Assistant Professor(Physics)

Passage:
Education, particularly higher education is the obvious but crucially important instrument for nation building. As Confucious has said:

"If you are thinking of one year, plant rice. If you are thinking of a decade, plant trees. If you are thinking of a century, educate the people."

When we set about the task of higher education, we should be absolutely clear in our perception of the goals of education in the specific context of our nation's development. No doubt, one of the important aims of education would be to create the required range and nature of trained manpower assessed to be needed by different sectors of national growth. The entire educational apparatus must be geared progressively to fulfill the requirements of the different phases of our growth in every sector- primary, secondary and tertiary. The aim must be to ensure that our country does not experience either paucity, or a surfeit of trained manpower in any specific segment of our economy. The requirements of our country, as a free, democratic, secular, socialist, nation, aspiring for rapid development, entail a specific recipe of our educational institutions. Today's educational institutions must therefore be developed accordingly and must regulate themselves to give the country the precise nature and quantum of trained manpower as projected by the requirements of our planned economy.

Itemcode : **YS1071**
Q1 : The author has quoted thoughts of Confucious to stress

(a) importance of planting trees for human beings
(b) the worthless efforts in planting rice
(c) the benefits of investing in education
(d) the need for assessing manpower requirement
Key: **D**

Itemcode : **YS1072**
Q2 : Which statement cannot be made on the basis of the passage?

(a) Higher Education should keep in view the requirements of national economy
(b) Higher education has not been employed for nation building
(c) All levels of education have a role to play in nation's growth
(d) In our country we need to have a specially planned educational system
Key: **D**

Itemcode : **YS1073**
Q3 : The writer believes that

(a) There are no problems related to higher education
(b) investment in education is of long range
(c) higher education should be used to assess manpower needs
(d) aims of higher education in India are absolutely clear
Key: **C**

Itemcode : **YS1074**
Q4 : The writer indicates that

(a) higher education did not play any role in national growth
(b) primary education did not play any role in national growth
(c) our nation experiences paucity of trained manpower in many sectors
(d) today's higher education has no precise goals to achieve
Key: **D**

Itemcode : **YS1075**
Q5 : Author has used the word 'apparatus'to indicate the

(a) scientific nature of education
(b) complicated organization demanded by education
(c) readily visible benefits of education
(d) entire equipment of education to perform particular function
Key: **D**

Itemcode : **YS1051**
Q6 : Suppose an implication is derived from a hypothesis, and the implication turns out to be true. This fact:

(a) Makes the hypothesis easier to understand.
(b) Tends to confirm the hypothesis.
(c) Proves the hypothesis true.
(d) Sheds light on the hypothesis
Key: **B**

Itemcode : **YS1052**
Q7 : Hypothetical reasoning is used to produce an explanation for the occurrence of a phenomenon when:

(a) The phenomenon is not observable.
(b) The reason for its occurrence is incomprehensible.
(c) The phenomenon is not measurable.
(d) The reason for its occurrence is not immediately observable
Key: **D**

Itemcode : **YS1053**
Q8 : The letters in the first set have a certain relationship. On the basis of this relationship mark the right choice for the second set: BDFH:OMKI::GHIK:?

(a) FHJL
(b) RPNL
(c) LNPR
(d) LJHF
Key: **C**

Itemcode : **YS1054**
Q9 : Find out the wrong number in the sequence, 52,51,48, 43,34, 27,16

(a) 27
(b) 34
(c) 43
(d) 48
Key: **B**

Itemcode : **YS1055**
Q10 : Four sentences or parts of sentences that form a paragraph are given. Identify the sentence(s) or part(s) of sentence(s) that is/are incorrect in terms of grammar

and usage. Then, choose the most appropriate option.

Sentences
P. China is currently affording an opportunity to nations in the region
Q. to become a part of a Beijing-contrived "security alliance", holding forth
R. the promise of a new Asian security paradigm, previously embedded
S. as Chinese President Xi Jinping's "Code of Conduct for Asia".

(a) P only
(b) R only
(c) P and R only
(d) Q and S only
Key: **D**

Itemcode : **YS1056**
Q11 : Here are some words translated from an artificial language.
moolokarn means blue sky
wilkospadi means bicycle race
moolowilko means blue bicycle
Which word could mean "racecar"?

(a) wilkozwet
(b) spadiwilko
(c) moolobreil
(d) spadivolo
Key: **D**

Itemcode : **YS1057**
Q12 : Here are some words translated from an artificial language.
lelibroon means yellow hat
plekafroti means flower garden
frotimix means garden salad
Which word could mean "yellow flower"?

(a) lelifroti
(b) lelipleka
(c) plekabroon
(d) frotibroon
Key: **B**

Itemcode : **YS1058**
Q13 : Each question has an underlined word followed by four answer choices. You will choose the word that is a necessary part of the underlined word.
pain

(a) cut
(b) burn
(c) nuisance
(d) hurt
Key: **D**

Itemcode : **YS1059**
Q14 : Each question has an underlined word followed by four answer choices. You will choose the word that is a necessary part of the underlined word.
gala

(a) celebration
(b) tuxedo
(c) appetizer
(d) orator
Key: **A**

Itemcode : **YS1060**
Q15 : Five books on Mathematics M1, M2, M3,M4 and M5 are arranged in a shelf. Book M5 is arranged next to M1 which is kept on the extreme left and book M2 is not kept next to book M5. Book M4 is kept next to M3 but not M2. Which books are arranged adjacent to M3?

(a) M5 and M2
(b) M1 and M4
(c) M5 and M4
(d) M4 and M2
Key: **C**

Itemcode : **YS1061**
Q16 : Photosynthesis is a process

(a) reductive and exergonic
(b) reductive and catabolic
(c) reductive, endergonic and catabolic
(d) reductive, endergonic and anabolic
Key: **D**

Itemcode : **YS1062**
Q17 : Organic Substances which, in very small amounts, control growth and development called

(a) vitamins
(b) hormones
(c) enzymes
(d) None of the above
Key: **B**

Itemcode : **YS1063**
Q18 : The Netaji Subhas National Institute of Sports is located at

(a) Bangalore
(b) Kolkata
(c) Darjeeling
(d) Patiala
Key: **D**

Itemcode : **YS1064**
Q19 : The largest lake in India is

(a) Luni lake
(b) Sambhar lake
(c) Wular lake
(d) None of the above
Key: **C**

Itemcode : **YS1065**
Q20 : The gas usually filled in the electric bulb is

(a) nitrogen
(b) hydrogen
(c) carbon dioxide
(d) oxygen
Key: **A**

Itemcode : **YS1066**

Q21 : Permanent hardness of water may be removed by the addition of

(a) sodium carbonate
(b) alum
(c) potassium permanganate
(d) lime
Key: **A**

Itemcode : **YS1067**
Q22 : Corey Anderson who has hit the fastest ODI century in 36 balls is from

(a) England
(b) Australia
(c) West Indies
(d) New Zealand
Key: **D**

Itemcode : **YS1068**
Q23 : Ball pen function on which one of the following principal?

(a) Boyle's law
(b) Gravitational force
(c) Surface tension
(d) Viscosity
Key: **C**

Itemcode : **YS1069**
Q24 : Outer covering of virus made up of protein is

(a) capsid
(b) coat
(c) virion
(d) viriod
Key: **A**

Itemcode : **YS1070**
Q25 : Which among the following is known as "Sairandhri Vanam"?

(a) Silent Valley National Park
(b) Mudumalai National Park
(c) Periyar National Park
(d) Guindy National Park
Key: **A**

Itemcode : **YS1001**
Q26 : If a particle is orbiting with constant angular speed ω in a circular orbit of radius ρ in a plane, $\vec{r} \times \frac{d\vec{r}}{dt}$ is

(a) $\rho^2 \omega \hat{k}$
(b) $\rho^2 \cos(2\omega t)\, \hat{k}$
(c) $-\rho^2 \omega \hat{k}$
(d) $-\rho^2 \cos(2\omega t)\, \hat{k}$
Key: **A**

Itemcode : **YS1002**
Q27 : The integral $\int_0^\infty \frac{\sin x}{x} dx$ is

(a) 0
(b) π
(c) 2π
(d) $\frac{\pi}{2}$
Key: **D**

Itemcode : **YS1003**
Q28 : If the differential equation is $(1-x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + n(n+1)y = 0$, then the indicial equation using the power series expansion $y = \sum_{\lambda=0}^{\infty} a^{\lambda+k}$ is

(a) $k(k+1) = 0$
(b) $k(k-1) = 0$
(c) $k(k+1) + n(n+1) = 0$
(d) $k(k-1) - n(n-1) = 0$
Key: **B**

Itemcode : **YS1004**
Q29 :

If $A = \begin{bmatrix} 3 & 2 \\ 4 & -1 \end{bmatrix}$, then $A^2 - 2A - 10$ is

(a) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

(b) $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(d) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

Key: **C**

Itemcode : **YS1005**

Q30 : Suppose that we have 3 cards identical in form except that both sides of the first card are colored red, both sides of the second card are colored black, and one side of the third card is colored red and the other side black. The 3 cards are mixed up in a hat, and 1 card is randomly selected and put down on the ground. If the upper side of the chosen card is colored red, what is the probability that the other side is colored black?

(a) 1/6

(b) 1/2

(c) 1/3

(d) 2/3

Key: **C**

Itemcode : **YS1006**

Q31 : Consider an experiment that consists of counting the number of α-particles given off in a 1-second interval by 1 gram of radioactive material. If we know from past experience that, on the average, 3.2 such α-particles are given off, what is a good approximation to the probability that no more than 2 α-particles will appear?

(a) 0

(b) 0.38

(c) 0.03

(d) 0.13

Key: **B**

Itemcode : **YS1007**

Q32 : The expected value of normally distributed random variable X is, where the distribution is given by

$$f(X = x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2} \quad \text{for} -\infty < x < \infty$$

(a) 1

(b) -1

(c) 0

(d) ∞.

Key: **C**

Itemcode : **YS1008**

Q33 :

An astronomer is interested in measuring, in light years, the distance from his observatory to a distant star. The astronomer plans to make a series of measurements and then use the average value of these measurements as his estimated value of the actual distance. If the astronomer believes that the values of the measurements are independent and identically distributed random variables having common mean μ light years and a common variance 4 light years, how many measurements need he make to be 95% sure that his estimated distance is accurate to within ±0.5 light year ? [$\int_{-\infty}^{1.96} \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx = 0.975$]

(a) 62

(b) ∞

(c) 95

(d) 20

Key: **A**

Itemcode : **YS1009**

Q34 : If $\vec{B} = \vec{\nabla} \times \vec{A}$, then $\oiint_{Surface} \vec{B} \cdot d\vec{S}$ is

(a) 1

(b) 0

(c) -1

(d) 4π

Key: **B**

Itemcode : **YS1010**

Q35 : The eigenvectors of $\begin{bmatrix} 1 & \varepsilon \\ \varepsilon & 1 \end{bmatrix}$ are

(a) $\left\{ \begin{bmatrix} -1 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \end{bmatrix} \right\}$

(b) $\left\{ \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \end{bmatrix} \right\}$

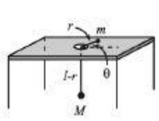
(c) $\left\{ \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix} \right\}$

(d) $\left\{ \begin{bmatrix} -1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix} \right\}$

Key: **C**

Itemcode : **YS1011**

Q36 : A mass m is free to slide on a frictionless table and is connected, via a string that passes through a hole in the table, to a mass M that hangs below. Assume that M moves in a vertical line only, and assume that the string always remain taut. The reference potential on the table is assumed to be zero. The Lagrangian is



(a) $\frac{1}{2}M(\dot{r}^2 + (l-r)^2\dot{\theta}^2) + \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + Mgr$

(b) $\frac{1}{2}M\dot{r}^2 + \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + Mg(l-r)$

(c) $\frac{1}{2}M\dot{r}^2 + \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) - Mgr$

(d) $\frac{1}{2}M(\dot{r}^2 + (l-r)^2\dot{\theta}^2) + \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) - Mgr$

Key: **B**

Itemcode : **YS1012**

Q37 : Consider the Lagrangian is

$L=\frac{1}{2}ma^2\dot{\theta}^2+\frac{1}{2}ma^2\omega^2\sin^2\theta+mga\cos^2\theta$; where m, a, ω and g are constants.

The Euler-Langrage equation of motion is

(a) $a\ddot{\theta}-a\omega^2\sin\theta\cos\theta+g\sin\theta=0$

(b) $a\ddot{\theta}+a\omega^2\sin\theta\cos\theta-g\sin\theta=0$

(c) $a\ddot{\theta}-a\omega^2\sin\theta\cos\theta+2g\sin\theta\cos\theta=0$

(d) $a\ddot{\theta}-a\omega^2\sin\theta\cos\theta+g\sin\theta\cos\theta=0$

Key: **C**

Itemcode : **YS1013**

Q38 : If the Lagrangian of a particle is

$L=\frac{1}{2}ma^2\dot{\theta}^2+\frac{1}{2}ma^2\dot{\phi}^2\sin^2\theta$; where m and a are constants, then the Hamiltonian H is

(a) $ma^2\dot{\theta}^2+ma^2\dot{\phi}^2\sin^2\theta$

(b) $-ma^2\dot{\theta}^2+ma^2\dot{\phi}^2\sin^2\theta$

(c) $ma^2\dot{\theta}^2-ma^2\dot{\phi}^2\sin^2\theta$

(d) $\frac{1}{2}ma^2(\dot{\theta}^2+\dot{\phi}^2\sin^2\theta)$

Key: **D**

Itemcode : **YS1014**

Q39 : A particle of mass m moves along the x-axis under the influence of the potential energy $V(x)=-k\,x\,e^{-ax}$, where k and a are positive constants. The period of small oscillation about the equilibrium position is

(a) $2\pi\sqrt{\frac{ak}{me}}$

(b) $2\pi\sqrt{\frac{k}{m}}$

(c) $2\pi\sqrt{\frac{m}{k}}$

(d) $2\pi\sqrt{\frac{me}{ak}}$

Key: **D**

Itemcode : **YS1015**

Q40 : The Hamiltonian of the system is given as

$$H=\frac{1}{2m}(p_x^2+p_y^2+p_z^2)+\frac{1}{2\mu}(p_r^2+\frac{p_\theta^2}{r^2}+\frac{p_\phi^2}{r^2\sin^2\theta})-\frac{2A}{r^6}+\frac{B}{r^{12}}$$, where

$m, \mu, A, B, r>0$ and $\sin\theta\neq 0$. The energy of the lowest classical state is

(a) $-\frac{A^2}{B}$

(b) $-\frac{2A}{r^6}+\frac{B}{r^{12}}$

(c) 0

(d) ∞

Key: **A**

Itemcode : **YS1016**

Q41 : A pendulum hangs from the ceiling of an elevator. Which of the following scenarios yields the largest frequency of oscillations?

(a) The elevator moves downward at constant speed 5 m/s.

(b) The elevator accelerates upward at 5 m/s^2

(c) The elevator moves upward at constant speed 5 m/s.

(d) The elevator accelerates downward at 5 m/s^2

Key: **B**

Itemcode : **YS1017**

Q42 : Suppose you are walking around in an arbitrary manner on a large rotating platform. At a given instant, under which of the following conditions is the coriolis force on you much smaller than the centrifugal force (in magnitude)?

(a) The angular velocity of the platform is small.

(b) The radial component of your velocity is small.

(c) Your speed with respect to the rotating platform is small compared with the speed of the platform with respect to the inertial frame of the ground.

(d) The tangential component of your velocity is small.

Key: **C**

Itemcode : **YS1018**

Q43 : A mass slides on a frictionless horizontal surface. A string connects it(mass) to a pole, and it circles around the pole. Assume that it was given an initial speed v_0 . The radius of the pole is small but nonzero, so as the inextensible string wraps around the pole, the mass gradually spirals inwards. During the process,

(a) kinetic energy of the mass is conserved.

(b) angular momentum of the mass relative to the centre of the pole is conserved.

(c) both kinetic energy of the mass and angular momentum of the mass relative to the centre of the pole are conserved.

(d) neither kinetic energy of the mass nor angular momentum of the mass relative to the centre of the pole are conserved.

Key: **A**

Itemcode : **YS1019**

Q44 : Consider a ball that rolls down on a long plane without slipping. And consider a cuboid block that slides down on another long plane of same height and inclined at the same angle, which is frictionless. At time t=0 the ball and the block begin to move. After time t= t_0, we found that the acceleration of the centre of mass of the ball is smaller than the acceleration of the block because

(a) the acceleration due to gravity pointing down the plane is smaller in the case of the ball.

(b) there is a frictional force on the ball pointing up the plane.

(c) the ball has one contact point with its plane, whereas the block has a whole surface of contact point with its plane.

(d) the energy of the ball is lost due to friction.

Key: **B**

Itemcode : **YS1020**

Q45 : A very long solenoid (n turns per unit length, current I) is filled with linear magnetic material of susceptibility χ_m. The magnetic field (B) inside the solenoid (r<R) is

(a) nI

(b) $\mu_0(1+\chi_m)nI$

(c) $\chi_m nI$

(d) $\mu_0(1-\chi_m)nI$

Key: **B**

Itemcode : **YS1021**

Q46 :

A mass of mercury at standard atmospheric pressure (atm) and a temperature of 15° C is kept at constant volume. If the temperature is raised to 25° C, what will be the final pressure?

$$[\beta \equiv \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P = 1.81\times10^{-4}K^{-1}, k_T \equiv -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T = 4.01\times10^{-11}Pa^{-1}, 1atm = 1\times10^5 Pa]$$

(a) $1.67X10^5$ Pa

(b) $2.26 X 10^7$ Pa

(c) $1.03X10^5$ Pa

(d) $4.52 X 10^7$ Pa

Key: **D**

Itemcode : **YS1022**

Q47 : Consider the Vander Waals equation of state for a real gas is $P = \frac{RT}{v-b} - \frac{a}{v^2}$, where a and b are constants. At critical point (P_c, v_c, T_c): $\left(\frac{\partial P}{\partial v}\right)_{T=T_C} = 0, \left(\frac{\partial^2 P}{\partial v^2}\right)_{T=T_C} = 0$. The $\frac{RT_C}{P_C v_C}$ is

(a) 1

(b) 2.67

(c) 3.26

(d) 4.36

Key: **B**

Itemcode : **YS1023**

Q48 : If the pressure on 15 cm^3 of mercury at 20^0C is increased reversibly and isothermally from 0 to 1000 atm(atmospheric standard pressure), the heat transferred will be approximately

$$[\beta \equiv \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P = 1.81\times10^{-4}K^{-1} 1atm = 1\times10^5 Pa;$$

Assume β and volume (V) are approximately constant]

(a) -80 J

(b) -40 J

(c) 0

(d) -160 J

Key: **A**

Itemcode : **YS1024**

Q49 : The ratio of specific heat $\left(\gamma \equiv \frac{c_P}{c_V}\right)$ of mercury at 20^0 C and atmospheric pressure is

$$[c_P = 139 \text{ J/K} \quad \text{and specific volume } v = 7.38\times10^{-5} m^3/kg$$

$$\beta \equiv \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P = 1.81\times10^{-4}K^{-1}, k_T \equiv -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T = 4.01\times10^{-11}Pa^{-1}]$$

(a) 1.46

(b) 1.67

(c) 1.15

(d) 1.4

Key: **C**

Itemcode : **YS1025**

Q50 :

The thermodynamics of a classical paramagnetic system is expressed by the variables: magnetization M, magnetic field B, and absolute temperature T. The equation of state is $M = \frac{CB}{T}$, where C is curie constant. The system's internal energy is $U = -MB$. If the initial entropy is S_0, then the entropy S after application of magnetic field B is

(a) $S_0 - \frac{3M^2}{2C}$

(b) $S_0 + \frac{M^2}{2C}$

(c) $S_0 + \frac{3M^2}{2C}$

(d) $S_0 - \frac{M^2}{2C}$.

Key: **D**

Itemcode : **YS1026**

Q51 :

A solid contains N magnetic atoms having spin $\frac{1}{2}$. At sufficiently high temperature each spin is completely randomly oriented. At sufficiently low temperature all the spins become oriented along the same direction (i.e. Ferromagnetic). It is known that the heat capacity of the solid can be described as $C(T) = \begin{cases} c_1(\frac{2T}{T_1} - 1) & \text{if } \frac{T_1}{2} \le T \le T_1 \text{ for some fixed } T_1 \\ 0 & \text{otherwise} \end{cases}$. If $S(\infty) = Nk_B \ln 2, S(0) = 0,$ the maximum value of c_1 is

(a) 0

(b) Nk_B

(c) $\frac{Nk_B \ln 2}{1 - \ln 2}$

(d) $Nk_B \ln 2$

Key: **C**

Itemcode : **YS1027**

Q52 :

A system of two energy levels E_0 and E_1 ($E_1 > E_0$) is populated by N particles at temperature T. The particles populate the energy levels according to the Bose distribution law. The average energy per particle as $T \to 0$ is

(a) E_0

(b) E_1

(c) 0

(d) $\frac{E_0 + E_1}{2}$

Key: **A**

Itemcode : **YS1028**

Q53 :

Suppose that in some sample, the density of state of the electron $D(\varepsilon) = \begin{cases} D_0 & \text{for energy } \varepsilon \ge 0 \\ 0 & \varepsilon < 0 \end{cases}$ and that the total number of electrons is equal to N_0. The Fermi potential μ_0 at T=0 K in volume V is

(a) 0

(b) $\frac{N}{2VD_0}$

(c) $\frac{2N}{VD_0}$

(d) $\frac{N}{VD_0}$

Key: **B**

Itemcode : **YS1029**

Q54 : The specific heat at constant volume for a metallic solid is

(a) γT

(b) $\gamma T + AT^3$

(c) AT^3

(d) σT^4

Key: **B**

Itemcode : **YS1030**

Q55 : Consider an ideal gas of N particles of mass m confined to a volume V at a temperature T. Using the classical approximation for the partition function and assuming the particles are indistinguishable $[Z = \frac{V^N}{N!}\left(\frac{2\pi m k_B T}{h^2}\right)^{\frac{3N}{2}}]$. The Gibbs free energy of the gas is

(a) $Nk_BT\left[\ln\frac{V}{N} + \frac{3}{2}\ln\left(\frac{2\pi m k_B T}{h^2}\right)\right]$

(b) $-Nk_BT\left[\ln\frac{V}{N} + \frac{3}{2}\ln\left(\frac{2\pi m k_B T}{h^2}\right)\right]$

(c) $Nk_BT\left[\ln\frac{N}{V} + \frac{3}{2}\ln\left(\frac{2\pi m k_B T}{h^2}\right)\right]$

(d) $Nk_BT\left[\ln\frac{N}{V} - \frac{3}{2}\ln\left(\frac{2\pi m k_B T}{h^2}\right)\right]$

Key: **D**

Itemcode : **YS1031**

Q56 : The electric field at a distance z above the midpoint of a straight line segment of length 2L that carries a uniform line charge density λ is

(a) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{\sqrt{z^2+L^2}}$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{2\lambda}{z}$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{z}$

(d) $\frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z\sqrt{z^2+L^2}}$

Key: **D**

Itemcode : **YS1032**

Q57 : A very long solid cylinder of radius R carries a charge density

$\left(\rho = \begin{cases} ks;\ \mathrm{s} \le \mathrm{R}\ \text{and k , constant} \\ 0;\ \text{otherwise} \end{cases}\right)$ that is proportional to the distance from the axis. The electric field inside the cylinder is

(a) $\frac{1}{3\varepsilon_0} ks^2$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{ks^2}{R^2}$

(c) $\frac{ks}{2\varepsilon_0}$

(d) $\frac{ks}{\varepsilon_0}$

Key: **A**

Itemcode : **YS1033**

Q58 : The capacitance of two concentric spherical metal shells, with radii a and 3a is

(a) $16\pi\varepsilon_0 a$

(b) $6\pi\varepsilon_0 a$

(c) $18\pi\varepsilon_0 a$

(d) $2\pi\varepsilon_0 a$

Key: **B**

Itemcode : **YS1034**

Q59 : An uncharged metal sphere of radius R is placed in an uniform electric field $\vec{E} = E_0\hat{k}$. The potential in the region outside the sphere is

[*Legende* Polynomial s : $P_0(\cos\theta) = 1,\ P_1(\cos\theta) = \cos\theta, \ldots$;

The potential in azimuthal symmetry : $V(r,\theta) = \sum_{l=0}^{\infty}\left(A_l r^l + \frac{B_l}{r^{l+1}}\right)P_l(\cos\theta)$]

(a) $-E_0(r + \frac{R^3}{r^2})\cos\theta$

(b) $E_0(r - \frac{R^3}{r^2})\cos\theta$

(c) $-E_0(r - \frac{R^3}{r^2})\cos\theta$

(d) $E_0(r + \frac{R^3}{r^2})\cos\theta$

Key: **C**

Itemcode : **YS1035**

Q60 : The electric field produced by a uniformly polarized (polarization vector $\vec{P}$) sphere of radius R at a distance r <R from the centre of the sphere is

(a) $-\frac{\vec{P}}{3\varepsilon_0}$

(b) $-\frac{\vec{P}}{4\pi\varepsilon_0}$

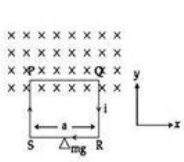
(c) $-\frac{R^3\vec{P}}{3\varepsilon_0 r^3}$

(d) 0

Key: **A**

Itemcode : **YS1036**

Q61 : A rectangular loop of wire, supporting a mass m, hangs vertically with one end in a uniform magnetic field $\vec{B}$, which points into the page in the shown region. For what current in the loop, would the magnetic force exactly balance the gravitational force.



(a) $\frac{mgh}{Ba^2}$

(b) $\frac{2mg}{Ba}$

(c) $\frac{mg}{Ba}$

(d) $\frac{2mgh}{Ba^2}$

Key: **C**

Itemcode : **YS1037**

Q62 : A very long cylindrical rod of radius R carries a uniformly distributed current (free) I. The auxiliary field H inside the rod at a distance s from the axis is

(a) $\frac{I}{2\pi s}$

(b) $\frac{Is}{2\pi R^2}$

(c) $\frac{\mu_0 Is}{2\pi R^2}$

(d) $\frac{\mu_0 I}{2\pi s}$

Key: **B**

Itemcode : **YS1038**

Q63 : Two very long coaxial metal cylinders (radii a and 2a) are separated by material of conductivity σ. If they are maintained at a potential difference V. The current flows from one to the other, in a length L is

(a) $\frac{4\pi\sigma L}{\ln 2}V$

(b) $\frac{2\pi\sigma L}{\ln 2}V$

(c) $\frac{\sigma}{2\pi\varepsilon_0}\ln 2$

(d) $\frac{\sigma}{4\pi\varepsilon_0}\ln 2$

Key: **B**

Itemcode : **YS1039**

Q64 : Suppose you put some free charge density ρ_0 at t=0 on a conductor (not perfect conductor) of permittivity ε and conductivity σ. After sometime Δt, free charge density $\rho(\Delta t > 0)$ is

(a) ρ_0

(b) 0

(c) $\rho_0 e^{-\frac{\sigma}{\varepsilon}\Delta t}$

(d) $\rho_0 e^{-\frac{\varepsilon}{\sigma}\Delta t}$

Key: **C**

Itemcode : **YS1040**

Q65 : The ground state(quantum) energy of a particle of mass m in the potential

$V(x) = V_0 \cosh(\frac{x}{L})$, where L >> x and V_0 are constants (and $V_0 >> \frac{h^2}{2mL^2}$) is

(a) $V_0 + \frac{\eta}{L}\sqrt{\frac{2V_0}{m}}$

(b) $V_0 + \frac{\eta}{L}\sqrt{\frac{V_0}{m}}$

(c) $V_0 + \frac{\eta}{4L}\sqrt{\frac{V_0}{m}}$

(d) $V_0 + \frac{\eta}{2L}\sqrt{\frac{V_0}{m}}$

Key: **D**

Itemcode : **YS1041**

Q66 : The value of the Lande g-factor for a fine structure level defined by the quantum numbers L=1, J=2 and S=1 is

(a) 11/6

(b) 4/3

(c) 8/3

(d) 3/2

Key: **D**

Itemcode : **YS1042**

Q67 : Consider an electron of energy E=5eV incident on the potential step

$V(x) = \begin{Bmatrix} 0, & x < 0 \\ V_0 = 10eV, & x \geq 0 \end{Bmatrix}$. The reflection coefficient (R) is

(a) $e^{2i\tan^{-1}(-1)}$

(b) 1

(c) $e^{-2i\tan^{-1}(-1)}$

(d) 0

Key: **B**

Itemcode : **YS1043**

Q68 : Consider a particle of mass m moving in one dimension in an infinite square well of width L, such that the origin has been chosen to be the left corner of the well. The solution of energy eigenfunctions are given as $\psi_n(x) = A\sin\frac{n\pi x}{L}, n = 1,2,..., where$ A is a normalization constant.

The normalization constant A is

(a) $\sqrt{\frac{L}{2}}$

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

(c) $\sqrt{L}$

(d) $\frac{1}{\sqrt{L}}$

Key: **B**

Itemcode : **YS1044**

Q69 : Consider a particle of mass m which is constrained by impenetrable walls to move in cubical box of side L. Inside the box the potential energy V is zero, while at wall V is infinite. Number of degeneracy of first quantum excited energy state is

(a) 2

(b) 3

(c) 6

(d) 1

Key: **B**

Itemcode : **YS1045**

Q70 : Consider a particle of mass m which is constrained by the potential

$V(x,y,z)=\frac{k}{2}(x^2+y^2+z^2)$. The energy of the Quantum ground state of the particle is

(a) $3\eta\omega$

(b) $\frac{\eta\omega}{2}$

(c) $\eta\omega$

(d) $\frac{3\eta\omega}{2}$

Key: **D**

Itemcode : **YS1046**

Q71 : If $[a,b]=ab-ba$ and $\vec{L}=\vec{r}\times\vec{p}$, then $[L_i,x_j]$ *is*

(a) $i\hbar\varepsilon_{ijk}x_k$

(b) $i\hbar\varepsilon_{ijk}L_k$

(c) 0

(d) $i\hbar\varepsilon_{ijk}p_k$

Key: **A**

Itemcode : **YS1047**

Q72 : $\langle njlm_j|\vec{L}\cdot\vec{S}|njlm_j\rangle$; *where* $\vec{J}=\vec{L}+\vec{S}$ is

(a) $\hbar^2[j(j+1)-l(l+1)-s(s+1)]$

(b) $\frac{\hbar^2}{2}[j(j+1)-l(l+1)-s(s+1)]$

(c) $\hbar^2[m_j^2-m_l^2-m_s^2]$

(d) $\frac{\hbar^2}{2}[m_j^2-m_l^2-m_s^2]$

Key: **B**

Itemcode : **YS1048**

Q73 : The polarization vector ($\vec{P}$) is defined in terms of Pauli matrix vectors $\vec{\sigma}$ as

(a) $\vec{\sigma}$

(b) $\frac{\vec{\sigma}}{2}$

(c) $\langle\vec{\sigma}\rangle$

(d) $\frac{\langle\vec{\sigma}\rangle}{2}$

Key: **C**

Itemcode : **YS1049**

Q74 : If the density operator of pure state is $\rho^2=\rho$; where $\rho=\frac{1}{2}(I+\vec{\sigma}\cdot\vec{P})$, then P^2

(a) -1

(b) 1

(c) 2

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

Key: **B**

Itemcode : **YS1050**

Q75 : The eigenstates corresponding to eigenvalues E_1 and E_2 of a time independent Hamiltonian are $|1>$ and $|2>$ respectively. If at t=0, the system is in a state $|\psi(t=0)>=\sin\theta|1>+\cos\theta|2>$, the value of $<\psi(t)|\psi(t)>$ at time t will be

(a) 1

(b) $\dfrac{E_1 \sin^2\theta + E_2\cos^2\theta}{\sqrt{E_1^2+E_2^2}}$

(c) $e^{\frac{iE_1 t}{\eta}}\sin^2\theta + e^{\frac{iE_2 t}{\eta}}\cos^2\theta$

(d) $e^{-\frac{iE_1 t}{\eta}}\sin^2\theta + e^{-\frac{iE_2 t}{\eta}}\cos^2\theta$

Key: **A**