A) 0 and $\frac{2\pi}{3}$ (B) $\frac{\pi}{3}$ and $\frac{2\pi}{3}$ (C) 0 and $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$ and $\frac{\pi}{3}$ (E) 0 and $\frac{\pi}{2}$

Space for rough work

45. The value of $10 \tan(\cot^{-1} 3 + \cot^{-1} 7)$ is equal to
(A) 3 (B) 5 (C) 7 (D) 9 (E) 10
46. If $\tan x + \tan y = \frac{5}{6}$ and $\cot x + \cot y = 5$, then $\tan(x + y)$ is
(A) $\frac{6}{5}$ (B) $\frac{5}{6}$ (C) 5 (D) 6 (E) 1
47. $\frac{\sin 91^\circ + \sin 1^\circ}{\sin 91^\circ - \sin 1^\circ} =$
(A) $\tan 46^\circ$ (B) $\cot 46^\circ$ (C) $\sin 46^\circ$ (D) $\cos 46^\circ$ (E) 1
48. The value of $\cos\left(\cos^{-1}\frac{1}{5} + 2\sin^{-1}\frac{1}{5}\right)$ is equal to
(A) $\frac{4}{5}$ (B) $\frac{-4}{5}$ (C) $\frac{3}{5}$ (D) $\frac{-1}{5}$ (E) $\frac{1}{5}$

Space for rough work

49. The equation of the line passing through the point $(-3, 7)$ with slope zero is
(A) $x = 7$ (B) $y = 7$ (C) $x = -3$ (D) $y = -3$ (E) $x = 0$
50. The line $y = mx + 2$ intersects the parabola $y = ax^2 + 5x - 2$ at $(1, 5)$. Then the value of $a + m$ is equal to
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
51. If the points $P(7, 5)$, $Q(a, 2a)$ and $R(12, 30)$ are collinear, then the value of a is equal to
(A) 5 (B) 6 (C) 8 (D) 9 (E) 10
52. If the straight lines $4x + 6y = 5$ and $6x + ky = 3$ are parallel, then the value of k is equal to
(A) $\frac{-2}{3}$ (B) 8 (C) 9 (D) 10 (E) $\frac{3}{2}$
53. If $(a, 2)$ is the point of intersection of the straight lines $y = 2x - 4$ and $y = x + c$, then the value of c is equal to
(A) -1 (B) 3 (C) -2 (D) -3 (E) 1

Space for rough work

54. The maximum value of $z = 7x + 5y$ subject to $2x + y \leq 100$, $4x + 3y \leq 240$, $x \geq 0$, $y \geq 0$ is
(A) 350 (B) 380 (C) 400 (D) 410 (E) 420
55. A circle with centre at $(3, 6)$ passes through $(-1, 1)$. Its equation is
(A) $x^2 + y^2 - 6x - 12y + 3 = 0$ (B) $x^2 + y^2 + 6x - 10y + 3 = 0$
(C) $x^2 + y^2 - 3x - 6y + 1 = 0$ (D) $x^2 + y^2 + 5x + 9y + 5 = 0$
(E) $x^2 + y^2 - 6x - 12y + 4 = 0$
56. The centre and radius of the circle $x^2 + y^2 - 4x + 2y = 0$ are
(A) $(2, -1)$ and 5 (B) $(4, 2)$ and $\sqrt{20}$ (C) $(2, -1)$ and $\sqrt{5}$
(D) $(-2, 1)$ and 5 (E) $(-2, 1)$ and $\sqrt{5}$
57. The equation of the circle whose radius is $\sqrt{7}$ and concentric with the circle $x^2 + y^2 - 8x + 6y - 11 = 0$ is
(A) $x^2 + y^2 - 8x + 6y + 7 = 0$ (B) $x^2 + y^2 - 8x + 6y + 18 = 0$
(C) $x^2 + y^2 - 8x + 6y - 4 = 0$ (D) $x^2 + y^2 - 8x + 6y - 18 = 0$
(E) $x^2 + y^2 - 8x + 6y - 7 = 0$

Space for rough work

58. The vertex of the parabola $y = x^2 - 2x + 4$ is shifted p units to the right and then q units up. If the resulting point is $(4, 5)$, then the values of p and q respectively are
(A) 2 and 3 (B) 3 and 5 (C) 5 and 2 (D) 3 and 2 (E) 1 and 2
59. The vertex of the parabola $y = (x - 2)(x - 8) + 7$ is
(A) $(5, 2)$ (B) $(5, -2)$ (C) $(-5, -2)$ (D) $(-5, 2)$ (E) $(2, 8)$
60. The major and minor axis of the ellipse $400x^2 + 100y^2 = 40000$ respectively are
(A) 100 and 20 (B) 20 and 10 (C) 40 and 20
(D) 400 and 100 (E) 16 and 8
61. The eccentricity of the ellipse $x^2 + \frac{y^2}{4} = 1$ is
(A) $\sqrt{3}$ (B) $\frac{1}{2}$ (C) $\frac{\sqrt{3}}{4}$ (D) $\frac{\sqrt{3}}{2}$ (E) $\frac{1}{\sqrt{3}}$
62. The latus rectum of the hyperbola $3x^2 - 2y^2 = 6$ is
(A) $\frac{3}{\sqrt{2}}$ (B) $\frac{4}{\sqrt{3}}$ (C) $\frac{2}{\sqrt{3}}$ (D) 3 (E) $3\sqrt{2}$

Space for rough work

63. If $\vec{u} = \hat{i} - 3\hat{j} + 2\hat{k}$ and $\vec{v} = 2\hat{i} + 4\hat{j} - 5\hat{k}$, then $|\vec{u} \times \vec{v}|^2 + |\vec{u} \cdot \vec{v}|^2 =$

(A) 640 (B) 630 (C) 690 (D) 740 (E) 730

64. The direction cosines of the vector $\hat{i} - 5\hat{j} + 8\hat{k}$ are

(A) $\left(\frac{1}{\sqrt{10}}, \frac{-5}{\sqrt{10}}, \frac{8}{\sqrt{10}}\right)$ (B) $\left(\frac{1}{3\sqrt{10}}, \frac{-5}{3\sqrt{10}}, \frac{8}{3\sqrt{10}}\right)$ (C) $\left(\frac{1}{3}, \frac{-5}{3}, \frac{8}{3}\right)$

(D) $\left(\frac{1}{3\sqrt{10}}, \frac{-1}{3\sqrt{10}}, \frac{1}{3\sqrt{10}}\right)$ (E) $\left(\frac{1}{3\sqrt{10}}, \frac{5}{3\sqrt{10}}, \frac{8}{3\sqrt{10}}\right)$

65. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} + 3\hat{j} + \hat{k}$ and θ is the angle between them, then $\tan \theta =$

(A) $\frac{\sqrt{38}}{4}$ (B) $\frac{\sqrt{26}}{4}$ (C) $\frac{\sqrt{26}}{5}$ (D) $\frac{\sqrt{26}}{6}$ (E) $\frac{\sqrt{38}}{6}$

66. The value of λ such that the vectors $2\hat{i} - \hat{j} + 2\hat{k}$ and $3\hat{i} + 2\lambda\hat{j}$ are perpendicular is

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

Space for rough work

67. The values of α so that $|\alpha\hat{i} + (\alpha+1)\hat{j} + 2\hat{k}| = 3$, are
 (A) 2, -4 (B) 1, 2 (C) -1, 2 (D) -2, 4 (E) 1, -2
68. If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$, then the value of $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})$ is equal to
 (A) 8 (B) 7 (C) 9 (D) 11 (E) 13
69. Let $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = \lambda\hat{j} + 3\hat{k}$. If the projection of \vec{a} on \vec{b} is equal to the projection of \vec{b} on \vec{a} , then the values of λ are
 (A) $\pm\sqrt{7}$ (B) $\pm\sqrt{3}$ (C) ± 5 (D) ± 3 (E) $\pm\sqrt{5}$
70. If $|\vec{a}| = 2$, $|\vec{b}| = 3$ and $\vec{a} \cdot \vec{b} = 4$, then $|\vec{a} - \vec{b}|$ is equal to
 (A) $\sqrt{5}$ (B) $\sqrt{7}$ (C) $\sqrt{6}$ (D) 5 (E) 6
71. Which one of the following points lies on the straight line $\frac{x-1}{2} = \frac{y+1}{4} = \frac{z-2}{-2}$?
 (A) (2, 6, -2) (B) (4, 3, 1) (C) (3, 4, -1) (D) (3, 3, 0) (E) (6, 2, -1)

Space for rough work

72. A plane passes through the point $(0, 1, 1)$ and has normal vector $\hat{i} + \hat{j} + \hat{k}$. Its equation is
- (A) $x + y + z = 1$ (B) $x + y + z = 2$ (C) $2x + 2y + 2z = 1$
 (D) $y + z = 2$ (E) $y + z = 1$
73. The distance of the point $(4, 2, 3)$ from the plane $\vec{r} \cdot (6\hat{i} + 2\hat{j} - 9\hat{k}) = 46$ is
- (A) $\frac{23}{5}$ (B) $\frac{46}{11}$ (C) $\frac{45}{11}$ (D) $\frac{11}{45}$ (E) $\frac{5}{23}$
74. The sum of the intercepts made by the plane $\vec{r} \cdot (3\hat{i} + \hat{j} + 2\hat{k}) = 18$ on the co-ordinate axes is
- (A) 30 (B) 18 (C) 33 (D) 36 (E) 27
75. The point at which the line $\frac{x-2}{1} = \frac{y-4}{-5} = \frac{z+3}{4}$ intersects the xy -plane is
- (A) $\left(\frac{11}{4}, \frac{1}{4}, 0\right)$ (B) $\left(\frac{5}{4}, \frac{1}{4}, 0\right)$ (C) $\left(\frac{11}{4}, \frac{3}{4}, 0\right)$ (D) $\left(\frac{7}{4}, \frac{1}{4}, 0\right)$ (E) $\left(\frac{11}{4}, \frac{7}{4}, 0\right)$

Space for rough work

76. The Cartesian equation of the line passing through the points $(1, -1, 2)$ and $(7, 0, 5)$ is

(A) $\frac{x-1}{4} = \frac{y+1}{1} = \frac{z-2}{2}$

(B) $\frac{x-7}{1} = \frac{y}{-1} = \frac{z-5}{2}$

(C) $\frac{x-1}{7} = \frac{y+1}{1} = \frac{z-2}{5}$

(D) $\frac{x-1}{6} = \frac{y+1}{1} = \frac{z-2}{3}$

(E) $\frac{x-7}{6} = \frac{y}{-1} = \frac{z-5}{3}$

77. The angle between the planes $x + y + z = 1$ and $x - 2y + 3z = 1$ is

(A) $\cos^{-1}\left(\frac{2}{\sqrt{42}}\right)$

(B) $\cos^{-1}\left(\frac{5}{\sqrt{42}}\right)$

(C) $\cos^{-1}\left(\frac{3}{\sqrt{42}}\right)$

(D) $\cos^{-1}\left(\frac{1}{\sqrt{42}}\right)$

(E) $\cos^{-1}\left(\frac{4}{\sqrt{42}}\right)$

78. The equation of the plane passing through the intersection of the planes

$x + 2y - z = 3$ and $x + y - 3z = 5$ and passing through the point $(1, -1, 0)$ is

(A) $x + 7y + 6z + 6 = 0$

(B) $x - 6y - 7z + 5 = 0$

(C) $x + 7y + 6z + 5 = 0$

(D) $x + 6y - 7z - 5 = 0$

(E) $x + 6y + 7z + 5 = 0$

Space for rough work

79. The average marks of 30 students in a class was 80. After two students left out of the class, the average marks of the remaining students was 82. Then the average marks of the two left out students is
(A) 62 (B) 72 (C) 70 (D) 52 (E) 60
80. Two dice are rolled. If each die has six faces which are numbered 2, 3, 5, 7, 11, 13, then the probability that sum of the numbers on the top faces being a prime number is
(A) $\frac{1}{6}$ (B) $\frac{5}{36}$ (C) $\frac{1}{18}$ (D) $\frac{1}{9}$ (E) $\frac{1}{12}$
81. Three different numbers are chosen at random from the set $\{1, 2, 3, 4, 5\}$ and arranged in increasing order. The probability that the resulting sequence is an A.P. is
(A) $\frac{1}{2}$ (B) $\frac{3}{10}$ (C) $\frac{1}{5}$ (D) $\frac{1}{10}$ (E) $\frac{2}{5}$
82. In an examination, 20% of the students scored 70 marks, 40% scored 80 marks, 30% scored 90 marks and the rest scored 100 marks. Then the mean score of the students is
(A) 82 (B) 85 (C) 83 (D) 90 (E) 93

Space for rough work

83. If A and B are mutually exclusive events such that $p(A) = 0.5$ and $p(A \cup B) = 0.75$, then $P(B)$ is equal to

- (A) 0.4 (B) 0.25 (C) 0.5 (D) 0.6 (E) 0.75

84. A jar contains 7 black balls, 6 yellow balls, 4 green balls and 3 red balls. All of them are of same size and weight. If a ball is drawn at random, then the probability of the ball being red is

- (A) $\frac{1}{5}$ (B) $\frac{3}{20}$ (C) $\frac{1}{10}$ (D) $\frac{3}{10}$ (E) $\frac{1}{20}$

85. Let the probability distribution of a random variable X be given by

X	-1	0	1	2	3
$p(X)$	a	$2a$	$3a$	$4a$	$5a$

Then the expectation of X is

- (A) $\frac{1}{5}$ (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) $\frac{4}{15}$ (E) $\frac{5}{3}$

Space for rough work

86. Let $f(x) = \begin{cases} 1-5x, & \text{if } x < -2 \\ x^2 - 2x, & \text{if } -2 \leq x \leq 1 \\ -1+2x, & \text{if } x > 1. \end{cases}$

Then the value of $f(-1)$ is equal to

- (A) -3 (B) 3 (C) -1 (D) 1 (E) 0

87. The general solution of $\frac{dy}{dx} = \frac{2x-y}{x+2y}$ is given by

- (A) $x^2 - y^2 - xy = C$ (B) $x^2 + y^2 + xy = C$
 (C) $x^2 + 2y^2 + y + x = C$ (D) $2x^2 + y^2 + xy + y = C$
 (E) $x^2 - y^2 - xy + x = C$

88. $\lim_{x \rightarrow 3} \frac{e^{x-3} - x + 1}{x^2 - \log(x-2)}$ is equal to

- (A) $\frac{-1}{3}$ (B) $\frac{-2}{9}$ (C) $\frac{-1}{2}$ (D) $\frac{-1}{4}$ (E) $\frac{-1}{9}$

Space for rough work

89. $\lim_{x \rightarrow 4} \frac{\sqrt{x^2 + 9} - 5}{x - 4}$ is equal to

- (A) $\frac{2}{5}$ (B) $\frac{8}{25}$ (C) 0 (D) $\frac{8}{5}$ (E) $\frac{4}{5}$

90. Let $f(x) = \begin{cases} cx^2 + 2x, & \text{if } x < 2 \\ 2x + 4, & \text{if } x \geq 2 \end{cases}$

If the function f is continuous on $(-\infty, \infty)$, then the value of c is equal to

- (A) 4 (B) 2 (C) 3 (D) 1 (E) 5

91. $\lim_{x \rightarrow 0} \frac{x^{100} \sin 7x}{(\sin x)^{101}}$ is equal to

- (A) 7 (B) $\frac{1}{7}$ (C) 14 (D) 1 (E) 0

92. Let $f(x) = \frac{5}{2}x^2 - e^x$. Then the value of c such that $f''(c) = 0$ is

- (A) 1 (B) $\log 5$ (C) $5e$ (D) e^5 (E) 0

Space for rough work

93. If $y = (\cos x)^{2x}$, then $\frac{dy}{dx}$ is equal to

- (A) $2(\cos x)^{2x}(\sin x - x \tan x)$ (B) $2(\cos x)^{2x}[\log(\cos x) + x \tan x]$
(C) $2(\sin x)^{2x}[\log(\cos x) - x \tan x]$ (D) $2(\sin x)^{2x} x \cot x$
(E) $2(\cos x)^{2x}[\log(\cos x) - x \tan x]$

94. If $x^3 + 2xy + \frac{1}{3}y^3 = \frac{11}{3}$, then $\frac{dy}{dx}$ at $(2, -1)$ is

- (A) -2 (B) 2 (C) 5 (D) -5 (E) -10

95. Let $f(x) = \begin{cases} x^2, & \text{for } x \leq 1 \\ 1, & \text{for } 1 < x \leq 3 \\ 5 - 2x, & \text{for } x > 3 \end{cases}$

Then $f'(6)$ is equal to

- (A) -7 (B) 3 (C) -2 (D) -3 (E) 2

96. Given $F(x) = (f(g(x)))^2$, $g(1) = 2$, $g'(1) = 3$, $f(2) = 4$ and $f'(2) = 5$. Then the value of $F'(1)$ is equal to

- (A) 25 (B) 100 (C) 75 (D) 50 (E) 120

Space for rough work

97. If $y = 2 + \sqrt{u}$ and $u = x^3 + 1$, then $\frac{dy}{dx} =$
- (A) $\frac{x^2}{2\sqrt{x^3+1}}$ (B) $\frac{3x^2}{\sqrt{x^3+1}}$ (C) $\frac{3x^2}{2\sqrt{x^3+1}}$
 (D) $3x^2\sqrt{x^3+1}$ (E) $x^2\sqrt{x^3+1}$
98. The equation of the tangent to $y = -2x^2 + 3$ at $x = 1$ is
- (A) $y = -4x$ (B) $y = -4x + 5$ (C) $y = 4x$
 (D) $y = 4x + 5$ (E) $y = -4x + 3$
99. The function f given by $f(x) = x^3e^x$ is increasing on the interval
- (A) $(0, \infty)$ (B) $(3, \infty)$ (C) $(-3, \infty)$ (D) $(-3, 3)$ (E) $(-\infty, -3)$
100. Let $f(x) = \sqrt{x}$, $4 \leq x \leq 16$. If the point $c \in (4, 16)$ is such that the tangent line to the graph of f at $x = c$ is parallel to the chord joining $(16, 4)$ and $(4, 2)$, then the value of c is
- (A) 7 (B) 9 (C) 10 (D) 11 (E) 14
101. The function f given by $f(x) = (x^2 - 3)e^x$ is decreasing on the interval
- (A) $(-3, \infty)$ (B) $(1, \infty)$ (C) $(-\infty, 1)$ (D) $(-\infty, -3)$ (E) $(-3, 1)$

Space for rough work

102. The equation of normal to the curve $y = \frac{2}{x^2}$ at the point on the curve where $x = 1$, is

(A) $4y - x - 7 = 0$

(B) $y - 4x + 2 = 0$

(C) $4y + x - 9 = 0$

(D) $y - x - 1 = 0$

(E) $4y + x + 7 = 0$

103. The local minimum value of the function f given by $f(x) = x^2 - x$, $x \in \mathbb{R}$, is

(A) $\frac{1}{2}$

(B) $\frac{1}{4}$

(C) $-\frac{1}{4}$

(D) $\frac{3}{4}$

(E) $-\frac{1}{2}$

104. $\int 3x^2(x^3 + 1)^{10} dx =$

(A) $\frac{(x^3 + 1)^{11}}{11} + C$

(B) $\frac{(x^3 + 1)^9}{9} + C$

(C) $\frac{(x^3 + 1)^{11}}{33} + C$

(D) $\frac{(x^3 + 1)^{11}}{11} + x^3 + C$

(E) $\frac{(x^3 + 1)^{11}}{10} + C$

105. $\int \frac{2x + \sin 2x}{1 + \cos 2x} dx =$

(A) $x^2 \sec x + C$

(B) $x + \tan x + C$

(C) $x^2 \tan x + C$

(D) $x \sec x + C$

(E) $x \tan x + C$

Space for rough work

106. $\int \frac{1}{x^2 - 25} dx =$

(A) $\log \left| \frac{x-5}{x+5} \right| + C$

(B) $\log \left| \frac{x+5}{x-5} \right| + C$

(C) $\frac{1}{5} \log \left| \frac{x-5}{x+5} \right| + C$

(D) $\frac{1}{10} \log \left| \frac{x-5}{x+5} \right| + C$

(E) $\frac{1}{5} \log \left| \frac{x+5}{x-5} \right| + C$

107. $\int \frac{1}{x(\log x)} dx =$

(A) $\log |\log x| + C$

(B) $\frac{(\log |x|)^2}{2} + C$

(C) $\log |x| + C$

(D) $\frac{1}{\log |x|} + C$

(E) $\frac{1}{(\log |x|)^2} + C$

108. $\int e^x \sec x (1 + \tan x) dx =$

(A) $e^x \tan x + C$

(B) $e^x + \sec x + C$

(C) $e^{-x} \sec x + C$

(D) $e^x + \tan x + C$

(E) $e^x \sec x + C$

109. $\int \frac{1}{x + \sqrt{x}} dx =$

(A) $\log |1 + \sqrt{x}| + C$

(B) $2 \log |1 - \sqrt{x}| + C$

(C) $\log |1 - \sqrt{x}| + C$

(D) $2 \log |1 + \sqrt{x}| + C$

(E) $2 \log |x + \sqrt{x}| + C$

Space for rough work

110. $\int \sec^2(5x-1) dx =$

(A) $\frac{1}{5} \tan(5x-1) + C$

(B) $5 \tan(5x-1) + C$

(C) $\tan(5x-1) + C$

(D) $\cot(5x-1) + C$

(E) $\frac{1}{5} \cot(5x-1) + C$

111. $\int_0^{\frac{\pi}{2}} \frac{1}{1 + \cot^4 x} dx =$

(A) $\frac{\pi}{2}$

(B) $\frac{\pi}{4}$

(C) π

(D) $\frac{\pi}{8}$

(E) 2π

112. The value of $\int_{-10}^{10} (0.0002x^3 - 0.3x + 20) dx$ is equal to

(A) 423

(B) 400

(C) 378

(D) 410

(E) 390

113. The area enclosed by the curve $x = 3 \cos \theta$, $y = 2 \sin \theta$, $0 \leq \theta \leq \pi$, is (in square units)

(A) 9π

(B) 6π

(C) 4π

(D) 3π

(E) 2π

Space for rough work

114. The area of the region bounded by $y = |x|$, $y = 0$, $x = 3$ and $x = -3$ is (in square units)
(A) 3 (B) 6 (C) 7 (D) 9 (E) 10
115. The value of $\int_e^{e^2} \frac{1}{x} dx$ is equal to
(A) e (B) 1 (C) e^2 (D) $e^2 - e$ (E) 0
116. $\int_{-3}^3 |x+2| dx =$
(A) 17 (B) 9 (C) 14 (D) 13 (E) 12
117. The order and degree of the differential equation $\frac{d^2y}{dx^2} + \sqrt{x^2 + \left(\frac{dy}{dx}\right)^{3/2}} = 0$
are respectively
(A) 2, 4 (B) 2, 3 (C) 2, 2 (D) 3, 4 (E) 4, 3

Space for rough work

Ans

118. The general solution of the differential equation $xy' + y = x^2, x > 0$ is

(A) $y = \frac{x^2}{2} + Cx$

(B) $y = \frac{x^3}{3} + C$

(C) $y = \frac{x^2}{3} + C$

(D) $y = \frac{x^3}{3} + \frac{C}{x}$

(E) $y = \frac{x^2}{3} + \frac{C}{x}$

119. The integrating factor of the differential equation $3xy' - y = 1 + \log x, x > 0$ is

(A) $\log x$

(B) $\frac{1}{x}$

(C) $x^{-1/3}$

(D) $\frac{1}{x^3}$

(E) $x^{1/3}$

120. Elimination of arbitrary constants A and B from $y = \frac{A}{x} + B, x > 0$ leads to the differential equation

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

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

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

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

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

Space for rough work

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KEY**PAPER II: MATHEMATICSVersion-B1**

1	C	21	D	41	C	61	D	81	E	101	E
2	D	22	C	42	B	62	E	82	C	102	A
3	A	23	A	43	E	63	B	83	B	103	C
4	C	24	D	44	A	64	B	84	B	104	A
5	B	25	E	45	B	65	B	85	E	105	E
6	C	26	C	46	E	66	D	86	B	106	D
7	B	27	B	47	A	67	E	87	A	107	A
8	C	28	A	48	D	68	D	88	E	108	E
9	A	29	C	49	B	69	E	89	E	109	D
10	A	30	D	50	E	70	A	90	D	110	A
11	D	31	E	51	E	71	D	91	A	111	B
12	C	32	C	52	C	72	B	92	B	112	B
13	D	33	B	53	A	73	C	93	E	113	B
14	C	34	D	54	D	74	C	94	A	114	D
15	D	35	A	55	E	75	A	95	C	115	B
16	E	36	C	56	C	76	D	96	E	116	D
17	C	37	E	57	B	77	A	97	C	117	A
18	E	38	D	58	D	78	E	98	B	118	E
19	A	39	B	59	A	79	D	99	C	119	C
20	D	40	B	60	C	80	A	100	B	120	A