# ASSIGNMENT: MATHEMATICAL MODELING

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# MCQ QUESTIONS WITH SOLUTIONS

1. Bacteria in a certain culture increase at a rate proportional to the number present.If the number of bacteria increases from 1000 to 2000 in one hour, then find the number of bacteria at the end of 6 hours.

   (a) 48000

   (b) 94000

   (c) 84000

   (d) 64000

- **Hints and Solution:**

Let $x(t)$ denotes the size(number) of the bacteria at any time $t$. Then, the given problem is governed by the differential equation,

$$\frac{dx}{dt} = rx \tag{1}$$

Whose solution is given by,

$$x(t) = x_0 e^{rt} \tag{2}$$

where $x_0 = 1000$, when $t = 0$.
Again, Since the number of bacteria becomes 2000 at the end of one hour i.e. $x(1) = 2000$ at $t = 1$, therefore by using the equation(2), we have

$$2000 = 1000e^r$$

which gives,

$$e^r = 2 \tag{3}$$

Now, let $x(6)$ be the number of bacteria at the end of 6 hours, therefore again by using equation(2), we have,

$$x(6) = 1000e^{r(6)} = 1000(2)^6$$

$$\text{or,} \quad x(6) = 64000$$

So, (d) 64000 is the correct option.

2. What are the behaviour of the curve in **Exponential population growth** ?

   (a) It's J shaped curve
   (b) It's S shaped curve
   (c) It's a parabolic curve
   (d) It's a hyperbolic curve

Correct option is, (a) J shaped curve

3. What are the behaviour of the curve in **Logistics population growth** ?

   (a) It's J shaped curve
   (b) It's a hyperbolic curve
   (c) It's a S shaped curve
   (d) it's a Y shaped curve

Correct option is, (c) S shaped curve

4. Which of these is not a **greenhouse gas** ?

   (a) Oxygen
   (b) Methane
   (c) Corbon di-oxide
   (d) Ozone

Correct option is, (a) Oxygen

5. What do you mean by **Emigration** ?

   (a) Population leaving the space
   (b) Population comes from outside the space
   (c) Population died
   (d) Population take birth

Correct option is, (a) Population leaving the space

6. Which of the following counter acts biotic potential ?

   (a) Limitations of food supply

   (b) Predation

   (c) Competition

   (d) All of the Above

Correct option is, (d) All of the Above

7. Which of the these pairs are prey-predator model of Lotka-Volterra ?

   (a) $\frac{dx}{dt} = \alpha x + \beta xy$
   $\frac{dy}{dt} = \delta xy - \gamma y$

   (b) $\frac{dx}{dt} = \alpha x + \beta xy$
   $\frac{dy}{dt} = \delta xy + \gamma y$

   (c) $\frac{dx}{dt} = \alpha x - \beta xy$
   $\frac{dy}{dt} = \delta xy - \gamma y$

   (d) $\frac{dx}{dt} = \alpha x - \beta xy$
   $\frac{dy}{dt} = \delta xy + \gamma y$

Correct option is, (c)

$$\frac{dx}{dt} = \alpha x - \beta xy$$
$$\frac{dy}{dt} = \delta xy - \gamma y$$

8. Lotka-Volterra model is based on,

   (a) Logistics population growth

   (b) Exponential population growth

   (c) Both (a) and (b)

   (d) None of the Above

Correct option is, (a) Logistics population growth

9. In two species model, what's the meaning of prey and predator ?

   (a) Hunter organisms and hunted organisms
   (b) Hunted organisms and hunter organisms
   (c) Organisms that are died and organisms that are take birth
   (d) None of the Above

   Correct option is, (b) Hunted organisms and hunter organisms

10. Lotka-Volterra prey-predator differential equations are,

    (a) Non-linear differential equations
    (b) Linear differential equations
    (c) Ordinary differential equations
    (d) None of the Above

    Correct option is, (a) Non-linear differential equations

11. What is **Epidemic** ?

    (a) A large long-term outbreak of disease
    (b) A small short-term outbreak of disease
    (c) A large short-term outbreak of disease
    (d) None of the Above

    Correct option is, (c) A large short-term outbreak of disease

12. In SI Model which is true,

    (a) $\frac{dS}{dt} + \frac{dI}{dt} = 0$
    (b) $\frac{dS}{dt} - \frac{dI}{dt} = 0$
    (c) $\frac{dS}{dt} + \frac{dI}{dt} = 1$
    (d) None of the Above

    Correct option is, (a) $\frac{dS}{dt} + \frac{dI}{dt} = 0$

13. Basic reproductive ratio, $R_0$ in SIR Model is given by,

    (a) $\frac{\beta S_0}{\gamma}$

    (b) $\frac{\gamma S_0}{\beta}$

    (c) $\frac{\beta I_0}{\gamma}$

    (d) None of the Above

where, $\beta$ is the transmission contact rate and $\gamma$ is tne mean recovery rate.

Correct option is, (a) $\frac{\beta S_0}{\gamma}$

14. Most pandemics have arisen from influenza viruses from which of the following animals ?

    (a) Pigs

    (b) Wild birds

    (c) Humans

    (d) Bats

Correct option is, (b) Wild birds

15. SARS is described as a zoonotic-virus, what does this mean ?

    (a) Such viruses are confined to animals

    (b) They do not cause disease in humans

    (c) They cause pandemics

    (d) They emerge from animals to cross the species barrier infrequently

Correct option is, (d) They emerge from animals to cross the species barrier infrequently

16. The area under the serum concentration time curve of the drug represents :

    (a) The biological half life of the drug

    (b) The amount of the drug in the original dosage from

    (c) The amount of drug absorbed

    (d) The amount of drug excreted in the urine

Correct option is, (c) The amount of drug absorbed

17. Time dependent change in drug kinetics is known as:

    (a) Pharmacokinetics
    (b) Chronokinetics
    (c) Drug regulation
    (d) None of the Above

    Correct option is, (b) Chronokinetics

18. Which of the following drugs get distributed to the same extent in both lean and adipose tissue:

    (a) Phenytoin
    (b) Digoxin
    (c) Antibiotics
    (d) Caffeine

    Correct option is, (d) Caffeine

19. Which of the following is not a mechanism for pharmacokinetics analysis:

    (a) Compartment analysis
    (b) Non-compartment analysis
    (c) Physiologic modeling
    (d) Human model

    Correct option is, (d) Human model

20. Which organs comprise the central compartment in a two compartment model:

    (a) Liver
    (b) Muscles
    (c) Adipose
    (d) Skin

    Correct option is, (a) Liver

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