MATHEMATICS-2018

1. The symmetric difference of $A = \{1,2,3\}$ and $B = \{3,4,5\}$ is
   a. $\{1,2\}$
   b. $\{1,2,4,5\}$
   c. $\{4,3\}$
   d. $\{2,5,1,4,3\}$

2. The area enclosed by the curve $x = 3\cos t$, $y = 2\sin t$ is
   a. 5π
   b. 6π
   c. 7π
   d. 8π

3. The value of $\sec^2(\tan^{-1}(2)) + \operatorname{cosec}^2(\cot^{-1}(3))$ is
   a. 15
   b. 10
   c. 5
   d. 0

4. Let $P(n) = \dfrac{n^5}{5} + \dfrac{n^3}{3} + \dfrac{7n}{15}$. Then $P(n)$ is
   a. A natural number for all $n \in \mathbb{N}$
   b. Not a natural number for all $n \in \mathbb{N}$
   c. A natural number only for some $n \in \mathbb{N}$
   d. None of the above

5. If z_1 and z_2 are complex numbers. Which of the following is false
   a. $\arg(z_1 z_2) = \arg(z_1) + \arg(z_2)$
   b. $\arg\left(\dfrac{z_1}{z_2}\right) = \arg(z_1) - \arg(z_2)$, $(z_2 \neq 0)$
   c. $\arg(z_1) - \arg(\bar{z_2}) = 0$
   d. $\arg(\bar{z_1}) + \arg(z_2) = 0$

6. The value of x, which satisfy the inequality $|3 - 4x| \geq 9$ is belonging in
   a. $\left(\dfrac{-3}{2}, 3\right]$
   b. $\left(-\infty, \dfrac{-3}{2}\right] \cup (3, \infty)$
   c. $\left(-\infty, \dfrac{-3}{2}\right) \cup [3, \infty)$
   d. $\left(-\infty, \dfrac{-3}{2}\right] \cup [3, \infty)$

7. How many numbers are there between 99 and 1000 having 5 in the units place?
   a. 90
   b. 105
   c. 101
   d. None of these

8. Which of the following is true
   a. $e^\pi = \pi^e$
   b. $e^\pi > \pi^e$
   c. $e^\pi < \pi^e$
   d. Cannot say

9. The two successive terms in the expansion of $(1 + x)^{24}$ whose coefficients are in the ratio $1:4$ are
   a. 3rd and 4th
   b. 4th and 5th
   c. 5th and 6th
   d. 6th and 7th

10. If $a_1, a_2, a_3, \dots$ are in A.P. and $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$. Then the sum of $a_1 + a_{24}$ is
    a. 70
    b. 80
    c. 85
    d. 75

11. If the line joining two points $A(2,0)$ and $B(3,1)$ is rotated about A in anticlockwise direction through an angle of 15°. Then the new equation of line is
    a. $y - \sqrt{3}x + 2\sqrt{3} = 0$
    b. $y + \sqrt{3}x + 2\sqrt{3} = 0$
    c. $y - \sqrt{3}x - 2\sqrt{3} = 0$
    d. $y + \sqrt{3}x - 2\sqrt{3} = 0$

12. The area of the triangle formed by the lines joining the vertices of the parabola $x^2 = 12y$ to the ends of its latus rectum is
    a. 12 sq. units
    b. 16 sq. units
    c. 18 sq. units
    d. 24 sq. Units

13. Let $P(x, y, z)$ be a point, equidistant from the four point $O(0,0,0)$, $A(l, 0,0)$, $B(0, m, 0)$ and $C(0,0, n)$. Then $(2x, 2y, 2z)$ is equal to

    a. $\left(\frac{l}{2}, \frac{m}{2}, \frac{n}{2}\right)$
    b. $(2l, 2m, 2n)$
    c. (l, m, n)
    d. None of the above

14. Let $f: [0,10] \to P$ be a function defined by
$$f(x) = \begin{cases} x(x-1)(x-2)(x-3)(x-4), & x \in [0,10] \cap Q \\ 0, & x \in [0,10] \cap Q^c. \end{cases}$$
    Then the number of points where f is not continuous are

    a. 4
    b. 5
    c. 0
    d. Infinite

15. The negation of the statement '*It is raining and weather is cold*' is

    a. It is not raining and weather is cold
    b. It is raining or weather is not cold
    c. It is not raining or weather is not cold
    d. It is not raining and weather is not cold

16. A set of p values $x_1, x_2, \dots, x_p$ has standard deviation σ. The standard deviation of p values $x_1 + c, x_2 + c, \dots, x_p + c$ will be

    a. σ
    b. $\sigma + c$
    c. $\sigma - c$
    d. $c\sigma$

17. Three of the six vertices of a regular hexagon are chosen at random. What is the probability that the triangle with these vertices is equivalent?

    a. $\frac{1}{20}$
    b. $\frac{1}{10}$
    c. $\frac{3}{10}$
    d. $\frac{3}{20}$

18. Which of the following functions is periodic?
    a. $f(x) = x - [x]$, where $[x]$ is greatest integer function
    b. $f(x) = \sin\left(\frac{1}{x}\right)$, for $x \neq 0, f(0) = 0$
    c. $f(x) = x \cos x$
    d. None of these

19. If $3\sin^{-1}\left(\frac{2x}{1+x^2}\right) - 4\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right) + 2\tan^{-1}\left(\frac{2x}{1-x^2}\right) = \frac{\pi}{3}$. Then $x =$
    a. $\frac{1}{\sqrt{3}}$
    b. $\frac{1}{\sqrt{2}}$
    c. $\frac{1}{3}$
    d. $\frac{1}{2}$

20. If $\begin{bmatrix} -2 & 3 \\ -1 & 1 \end{bmatrix}$, then $I + A + A^2 + \cdots \infty =$
    a. $\begin{bmatrix} 0 & 3 \\ 1 & 3 \end{bmatrix}$
    b. $\frac{1}{3}\begin{bmatrix} 0 & -3 \\ -1 & 3 \end{bmatrix}$
    c. $\frac{1}{3}\begin{bmatrix} 0 & 3 \\ -1 & 3 \end{bmatrix}$
    d. Undefined

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1. Four electromagnetic waves of different wavelengths are given. X-rays, Microwaves, Ultraviolet, Infrared.
   Their correct arrangement in the descending order of wavelength is
   a) X-rays, Ultraviolet, Infrared and Microwaves
   b) Microwaves, Infrared, Ultraviolet and X-rays
   c) Ultraviolet, Infrared, X-rays and Microwaves
   d) Microwaves, X-rays, Infrared and Ultraviolet

2. In Fabry-Perot interferometer fringes are formed due to-
   a) Division of wavefront
   b) Division of rays
   c) Division of amplitude
   d) None of these

3. When a wave goes from one place to another it transports-
   a) Matter
   b) Energy
   c) Mass
   d) Nothing

4. A 100W bulb will consume one unit of electrical energy in
   a) 1 hour
   b) 10 hours
   c) 1 day
   d) 60 hours

5. The numerical aperture of a fiber if the angle of acceptance is 15 degrees, is
   a) 0.17
   b) 0.26
   c) 0.50
   d) 0.75

6. Which of the following waves/rays are produced by nuclear changes in the atom?
   a) Infrared rays
   b) Light waves
   c) X-rays
   d) γ-rays

7. The photovoltaic effect takes place only –
   a) $h\nu > Eg$
   b) $h\nu = Eg$
   c) $h\nu < Eg$
   d) None of the above

8. When fast moving electrons are stopped suddenly by a metal target
   a) Alpha rays are produced
   b) Beta rays are produced
   c) Gamma rays are produced
   d) X-rays are produced

9. If $\overline{A} = (x + y)\hat{\imath} + (y - z)\hat{\jmath} + (x + 2az)\hat{k}$ is solenoidal vector field then the value of constant 'a' is:
   a) 0
   b) 1
   c) -1
   d) ∞

10. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is-
    a) Greater than the mean velocity
    b) Equal to the mean velocity
    c) Equal to root mean square velocity
    d) Less than the root mean square velocity

11. The excess pressure applied at a point inside a liquid at rest is distributed equally in all directions. This principle is known as -
    a) Boyle's law
    b) Charles' law
    c) Avogadro's law
    d) Pascal's law

12. Which of the following is the exact value of L_+L_-?
    a) $L_x^2 + L_y^2 - i[L_x, L_y]$
    b) $L_x + L_y + L_z$
    c) L^2
    d) $L_x^2 + L_y^2 + L_z^2$

13. What is the quantity of heat required to raise 2 Kg of copper from 303 K to 353 K?
    (Specific heat capacity of copper = 355 J/Kg/K)-
    a) 3.85
    b) 38500
    c) 38.5
    d) 0.385

14. The packing fraction for a FCC lattice is greater than that of SC lattice by a factor-
    a) $\sqrt{2}$
    b) 2
    c) $2\sqrt{2}$
    d) 3/2

15. According to free electron theory Sommerfeld's model, the energy can have discrete values given by-
    a) $E = n^2h^2/8mL^2$
    b) $E = mh^2/8nL^2$
    c) $E = Lh^2/8mn$
    d) $E = 8n^2h^2/mL^2$

16. In a tape recorder the sound is recorded on the tape as-
    a) Variable magnetic field
    b) Variable electrical resistance
    c) Variable sound
    d) Variable thickness

17. A coil of wire is placed in a changing magnetic field. If the number of turns in the coil is decreased, the voltage induced across the coil will
    a) Increase
    b) Decrease
    c) Remain constant
    d) Be excessive

18. Let a thin capillary tube be replaced with another tube of insufficient length then, we find water
    a) Will over flow
    b) Will not rise
    c) Depressed
    d) Will only change its meniscus

19. Rate of change of momentum is
    a) Velocity
    b) Work
    c) Force
    d) Speed

20. The force of attraction between planets was correctly given by
    a) Kepler
    b) Newton
    c) Galileo
    d) Ptolemy

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1. The electrical conductance of electrolyte is dependent on

    a) Atmospheric conditions
    b) Dielectric carriers
    c) Dielectric constant
    d) All of the above

2. Saponification of methyl acetate by sodium hydroxide is

    a) 1st order reaction
    b) 2nd order reaction
    c) Zero order reaction
    d) Pseudo 1st order reaction

3. Water molecules in crystallisation of $CuSO_4$ is in range of :

    a) 1-5
    b) 7-11
    c) 3-7
    d) 10-14

4. The experiment to determine the solubility of a sparingly soluble salt in water is based on

    a) Raoult's Law
    b) Vant Hoff Principle
    c) Law of Mass action
    d) None of these

5. Heat of neutralisation is negative because

    a) It is endothermic
    b) It exothermic
    c) It is only partially completed
    d) It is in accordance to a set standard

6. The reaction of potassium nitrate with water is

    a) Endothermic
    b) Exothermic
    c) No reaction
    d) Isenthalpic

7. Charcoal is a ..... bonded solid, more effective at absorbing molecules than ion.
   a) ionically
   b) covalently
   c) metallic
   d) non polar covalent compound

8. Rare gases are

   a) mono atomic
   b) di atomic
   c) tri atomic
   d) None of above

9. The term PVC used in the plastic industry stands for
   a) polyvinyl chloride
   b) polyvinyl carbobate
   c) phosphor vanadiu chloride
   d) phosphavinyl chloride

10. The phenomenon of concentration of molecules of a gas or liquid at a solid is called -
   a) Absorption
   b) Adsorption
   c) Deposition
   d) Dissociation

11. Which of the following is not a strong electrolyte?
   a) KNO_3
   b) CH_3COOH
   c) $NaClO_4$
   d) KCl

12. What should be the free energy so that reaction is spontaneous?
   a) Positive
   b) Negative
   c) Neutral
   d) None of the Above

13.   Ksp is known as -
    a) Solubility product
    b) Solubility reactant
    c) Solution equilibrium
    d) Solubility equilibrium

14.   A strong base dissociates completely in aqueous solution to form-
    a) H+ ion
    b) H- ion
    c) OH- ion
    d) None of the Above

15. Which one of the following is NOT an assumption of Langmuir Adsorption isotherm?

    a) Each adsorption site accommodates only one molecule
    b) Adsorbed molecules do not interact
    c) Phase transition takes place.
    d) Only a monolayer is formed on the adsorbent.

16. The unit of rate constant for a second order reaction is _____

    a) s^{-1}
    b) $L\ mol^{-1}\ s^{-1}$
    c) No unit
    d) $L^2\ mol^{-2}\ s^{-1}$

17. What is Calcium sulphate?

    a) epsom salt
    b) blue vitriol
    c) gypsum salt
    d) potash alum

18. What is general formula of alkenes?

    a) CnH2n+2
    b) CnH2n
    c) CnH2n-2
    d) None of these

19. Which of following is widely used in oxy-acetylene welding and cutting metals?

    a) Ethylene
    b) Acetylene
    c) Phenol
    d) Methanol

20. What is term used for a series of related compounds in which any two adjacent molecules differ by -CH2- group?

    a) Cyclic compounds
    b) Functional groups
    c) Homologous series
    d) None of these

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1. The kinematic viscosity is the
   a) ratio of absolute viscosity to the density of the liquid
   b) ratio of density of the liquid to the absolute viscosity
   c) product of absolute viscosity and density of the liquid
   d) product of absolute viscosity and mass of the liquid

2. Cycle consisting of one constant pressure, one constant volume and two isentropic processes is known as
   a) Carnot cycle
   b) Stirling cycle
   c) Otto cycle
   d) Diesel cycle

3. The efficiency and work ratio of a simple gas turbine cycle are
   a) Low
   b) Very low
   c) High
   d) Very high

4. The ratio of specific heat at constant pressure (c_p) and specific heat at constant volume (c_v) is
   a) equal to one
   b) less than one
   c) greater than one
   d) none of these

5. If the value of $n = 0$ in the equation $pv^n = C$, then the process is called
   a) equal to one
   b) less than one
   c) greater than one
   d) none of these

6. During which of the following process does heat rejection takes place in Carnot cycle?
   a) Isothermal expansion
   b) Isentropic expansion
   c) Isothermal compression
   d) Isentropic compression

7. The reference fuels for knock rating of spark ignition engines would include
   a) iso-octane and alpha-methyl naphthalene
   b) normal octane and aniline
   c) iso-octane and normal hexane
   d) normal heptane and iso-octane

8. Fourier's law of heat conduction is (where Q = Amount of heat flow through the body in unit time, A = Surface area of heat flow, taken at right angles to the direction of heat flow, dT = Temperature difference on the two faces of the body, dx = Thickness of the body, through which the heat flows, taken along the direction of heat flow, and k = Thermal conductivity of the body)

   a) $Q = k \cdot A \times \dfrac{dT}{dx}$

   b) $Q = k \cdot A \times \dfrac{dx}{dT}$

   c) $Q = k \times \dfrac{dT}{dx}$

   d) $Q = k \times \dfrac{dx}{dT}$

9. The heat transfer takes place according to
   a) Zeroth law of thermodynamics
   b) First law of thermodynamics
   c) Second law of thermodynamics
   d) Kirchhoff's law

10. The emissivity for a black body is
    a) 0
    b) 0.5
    c) 0.75
    d) 1

11. Conduction is a process of heat transfer
    a) from one particle of the body to another without the actual motion of the particles
    b) from one particle of the body to another by the actual motion of the heated particles
    c) from a hot body to a cold body, in a straight line, without affecting the intervening medium
    d) none of the above

12. The neutral axis of the cross-section a beam is that axis at which the bending stress is
    a) Zero
    b) Minimum
    c) Maximum
    d) Infinity

13. The point of contraflexure is a point where
    a) shear force changes sign
    b) bending moment changes sign
    c) shear force is maximum
    d) bending moment is maximum

14. The point of contraflexure occurs in
    a) cantilever beams
    b) simply supported beams
    c) overhanging beams
    d) fixed beams

15. A disturbing mass m1 attached to the rotating shaft may be balanced by a single mass m_2 attached in the same plane of rotation as that of m_1, such that (where r_1 and r_2 are the radii of rotation of m_1 and m_2 respectively)
    a) $m_1 r_2 = m_2 r_1$
    b) $m_1 r_1 = m_2 r_2$
    c) $m_1 m_2 = r_1 r_2$
    d) none of these

16. In railway axle boxes, the bearing used is
    a) deep groove ball bearing
    b) double row self-aligning ball bearing
    c) double row spherical roller bearing
    d) cylindrical roller bearing

17. The ability of a material to absorb energy in the plastic range is called
    a) Resilience
    b) Creep
    c) Fatigue Strength
    d) Toughness

18. Brass is an alloy of
    a) copper and zinc
    b) copper and tin
    c) copper, tin and zinc
    d) none of these

19. Segmental chips are formed during machining
    a) mild steel
    b) cast iron
    c) high speed steel
    d) high carbon steel

20. Internal gears can be made by
    a) hobbing
    b) shaping with pinion cutter
    c) shaping with rack cutter
    d) milling

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ANSWER SHEET

Date: 14th June, 2018   **Time: 11:00 AM – 01:00 PM**

Name of the Candidate:_____

Admit Card No:_____**Centre:**_____**Singnature of the Candidate:**_____

Mathematics		Physics		Chemistry		Engineering	
Q.No	Answer	Q.No	Answer	Q.No	Answer	Q.No	Answer
1		1		1		1	
2		2		2		2	
3		3		3		3	
4		4		4		4	
5		5		5		5	
6		6		6		6	
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20		20		20		20	

ROUGH WORK

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