Combined Geo-Scientist (P) Examination 2020
Paper-II (Geophysics)

1.
Bode's law is associated with:
   (a) Distance between two planets
   (b) Distance between sun and planets
   (c) Distance between earth and moon
   (d) Distance between two stars

2.
Which one of the following is NOT a branch of geophysics?
   (a) Plutology
   (b) Seismology
   (c) Hydrology
   (d) Topographic surveying and mapping

3.
Which branch of geophysics deals with the internal structure of earth?
   (a) Active reflection seismics
   (b) Active refraction seismics
   (c) Passive seismology
   (d) Magnetotellurics

4.
Which one amongst the following phenomena provides evidence that 'the universe is expanding'?
   (a) Newton's law of gravitation
   (b) Coloumb's law
   (c) Green house effect
   (d) Doppler effect

5.
A three component seismometer was installed at a granite site. The thickness of rock layer is 15 km. An earthquake occurred at a depth of 10 km with an epicentral distance of 30 km. The observed seismic moment is 6×10^{27}. Which one of the following is the correct relationship among body-wave magnitude (m_b), surface-wave magnitude (M_s) and moment magnitude (M_w)?
   (a) $m_b < M_s = M_w$
   (b) $m_b = M_s < M_w$
   (c) $m_b < M_s < M_w$
   (d) $m_b > M_s > M_w$

6.

The core of Jupiter is surrounded by the layers of:

    (a) Liquid hydrogen and iron

    (b) Liquid-metallic, non-metallic and gaseous hydrogen

    (c) Gaseous hydrogen and gaseous helium only

    (d) Gaseous hydrogen, gaseous helium and liquid helium

7.

The Earth's magnetic poles are shifting because of:

    1. Shifts in the core's rate of spin

    2. Changes in the convection of the core

    3. Large earthquakes

Select the correct answer using the code given below:

    (a) 1 and 3 only

    (b) 1 and 2 only

    (c) 2 only

    (d) 1, 2 and 3

8.

Acceleration due to gravity g at a distance $(r > R_{earth})$ from the centre of earth is given by:

    (a) $\frac{\partial g}{\partial r} + \frac{2}{r^2} g = 0$

    (b) $\frac{\partial g}{\partial r} - \frac{g}{2r} = 0$

    (c) $\frac{\partial g}{\partial r} - 2 \frac{g}{r} = 0$

    (d) $\frac{\partial g}{\partial r} + 2 \frac{g}{r} = 0$

9.

Aurora Borealis occurs near the:

    (a) Magnetic north pole of earth

    (b) Equator of earth

    (c) Sea shore

    (d) Desert region

10.

The distance between south geographic pole and south magnetic pole is approximately:

    (a) 4000 km

    (b) 1500 km

    (c) 1020 km

    (d) 2860 km

11.

At neutral point of a bar magnet, a compass needle can stay in any position because:

(a) Magnetic declination at that point is zero

(b) Angle of dip at that point is zero

(c) Earth's magnetic field is zero

(d) Magnetic field of the bar magnet cancels the horizontal component of earth's magnetic field

12.

Match List-I with List-II and select the correct answer using the code given below:

List-I	List-II
(*Mineral*)	(*Magnetic property*)
A. Calcite	1. Diamagnetic
B. Magnetite	2. Paramagnetic
C. Ilmenite	3. Ferrimagnetic
D. Amphibole	4. Anti-ferromagnetic

Code:

	A	B	C	D
(a)	1	3	4	2
(b)	1	4	3	2
(c)	2	3	4	1
(d)	2	4	3	1

13.

Which of the following has maximum Koenigsberger ratio?

(a) Igneous rock

(b) Sedimentary rock

(c) Metamorphic rock

(d) Depends only on temperature of rock

14.

Which one of the following is believed to be the cause of earth's magnetism?

(a) The earth has a large bar magnet at its centre

(b) The abundance of magnetic materials present in the crust of earth

(c) The electric currents conducting in the liquid core

(d) The magnetic fields produced by the magnetic materials present in the solid mantle

15.

When an elastic wave propagates in a medium, its velocity depends on:

    (a) Density of the medium only

    (b) Elasticity of the medium only

    (c) Both density and elasticity of the medium

    (d) Neither density nor elasticity of the medium

16.

In travel time versus distance plot in seismic refraction, the slope of the segments depends on the:

    (a) Impedance contrast between two layers

    (b) Seismic velocity and dip in each layer

    (c) Seismic velocity in each layer

    (d) Thickness of each layer

17.

Which one of the following statements regarding planet earth is NOT correct?

    (a) Its shape is oblate spheroid

    (b) Its polar radius is shorter than its equatorial radius

    (c) Some of the oceanic islands are formed by the basalt volcanoes

    (d) The deepest layer of the earth is core which is composed of liquid only

18.

The most homogeneous layer of the earth is:

    (a) Oceanic crust

    (b) Mantle

    (c) Outer core

    (d) Inner core

19.

Plate recycling occurs below the surface of earth because of:

    1. Pulling force of a sinking lithospheric slab

    2. Pushing force of sliding off a mid oceanic ridge

    3. Rising convection current at boundary regions

Select the correct answer using the code given below:

    (a) 1 and 2 only

    (b) 2 and 3 only

    (c) 1 and 3 only

    (d) 1, 2 and 3

20.

Two seismic recording stations receive data of S wave, P wave and PP wave consequently. On that basis, which of the following statements are correct?

    1. The time difference of S wave and P wave determines the epicentral angle to the source

    2. The time difference of S wave and PP wave determines the depth of the hypo centre

    3. P-S arrival time difference from two stations determines the location of the earthquake

Select the correct answer using the code given below:

    (a) 1 and 2 only

    (b) 2 and 3 only

    (c) 1 and 3 only

    (d) 1, 2 and 3

21.

The power of an earthquake of magnitude 7 is higher than that of 5 on Richter scale by:

    (a) 2 times

    (b) 7/5 times

    (c) 31 times

    (d) 961 times

22.

The directional derivative of $f(x, y, z) = 2x^2+3y^2+z^2$ at a point P: (2, 1, 3) in the direction of $\vec{a} = \hat{\imath}-2\hat{k}$ is:

    (a) $\frac{4}{\sqrt{5}}$

    (b) $\frac{-4}{\sqrt{5}}$

    (c) $\frac{2}{\sqrt{5}}$

    (d) $\frac{-2}{\sqrt{5}}$

23.

The divergence of the vector $e^{-x}\sin y\,\hat{\imath} - e^{-x}\cos y\,\hat{\jmath} + xy\,\hat{k}$ is:

    (a) $2\,e^{-x}\sin y$

    (b) $2\,e^{-x}\cos y$

    (c) xy

    (d) 0 (zero)

24.

The Eigen values of the matrix $A = \begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix}$ are:

    (a) 1, –1

    (b) 1, –4

    (c) –1, 3

    (d) 1, –3

25.

Which one of the following matrices is an orthogonal matrix?

(a) $\begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

(b) $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

(c) $\begin{bmatrix} \sin\theta & -\sin\theta \\ \cos\theta & \cos\theta \end{bmatrix}$

(d) $\begin{bmatrix} \sin\theta & \cos\theta \\ \cos\theta & \sin\theta \end{bmatrix}$

26.

In gravity method, the vertical fault block can be modeled as:

    (a) Horizontal cylinder

    (b) Vertical cylinder

    (c) Infinite horizontal slab

    (d) Semi-infinite horizontal slab

27.

If the gravitational potential on the surface of the earth is 6×10^{10} ergs/gm, then the gravitational potential at the center of the earth can be:

    (a) 6×10^{10} ergs/gm

    (b) 9×10^{10} ergs/gm

    (c) 3×10^{10} ergs/gm

    (d) 7.5×10^{10} ergs/gm

28.

Two spheres of equal mass are separated by a distance of 'r' and are subjected to their mutual gravitational attraction. Which of the following quantities must have the same magnitude for both the spheres?

    1. Velocity

    2. Kinetic energy

    3. Gravitational force

Select the correct answer using the code given below:

    (a) 1 only

    (b) 2 and 3 only

    (c) 1 and 2 only

    (d) 1, 2 and 3

29.

Which one of the following systems shows an example of the presence of at least three fundamental forces?

       (a) Pair of neutrons (n-n)
       (b) Pair of electrons (e-e)
       (c) Pair of protons (p-p)
       (d) Neutron and proton (n-p)

30.

Which of the following quantities are conserved in a weak interaction?

    1. Charge
    2. Lepton number
    3. Baryon number
    4. Strangeness

Select the correct answer using the code given below:

       (a) 1 and 2 only
       (b) 1, 2 and 3 only
       (c) 3 and 4 only
       (d) 1, 2, 3 and 4

31.

α-decay and β-decay are due to:

       (a) strong force and weak force respectively
       (b) electromagnetic force and weak force respectively
       (c) electrostatic force and weak force respectively
       (d) electromagnetic force and strong force respectively

32.

A sphere, a cylinder and ring of same radius are allowed to roll down simultaneously on an inclined plane from the same height without slipping. Which of the following will reach the bottom first?

       (a) Sphere
       (b) Cylinder
       (c) Ring
       (d) All will reach simultaneously

33.

Two particles of equal mass travelling with velocities 2m/s and 4m/s collide and stick together. What would be the velocity of the combined mass?

       (a) 2m/s
       (b) 4m/s
       (c) 3m/s
       (d) 6m/s

34.

A slender uniform rod of total length 'L' and total mass 'M' has its rotational axis at the center of the length and perpendicular to length. Its moment of inertia can be given by:

(a) $\frac{1}{3}ML^2$

(b) $\frac{1}{4}ML^2$

(c) $\frac{1}{8}ML^2$

(d) $\frac{1}{12}ML^2$

35.

Total number of degrees of freedom for a rigid body around a fixed point is:

(a) Zero

(b) One

(c) Two

(d) Three

36.

The speed of an electron in a uniform electric field changes from 0.95c to 0.98c, where c is the velocity of light. Change in the mass of electron will be:

(Rest mass of electron = 9.11×10^{-31} kg)

(a) 1.8×10^{-31} kg

(b) 16.4×10^{-27} kg

(c) 1.8×10^{-27} kg

(d) 16.4×10^{-31} kg

37.

What will be the speed of a proton, whose kinetic energy is double to its rest mass energy?

(a) $\frac{2\sqrt{2}}{3}c$

(b) $\frac{c}{\sqrt{2}}$

(c) $\frac{c}{\sqrt{3}}$

(d) $\frac{c}{2}$

Courtesy:UPSC

38.

In geophysical inverse problem, if the rank of a matrix is K, N is the number of data points and M is the number of unknown parameters, then the condition for over determined problem is:

1. N=M and K <M
2. N>M and K <M
3. N>M and K=M
4. N = M and K=M

Select the correct answer using the code given below:

(a) 1 and 4
(b) 2 and 3
(c) 1 and 3
(d) 2 and 4

39.

Which one of the following distributions is symmetric about its mean and has zero skewness?

(a) Laplacian distribution
(b) Gaussian distribution
(c) Poisson distribution
(d) Binomial distribution

40.

The probability of having at least two tails in 4 throws with a fair coin is:

(a) $\frac{1}{8}$
(b) $\frac{3}{4}$
(c) $\frac{3}{8}$
(d) $\frac{11}{16}$

41.

Characteristic polynomial $\Delta(t)$ of the matrix A = $\begin{bmatrix} 2 & 5 \\ 4 & 1 \end{bmatrix}$ is:

(a) $t^2 - 5t + 1$
(b) $t^2 + 9$
(c) $t^2 - 3t + 7$
(d) $t^2 - 3t - 18$

42.

The two vectors **U** = (1, -3) and **V** = (-2, 6) are:

(a) Linearly dependent
(b) Linearly independent
(c) **U** is subset of **V**
(d) **V** is subset of **U**

43.

The solution of the differential equation $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 15\,y = 0$ is:

    (a) $y = C_1\,e^{3x} + C_2\,e^{5x}$
    (b) $y = C_1\,e^{3x} + C_2\,e^{3x}$
    (c) $y = C_1\,3x + C_2\,5x$
    (d) $y = C_1\,e^{-3x} + C_2\,e^{-5x}$

44.

In Laplace equation $\nabla^2\,\psi = 0$, all the stationary points of ψ must belong to:

    (a) Maxima
    (b) Minima
    (c) Saddle points
    (d) Zero

45.

Interpolation is a method to:

    (a) Solve differential equations numerically
    (b) Find roots of a polynomial
    (c) Find the value beyond the points in a data set
    (d) Find the value of a point lying between known points

46.

We can find the value of the integral $\int_0^1 \left(\frac{x}{1+x}\right)\,dx$ by using Simpson's 3/8 rule, if the interval number is:

    (a) 7
    (b) 6
    (c) 8
    (d) any positive integer

47.

What is the magnetic force per unit length between two parallel wires separated by a distance 'd' each carrying a current 'I' in the same direction?

    (a) $\frac{\mu_0 I}{2\pi d}$, attractive
    (b) $\frac{\mu_0 I}{2\pi d}$, repulsive
    (c) $\frac{\mu_0 I^2}{2\pi d}$, attractive
    (d) $\frac{\mu_0 I^2}{2\pi d}$, repulsive

48.

Two charges +2C and +3C are placed at the end points of a straight line AB. The point P at which the electric field is zero, when P lies in between A and B is:

(Given AB = 4m)

       (a) at a distance 1.8 m from point B

       (b) at a distance 1.8 m from point A

       (c) at a distance 2.5 m from point B

       (d) at a distance 2.5 m from point A

49.

A thin disc of radius 'R' carrying a uniform surface charge density 'σ' rotates with a constant angular velocity 'ω' about its axis (z-axis). The torque on the disc if placed in a uniform magnetic field $\vec{B}$ acting along x-direction would be:

       (a) $\frac{\pi}{4}\omega\sigma BR^4$ along + y direction

       (b) $\frac{\pi}{4}\omega\sigma BR^4$ along − y direction

       (c) $\frac{\pi}{4}\omega\sigma BR^3$ along + y direction

       (d) $\frac{\pi}{4}\omega\sigma BR^3$ along − y direction

50.

The electrostatic force between two charged particles separated by a distance 'd' and placed in a medium having dielectric constant 'K' is 8 Newton. If the medium is replaced by another medium having dielectric constant '2K' and in the new medium, if the distance between two charged particles is increased to '2d', then the electrostatic force becomes:

       (a) 1 Newton

       (b) 2 Newton

       (c) 4 Newton

       (d) 8 Newton

51.

If in a cyclotron, a particle of charge 'q' and mass 'm' with a speed 'v' follows a circular path of radius 'R', because of a centripetal force 'F' exerted upon it by a magnetic field 'B', the radius of the path may be determined by using the equation:

       (a) $R = \frac{qvB}{m}$

       (b) $R = \frac{mv}{qB}$

       (c) $R = \frac{m}{qvB}$

       (d) $R = \frac{Bv}{qm}$

52.

If the potential in a certain medium is given by $\emptyset(r) = \frac{q}{4\pi\epsilon_0} \frac{e^{-r/\lambda}}{r}$ where 'λ' is a constant, the total charge associated with the medium is:

      (a) q
      (b) 2q
      (c) 0 (zero)
      (d) q/ λ

53.

Consider the following equations:

      1. $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$
      2. $\vec{\nabla}.\vec{D} = 0$

Gauss law for free ions embedded in dielectric material follows which of the above equations?

      (a) 1 only
      (b) 2 only
      (c) Both 1 and 2
      (d) Neither 1 nor 2

54.

The solution of the differential equation $\frac{d^2 V}{dx^2} = 0$ with the boundary conditions V(2) = 3 and V(5) = 0 is:

      (a) -x+5
      (b) -x-5
      (c) x+5
      (d) x-5

55.

A circular loop of wire of radius 'a' and resistance 'R' is oriented in the xy-plane. A uniform magnetic field of magnitude 'B' points in the $+ \hat{Z}$-direction. If the loop of wire is rotated about the x-axis with an angular frequency 'ω', what is the average power dissipated by the joule heating in the loop?

      (a) $\frac{\pi^2 a^4 B^2 \omega^2}{2R}$
      (b) $\frac{\pi^2 a^4 B^2 \omega^2}{R}$
      (c) $\frac{\pi^2 a^4 B^2 \omega^2}{3R}$
      (d) 0 (zero)

56.

Consider the following statements regarding displacement current:

1. It is not linked with the motion of charges
2. It has finite value even in a perfect vacuum

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

57.

Which one of the following statements is correct with reference to Faraday's law of electromagnetic induction?

(a) Magnetic field produces electric field
(b) Time varying electric field produces magnetic field
(c) Time varying magnetic field produces conservative electric field
(d) Time varying magnetic field produces non-conservative time varying electric field

58.

If a magnetic monopole existed, which one of the following expressions would be proportional to the "magnetic charge" of the monopole? (Assuming that there are no other sources of electric or magnetic fields present)

(a) $\int (\vec{\nabla} . \vec{E}) \, dV$
(b) $\int (\vec{\nabla} . \vec{B}) \, dV$
(c) $\int (\vec{E} . \vec{B}) \, dV$
(d) $\int |E|^2 \, dV$

59.

The magnetic field corresponding to the vector potential $\vec{A}(\vec{r}) = 0.25 \, (\vec{C} \times \vec{r}) + 0.7 \, r^{-2} \hat{r}$ (where $\vec{C}$ is a constant vector) is:

(a) $0.175 \, \vec{r}$
(b) $0.175 \, \vec{C}$
(c) $2 \, \vec{C}$
(d) $0.5 \, \vec{C}$

60.

Which one of the following equations will remain the same while changing the medium?

(a) $\vec{\nabla} . \vec{E} = \frac{\rho}{\epsilon_0}$
(b) $\vec{\nabla} . \vec{B} = 0$
(c) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}$
(d) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$

61.

An electromagnetic wave crossing from one medium to other (if there is no free charge or free current at interface), then:

       (a) Parallel component of $\vec{E}$ and $\vec{B}$ are continuous

       (b) Perpendicular component of $\vec{E}$ and $\vec{B}$ are continuous

       (c) Perpendicular component of $\vec{E}$ and parallel component of $\vec{B}$ are continuous

       (d) Parallel component of $\vec{E}$ and perpendicular component of $\vec{B}$ are continuous

62.

Consider the following statements with regard to boundary condition:

       1. The tangential component of electric field is zero along the perfectly conducting surface

       2. The boundary condition for electric field vector is found from the fact that no work is done in taking a unit test charge around a closed path

Which of the above statements is/are correct?

       (a) 1 only

       (b) 2 only

       (c) Both 1 and 2

       (d) Neither 1 nor 2

63.

Electromagnetic induction method of geophysics obeys:

       (a) Wave equation

       (b) Diffusion equation

       (c) Laplace equation

       (d) Poisson equation

64.

Consider the following statements with regard to propagation of electromagnetic wave in a conducting medium:

       1. The field vectors $\vec{E}$ and $\vec{H}$ are not in phase; but $\vec{H}$ lags behind $\vec{E}$

       2. The field vectors $\vec{E}$ and $\vec{H}$ are not in phase; but $\vec{E}$ lags behind $\vec{H}$

Which of the above statement is/are correct?

       (a) 1 only

       (b) 2 only

       (c) Both 1 and 2

       (d) Neither 1 nor 2

65.

If the electrical permittivity of certain non-magnetic medium is 140 times higher than the electrical permittivity of space, the speed of electromagnetic wave in this medium would be approximately:

       (a) 2142.9 km/s

       (b) 25354.6 km/s

       (c) 3×10^5 km/s

       (d) 3.6×10^5 km/s

66.

Electromagnetic survey gives better results if the top surface layer is:

    (a) More conductive

    (b) Less conductive

    (c) Highly magnetic

    (d) Having same conductivity as sub-surface layers

67.

In TURAM method an anomaly is indicated by:

    (a) Amplitude ratio of less than 1 and negative phase anomaly

    (b) Amplitude ratio of more than 1 and negative phase anomaly

    (c) Amplitude ratio of less than 1 and positive phase anomaly

    (d) Amplitude ratio of more than 1 and positive phase anomaly

68.

In electrical resistivity methods, the coefficient of anisotropy (λ) is generally:

    (a) Between 0 to 0.5

    (b) Between 1 to 2

    (c) More than 2

    (d) Between 0.5 and 1

69.

The law of refraction for plane seismic waves can be written as:

    (a) $\dfrac{\tan i}{\tan r} = \dfrac{\alpha_1}{\alpha_2}$

    (b) $\dfrac{\sin i}{\sin r} = \dfrac{\alpha_2}{\alpha_1}$

    (c) $\dfrac{\sin i}{\sin r} = \dfrac{\alpha_1}{\alpha_2}$

    (d) $\dfrac{\tan i}{\tan r} = \dfrac{\alpha_2}{\alpha_1}$

70.

The presence of gas in sedimentary rocks reduces:

1. Elastic moduli
2. Poisson's ratio
3. Ratio of P and S wave velocities
4. Porosity

Select the correct answer using the code given below:

   (a) 1, 2, 3 and 4
   (b) 1 and 4 only
   (c) 3 and 4 only
   (d) 1, 2 and 3 only

71.

If the acoustic impedances offered by two successive layers are same, then all the incident energy will be:

   (a) Reflected
   (b) Transmitted
   (c) Critically refracted
   (d) Partly reflected and partly transmitted

72.

A signal has a frequency spectrum of 0–5 kHz. If f_s is the sampling frequency of a data processing system then aliasing will arise when:

   (a) $f_s > 10$ kHz
   (b) $f_s = 10$ kHz
   (c) $f_s < 10$ kHz
   (d) $f_s = 20$ kHz

73.

The spectrum of a signal contains minimum and maximum frequency of 1kHz and 100 kHz respectively. To avoid aliasing effect, the signal must be sampled at:

   (a) more than 2 kHz
   (b) more than 200 kHz
   (c) more than 100 kHz
   (d) more than 1000 kHz

74.

In a seismic refraction survey, if V_u and V_d are updip and downdip velocity, T_u and T_d are the intercept times, then which one of the following relationships between velocities and intercept times is true?

   (a) $V_u > V_d, T_u < T_d$
   (b) $V_u > V_d, T_u > T_d$
   (c) $V_u < V_d, T_u < T_d$
   (d) $V_u < V_d, T_u > T_d$

75.

The input signal I(t) and Output signal g(t) are said to be linear, only if:

(a) g(t) $\propto$ I(t)

(b) g(t) $\propto \frac{1}{I(t)}$

(c) g(t) = I(t).g(t)

(d) I(t) = g(t).I(t)

76.

The Fourier transform of the function f(t) = $\begin{cases} 2 & -3 \leq t \leq 3 \\ 0, & \text{otherwise} \end{cases}$ is:

(a) $\frac{4}{\omega} \sin 3\omega$

(b) $\frac{4}{\omega} \cos 3\omega$

(c) $\frac{2 \sin 2\omega}{\omega}$

(d) $\frac{e^{i\omega t}}{\omega}$

77.

Transformation of a time domain signal to frequency domain is accomplished by:

(a) Fourier transform

(b) Laplace transform

(c) Fourier series

(d) Hilbert transform

78.

The two dimensional Fourier transform of a gravity data makes it possible to digitally filter the gravity anomalies. When the function representing gravity data is multiplied by the Fourier filter function, a new function is produced. This process is called:

(a) De-convolution

(b) Convolution

(c) Digitization

(d) Transformation

79.

If the Laplace transform of $2\sqrt{\frac{t}{\pi}}$ is $\frac{1}{s^{\frac{3}{2}}}$, then the Laplace transform of $\frac{1}{\sqrt{\pi t}}$ would be:

(a) $s^{-\frac{3}{2}}$

(b) $\sqrt{s}$

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

(d) $s^{\frac{3}{2}}$

80.

Relationship between Power Spectral Density (PSD) and autocorrelation of a real, stationary signal is:

    (a) PSD is the Fourier transform of autocorrelation

    (b) PSD is the Z transform of autocorrelation

    (c) PSD is the Laplace transform of autocorrelation

    (d) PSD is the Hilbert transform of autocorrelation

81.

The Laplace transform of a function f(t) is L{f(t)} = F(s). Let f(t) = e^{at}, when t$\geq$ 0 and 'a' is a constant and 'a' < s then the value of L{f(t)} is:

    (a) $\dfrac{1}{s-a}$

    (b) $\dfrac{1}{s+a}$

    (c) $\dfrac{1}{s^2+a^2}$

    (d) $\dfrac{1}{s^2-a^2}$

82.

If two functions have lengths of 4 and 3 respectively then their convolved output has a length of:

    (a) 7

    (b) 6

    (c) 1

    (d) −1

83.

Autocorrelation function of a wave form contains information on:

    (a) Phase only

    (b) Phase and amplitude

    (c) Amplitude only

    (d) Noise

84.

Cross correlation function measures the:

    (a) Degree of dissimilarity in wave forms

    (b) Degree of similarity in wave forms

    (c) Impulse response

    (d) De-convolution response

85.

The value of integral $\int_{-\infty}^{\infty} \delta\,(x^2-4\pi^2)\cos x\ dx$ is:

    (a) π

    (b) $-\pi$

    (c) $\dfrac{1}{2\pi}$

    (d) 0 (zero)

86.

Consider the unit-step function u(t–a) = $\begin{cases} 0 \text{ if } t < a \\ 1 \text{ if } t > a \end{cases}$

If f(t) be a function then the product function f(t)u(t–a) will produce:

(a) Rotation effect

(b) Damping effect

(c) No change

(d) Switching off and on effect

87.

The Laplace transform of a delta function at time t = 1 is:

(a) 1

(b) e^{-s}

(c) e^{-t}

(d) 1/t

88.

The value of $\int_{-\infty}^{+\infty} t^3 \delta(1-2t)dt$ will be:

(a) 1

(b) 8

(c) $\frac{1}{8}$

(d) $\frac{1}{16}$

89.

The ratio of total solar radiant energy returned by a body to the total radiant energy incident on the body is called:

(a) Reflectance

(b) Transmittance

(c) Albedo

(d) Reflection Coefficient

90.

Which of the following is NOT used as principle of remote sensing?

(a) Interaction of electromagnetic radiation with atmosphere

(b) Interaction of electromagnetic radiation with earth surface

(c) Interaction of electromagnetic radiation with satellites

(d) Interaction of electromagnetic radiation with clouds and aerosols

91.

Which one of the following statement is correct for remote sensing techniques?

    (a) They use both sonic and electromagnetic waves for investigation

    (b) They use entire range (radio waves to gamma-rays) of the electromagnetic spectrum for investigation

    (c) They use microwave, infrared and visual portions of the electromagnetic spectrum for investigation

    (d) They gather the information with or without actual contact with the object or area under investigation

92.

What is the refractive index of air at Standard Temperature Pressure (STP) for sodium yellow light?

    (a) Exactly 1.0

    (b) About 0.03% higher than that of vacuum

    (c) About 0.03% lower than that of vacuum

    (d) It depends on the location

93.

Which one of the following colours of light travel fastest through a transparent glass sheet?

    (a) Red

    (b) Yellow

    (c) Green

    (d) Violet

94.

A photon and an electron have same De Broglie wavelength. Which one of the following is correct?

    (a) Electron moves faster than photon

    (b) Photon moves faster than electron

    (c) Both move with same speed

    (d) Cannot be predicted

95.

The planet Saturn has a surface temperature 80K. The wavelength corresponding to maximum radiation that can be detected from it is:

    (a) 330 nm

    (b) 330 Å

    (c) 33μm

    (d) 33mm

96.

The total radiant emittance is given by $u = \sigma AT^4$. This equation represents:

      (a) Planck's radiation law

      (b) Wein's Law

      (c) Stefan-Boltzmann law

      (d) Kirchhoff's law

97.

The surface temperature of the sun is 6000 K and it emits maximum energy at a wavelength of 4753 Å. If the moon emits maximum energy at a wavelength 15×10^{-6} m, then what would be the surface temperature of the moon?

      (a) 180 K

      (b) 190 K

      (c) 200 K

      (d) 210 K

98.

What is the most probable energy 'E' for photons emitted by a black body of temperature T, assuming that the intensity $I(E) \sim E^5 e^{-E/kT}$?

(where k is Boltzmann constant)

      (a) kT

      (b) 2 kT

      (c) ½ kT

      (d) 4 kT

99.

The ratio of photons presents in 1cm^3 of radiation in thermal equilibrium at 1000 K to the photons present in the same volume of radiation in thermal equilibrium at 8000 K is:

      (a) 1:2

      (b) 2:1

      (c) 1:64

      (d) 1:512

100.

Planck's formula for black body radiation reduces to Rayleigh and Wien's formulae respectively for:

      (a) Small and large wavelength

      (b) Large and small wavelength

      (c) Large and complex wavelength

      (d) Complex and large wavelength

101.
There are four dishes (i) a ladoo (spherical) with a radius of 4 cm; (ii) another ladoo with a radius of 8 cm; (iii) a pizza (disc) with a radius of 10 cm; and a pizza of same thickness with a radius of 20 cm. All the four dishes are simultaneously heated in an oven. Which one of them will be heated first?

       (a) Smaller ladoo will be heated first
       (b) Both the ladoos will be heated in the same time and prior to pizzas
       (c) Both the pizzas will be heated in the same time and prior to ladoos
       (d) All the four dishes will be heated in the same time

102.
For a reversible isothermal process, the work done by the system is equal to:

       (a) Decrease in Helmholtz function
       (b) Increase in Helmholtz function
       (c) Decrease in Gibb's free energy
       (d) Increase in Gibb's free energy

103.
A resistor immersed in running water carries an electric current. Considering the resistor as the system, which of the following holds true?

       (a) $Q = 0$, $W = -ve$, $\Delta U = -ve$
       (b) $Q = 0$, $W = -ve$, $\Delta U = +ve$
       (c) $Q = 0$, $W = +ve$, $\Delta U = -ve$
       (d) $Q = 0$, $W = +ve$, $\Delta U = +ve$

104.
The difference of Helmholtz free energy F and Gibbs free energy G, (that is F–G) for an ideal gas sample of one mole is:

       (a) RT
       (b) –RT
       (c) T
       (d) –T

105.
What will be the radius of the nucleus with atomic mass 216, if nuclear radius parameter is $r_o = 1.5$ fm?

     (a) 9.0 fm
     (b) 54.0 fm
     (c) 6.0 fm
     (d) 324 fm

106.

Two spherical nuclei have mass numbers 216 and 64 with their radii a_1 and a_2 respectively. The ratio a_1/a_2 is:

(a) 1.5

(b) 3

(c) 2.5

(d) 6

107.

Mass of a helium nucleus is 4.0028 amu, where as the mass of a proton is 1.00758 amu and that of neutron is 1.00897 amu. The biding energy of alpha particle in MeV unit will be:

(1 amu $\equiv$ 931 Mev)

(a) 21.5 MeV

(b) 0.0303 MeV

(c) 28.21 MeV

(d) 28.21×10^{-6} MeV

108.

Which one of the following properties of the nuclear force is correct?

(a) It depends on the charge of the nucleons

(b) It depends on the directions of the spins of the nucleons

(c) It does not depend on the directions of the spins of the nucleons

(d) It depends on the mass of the nucleons

109.

Which one of the following statements regarding β-decay is correct?

(a) α-particles have a greater range than β- particles

(b) Parity is not conserved in β-decay

(c) The longest lived nuclei emit the most energetic particles

(d) β-particles emitted by a radioactive element have same energy and range

110.

Which one of the following statements is NOT correct?

(a) A bright light yields more photoelectrons than a dim one of the same frequency

(b) Red light produces faster photoelectrons than blue light

(c) Pair production cannot occur in empty space

(d) Compton shift is maximum for scattering angle of 180^0

111.

For pair production to take place γ-ray energy should be greater than:

(a) 1.02 MeV

(b) 2.56 MeV

(c) 2.05 MeV

(d) 0.78 MeV

112.

A certain radioactive material has a life time of 30 days in which it reduces half to its amount that is $t_{1/2} = 30$ days. What will be its mean life?

      (a) 20.79 days

      (b) 15 days

      (c) 43.29 days

      (d) 231 days

113.

Radon environmental hazard is associated with the radioactive decay of:

      (a) Rubidium (Rb-87)

      (b) Potassium (K-40)

      (c) Carbon (C-14)

      (d) Uranium (U-238)

114.

Which one of the following statements regarding scintillation counter is correct?

      (a) It makes use of very fine drops of oil

      (b) It is not used for counting alpha particles

      (c) It uses a material which emits light when a charged particle strikes it

      (d) It cannot be used for detection of radiations but for scintillating the screen of a detector

115.

Which one of the following instruments separates the characteristic γ-rays of ^{40}K, ^{238}U and ^{232}Th?

      (a) Geiger Muller Counter

      (b) Scintillation Detector

      (c) Pulse-height analyzer

      (d) Radiation Counter

116.

Which one of the following statement regarding Geiger-Muller Tube is correct?

      (a) It has a metallic casing filled with a high pressure gas

      (b) Both the ends of its tube are fixed with thin mica sheets

      (c) It has a metallic casing filled with low pressure gas

      (d) It can detect all radiations emerging out from a radioactive source

117.

A particle of mass 10 gram is moving with velocity 10m/sec. What will be the De Broglie wavelength associated with the particle?

(Plank's constant = 6.62×10^{-34} Js)

      (a) 6.62×10^{-32} m

      (b) 6.62×10^{-33} m

      (c) Zero

      (d) Infinity

118.

Which of the following particle always obey Pauli exclusion principle?

      (a) All charged particles

      (b) All particles

      (c) All particles that have spin quantum numbers as multiples of ½

      (d) All particles that have spin quantum numbers as multiples of 1

119.

The Balmer lines of hydrogen (transition to n = 2) span the visible frequency range. What is the maximum energy of the balmer line photons?

      (a) 3.4 eV

      (b) 1.9 eV

      (c) 13.6 eV

      (d) 7.5 eV

120.

Which one of the following statement is NOT correct?

      (a) The longest wavelength line of Lyman series is the resonance line of hydrogen spectrum

      (b) Balmer series contains only those spectral lines of hydrogen atom, which occur in the visible part of the spectrum

      (c) In spectrum of helium, for each singlet energy state there is a corresponding triplet energy state

      (d) The sharp and diffuse series of spectra of alkali atoms have a common convergence limit