GATE BT 2021

EE25BTECH11044 - Pappula Sai Hasini

1) The ratio of boys to girls in a class is 7 to 3. Among the options below, an acceptable value for the total number of students in the class is:
   a) 21
   b) 37
   c) 50
   d) 73

(GATE BT 2021)

2) 2. A polygon is convex if, for every pair of points, P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon. Which one of the following is NOT a convex polygon?
   a) square
   b) triangle
   c) pentagon
   d) trapezium

(GATE BT 2021)

3) Consider the following sentences: (i) Everybody in the class is prepared for the exam. (ii) Babu inviterl Danish to his home because he enjoys playing chess. Which of the following is the CORRECT observation about the above two sentences?
   a) (i) is grammatically correct and (ii) is tmai bipiious
   b) (i) is grammatically incorrect end (ii) is unambiguous
   c) (i) is grammatically correct and (ii) is ambiguous
   d) (i) is grammatically incorrect end (ii) is or bipuous

(GATE BT 2021)

4) is to surgery as writer is to Which one of 4he following options maintains a similar logical relation in the above sentence?
   a) Plan, outline
   b) Hospital, library
   c) Doctor, book
   d) Medicine, grammar

(GATE BT 2021)

5) Details of prices of two items P and Q are presented in the above table. The ratio of cost of item P to cost of item Q is 3:4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost to the cost (Profit % = $\dfrac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100$). The discount on item Q, as a percentage of its marked price, is
   a) 25
   b) 12.5
   c) 10
   d) 5

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6) The order of genes present in a chromosome is as follows: L M N O P Q. Which one of the following rearrangements represents a paracentric inversion?

a) A) _ _ _ _ L
b) B) _ _ _ _ M
c) C) _ _ _ _ N
d) D) _ _ _ _ O

(GATE BT 2021)

7) We have 2 rectangular sheets of paper, M tnd N, of dimensions $6cm$ each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches anrl assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is

a) $\pi/2$
b) $3/\pi$
c) $9/\pi$
d) 3π

(GATE BT 2021)

8) The process and instrumentation diagram for a feedback control strategy to maintain the liquid level (h) by regulating a valve (V) in a tank is shown below. F_1 is the inlet liquid flow rate, F_2 is the outlet liquid flow rate, LT is the liquid level transmitter, LC is the liquid level controller, h_{sp} is the setpoint value of the liquid level, h_m is the measured value of the liquid level, and P_V is the valve pressure. The manipulating variable(s) is/are
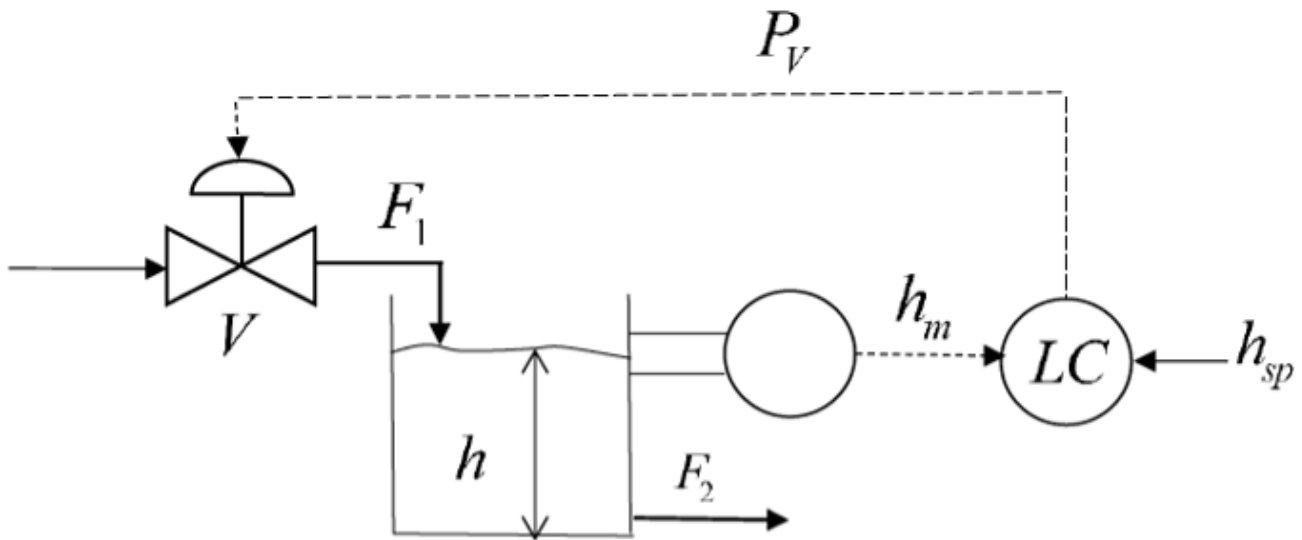

Fig. 8. Process and instrumentation diagram for level control by regulating valve V.

a) F_1 only
b) F_2 only
c) h_m and P_V only
d) h_{sp} and P_V only

(GATE BT 2021)

9) There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag. The probability that at least two chocolates are identical is

a) 0.3024

b) 0.4235
c) 0.6976
d) 0.8125

10) is to surgery as writer is to
Which one of the following options maintains a similar logical relation in the above sentence?

a) *Plan*, *outline*
b) *Hospital*, *library*
c) *Doctor*, *book*
d) Medicine, grammar

11) In adsorption chromatography, the adsorption of uncharged solute molecules onto a silica-based stationary phase is by

a) covalent bonds
b) electrostatic interactions
c) ionic bonds
d) van der Waals forces

12) Which one of the following statements is correct in the context of thermodynamics?

a) In a closed system, neither mass nor energy is transferred across the system boundary
b) In a closed system, both mass and energy can be transferred across the system boundary
c) The total energy of the system is the sum of kinetic and potential energies
d) In a closed system, only energy can be transferred across the system boundary and not mass

13) In Neurospora crassa, a mutation in the poky gene results in a slow-growth phenotype (poky). The results of four crosses are given below:

$$(1) \text{ wild-type} \times \text{wild-type} \rightarrow \text{All progeny are wild-type}$$
$$(2) \text{ wild-type} \times poky \rightarrow \text{All progeny are wild-type}$$
$$(3) \ poky \times \text{wild-type} \rightarrow \text{All progeny are poky}$$
$$(4) \ poky \times poky \rightarrow \text{All progeny are poky}$$

Which one of the following explains the inheritance mode of poky?

a) Episomal inheritance
b) Mendelian inheritance
c) Mitochondrial inheritance
d) X-linked inheritance

14) A feed stream (F_1) containing components A and B is processed in a system comprising a separation unit and a mixer as shown in the schematic below. The mole fractions of components A and B are x_A and x_B, respectively. If $F_1 + F_2 = 100 \text{ kg h}^{-1}$, the degrees of freedom of the system is

15) Some people suggest anti-obesity measures (AOM) such as displaying calorie information in restaurant menus. Such measures sidestep addressing the core problems that cause obesity: poverty and income inequality.
Which one of the following statements summarizes the passage?

a) The proposed AOM addresses the core problems that cause obesity.
b) If obesity reduces, poverty will naturally reduce, since obesity causes poverty.
c) AOM are addressing the core problems and are likely to succeed.
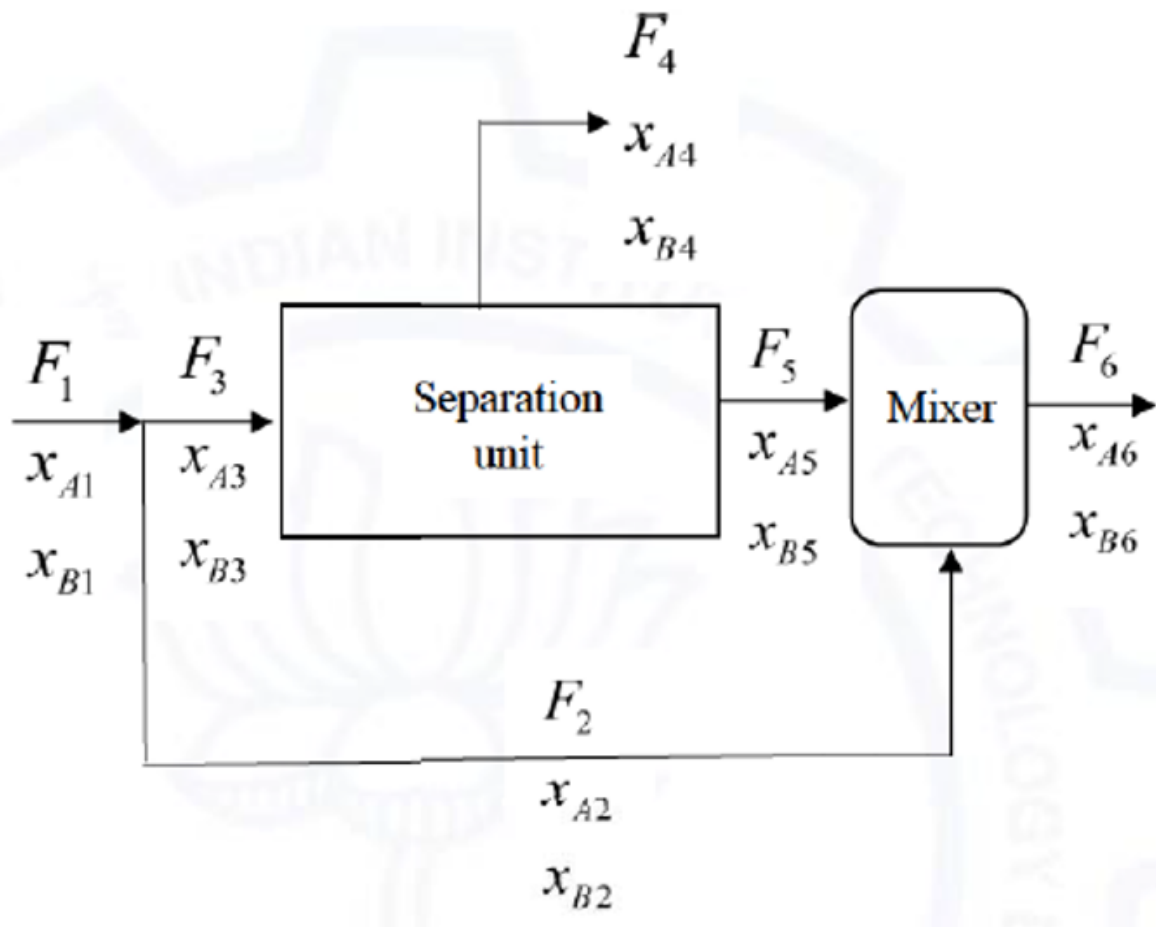
Fig. 14. Schematic of separation unit and mixer.

    d) AOM are addressing the problem superficially.

<div align="right">(GATE BT 2021)</div>

16) It is desired to scale-up a fermentation from 1 L to 1000 L vessel by maintaining a constant power-to-volume ratio. The small fermenter is operated at an agitator speed of 300 rotations per minute (rpm). If the value of scale-up factor is 10, agitator speed in rpm (rounded off to the nearest integer) for the large fermenter is   (GATE BT 2021)

17) Coronavirus genome consists of

    a) double-stranded DNA
    b) double-stranded RNA
    c) negative-sense single-stranded RNA
    d) positive-sense single-stranded RNA

<div align="right">(GATE BT 2021)</div>

18) The enzyme that transcribes the eukaryotic genes encoding precursor ribosomal RNAs (pre-rRNAs) of 28S, 18S and 5.8S rRNAs is

    a) RNA polymerase I
    b) RNA polymerase II
    c) RNA polymerase III
    d) RNA polymerase IV

<div align="right">(GATE BT 2021)</div>

19) Number of unrooted trees in a phylogeny of five sequences is

    a) 3
    b) 15
    c) 105
    d) 945

<div align="right">(GATE BT 2021)</div>

20) Which one of the following methods is used to test the significance of a predicted phylogeny?

    a) Bootstrap
    b) Maximum likelihood
    c) Maximum parsimony
    d) Minimum evolution

<div align="right">(GATE BT 2021)</div>

21) The Cartesian coordinates (x, y) of a point A with polar coordinates $(4, \pi/4)$ is

    a) $(3, 2\sqrt{3})$
    b) $(2, 2\sqrt{3})$
    c) $(4, 4\sqrt{2})$
    d) $(3, 4\sqrt{2})$

<div align="right">(GATE BT 2021)</div>

22) Which one of the following statements is INCORRECT about hybridoma production?

    a) Hybridoma cells can utilise hypoxanthine and thymidine
    b) DNA synthesis in myeloma cells is blocked by aminopterin
    c) Hybridoma cells are made to produce polyclonal antibodies
    d) Polyethylene glycol is used to fuse myeloma cells to B-cells

<div align="right">(GATE BT 2021)</div>

23) $\dfrac{d}{dx}[\ln(2x)]$ is equal to

    a) $1/2x$
    b) $1/x$
    c) $1/2$
    d) x

<div align="right">(GATE BT 2021)</div>

24) Which one of the following techniques/tools is NOT used for inserting a foreign gene into a cell?

    a) DNA microarray
    b) Electroporation
    c) Gene gun
    d) Microinjection

<div align="right">(GATE BT 2021)</div>

25) Under standard temperature (T) and pressure (P) conditions, $128\,g$ of an ideal gas molecule A occupies a volume of $1\,L$. The gas molecule A obeys the relationship $RT = 0.25\,PV$. R and V are universal gas constant and ideal gas volume, respectively. The molecule A is

    a) CO_2
    b) H_2
    c) N_2
    d) O_2

<div align="right">(GATE BT 2021)</div>

26) CRISPR-Cas system is associated with

    a) adaptive immunity in eukaryotes
    b) adaptive immunity in prokaryotes

c) innate immunity in eukaryotes

d) innate immunity in prokaryotes

27) The process by which intracellular macromolecules are supplied for lysosomal degradation during nutrient starvation is

a) apoptosis

b) autophagy

c) phagocytosis

d) pinocytosis

(GATE BT 2021)

28) A protein without its prosthetic group is known as

a) apoprotein

b) hemoprotein

c) holoprotein

d) lipoprotein

(GATE BT 2021)

29) The enzyme which adds phosphate group to the free 5′ terminus of a DNA sequence is

a) adenosine kinase

b) alkaline phosphatase

c) polynucleotide kinase

d) terminal deoxynucleotidyl transferase

(GATE BT 2021)

30) Which one of the following is CORRECT about microbial growth medium?

a) Luria-Bertani broth is a synthetic medium

b) Nutrient broth is a defined medium

c) Sabouraud dextrose agar is a differential medium

d) Trypticase soy agar is a complex medium

(GATE BT 2021)

31) The cellular process which utilizes RNA-induced silencing complex to block gene expression is

a) RNA editing

b) RNA interference

c) RNA polyadenylation

d) RNA splicing

(GATE BT 2021)

32) Which of the following layer(s) is/are formed from the inner cell mass of the blastocyst?

a) Ectoderm

b) Endoderm

c) Mesoderm

d) Trophectoderm

(GATE BT 2021)

33) Which of the following cell organelle(s) is/are surrounded by a single phospholipid membrane?

a) Golgi apparatus

b) Lysosome

c) Mitochondria

d) Nucleus

(GATE BT 2021)

34) The sum of the infinite geometric series $1 + \frac{1}{3} + \frac{1}{3^2} + \frac{1}{3^3} + \cdots$ (rounded off to one decimal place) is

35) Three balls, colored in blue, green and red, are successively transferred from box A to box B in the order BLUE-GREEN-RED. The probability of a reverse transfer of the balls to the box in the same order (rounded off to two decimal places) is

36) Decimal reduction time of a bacterial strain is 20 min. Specific death rate constant in min^{-1} (rounded off to two decimal places) is

37) The value of $\lim_{x \to 0} \dfrac{x - \sin 2x}{x - \sin 5x}$ (rounded off to two decimal place is

38) A system consists of two reactors, connected by a valve. The first reactor (A1) contains an ideal gas A of volume 5 L and the second reactor (A2) has an ideal gas B of volume 10 L. Initially, the valve is closed and pressure P in A1 and A2 are 9 and 6 atm, respectively. Later, when the valve is opened, the system reaches equilibrium. If the temperature T of both the reactors is maintained constant, the final equilibrium pressure in atm of the system is

39) The enzyme α-amylase used in starch hydrolysis has an affinity constant K_p value of 0.005 M. To achieve one-fourth of the maximum rate of hydrolysis, the required starch concentration in mM (rounded off to two decimal places) is
   a) 1.67
   b) 2.50
   c) 3.33
   d) 5.00

40) Match enzymes in Group I with their corresponding industrial application in Group II.

Group I	Group II
P. Amylase	1. Laundry detergent
Q. Invertase	2. Fruit juice clarification
R. Pectinase	3. Liquefaction of sucrose
S. Xylanase	4. Pulp and paper processing

   a) (A) P-2, Q-3, R-4, S-1
   b) (B) P-1, Q-3, R-2, S-4
   c) (C) P-1, Q-2, R-3, S-4
   d) (D) P-1, Q-4, R-2, S-3

41) Match separation methods in Group I with associated properties in Group II.

Group I	Group II
P. Centrifugation	1. Density
Q. Dialysis	2. Diffusivity
R. Solvent extraction	3. Size
S. Ultrafiltration	4. Solubility

   a) (A) P-4, Q-2, R-1, S-3
   b) (B) P-3, Q-1, R-2, S-4
   c) (C) P-1, Q-3, R-2, S-4
   d) (D) P-1, Q-2, R-4, S-3

42) Match the autoimmune diseases in Group I with the corresponding primarily affected organ in Group II.

Group I   Group II

P. Hashimoto's disease   1. Brain

Q. Juvenile diabetes   2. Pancreas

R. Multiple sclerosis   3. Skeletal muscle

S. Myasthenia gravis   4. Thyroid

a) (A) P-1, Q-2, R-3, S-4

b) (B) P-3, Q-1, R-2, S-4

c) (C) P-4, Q-2, R-1, S-3

d) (D) P-1, Q-2, R-4, S-3

(GATE BT 2021)

43) Match hypersensitivity types in Group I with their corresponding condition in Group II.

Group I   Group II

P. Type I   1. Erythroblastosis fetalis

Q. Type II   2. Host reaction to bee venom

R. Type III   3. Systemic lupus erythematosus

S. Type IV   4. Tuberculin reaction

a) (A) P-2, Q-3, R-1, S-4

b) (B) P-3, Q-1, R-4, S-2

c) (C) P-2, Q-3, R-4, S-1

d) (D) P-2, Q-1, R-3, S-4

(GATE BT 2021)

44) Which of the following combinations of plant hormones and their associated function are CORRECT?

Hormone   Function

P. Abscisic acid   Breaks seed dormancy

Q. Auxin   Induces cell division

R. Ethylene   Stimulates ripening of fruits

S. Gibberellin   Promotes seed dormancy

a) (A) P and R only

b) (B) P and S only

c) (C) Q and R only

d) (D) Q and S only

(GATE BT 2021)

45) Which one of the following tools is used to compare all the possible six-open reading frames of a given nucleotide query sequence with all the available six-open reading frames of the nucleotide sequence database?

a) (A) BLASTN

b) (B) BLASTX

c) (C) TBLASTN

d) (D) TBLASTX

(GATE BT 2021)

46) Tertiary structure of a protein consisting of α-helices and β-strands can be determined by

a) (A) Circular dichroism spectroscopy

b) (B) Mass spectrometry

c) (C) Nuclear magnetic resonance spectroscopy

d) (D) UV spectroscopy

(GATE BT 2021)

47) Which of the following statement(s) is/are CORRECT about *Agrobacterium*?

a) (A) It contains tumor inducing plasmid

    b) (B) It causes crown gall disease in dicotyledonous plants

    c) (C) It is a Gram-positive soil bacterium

    d) (D) It is used in generating transgenic plants

<div align="right">(GATE BT 2021)</div>

48) Which of the following antimicrobial agent(s) is/are growth factor analog(s)?

    a) (A) 5-Fluorouracil

    b) (B) Isoniazid

    c) (C) Sulfanilamide

    d) (D) Tetracycline

<div align="right">(GATE BT 2021)</div>

49) Which of the following chemical messenger(s) is/are derivative(s) of tryptophan?

    a) (A) γ-amino butyric acid

    b) (B) Indole acetic acid

    c) (C) Melatonin

    d) (D) Serotonin

<div align="right">(GATE BT 2021)</div>

50) Which of the following nucleus/nuclei is/are NMR active?

    a) (A) ^{1}H

    b) (B) ^{13}C

    c) (C) ^{16}O

    d) (D) ^{32}S

<div align="right">(GATE BT 2021)</div>

51) In a Mendel's dihybrid experiment, a homozygous pea plant with round yellow seeds was crossed with a homozygous plant with wrinkled green seeds. F_1 intercross produced 560 F_2 progeny. The number of F_2 progeny having both dominant traits (round and yellow) is   (GATE BT 2021)

52) A 0.1 mL aliquot of a bacteriophage stock having a concentration of 4×10^9 phages mL^{-1} is added to 0.5 mL of $E.$ $coli$ culture having a concentration of 2×10^8 cells mL^{-1}. The multiplicity of infection is   (GATE BT 2021)

53) If the area of a triangle with the vertices $(k, 0)$, $(2, 0)$ and $(0, -2)$ is 2 square units, the value of k is (GATE BT 2021)

54) In a chemostat with a dilution rate of 0.8 h^{-1}, the steady state biomass concentration and the specific product formation rate are 8 mol m^{-3} and 0.2 (mol product)(mol biomass)$^{-1}$ h^{-1}, respectively. The steady state product concentration in mol m^{-3} is   (GATE BT 2021)

55) If the values of two random variables (X, Y) are $(121, 360)$, $(242, 361)$ and $(363, 362)$, the value of the correlation coefficient between X and Y (rounded off to one decimal place) is (GATE BT 2021)

56) It is desired to scale-up a fermentation from 1 L to 1000 L vessel by maintaining a constant power-to-volume ratio. The small fermenter is operated at an agitator speed of 300 rotations per minute (rpm). If the value of scale-up factor is 10, agitator speed in rpm (rounded off to the nearest integer) for the large fermenter is   (GATE BT 2021)

57) The specific growth rate of a mold during exponential phase of its growth in a batch cultivation is 0.15 h^{-1}. If the cell concentration at 30 h is 33 g L^{-1}, the cell concentration in g L^{-1} (rounded off to the nearest integer) at 24 h is   (GATE BT 2021)

58) A sedimentation tank of height 100 cm is used in a conventional activated sludge process to separate a suspension of spherical shaped granular sludge biomass of 0.5 mm diameter. The viscosity of the liquid is 1 cP. The difference in density between the suspended biomass and the liquid is 0.1 g cm^{-3}. If the biomass reach their terminal velocity instantaneously, the biomass settling time in min (rounded off to two decimal places) is   (GATE BT 2021)

59) In a random mating population, Y and v are dominant and recessive alleles, respectively. If the

frequency of Y allele in both sperm and egg is 0.70, then the frequency of Y/v heterozygotes (rounded off to two decimal places) is   (GATE BT 2021)

60)
$$\int_0^{\pi^2/4} \sin \sqrt{x}\,dx = \ \_\_\_\_\_ .$$

(GATE BT 2021)

61) A batch cultivation of *E. coli* follows zeroth-order Monod's growth kinetics. The cell growth is terminated when the residual dissolved oxygen concentration attains 10% of its saturation value and oxygen mass transfer coefficient ($k_L a$) reaches its maximum value ($80\,\text{h}^{-1}$). The saturation value of dissolved oxygen concentration is $0.007\,\text{kg m}^{-3}$. If the maximum specific growth rate and yield coefficient (Y_{X/O_2}) are $0.2\,\text{h}^{-1}$ and 1.5 (kg cells)(kg O_2)$^{-1}$, respectively, then the final cell concentration in kg m^{-3} (rounded off to two decimal places) at the end of the batch cultivation is   (GATE BT 2021)

62) Milk flowing through a stainless steel inner tube (40 mm inner diameter) of a double tube-type heater is to be heated from 10°C to 85°C by saturated steam condensing at 120°C on the outer surface of the inner tube. Total heat transferred (Q) is 146200 kcal h^{-1} and the overall heat transfer coefficient is 750 kcal h^{-1} m^{-2} °C^{-1}. The total length of the heating tube in m (rounded off to one decimal place) is   (GATE BT 2021)

63) A DNA solution of $50\,\mu g\,mL^{-1}$ concentration gives an absorbance of 1.0 at 260 nm. An aliquot of $20\,\mu L$ from a $50\,\mu L$ purified plasmid solution is diluted with distilled water to a total volume of $1000\,\mu L$. The diluted plasmid solution gives an absorbance of 0.550 at 260 nm. The concentration of the purified plasmid in $\mu g\,\mu L^{-1}$ (rounded off to two decimal places) is   (GATE BT 2021)

64) The possible number of SalI restriction sites in a 9 kb double-stranded DNA, with all four bases occurring in equal proportion (rounded off to the nearest integer) is   (GATE BT 2021)

65) A bacterium produces acetic acid from ethanol as per the following reaction

$$2CH_3CH_2OH + 2O_2 \rightarrow 2CH_3COOH + 2H_2O$$
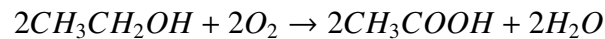
The thermodynamic maximum yield of acetic acid from ethanol in $g\,g^{-1}$ (rounded off to two decimal places) is   (GATE BT 2021)