EAMCET

ENGINEERING ENTRANCE EXAM
SOLVED PAPER–1993

PHYSICS

1. In a parallel plate air capacitor, of capacitance 4 F if the lower half of air space is filled with a material of dielectric constant 3, its capacitance changes to :
(a) $\frac{4}{3}$ F   (b) $\frac{8}{3}$ F   (c) 8 F   (d) 12 F

2. In the experiment to verify inverse square law, with deflection magnetometer the value of $\frac{\tan \theta_A}{\tan \theta_B}$ will come out as :
(a) 0.25   (b) 0.5   (c) 1   (d) 2

3. A compound slab is made with two different materials A and B with coefficient of thermal conductivity $K_A = 2K_B$ and thickness $x_A = \frac{1}{2} x_B$. If the face of the A surface is at 100°C and that of the B surface is at 25°C the temperature of the common surface will be :
(a) 85°C   (b) 45°C   (c) 40°C   (d) 15°C

4. In a Ramsden eyepiece of effective focal length 3 cm the focal length of eye lens, in cm, is :
(a) 1.5   (b) 8/3   (c) 3   (d) 4

5. The angle of a prism is 60° and the angle of minimum deviation of light passing through it is observed to be 40°. The angle of incidence of light is :
(a) 30°   (b) 40°   (c) 50°   (d) 60°

6. To obtain p-type extrinsic semi- conductor, the impurity element to be added to Germanium should be of valency :
(a) 2   (b) 3   (c) 4   (d) 5

7. A radioactive sample has half life of 5 days. To decay from 8 micro-curies to 1 micro-curie, the number of days taken will be :
(a) 40   (b) 25
(c) 15   (d) 10

8. If a is the radius of first Bohr orbit in hydrogen atom, the radius of 3rd orbit is :
(a) 3a   (b) 9a   (c) 27a   (d) 81a

9. Photoelectric current can be increased by using :
(a) higher frequency radiation
(b) higher intensity radiation
(c) higher work function of metal plates
(d) none of the above

10. The magnetic induction at a point, distance x from the centre, on the axis of a circular current carrying coil is inversely proportional to (if $x >>$ radius of coil) :
(a) x (b) x^2 (c) x^3 (d) $x^{3/2}$

11. A 2 kg body and 3 kg body have equal momentum. If the kinetic energy of 3 kg body is 10 Joules, the kinetic energy of 2 kg body will be, (in joules) :
(a) 6.66   (b) 15
(c) 22.5   (d) 45

12. If the earth suddenly stops rotating, the value of g at equator would :
(a) decrease   (b) remain unchanged
(c) increase   (d) become zero

13. The extension of a wire by application of a load is 0.3 cm. The extension in a wire of same material, but of double the length and half the radius of cross-section, by the same load will be, in cm :
(a) 0.3   (b) 0.6   (c) 1.2   (d) 2.4

14. A quantity of heat Q is supplied to a monoatomic ideal gas which expands at constant pressure. The fraction of heat that goes into work done by the gas is :
(a) 2/5   (b) 3/5   (c) 2/3   (d) 1

15. In resonance column experiment with a closed pipe, the first, second and third resonance lengths l_1, l_2, l_3 respectively bear the relationship :
   (a) $l_3 = 2l_2 = 4l_1$ (b) $(l_3 - l_2) = (l_2 - l_1)$
   (c) $l_3 = \dfrac{5}{3} l_2 = 5l_1$ (d) $(l_3 - l_2) = 2(l_2 - l_1)$

16. The pair of physical quantities not having the same dimensional formula is :
   (a) acceleration, gravitational field strength
   (b) torque, angular momentum
   (c) pressure, modulus of elasticity
   (d) all of the above

17. When two vectors $\vec{A}$ and $\vec{B}$ of magnitude a and b are added, the magnitude of the resultant vector is always :
   (a) equal to $(a + b)$
   (b) less than $(a + b)$
   (c) greater than $(a + b)$
   (d) not greater than $(a + b)$

18. A ball is thrown vertically upwards with a speed of 10m/sec from the top of a tower 200m high and another is thrown vertically downwards with the same speed simultaneously. The time difference between them in reaching the ground, in seconds, if g is taken as 10 m/s^2, is :
   (a) 12   (b) 6   (c) 2   (d) 1

19. A bomb travelling in a parabolic path under the effect of gravity, explodes in mid-air. The centre of mass of the fragments will :
   (a) move vertically upwards and then vertically downwards
   (b) move vertically downwards
   (c) move in irregular path
   (d) move in the parabolic path the unexploded bomb would have travelled

20. A bullet of mass x moves with a velocity y, hits a wooden block of mass z, at rest and gets embedded in it. After collision, if the wooden block with bullet in it moves, the velocity is :
   (a) $\dfrac{x}{x+z} y$ (b) $\dfrac{x+z}{x} y$ (c) $\dfrac{z}{x+y} y$ (d) $\dfrac{x+y}{z} y$

Fill in the Blanks

1. For a thermocouple, keeping the cold junction at constant temperature, if the hot junction temperature is increased, the thermo e.m.f. increases to a maximum at a temperature which is called ....

2. The speed of electrons in a cathode ray beam, which remains undeflected, in Thomson experiment, under the simultaneous action of a magnetic field 2×10^{-3} Wb/m^2 and that of an electric field 3.4×10^4 V/m is .... m/sec.

3. In neutron discovery experiment, berillium element is bombarded by ....

4. If Planck's constant is given as 6.4×10^{-34} J-s and electron charge is 1.6×10^{-19} coulomb, the maximum wavelength of X-rays emitted, when a 10 keV electron is completely stopped by a target, is .... Å.

5. The nucleus of $_{56}Ba^{141}$ contains .... neutrons.

6. The overall process of carbon-nitrogen fusion cycle results in fusion of four protons to yield the helium nucleus and two ....

7. If a battery is connected across a p-n junction with p-type connected to the negative terminal, the junction is said to be ....

8. The majority carriers in a p-type semiconductor are ....

9. If an intrinsic semi-conductor a pentavalent element is added as impurity, one gets extrinsic semi-conductor of .... type.

10. The wavelength of a wave represented by equation $y = 0.03 \sin \pi (2t - 0.01x)$ where y and x are in metres and t in seconds is .... m.

11. An astronomical telescope of magnifying power 12, has an objective of focal length 1.08 m. The focal length of its eyepiece will be .... m.

12. Two lenses of focal lengths 75 cm and 25 cm, will form a combination satisfying the conditions for no chromatic aberration and minimum spherical aberration, when they are placed with a distance of separation .... cm.

13. If μ for water is $\frac{4}{3}$ and the velocity of light in vacuum is 3×10^8 m/sec. the time taken for light to travel a distance of 450 m in water will be .... sec .

14. A material for which magnetic susceptibility is independent of temperature and applied magnetic field, is a .... material.

15. 3 lamps of 250 W, 500 W, 1000 W are connected in series across the mains. The one which will light the brightest is lamp of .... W.

16. To convert a 800 mV range millivoltmeter of resistance 40Ω, into a milliammeter of 100 mA range, the resistance to be connected as shunt is .... Ω.

17. A person measures the time period of a simple pendulum inside a stationary lift and finds it to be T. If the lift starts accelerating upwards with an acceleration of $g/3$, the time period of the pendulum, will be ....

18. If for a material Young's modulus $= 6.6 \times 10^{10}$ N/m^2 and Bulk modulus $= 11 \times 10^{10}$ N/m^2, its Poisson's ratio is ....

19. Boiling point of a liquid can be defined as that temperature at which .... of the liquid becomes equal to atmospheric pressure.

20. When a liquid is taken in a long cylindrical vessel of material, with linear coefficient of expansion α, is heated, the level of liquid did not change. The volume coefficient of expansion of liquid is ....

21. A spherical soap bubble of radius 1 cm is formed inside another of radius 3 cm. The radius of a single soap bubble which maintains the same pressure difference as inside the smaller and outside the larger soap bubble is .... cm.

22. Using the same tuning fork first resonance lengths were observed with an organ pipe open at both ends and also with an organ pipe closed at one end, as l_1 and l_2 respectively. The ratio $l_1 : l_2$ will be ....

23. A source of sound emitting sound with frequency 540 Hz approaches a stationary observer with a speed of 30m/sec. If velocity of sound is taken as 330 m/sec, the frequency as heard by the observer will be .... Hz.

24. If time period t of a drop of liquid of density d vibrating under surface tension s is given by the formula $t = \sqrt{d^a r^b s^c}$ where r is radius of drop $a = 1$ and $c = -1$, the value of b is ....

25. $\overrightarrow{A}$ and $\overrightarrow{B}$ are vectors such that $|\overrightarrow{A} + \overrightarrow{B}| = |\overrightarrow{A} - \overrightarrow{B}|$. Then the angle between them is ....

26. A very small particle rests on the top of a hemisphere of radius 20 cm. The smallest horizontal velocity to be given to it, if it is to leave the hemisphere without sliding down its surface, taking $g = 9.8$ m/sec^2 is .... m/sec.

27. A particle starts moving from rest under uniform acceleration. It travels a distance x in the first two seconds and a distance of y in the next two seconds. If $y = n x$, then $n = $ ....

28. A gun fires 50 gm bullets with velocity 1000m/sec each. The soldier holding the gun can exert an average force of 180N against the gun. The maximum number of bullets he can fire per minute is ....

29. A solid cylinder at rest at top of an inclined plane of height 2.7 metre, rolls down without slipping. If the same cylinder has to slide down a frictionless inclined plane and acquire the same velocity as that acquired by centre of mass of rolling cylinder, at the bottom of inclined plane, the height of the inclined plane should be .... m.

30. If the acceleration due to gravity g at the earth's surface is 9.8 m/sec^2 and mass of earth is 80 times that of moon and radius of earth 4 times that of moon, the value of g at the moon's surface will be ....m/sec^2.

CHEMISTRY

1. In which of the following compounds is hydrogen bonding strongest in liquid phase ?
   (a) HF   (b) CH_4 (c) HI   (d) PH_3

2. Which of the following contains a co-ordinate covalent bond ?
   (a) H_2O (b) NH_3
   (c) NH_4^+ (d) C_2H_4

3. The hybridisation involved in acetylene is :
   (a) sp (b) sp^2 (c) sp^3 (d) dsp^2

4. The cobalt isotope of mass 60 decays with a half-life of 5.3 years. How many years does it take for $\frac{7}{8}$ th of a sample of 500 g of cobalt-60 to disintegrate ?
   (a) 10.6   (b) 4.6   (c) 15.9   (d) 9.2

5. The reaction of I_2 with $Na_2S_2O_3$ gives NaI and :
   (a) SO_3 (b) $Na_2S_2O_6$
   (c) $Na_2S_4O_6$ (d) $Na_2S_2O_6$

6. If a reaction obeys the following equation $k = \frac{2.303}{t} \log_{10} \frac{a}{a-x}$ the order of the reaction will be :
   (a) zero order   (b) first order
   (c) second order   (d) third order

7. Which of the following electronic configurations corresponds to an inert gas ?
   (a) $1s^2, 2s^2, 2p^5$ (b) $1s^2, 2s^2, 2p^6$
   (c) $1s^2, 2s^1$ (d) $1s^2, 2s^2, 2p^6, 3s^1$

8. Which of the following alloys contains Cu and Zn ?
   (a) Bronze   (b) Brass
   (c) Gun metal   (d) Type metal

9. The $4f$ level is successively filled up in :
   (a) alkali metals   (b) rare gases
   (c) lanthanides   (d) actinides

10. In which of the following sulphur has the lowest oxidation state ?
    (a) H_2SO_4 (b) SO_2 (c) H_2SO_3 (d) H_2S

11. The oxidation number of manganese in $KMnO_4$ is :
    (a) 3   (b) 5   (c) 7   (d) 9

12. Silver is extracted from its......ore :
    (a) sulphide   (b) oxide
    (c) nitrate   (d) halide

13. A certain sample of a gas has a volume of 0.2 L measured at 1 atm. pressure and 0°C. At the same pressure but at 273°C its volume will be :
    (a) 0.4 L   (b) 0.8 L
    (c) 27.8 L   (d) 55.6 L

14. A solution that obeys Raoult's law is called :
    (a) normal solution (b) molar solution
    (c) ideal solution   (d) saturated solution

15. Quicklime is represented by the formula :
    (a) $Ca(OH)_2$ (b) CaO
    (c) $CaCO_3$ (d) $CaHCO_3$

16. The catalyst used in the manufacture of sulphuric acid by contact process is :
    (a) Al_2O_3 (b) Cr_2O_3 (c) V_2O_5 (d) MnO_2

17. An isomer of ethanol is :
    (a) methanol   (b) diethyl ether
    (c) acetone   (d) dimethyl ether

18. The pH of a 0.001 M aqueous solution of sodium hydroxide will be :
    (a) 5.0   (b) 7.5   (c) 9.0   (d) 11.0

19. Which of the following poisonous gases is formed when chloroform is exposed to light and moist air ?
    (a) Mustard gas   (b) Phosgene
    (c) Chlorine   (d) Carbon monoxide

20. The half-life period of a radio active-element is 120 days. After 480 days 4.0g of the element will be reduced to :
    (a) 2.0 g   (b) 1.0 g   (c) 0.5 g   (d) 0.25 g

Fill in the Blanks

1. Oxides of iron in the blast furnace get reduced due to the action of .... on haematite.

2. The reaction of magnesium boride (Mg_3B_2) with acid solution produces ....

3. The rare gas which is more abundant in atmosphere is ....

4. A 0.1M solution of sodium bisulphate is .... in nature.

5. The halogen with the highest ionisation potential is ....

6. The reduction of acetaldehyde by .... leads to the formation of ethanol.

7. Unpaired electrons in .... orbitals in transition metals leads to para- magnetism.

8. Transition elements exhibit variable valency on account of .... d orbitals.

9. Inner transition elements exhibit different coloured compounds on account of unfilled .... orbitals.

10. Temporary hardness of water is due to the presence of .... of calcium and magnesium in water.

11. Glass is soluble in a solution of .... acid.

12. A solution of $Cr(NO_3)_3$ slowly turns green when conc. HCl is added due to the formation of ....

13. The deep colour produced when iodine is dissolved in a solution of potassium iodide is caused by the presence of .... ion.

14. Old bottles of ether are dangerous because they frequently contains high concentration of ....

15. Charcoal is often used in gas masks because of its high capacity for adsorbing .... molecules.

16. Hydrogen gas may be readily prepared in the laboratory by reacting water with ....

17. The use of a catalyst in chemical reaction .... activation energy of the reaction.

18. The reaction which proceeds with evolution of heat is called .... reaction.

19. Ethyl bromide on treatment with KOH (aq) gives rise to ....

20. The IUPAC name of
$CH_3— CH— CH—CH_3$ is ....
      | |
    CH_3 OH

21. Valence bond theory of L. Pauling and J.C. Slater accounts for .... characteristics of covalent bond.

22. The ionic product of water $[H^+] [OH^-]$ is ....

23. The oxidation number of chlorine in $KClO_3$ is ....

24. According to aufbau principle the electron has a tendency to occupy that sub-shell which has .... energy.

25. The emission of an alpha particle from a radioactive element causes its atomic number to decrease by ....

26. The solutions which tend to keep the concentration of hydrogen ions constant even when small amount of strong acid or strong base are added to them are known as .... solution.

27. When hydrogen bond is formed between two molecules it is called .... hydrogen bond.

28. The chemical formula of plaster of paris is ....

29. The melting point of diamond is very high since the type of bonding in it is ....

30. The chemical formula of bleaching powder is ....

MATHEMATICS

1. If $a < 0, b > 0$, then $\int_a^b \frac{|x|}{x} dx$ is equal to :
   (a) $a - b$
   (b) $b - a$
   (c) $a + b$
   (d) $-a - b$

2. The subtangent, ordinate and subnormal to the parabola $y^2 = 4ax$ at a point (different from the origin) are in :
   (a) AP
   (b) GP
   (c) HP
   (d) none of these

3. The set of matrices $S = \begin{bmatrix} x & -x \\ -x & x \end{bmatrix}$, $x \in R, x \neq 0$ form a group under multiplication operation with the identity element which is :
   (a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
   (b) $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$
   (c) $\begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix}$
   (d) $\begin{bmatrix} \frac{1}{2} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$

4. $\vec{\gamma} \times \vec{a} = \vec{b} \times \vec{a}, \ \vec{\gamma} \times \vec{b} = \vec{a} \times \vec{b}, \ \vec{a} \neq 0, \ \vec{b} \neq 0,$ $\vec{a} \neq \lambda \vec{b}$ and $\vec{a}$ is not perpendicular to $\vec{b} \Rightarrow \vec{\gamma} =$
   (a) $\vec{a} - \vec{b}$ (b) $\vec{a} + \vec{b}$
   (c) $\vec{a} \times \vec{b} + \vec{a}$ (d) $\vec{a} \times \vec{b} + \vec{b}$

5. Volume of parallelopiped whose coterminal edges are $2\hat{i} - 3\hat{j} + 4\hat{k}, \ \hat{i} + 2\hat{j} - 2\hat{k}, \ 3\hat{i} - \hat{j} + \hat{k}$, is :
   (a) 5 cu unit (b) 6 cu unit
   (c) 7 cu unit (d) 8 cu unit

6. $A (-1, 1), B (5, 3)$ are opposite vertices of a square in the $x - y$ plane. The equation of other diagonal (not passing through A, B) of the square is given by :
   (a) $x - 3y + 4 = 0$ (b) $y + 3x - 8 = 0$
   (c) $2x - y + 3 = 0$ (d) $x + 2y - 1 = 0$

7. The number of solutions of the system of equations given below is $|x| + |y| = 1$, $x^2 + y^2 = a^2, \ 0 < a < 1$:
   (a) ∞ (b) 2 (c) 4 (d) 8

8. The graph represented by the equations $x = \sin^2 t, \ y = 2 \cos t$ is :
   (a) a portion of parabola
   (b) a parabola
   (c) a part of sine graph
   (d) a part of a hyperbola

9. A circle touches x-axis and also touches the circle with centre $(0, 3)$ and radius 2. The locus of the centre of the circle is :
   (a) a circle (b) a parabola
   (c) an ellipse (d) a hyperbola

10. $\lim\limits_{x \to 0} \dfrac{a^x - b^x}{x}$ is equal to :
   (a) $x\,a^{x-1} - x\,b^{x-1}$ (b) $\log \dfrac{a}{b}$
   (c) $\log \dfrac{b}{a}$ (d) does not exist

11. For the equation $|x|^2 + |x| - 6 = 0$:
   (a) there is only one root
   (b) there are only two distinct roots
   (c) there are only three distinct roots
   (d) there are four distinct roots

12. If ω is a complex cube root of unity, then $(1 - \omega + \omega^2)^6 + (1 - \omega^2 + \omega)^6$ is equal to :
   (a) 0 (b) 6 (c) 64 (d) 128

13. The ex-radii of a triangle r_1, r_2, r_3 are in HP, then the sides a, b, c are in :
   (a) HP (b) AP
   (c) GP (d) none of these

14. The determinant $\begin{vmatrix} 0 & p-q & p-r \\ q-p & 0 & q-r \\ r-p & r-q & 0 \end{vmatrix}$ is equal to :
   (a) 0 (b) $(p - q)(q - r)(r - p)$
   (c) pqr (d) $3pqr$

15. In a class of 125 students 70 passed in Mathematics and 55 in Statistics and 30 in both. The probability that a student selected at random from the class has passed in only one subject is :
   (a) $\dfrac{13}{25}$ (b) $\dfrac{3}{25}$ (c) $\dfrac{17}{25}$ (d) $\dfrac{8}{25}$

16. If a, b are positive integers, define $a - b = \alpha$, where $a \times b = \alpha \pmod{7}$ with operation the inverse of 3 in the group $G = \{1, 2, 3, 4, 5, 6\}$ is :
   (a) 3 (b) 1 (c) 5 (d) 4

17. If $f : R \to R$ is a function defined by $f(x) = 10x - 7$. If $g(x) = f^{-1}(x)$, then $g(x)$ is :
   (a) $\dfrac{1}{10x - 7}$ (b) $\dfrac{1}{10x + 7}$
   (c) $\dfrac{x + 7}{10}$ (d) $\dfrac{x - 7}{10}$

18. The value of the continued fraction $1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \dots \infty}}}$ is :
   (a) $\dfrac{\sqrt{5} - 1}{2}$ (b) $\dfrac{\sqrt{5} + 1}{2}$
   (c) $\dfrac{\sqrt{5} + 1}{3}$ (d) $\dfrac{\sqrt{5} - 1}{3}$

19. If $x = \log_a (bc), \ y = \log_b (ca), \ z = \log_c (ab)$ then xyz is equal to :
   (a) $x + y + z$ (b) $x + y + z + 1$
   (c) $x + y + z + 2$ (d) $x + y + z + 3$

20. Area of the triangle formed by the 3 complex numbers $1 + i, -1 + i, 2i$ in the argand diagram is :
   (a) $\dfrac{1}{2}$ sq unit (b) 1 sq unit
   (c) $\sqrt{2}$ sq unit (d) 2 sq unit

Fill in the Blanks

1. If $y = x^{\sin x} + (\sin x)^x$, then $\dfrac{dy}{dx} = \ldots$

2. $\int \tan^5 \theta \, d\theta = \ldots$

3. $\int_{-1}^{1} \dfrac{dx}{(1 + x^2)^2} = \ldots$

4. The acceleration of a particle moving on a line is given by $\vec{a}(t) = 2t + 1$. It starts at a time $t = 0$ from the origin with velocity 3 m/sec. At the end of 1 sec, it will be at a distance $\ldots$ from the origin.

5. $\int_{\sqrt{2}/3}^{\sqrt{3}/3} \dfrac{dx}{\sqrt{4 - 9x^2}} = \ldots$

6. The area bounded by $y = \cos x$, $y = x + 1$ and $y = 0$ is $\ldots$

7. If α, β are the roots of the quadratic equation $x^2 - (a - 2)x - (a + 1) = 0$, where a is variable. The least value of $\alpha^2 + \beta^2$ is $\ldots$

8. $[\vec{b} \times \vec{c} \ \ \vec{c} \times \vec{a} \ \ \vec{a} \times \vec{b}] = \ldots$

9. The set of natural numbers under the usual multiplication operation is not a group since ...

10. $ABCD$ is a parallelogram. Equations AB and AD are $4x + 5y = 0$ and $7x + 2y = 0$ and the equation of the diagonal BD is $11x + 7y = 9$. Then equation of AC is ...

11. The locus of points from which the length of the tangents to two circles $x^2 + y^2 + 4x + 3 = 0$ and $x^2 + y^2 - 6x + 5 = 0$ are in the ratio $2 : 3$ is a circle with centre $\ldots$

12. Normal at the point $(at_1^2, 2at_1)$ to the parabola $y^2 = 4ax$ meets the parabola again at $(at_2^2, 2at_2)$, then $t_2 = \ldots$

13. Pole of the line $2x + 3y + 4 = 0$, with respect to the ellipse $\dfrac{x^2}{2} + \dfrac{y^2}{4} = 1$ is $\ldots$

14. The product of distances from any point on the hyperbola $\dfrac{x^2}{16} - \dfrac{y^2}{9} = 1$ to its two asymptotes is $\ldots$

15. The point at which the tangents to the hyperbola $y = \dfrac{x - 1}{x + 1}$ are parallel to the line $y = 2x + 1$ are $\ldots$

16. $\lim\limits_{x \to \infty} \left(\dfrac{x}{1 + x} \right)^x = \ldots$

17. $\lim\limits_{n \to \infty} \dfrac{1}{n^3} \left[1 + 3 + 6 + \ldots + \dfrac{n(n+1)}{2} \right] = \ldots$

18. If in a triangle ABC we define $x = \tan \dfrac{B - C}{2} \tan \dfrac{A}{2}$, $y = \tan \dfrac{C - A}{2} \tan \dfrac{B}{2}$, $z = \tan \dfrac{A - B}{2} \tan \dfrac{C}{2}$, then $x + y + z$ (in terms of x, y, z only) is $\ldots$

19. $\cos^2 \dfrac{\pi}{12} + \cos^2 \dfrac{\pi}{4} + \cos^2 \dfrac{5\pi}{12} = \ldots$

20. A flag staff stands on a building of height 10m. At a distance of 20m away from the foot of the building, the flag staff and building are substending equal angle. The height of flag staff $\ldots$

21. $3 \tan(\theta - 15^\circ) = \tan(\theta + 15^\circ)$, $0 < \theta < \pi$, then $\theta = \ldots$

22. A problem in Mathematics is given to 3 students. Their chances of solving it individually are $\dfrac{1}{3}, \dfrac{1}{4}, \dfrac{1}{5}$. The probability that the problem will be solved, is $\ldots$

23. If X is a poisson variate and $P(X = 1) = P(X = 2)$, then $P(X = 0)$ is $\ldots$

24. Each set X_r contains 5 elements and each set Y_r contains 2 elements and $\bigcup_{r=1}^{20} X_r = \bigcup_{r=1}^{n} Y_r = S$. If each element of S belongs to exactly 10 of the X_r's and exactly 4 of the Y_r's, then $n = \ldots$

25. If $x > 0$ and $\log_4(x^3 + x^2) - \log_4(x + 1) = 2$, then $x = \ldots$

26. If $k > 0$ and the product of the roots of the equation $x^2 - 3kx + 2e^{2\log k} - 1 = 0$ is 7, the sum of roots is $\ldots$

27. Partial fraction form of $\dfrac{3x + 7}{x^2 - 3x + 2}$ is $\ldots$

28. If $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ and A^2 is the identity matrix, then $x = \ldots$

29. The roots of the determinant equation in
$$\begin{vmatrix} a & a & x \\ m & m & m \\ b & x & b \end{vmatrix} = 0 \text{ are } \dots\dots$$

30. If $x^2 + 4xy + 4y^2 + 4x + c_1y + 3 = 0$ can be written as a product of two linear factors, then $C_1 = \dots\dots$

Answers

Physics

1. (c)	2. (d)	3. (a)	4. (d)	5. (c)	6. (b)	7. (c)	8. (b)	9. (b)	10. (c)
11. (b)	12. (c)	13. (d)	14. (a)	15. (b)	16. (b)	17 (d)	18. (c)	19. (d)	20. (a)

Fill in the Blanks

1. Neutral temperature
2. 1.7×10^7 m/s
3. α-particle
4. 1.2 Å
5. 85
6. Positron
7. Reverse biased
8. Holes
9. n-type
10. 200 m
11. 0.09 m
12. 50 cm
13. 2×10^{-6} sec
14. Diamagnetic
15. 250 W
16. 10Ω
17. $\frac{\sqrt{3}}{2} T$
18. 0.4
19. Surface vapour pressure
20. 3α
21. 1.5 cm
22. 2 : 1
23. 394 Hz
24. 3
25. 90°
26. 1.4 m/s
27. 3
28. 216
29. 1.8 m
30. 1.96 m/s^2

Chemistry

1. (a)	2. (c)	3. (a)	4. (c)	5. (c)	6. (b)	7. (b)	8. (b)	9. (c)	10. (d)
11. (c)	12. (a)	13. (a)	14. (c)	15. (b)	16. (c)	17 (d)	18. (d)	19. (b)	20. (d)

Mathematics

1. (c)	2. (b)	3. (d)	4. (b)	5. (c)	6. (b)	7. (a)	8. (b)	9. (b)	10. (b)
11. (d)	12. (d)	13. (b)	14. (a)	15. (a)	16. (c)	17 (c)	18. (b)	19. (c)	20. (b)

Fill in the Blanks

1. $x^{\sin x}\left[\cos x \log x + \dfrac{\sin x}{x}\right] + (\sin x)^x [\log \sin x + x \cot x]$
2. $\dfrac{1}{4}\tan^4\theta - \dfrac{1}{2}\tan^2\theta + \log\sec\theta + c$
3. $\dfrac{\pi + 2}{4}$
4. $\dfrac{23}{6}$ m
5. $\dfrac{\pi}{36}$
6. $\dfrac{3}{2}$ sq units
7. 5
8. $[\vec{a}\ \vec{b}\ \vec{c}]^2$
9. Inverse property does not exist
10. $y = x$
11. $(-6, 0)$
12. $t_2 = -t_1 - \dfrac{2}{t_1}$
13. $(-1, -3)$
14. $\dfrac{144}{25}$

15. $(-2, 3)$

16. $\dfrac{1}{e}$

17. $\dfrac{1}{6}$

18. $-xyz$

19. $\dfrac{3}{2}$

20. $\dfrac{50}{3}$ m

21. $\dfrac{\pi}{4}$

22. $\dfrac{3}{5}$

23. e^{-2}

24. $n = 20$

25. $x = 4$

26. 6

27. $\dfrac{13}{x-2} - \dfrac{10}{x-1}$

28. $x = 0$

29. $x = a, b$

30. $c_1 = 8$

Hints & Solutions

PHYSICS

1. Capacitance of parallel plate capaitor

$$C = \frac{\varepsilon_0 A}{d} = 4 \text{ F}$$

Capacitance of Ist half

$$C_1 = \frac{\varepsilon_0 A/2}{d} = \frac{\varepsilon_0 A}{2d}$$

$$= \frac{4 \text{ F}}{2} = 2 \text{ F}$$

Capacitance of IInd half

$$C_2 = \frac{k\varepsilon_0 A/2}{d} = \frac{k}{2}\left(\frac{\varepsilon_0 A}{d}\right)$$

$$= \frac{3}{2} \times 4 = 6 \text{ F}$$

C_1 and C_2 are connected in parallel,
So, net capacitance $C = C_1 + C_2 = 2 + 6$
$$= 8 \text{ F}$$

2. From tangent law
$$B = H \tan \theta$$
For A position (axial position)
$$\frac{\mu_0}{4\pi} \frac{2M}{d^3} = H \tan \theta_A \qquad \dots(1)$$
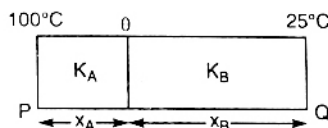For B position (equatorial position)
$$\frac{\mu_0}{4\pi} \frac{M}{d^3} = H \tan \theta_B \qquad \dots(2)$$
From equation (1) and (2)
$$\frac{\tan \theta_A}{\tan \theta_B} = \frac{2}{1}$$

3. The heat will flow from point P to point Q. Let the temperature of the common surface is θ, then.
Rate of flow of heat in A = Rate of flow of heat in B

$$K_A \frac{A(100 - \theta)}{x_A} = K_B \frac{A(\theta - 25)}{x_B}$$

$$\frac{2K_B(100 - \theta)}{x_A} = \frac{K_B(\theta - 25)}{2x_B}$$

$$4(100 - \theta) = (\theta - 25)$$

$$5\theta = 425° \Rightarrow \theta = \frac{425°}{5}$$

$$= 85° \text{ C}$$

4. In Ramsden's eyepiece, the focal length of eyepiece $f_e = \dfrac{4}{3}f$

where $f =$ effective focal length $= 3$ cm

$$\therefore \qquad f_e = \frac{4}{3} \times 3 = 4 \text{ cm}$$

5. Angle of prism $A = 60°$
Angle of minimum deviation $\delta_m = 40°$
Angle of incidence $i = \dfrac{A + \delta_m}{2} = \dfrac{60 + 40}{2}$
$$= 50°$$

6. To obtain p-type extrinsic semi conductor, a trivalent impurity should be added, because by doing so one covalent bond out of four covalent bonds of germanium will have the defficiency of one electron i.e. will have a hole.

7. Half life $T_{1/2} = 5$ days
Initial activity $R_0 = 8$ micro-curie
Final activity $R = 1$ micro-curie