BT : BIOTECHNOLOGY

Duration: Three Hours *Maximum Marks*: 100

Read the following instructions carefully.

1. Write your name and registration number in the space provided at the bottom of this page.
2. Take out the **O**ptical **R**esponse **S**heet (**ORS**) from this Question Booklet **without breaking the seal**.
3. Do not open the seal of the Question Booklet until you are asked to do so by the invigilator.
4. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**. Also, using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your test paper code (BT).
5. This Question Booklet contains **16** pages including blank pages for rough work. After opening the seal at the specified time, please check all pages and report discrepancy, if any.
6. There are a total of 65 questions carrying 100 marks. All these questions are of objective type. Questions must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number. **For each question darken the bubble of the correct answer**. In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as an incorrect response.
7. Questions Q.1 – Q.25 carry 1-mark each, and questions Q.26 – Q.55 carry 2-marks each.
8. Questions Q.48 – Q.51 (2 pairs) are common data questions and question pairs (Q.52, Q.53) and (Q.54, Q.55) are linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattempted, then the answer to the second question in the pair will not be evaluated.
9. Questions Q.56 – Q.65 belong to General Aptitude (GA). Questions Q.56 – Q.60 carry 1-mark each, and questions Q.61 – Q.65 carry 2-marks each. The GA questions begin on a fresh page starting from page **12**.
10. Unattempted questions will result in zero mark and wrong answers will result in **NEGATIVE** marks. For Q.1 – Q.25 and Q.56 – Q.60, $\frac{1}{3}$ mark will be deducted for each wrong answer. For Q.26 – Q.51 and Q.61 – Q.65, $\frac{2}{3}$ mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53), and (Q.54, Q.55) are questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair, i.e. for Q.52 and Q.54, $\frac{2}{3}$ mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.
11. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.
12. Rough work can be done on the question paper itself. Additionally, blank pages are provided at the end of the question paper for rough work.

Name								
Registration Number	**BT**							

Q. 1 – Q. 25 carry one mark each.

Q.1 Embryonic stem cells are derived from

(A) fertilized embryo
(B) unfertilized embryo
(C) sperm
(D) kidney

Q.2 Members of the antibody protein family that have common structural features are collectively known as

(A) haptens (B) allergens (C) antigens (D) immunoglobulins

Q.3 Apoptosis is characterized by

(A) necrosis
(B) programmed cell death
(C) membrane leaky syndrome
(D) cell cycle arrest process

Q.4 Yeast artificial chromosomes (YAC's) are used for cloning

(A) large segments of DNA
(B) mRNA
(C) bacterial DNA
(D) yeast DNA

Q.5 The product commercially produced by animal cell culture is

(A) insulin
(B) tissue plasminogen activator
(C) interferon
(D) hepatitis B vaccine

Q.6 An alternative to glycolysis pathway is

(A) glyoxylate pathway
(B) pentose phosphate pathway
(C) citric acid cycle
(D) gluconeogenesis

Q.7 A cell in G_1 of interphase has 12 chromosomes. How many chromatids will be found per cell during metaphase II of meiosis?

(A) 6 (B) 12 (C) 18 (D) 24

Q.8 Diploid *Drosophila* has eight chromosomes. Which one of the following terms should **NOT** be used to describe *Drosophila* with sixteen numbers of chromosomes?

(A) Polyploid (B) Aneuploid (C) Euploid (D) Tetraploid

Q.9 Hydrated synthetic seeds which are produced by ion exchange reaction involve mixing the somatic embryos in a solution of

(A) sodium alginate and dropping it in a solution of calcium nitrate
(B) calcium alginate and dropping it in a solution of sodium nitrate
(C) calcium alginate and dropping it in a solution of ammonium nitrate
(D) mannitol and dropping it in a solution of sodium nitrate

Q.10 Shoot organogenesis by tissue culture results into

(A) a bipolar structure that has no vascular connection with the explant
(B) a monopolar structure that has a strong connection with the pre-existing vascular tissue of the explant
(C) a monopolar structure that has no vascular connection with the explant
(D) a bipolar structure that has a strong connection with the pre-existing vascular tissue of the explant

Q.11 'Hairy roots' induced *in vitro* by the infection of *Agrobacterium rhizogenes,* are characterized by

P. a high degree of lateral branching
Q. genetic instability of culture
R. an absence of geotropism
S. poor biomass production

(A) P and R only
(B) P and Q only
(C) Q and R only
(D) R and S only

Q.12 In balanced growth phase of a cell

P. all components of a cell grow at the same rate
Q. specific growth determined by cell number or cell mass would be the same
R. the growth rate is independent of substrate concentration
S. the growth rate decreases with decreasing substrate concentration

(A) P, Q and S only
(B) Q, R and S only
(C) P, Q and R only
(D) P only

Q.13 In N-linked glycosylation, the oligosaccharide chain is attached to protein by

(A) asparagine
(B) arginine
(C) serine
(D) threonine

Q.14 Restriction endonucleases which recognize and cut same recognition sequences are known as

(A) isoschizomers
(B) isozymes
(C) isoaccepting endonucleases
(D) abzymes

Q.15 Substrate consumption in lag phase of microbial growth is primarily used for

P. turn over of the cell material
Q. maintenance of intracellular pH
R. motility
S. increase in cell number

(A) P, Q and S only
(B) Q, R and S only
(C) P, Q and R only
(D) S only

Q.16 Wash out (as defined by $D=\mu_{max}$) of a continuous stirred tank fermenter is characterized by (X=biomass, S=substrate concentration in bioreactor, S_0=substrate concentration in feed, P=product concentration in bioreactor)

(A) $X = 0, S = 0, P = 0$
(B) $X = 0, S = S_0, P = 0$
(C) $X = 0, S < 0, P = 0$
(D) $X < 0, S < 0, P < 0$

Q.17 The study of evolutionary relationships is known as

(A) genomics
(B) proteomics
(C) phylogenetics
(D) genetics

Q.18 The lipopolysaccharides present in bacterial cell wall has lipid A which is connected to

(A) O-polysaccharide
(B) core polysaccharide
(C) both with O-polysaccharide and core polysaccharide
(D) rhamnose-mannose disaccharide

Q.19 Molecular chaperones are class of proteins that facilitate

(A) the proper folding of newly synthesized proteins
(B) unfolding of newly synthesized proteins
(C) degradation of newly synthesized proteins
(D) targeting of newly synthesized proteins

Q.20 Gas vacuoles are present in

(A) *Anabaena flos-aquae*
(B) *Bacillus subtilis*
(C) *Acanthurus nigrofuscus*
(D) *Mycobacterium tuberculosis*

Q.21 In ABO blood group system, antigenic determinants are

(A) nucleic acid
(B) carbohydrate
(C) lipid
(D) protein

Q.22 The most widely used program for multiple sequence alignment is

(A) BLAST (B) FASTA (C) CLUSTAL (D) Chime

Q.23 Diphtheria toxin, tetracycline and streptomycin inhibit

(A) DNA repair
(B) DNA replication
(C) transcription
(D) translation

Q.24 The polymorphic domains for Class II MHC proteins are

(A) α_1 and β_2 domains only
(B) β_1 and α_2 domains only
(C) α_1 and β_1 domains only
(D) α_2 and β_2 domains only

Q.25 The protein in eukaryotes which is subjected to degradation undergoes

(A) phosphorylation
(B) carboxylation
(C) ubiquitation
(D) methylation

Q. 26 to Q. 55 carry two marks each.

Q.26 Match the viruses in **Group I** with their host cell receptors in **Group II.**

Group I	**Group II**
P. Hepatitis A virus	1. Heparan sulphate
Q. Human immunodeficiency virus	2. Acetylcholine receptor
R. Rabies virus	3. CD4 protein
S. Herpes simplex virus type I	4. Alpha-2 macroglobulin

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

Q.27 Match the microbial growth characteristics in **Group I** with the corresponding features in **Group II.**

Group I	**Group II**
P. Growth associated product formation	1. Specific growth rate decreases with increasing product concentration
Q. Non growth associated product formation	2. Specific product formation rate is constant
R. Product inhibition	3. Specific product formation rate is proportional to specific growth rate
S. Substrate inhibition	4. Specific growth rate decreases with increasing substrate concentration

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

Q.28 Match the items in **Group I** with **Group II.**

Group I	**Group II**
P. Circular dichroism	1. Concentration
Q. X-ray crystallography	2. Sedimentation coefficient
R. Freeze-drying	3. Secondary structure determination
S. Ultracentrifugation	4. Tertiary structure determination

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

Q.29 Match the products in **Group I** with their respective organisms in **Group II.**

Group I	**Group II**
P. Glycerol	1. *Corynebacterium glutamicum*
Q. Glutamic acid	2. *Alcaligenes faecalis*
R. Curdlan	3. *Dunaliella salina*
S. Amphotericin B	4. *Streptomyces nodosus*

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

Q.30 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r).

Assertion : I_gM is found in serum as a pentameric protein consisting of five I_gM monomers.

Reason : The pentameric form of I_gM is due to cross-linking of I_gM monomers via peptide bond.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.31 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r).

Assertion : N-methyl-N'-nitro-N-nitrosoguanidine (NTG) is an effective chemical mutagen.

Reason : Mutations induced by NTG mainly are the GC → AT transitions.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.32 Determine the correctness of the following statements

I. Enhancer sequences are those DNA sequences that are involved in increasing the rate of DNA replication.

II. Enhancer sequences work by binding with eukaryotic gene activator factors.

(A) only **I** is true
(B) only **II** is true
(C) both **I** and **II** are true
(D) both **I** and **II** are false

Q.33 In a well aerated and agitated microbial culture, the 'supply' of oxygen is equal to 'demand' (uptake) of the growing culture. The K_La for such a system will be (K_La = volumetric mass transfer coefficient, C^* = dissolved oxygen concentration in liquid in equilibrium with gaseous oxygen, C = instantaneous value of dissolved oxygen concentration, 'r' = specific oxygen uptake rate per unit weight of cells, X = dry weight of the cells per unit volume)

(A) $(r\ X) / (C^* - C)$
(B) $(r\ ) / X\ (C^* - C)$
(C) $(C^* - C) / (r\ X)$
(D) $(X) / r\ (C^* - C)$

Q.34 Structured William's model

P. can describe the changes in intracellular components of the cell during growth
Q. can not describe the death phase of the cells
R. can describe the variation of size of cells in the different phases of growth
S. can not describe the lag period of growth

Which one of the following is **CORRECT**?

(A) P, Q and S only
(B) P, Q and R only
(C) Q, R and S only
(D) P, R and S only

Q.35 Match items in **Group I** with **Group II.**

Group I	**Group II**
P. Glycolytic pathway	1. Chloroplast
Q. Eukaryotic oxidative metabolism	2. Glyoxysomes
R. Glyoxylate cycle	3. Mitochondria
S. Calvin cycle	4. Cytosol

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

Q.36 Match items in **Group I** with **Group II.**

Group I	**Group II**
P. Alzheimer's disease	1. H1N1
Q. Mad cow disease	2. Hemoglobin
R. Sickle cell anaemia	3. Prions
S. Swine flu	4. Amyloid

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

Q.37 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r)

Assertion: The elucidation of ribosome structure helps in the development of new generation drugs.

Reason: The high resolution of macromolecular structure has enabled in structure-based drug design.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.38 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r)
Assertion : A very low amount of inhibitor can act as an activator for allosteric enzymes.
Reason : Allosteric enzymes follow Michaelis-Menten kinetics.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.39 Match the terms in **Group I** with their associated functions in **Group II.**

Group I

P. Shine-Dalgarno sequences
Q. Leucine zipper
R. Aminoacyl tRNA synthetase
S. RNA interference (RNAi)

Group II

1. Aminoacylation of tRNA
2. Gene silencing
3. Ribosome binding and facilitation of translation initiation
4. Transcription factors

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

Q.40 Protein-protein interactions are studied by

P. DNA foot printing
Q. Yeast two hybrid system
R. Ligase chain reaction
S. Mass spectrometry

(A) P and S only
(B) Q and S only
(C) P and R only
(D) Q and R only

Q.41 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r)
Assertion : Isopropylthiogalactoside (IPTG) is a gratuitous inducer of lactose operon.
Reason : Gratuitous inducers are chemical analogs which behave like natural inducer but they do not serve as substrate for the enzymes that are subsequently synthesized.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.42 Determine the correctness or otherwise of the following **Assertion** (a) and the **Reason** (r)
Assertion : In synchronous culture, majority of the cells move to next phase of the cell cycle simultaneously.
Reason : Synchronous culture could be obtained by starving cells for essential nutrient components.

(A) both (a) and (r) are true and (r) is the correct reason for (a)
(B) both (a) and (r) are true but (r) is not the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

Q.43 Which of the following characteristics with respect to bacterial DNA polymerase III are **TRUE**?

P. Initiation of chain synthesis
Q. 5′– 3′ polymerization
R. 3′ – 5′ exonuclease activity
S. 5′ – 3′ exonuclease activity

(A) P and Q only
(B) Q and R only
(C) Q and S only
(D) P and S only

Q.44 Maximum specific growth rate (μ_{max}) of a microorganism is calculated by taking the (ln=$\log_e$, X=biomass, t = time)

(A) slope of ln X *vs* t of the growth cycle
(B) slope of ln X *vs* t during the exponential growth phase
(C) slope of X *vs* t
(D) slope of X *vs* t during the exponential phase of growth

Q.45 Identify the **CORRECT** statements

P. 5′ and 3′ ends of the transcripts can be mapped by utilizing polymerase chain reaction
Q. S_1 nuclease can cleave the DNA strand of a DNA-RNA hybrid
R. T_4 polynucleotide kinase is used for labeling 3′ end of DNA
S. Baculovirus (*Autographa californica*) can be used as an insect expression vector

(A) P and Q only
(B) R and S only
(C) P and S only
(D) Q and R only

Q.46 Value of the determinant mentioned below is

$$\begin{vmatrix} 1 & 0 & -1 & 0 \\ 4 & 7 & 0 & 2 \\ 1 & 1 & -1 & 1 \\ 2 & 0 & 2 & 1 \end{vmatrix}$$

(A) 24 (B) –30 (C) –24 (D) –10

Q.47 HAT (hypoxanthine, aminopterin and thymidine) is used for selecting the hybridomas based on the following

I. Only hybridoma will grow since it inherited the HGPRT genes from B-cells and can synthesize DNA from hypoxanthine.
II. Myeloma cells will not grow in cultures since *de novo* synthesis is blocked by aminopterin and due to the lack of HGPRT enzyme.

(A) only **I** is true
(B) only **II** is true
(C) both **I** and **II** are true
(D) **I** is true and **II** is false

Common Data Questions

Common Data for Questions 48 and 49:

Red-green colour blindness is inherited as a recessive X-linked trait.

Q.48 What will be the probability of having the colour-blind son to a woman with phenotypically normal parents and a colour-blind brother, and married to a normal man? (Assume that she has no previous children)

(A) 100 % (B) 50 % (C) 25 % (D) 12.5 %

Q.49 What will be the probability of having the colour-blind daughter to a phenotypically normal woman, who already had one colour-blind son, and is married to a colour-blind man?

(A) 75 % (B) 50 % (C) 25 % (D) 15%

Common Data for Questions 50 and 51:

A microorganism grows in a continuous 'chemostat' culture of 60 m^3 working volume with sucrose as the growth limiting nutrient at dilution rate, D = 0.55 h^{-1}. The steady state biomass concentration is 4.5 Kg dry biomass m^{-3} and the residual sucrose concentration is 2.0 Kg m^{-3}. The sucrose concentration in the incoming feed medium is 10.0 Kg m^{-3}.

Q.50 What would be the yield $Y_{X/S}$ (Kg biomass/Kg substrate)?

(A) 0.562 (B) 0.462 (C) 0.362 (D) 0.162

Q.51 What would be the sucrose concentration in the input feed for the output to be 45 Kg biomass h^{-1}?

(A) 3.225 Kg m^{-3} (B) 4.425 Kg m^{-3} (C) 5.115 Kg m^{-3} (D) 6.525 Kg m^{-3}

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

The abdomen length (in millimeters) was measured in 15 male fruit flies, and the following data were obtained: 1.9, 2.4, 2.1, 2.0, 2.2, 2.4, 1.7, 1.8, 2.0, 2.0, 2.3, 2.1, 1.6, 2.3 and 2.2 .

Q.52 Variance (V_X) for this population of fruit flies as calculated from the above data shall be

(A) 0.85 (B) 0.25 (C) 0.061 (D) 0.08

Q.53 The value of standard deviation (SD) will be

(A) 0.061 (B) 0.25 (C) 0.61 (D) 0.85

Statement for Linked Answer Questions 54 and 55:

A 200 µl of polymerase chain reaction has 100 template DNA molecules and the reaction was performed for 10 cycles.

Q.54 How many molecules of amplicons will be generated?

(A) 1.024×10^4 (B) 1.024×10^5 (C) 2.048×10^4 (D) 2.048×10^5

Q.55 How many molecules of amplicons will be present in 0.1 µl of reaction?

(A) 102.4 (B) 1024 (C) 51.2 (D) 512

General Aptitude (GA) Questions

Q. 56 – Q. 60 carry one mark each.

Q.56 Which of the following options is the closest in the meaning to the word below:
Inexplicable

(A) Incomprehensible
(B) Indelible
(C) Inextricable
(D) Infallible

Q.57 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

Q.58 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

Q.59 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

Q.60 If Log (P) = (1/2)Log (Q) = (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) $R = P^2Q^2$

Q. 61 to Q. 65 carry two marks each.

Q.61 **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

Q.62 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

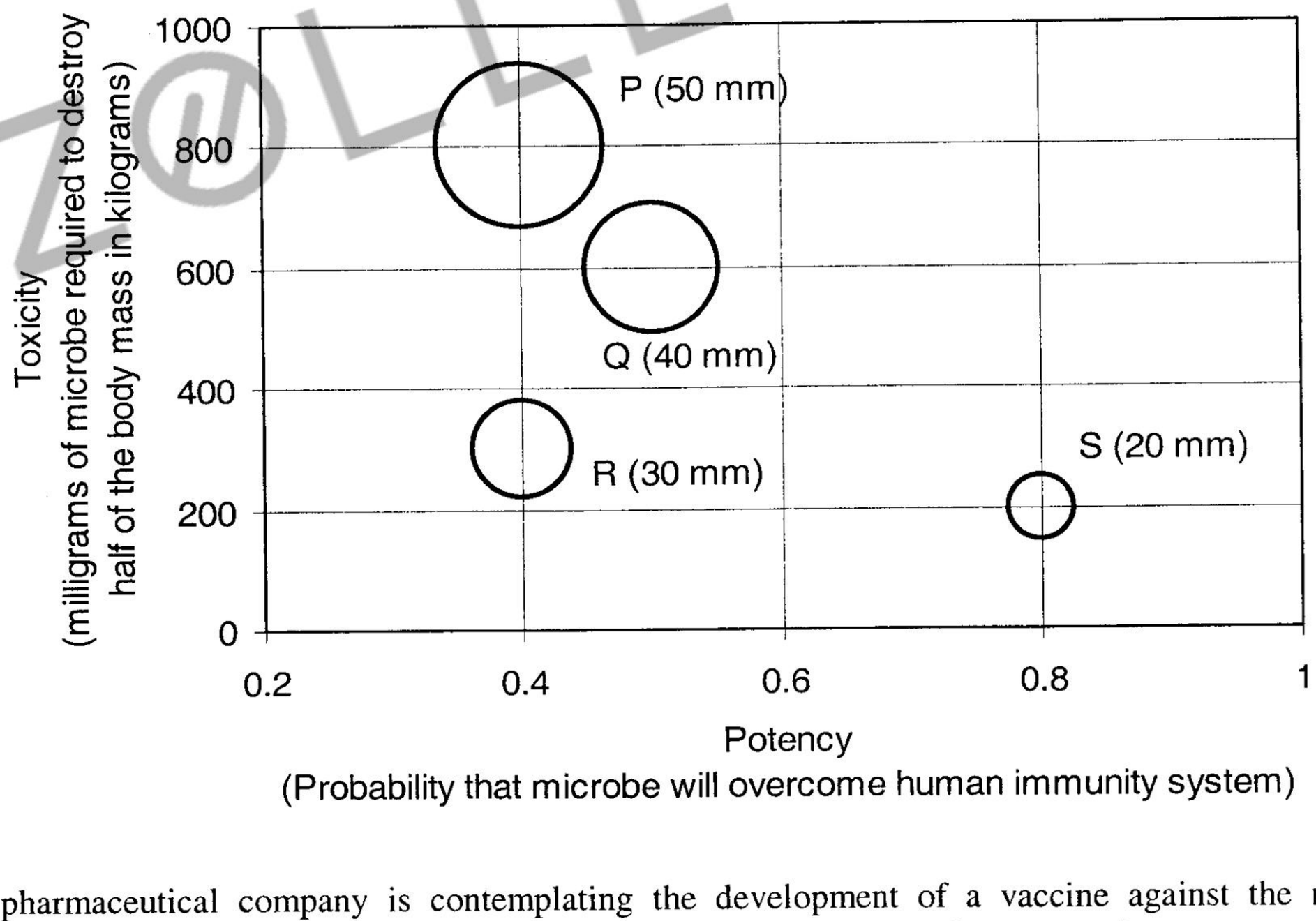
Q.63 A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4th day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10th 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

Q.64 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 same product reduces with q according to the equation F = 100/q. How many units should be produced to minimize the total cost (V+F)?

(A) 5 (B) 4 (C) 7 (D) 6

Q.65 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 human immunity 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 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

END OF THE QUESTION PAPER