1. In the following question, out of the given alternatives, choose the one which best expresses the meaning of the given word.

ENCUMBRANCE

A. Incentive   B. Stimulant   C. Impediment   D. Inducement

2. In the following question, out of the four alternatives, choose the one which can be substituted for the given words.

Wildly unreasonable, illogical or ridiculous.

A. Adject   B. Adept   C. Arid   D. Absurd

3. Pick out the most effective word from the given words to fill in the blanks to make the sentence meaningfully complete.

These essays are intellectually _____ and represent various levels of complexity.

A. revealing   B. modern   C. superior   D. demanding

4. In the following question, incomplete statements followed by some fillers are given. Pick out the best one which can complete the statement correctly and meaningfully.

Whichever way you approach the problem, ………………………………

     A. no one will not be solve
     B. it will not be solve
     C. it will not solve
     D. it will not be solved

5. In the following question four words are given, out of which either only one word is correctly spelt or only one word is incorrectly spelt. Find the correctly/incorrectly spelt word.

A. Enterprenure   B. Entreprenure   C. Entrepreneur   D. Enterpreneur

6. In the following question one of the term in the number series is wrong, Find out the wrong term?

10, 26, 74, 218, 654, 1946, 5834

A. 26   B. 74   C. 218   D. 654

7. Which of the following elements should come in place of '?'

AB3 CE6 FI10 JN15 ?

A. OT20   B. TO21   C. OT21   D. TS21

8. In the following question, there is certain relationship between two given words on one side of : : and one word is given on another side of : : while another word is to be found from the given alternatives, having the same relation with this word as the words of the given pair bear. Choose the best alternative.

Novelty : Oldness : : Newness : ?

A. Culture   B. Discovery   C. Model   D. Antiquity

9. Choose the odd pair of words.

A. White : Dirty   B. Easy : Difficult   C. Brave : Coward   D. End : Beginning

10. In the following question, find out which of the letter-series follows the given rule.

Number of letters skipped in between the adjacent letters in the series are multiple of 3.

A. AELPZ   B. DHLPU   C. GKOTZ   D. LORUX

11. How many zeros will be required to number the pages of a book containing 1000 pages?

A. 168   B. 184   C. 192   D. 216

12. A tailor has 37.5 meters of cloth and he has to make 8 pieces out of a meter of cloth. How many pieces can be make out of this cloth.

A. 320   B. 360   C. 400   D. None of these

13. A man takes 8 minutes to type a page. If 1710 pages are to be typed in the afternoon between 1 o'clock to 2 o'clock, how many men are required?

A. 221   B. 249   C. 256   D. None of these

14. The average weight of boys in a class is 30 kg and the average weight of girls in the same class is 20 kg. If the average weight of the whole class is 23.25, what could be the possible strength of boys and girls respectively in the same class?

A. 14 and 26   B. 13 and 27   C. 17 and 27   D. None of these

15. The ages of Sulekha and Arunima are in the ratio 9 : 8 respectively. After 5 years, the ratio of their ages will be 10 : 9. What is the difference in their ages.

D. 7 years

A. 4 years

B. 5 years

C. 6 years

16. Who came to India during the time of Chandragupta Maurya?

D. Strabo

A. Faxian (Fa-Hien) B. Xuanzang (Hiuen Tsang) C. Megasthenes

17. The Madagascar island is found in?

D. Mediterranean Sea

A. Pacific Ocean   B. Atlantic Ocean   C. Indian Ocean

18. Chairperson and Members of the State Human Rights Commission are appointed by?

B. President

A. Governor

D. Chief Justice of India

C. Chief Justice of the High Court of the Concerned State

19. PM JANMAN scheme, which was launched recently, is associated with which category of people?

A. MSME Owners   B. PVTGs   C. Farmers   D. NRIs

20. Which country announced the Indo-Pacific tech envoy?

A. UK   B. USA   C. Australia   D. Germany

21) Superconducting magnets have a persistent switch. This allows one to retain the field without a powersupply. Essentially the persisitent switch is a small superconducting wire that short circuits the magnet. A small heater locally near the wire can turn only this portion normal i.e resistive. Which of the following are true for operation of the switch

a) The switch needs to be heated to normal state to pass current through the magnet.
b) The switch needs to be cooled to superconducting state to pass current through the magnet.
c) Once the desired current is reached in the magnet the switch may be cooled to superconducting state to remove the current source
d) The state of the switch can be normal or superconducting to energize current through the magnet.

A) b and d   B) b and c   c) a and c   D) a and d

22) NMR uses RF signals. What is the characteristic impedance of Laboratory equipment like NMR working at Radio frequencies ?

a) 75 ohms
b) 50 ohms
c) 25 ohms
d) 25.24 Kohm or 1 Klitzing

23) The standard of resistance of 1 Klitzing is ~ 25.812 K ohms. Which combination of fundamental constants give this value

a) h/e^2
b) $2e^2/h$
c) $sqrt(\mu\_o /\varepsilon\_0)$
d) eh

24) What is the impedance of free space

   a) 10 ohms
   b) 100 ohms
   c) 50 ohms
   d) 376.73 ohms

25) Which of the following has high chance of producing asphyxiation by thinning oxygen

a) Chilled water in copper pipes for cooling equipment
b) Exhaust fans
c) Transfer process of Liquid Nitrogen to some equipment
d) All of the above

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26) A laboratory uses liquid nitrogen regularly. Which of the following protocols must be followed

a) The users must remove shoes and wear clean slippers provided in front of the laboratory in place of their footwear
b) The users must wear closed shoes or boots.
c) The windows and doors must be shut while transferring liquid N2
d) Cryogenic gloves must be used.

A) a and c   B) b and d   c) b and c   D) a and b

27) Which of the following acids requires maximum precaution

a) Hydrochloric Acid 50%
b) Hydrofluoric acid or any mixtures of it
c) Acetic Acid
d) Sulphuric acid

28) A high Vacuum leak detector works on what technique

a) A mass spectrometer connected to a vacuum system and it senses Helium sprayed via leaky joints.
b) A mass spectrometer connected to a vacuum system and it senses Argon via leaky joints.
c) soap bubbles
d) All the above

29) Which of the following pumping sequence is correct to start vacuum from a vented system.

a) Turbo pump followed by roughing pump
b) Both Turbo and Roughing pump together
c) Roughing pump followed by Turbo pump after pressure is $\sim 10^{-1}$ torr or lower
d) All options are fine

30) A vacuum chamber has been pumped down to 2×10^{-6} torr pressure with a Turbo pump directly connected to it and a roughing pump backing it. How should the chamber be vented ?

a) By opening any vent valve or door in the chamber when pumps are off.
b) By venting from backing side of Turbo pump
c) By venting from the screw type seal on side of turbo
d) All of the above.

A) a and b   B) b and c   C) a only   D) d only

31) What is the Nyquist criterion of sampling rate to observe a fast signal in a digital oscilloscope that directly records the signal

a) Sampling rate can be lower than the measured frequency
b) Sampling rate can be same or slightly above the frequency of the signal (say 10% higher)
c) Sampling rate is at least twice the frequency of the signal
d) Sampling frequency is an irrelevant parameter.

32) A Samples NMR data is in time domain format. How is it converted to frequency domain

a) By taking a Laplace transform
b) Dividing the time domain data by the NMR frequency
c) Multiplying the time domain data by twice the NMR frequency
d) Taking a Fast Fourier Transform of the time domain Data .

33) What is a choke to cut high frequencies made of

a) A high value resistor
b) A high value inductor
c) A low value resistor
d) none of the above

34) Which of the following has higher impedance at lower frequencies

a) A Capacitor
b) Resistor
c) Inductor
d) All have same impedance at all frequencies.

35) Which one of the following equations states there is no magnetic monopoles?

a) Div E= ρ/ε_0
b) Div B= 0
c) $H = B/\mu_0 - M$
d) None of the above

36) Which of the following equations also implies Electric fields generated both from static sources and Faraday's law   (Hint; Try operations like Divergence and curl)

a) $E = -\nabla\phi - \frac{\partial A}{\partial t}$
b) $E = -\nabla\phi$
c) $\nabla.E = \frac{\rho}{\varepsilon_0}$

d) $\nabla^2\phi = \frac{\rho}{\varepsilon_0}$

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37) Consider a LR circuit that is fed with a sinusoidal voltage $V = V_0 \sin(\omega t)$
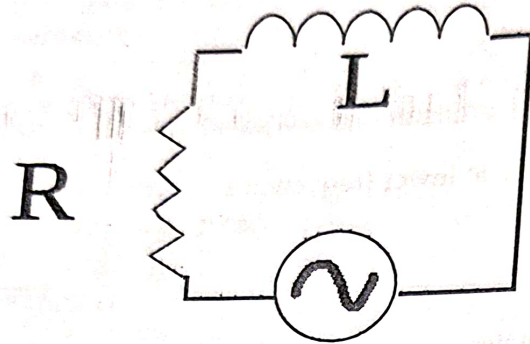
Let R = 8 ohms L = 2 mH and V = 60 Sin (3000 t) . What is the maximum magnitude of the current and the phase lag of the current

a) Current magnitude is 6 amps and phase lag is ~ 37 degrees
b) Current magnitude is 6 amps and phase lag is ~ 0 degrees
c) Current magnitude is 6 amps and phase lag is ~ 90 degrees
d) Current magnitude is 9 amps and phase lag is ~ 37 degrees

38) Which of the following is a low pass filter

a) A resistor in Series with signal and a second resistor going to ground.
b) Resistor in Series with signal and a Capacitor going to ground.
c) Capacitor in series with signal and inductor going to ground.
d) None of the above

39) A laser light with λ= 630 nm wavelength produces an interference pattern from double slits. The bright patterns are separated by Δx = 8.3 mm. A second light source produces $\Delta x'$ = 7.6 mm on the same interference setup. What is the wavelength of the second light source ? Where d the slit width and D the distance to screen are same in both cases.

a) 577 nm
b) 1044 nm
c) 630nm
d) 1260 nm

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40) A convex lens is placed on a glass surface . It is illuminated with a 6700 Angstrom light source from above. Newton's rings are formed. The radius of the 20th dark ring is 11mm. What is the approximate radius of curvature of the lens.

$2t = (m+1)\lambda/2$ is condition for constructive interference (m order of fringe t is gap)
$2t = m \lambda$ is condition for destructive interference . you can take $t^2 < r^2$ for an estimate

R
R-t
r = 11mm
t
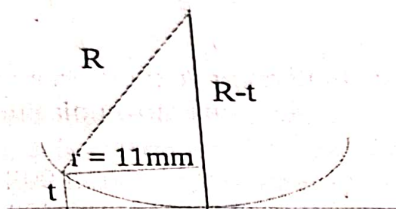
a) 11 mm
b) 22 m
c) 5.5 m
d) 9.03 m

41) The work function of sodium is 2.3 eV . What is the longest wavelength that can cause photoemission from sodium.

a) 100 nm
b) 800 mn
c) 1500 nm
d) 540 nm

42) The work function of sodium is 2.3 eV . Which of the following wavelengths of light can cause photo emission from sodium

a) 200 nm
b) 800 mn
c) 540 nm
d) None

A) a and b   B) a and c   C) b and c   D) d only

43) Nickel has a work function of 5.00 eV. Photons of 2000 Angstroms eject electrons from it. What minimum potential must be applied to stop these photoelectrons.

a) 0 eV
b) 10 eV
c) 1.2 eV
d) 2.4 eV

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44) Which of the following is bright as well as the most stable and also high current source for Scanning electron microscopes

a) Tugnsten filament
b) LaB6
c) Thermal Field emission Schottky emitters
d) Cold cathode single crystal tungsten source

45) Which of the following wave forms have the least number of harmonics

a) Square wave
b) Sawtooth
c) Sine wave
d) Triangular wave

46) The grating spacing or lattice spacing of rock salt is d = 2.8 Angstroms. Suppose a second order Bragg reflection occurs at 30 degree what is the wavelength of the x-ray

a) 1.4 Angstroms
b) 2.8 Angstroms
c) 5.6 Angstroms
d) 7.2 Angstroms

47) Energy dispersive scattering(EDS) is used to identify elements in a scanning electron microscope (SEM) and Transmission electron microscope (TEM) works by

a) Studying energy of scattered electrons
b) By studying X-rays emitted by samples after subject to electron irradiation
c) Electrons produced by X-rays from a Cu Ka line source.
d) none   C

48) Energy dispersive scattering(EDS) is used to identify elements in a scanning electron microscope (SEM) and Transmission electron microscope (TEM) Which of the elements in the list is easiest to identify.

a) Uranium as high Z
b) Hydrogen as Z is low
c) Copper
d) All are same

49) Plutonium has a Half life of 24000 years. If a sample is kept for 72000

a) $1/8^{th}$
b) ½
c) 1
d) $1/100^{th}$

50) A lab has two identical white plastic coated cylindrical tubes. One tube is filled with solid copper, Another with Teflon and another with copper that has many holes. A student is given a magnet to be dropped through the tube. Which of the following is true

a) Solid copper will make the magnet fall with the least time .
b) Solid copper will make the magnet fall with the maximum time
c) Copper with holes will make the magnet fall with the maximum time
d) The rate depends only on **g** so all tubes will give the same time

51) A lock-in amplifier minimizes noise by sending and measuring signals one specific frequency. The RMS voltage or current is treated as average response similar to DC voltage. By choosing a frequency where there is no external noise source parameters like resistance can be precisely measured. Can you state which frequency must definitely be avoided for a research lab in Ropar

A) 17.3 Hz
B) 24.6 Hz
C) 50 Hz
D) All are fine

52) A lock-in amplifier minimizes noise by sending and measuring signals one specific frequency. The RMS voltage or current is treated as average response similar to DC voltage. Suppose the lock-in is enable to detect harmonics i.e ω , 2 ω , 3 ω etc. Which of the following are useful to check thermal power dissipated in a conductor

a) 1 ω
b) 2 ω
c) 4 ω
d) 100 ω

53) A Transformer has N1 primary turns and N2 secondary turns. The ratio of voltages is same as ratio of turns. If secondary is completed with a resistor so $I_2 = V_2/R$ what is I_1 interms of V_1 and the turns

a) $I_1 = V_1/ (N1/N2)^2 R$
b) $I_1 = I_2$
c) $I_1 = (N1/N2) V_1/ R$
d) $I_1 = 2I_2 V_1/R$

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54) What is the most plausible mechanism for an electric vehicle to convert breaking energy to useful battery charge.

a) Collect the heat in breaking and convert it to electricity via steam
b) Store the energy in flywheel like automatic watch converting motion of pendulum to spring and transfer it to battery.
c) simple stopping of motor by removing power
d) clutch disabling the gear

55) In Vacuum Roughing pump vacuum level is at what ranges of pressure . This is only a range and not an exact value

a) ~ few mBar to 10^{-2-} mBar
b) 1000 mbar to 2000 mBar
c) 1 kilo bar to 5 kilo bar
d) 1 x 10^{-9} mBar to 1x 10^{-10} mBar

56) In Ultra high vacuum where pressure is of the order of 10^{-9-} to 10^{-10} torr or lower which vacuum gaskets are used

a) Copper Gaskets
b) Viton Rubber gaskets
c) Teflon
d) None of the above

57) Diffusion pumps have a liquid nitrogen cold trap . When this needs to be filled

a) After the system gets to fore-pump level vacuum or slightly lower pressure
b) When the system is at atmosphere
c) When the system is in high vacuum 10^{-6} mBar
d) It does not matter

58) Which of the following can improve the base vacuum of any vacuum chamber

a) Heating the chamber walls for a few hours with an external heater
b) Poring Liquid nitrogen in a cold trap
c) Heating Titanium inside the chamber
d) All of the above

59) Which Pressure Gauges are not sensitive to the type of gas

a) Capacitance diaphragm Gauge
b) Pirani or Thernocouple gauge
c) Ion gauge
d) All are insensitive to gas type

60) What is the minimum number of discrete energy levels needed for a laser

a) 3 levels
b) 2 levels
c) Anything more than 1 level will work
d) None of the above

61) Where should the chassis of an instrument be connected to

a) Live wire from supply
b) Neutral from supply
c) Any grounding or earthing point.
d) Can be floating

62) Which of the following technique is sensitive to magnetic structure of a material .

a) Electron diffraction
b) Simple X-ray Diffraction
c) Neutron diffraction with polarized Neutrons
d) All

63) Among The following materials all of them have a diamond like lattice. Which of them can show piezo-electric behaviour

a) Silicon
b) Gallium Arsenide GaAs
c) Diamond
d) Quartz in Crystalline form

A) a and c   B) a and d   c) b and d   D) a and b

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64) In an SEM when is the damage more to a surface of a polymer specimen like PMMA.

a) When acceleration voltage is high
b) When acceleration voltage is low
c) Does not matter
d) None of the above

65) A semicircular electrode of radius R has a linear charge density λ per unit length.

$dq = \lambda\, dl$
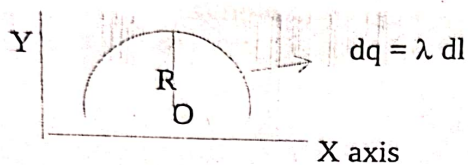
At the origin what can you say about the electric field components in X and Y axis

a) $E_y = 0$
b) $E_x = 0$
c) $E_x = E_y = 0$
d) $E_x = E_y = \lambda/4$

66) A toy can launch a plastic ball at different angles. Assuming it gives the same initial speed find the angle that gives the maximum distance. You can assume 90 degrees is vertical in our notation

a) 75 degrees
b) 60 degrees
c) 45 degrees
d) 30 degrees

67) Mass spectrometers work on what principle

a) Ionized particles are subject to an initial acceleration and they are subject to a magnetic field perpendicular to its velocity . Based on the ratio of mass and charge different particles follow different paths .

b) Ionized particles are subject to an initial acceleration and the time it takes to reach another end used to estimate the mass.

c) Ionized particles are subject to an initial acceleration and they are subject to a magnetic field parallel to its velocity . Based on the ratio of mass and charge different particles follow different paths .

d) None

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68) Secondary Ion Mass spectrometer (SIMS works on)

a) Bombarding specimen or particles coming from the specimen like an alcohol swab specimen with Ar+ ions and feeding the ionized particles to a mass spectrometer
b) Dissolving the specimen in an acid and subjecting the vapours to a mass spectrometer
c) Evaporating the specimen thermally in a chamber and testing it with a mass spectrometer.
d) None

69) Who showed the first NMR in a molecular Beam

a) CV Raman
b) F. Bloch and E.M. Purcell
c) Stern and Gerlach
d) I.I. Rabi

70) Who demonstrated the first NMR in a liquids and Solids

a) I.I. Rabi
b) Stern and Gerlach
c) F. Bloch and E.M. Purcell
d) Albert Einstein

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