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EE24BTECH11007 - Arnav Makarand Yadnopavit

In a one-dimensional harmonic oscillator, φ_0, φ_1 and φ_2 are respectively the ground, first, and the second excited states. These three states are normalized and are orthogonal to one another.
ψ_1 and ψ_2 are two states defined by

$$\psi_1 = \varphi_0 - 2\varphi_1 + \varphi_2$$

$$\psi_1 = \varphi_0 - \varphi_1 + \alpha\varphi_2$$

where α is a constant.

52) The value of α for which ψ_2 is orthogonal to ψ_1 is

a) 2 b) 1 c) -1 d) -2

53) For the value α determined in Q52, expectation value of energy of oscillator in the state ψ_2 is

a) $\hbar\omega$ b) $3\hbar\omega/2$ c) $3\hbar\omega$ d) $9\hbar\omega/2$

A plane electromagnetic wave has the magnetic field given by

$$\mathbf{B}(x, y, z, t) = B_o \sin\left[(x + y)\frac{k}{\sqrt{2}} + \omega t\right]\hat{k}$$

where k is the wave number and $\hat{i}$, $\hat{j}$, $\hat{k}$ are the Cartesian unit vectors in x, y, and z directions, respectively.

54) The electric field $\mathbf{E}(x, y, z, t)$ corresponding to the above wave is given by:

a) $cB_o \sin\left[(x + y)\frac{k}{\sqrt{2}} + \omega t\right]\frac{\hat{i}-\hat{j}}{\sqrt{2}}$
b) $cB_o \sin\left[(x + y)\frac{k}{\sqrt{2}} + \omega t\right]\frac{\hat{i}+\hat{j}}{\sqrt{2}}$
c) $cB_o \sin\left[(x + y)\frac{k}{\sqrt{2}} + \omega t\right]\hat{i}$
d) $cB_o \sin\left[(x + y)\frac{k}{\sqrt{2}} + \omega t\right]\hat{j}$

55) The average Poynting vector is given by:

a) $\frac{cB_o^2}{2\mu_o}\frac{(\hat{i}-\hat{j})}{\sqrt{2}}$
b) $-\frac{cB_o^2}{2\mu_o}\frac{(\hat{i}-\hat{j})}{\sqrt{2}}$
c) $\frac{cB_o^2}{2\mu_o}\frac{(\hat{i}+\hat{j})}{\sqrt{2}}$
d) $-\frac{cB_o^2}{2\mu_o}\frac{(\hat{i}+\hat{j})}{\sqrt{2}}$

56) Choose the most appropriate word from the options given below to complete the following sentence:
If you are trying to make a strong impression on your audience, you cannot do so by being understated, tentative or _____.

a) hyperbolic
b) restrained
c) argumentative
d) indifferent

57) Choose the most appropriate word(s) from the options given below to complete the following sentence:
I contemplated _____ Singapore for my vacation but decided against it.

a) to visit
b) having to visit
c) visiting
d) for a visit

58) If $\log(P) = \left(\frac{1}{2}\right)\log(Q) = \frac{1}{3}\log(R)$, then which of the following options is TRUE?

a) $P^2 = Q^3R^2$ b) $Q^2 = PR$ c) $Q^2 = R^3P$ d) $R = P^2Q^2$

59) Which of the following options is the closest in meaning to the word below:
Inexplicable
a) Incomprehensible
b) Indelible
c) Inextricable
d) Infallible

60) Choose the word from the options given below that is most nearly opposite in meaning to the given word:
Amalgamate
a) merge
b) split
c) collect
d) separate

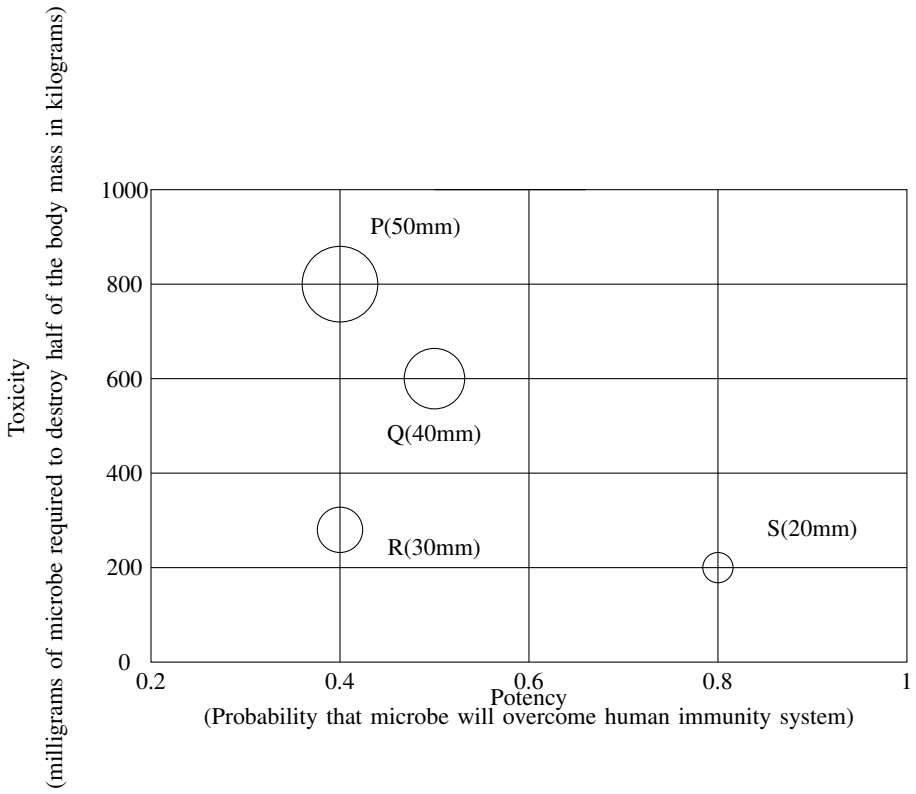
61) A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4th day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10th day. What is the minimum number of trucks required so that there will be no pending order at the end of the 5th day?

a) 4 b) 5 c) 6 d) 7

62) The variable cost (V) of manufacturing a product varies according to the equation $V = 4q$, where q is the quantity produced. The fixed cost (F) of production of the same product reduces with q according to the equation $F = \frac{100}{q}$. How many units should be produced to minimize the total cost ($V + F$)?

a) 5 b) 4 c) 7 d) 6

63) P, Q, R, and S are four types of dangerous microbes recently found in a human habitat. The area of each circle with its diameter printed in brackets represents the growth of a single microbe surviving the human immune system within 24 hours of entering the body. The danger to human beings varies proportionately with the toxicity, potency, and growth attributed to a microbe, as shown in the figure below:



A pharmaceutical company is contemplating the development of a vaccine against the most dangerous microbe. Which microbe should the company target in its first attempt?

a) P b) Q c) R d) S

64) Few school curricula include a unit on how to deal with bereavement and grief, and yet all students at some point in their lives suffer from losses through death and parting.
Based on the above passage which topic would not be included in a unit on bereavement?
a) how to write a letter of condolence
b) what emotional stages are passed through in the healing process
c) what the leading causes of death are
d) how to give support to a grieving friend

65) A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time. How much spirit is now left in the container?

a) 7.58 litres
b) 7.84 litres
c) 7 litres
d) 7.29 litres