GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

1	You have not visited the question yet.
3	You have not answered the question.
5	You have answered the question.
7	You have NOT answered the question, but have marked the question for review.
9	You have answered the question, but marked it for review.

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is answered, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

7. To answer a question, do the following:
   a. Click on the question number in the Question Palette to go to that question directly.
   b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
   c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
   d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
   a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
   b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
   c. To change your chosen answer, click on the bubble of another option.
   d. To save your answer, you MUST click on the **Save & Next** button.

9. Procedure for answering a numerical answer type question:
   a. To enter a number as your answer, use the virtual numerical keypad.
   b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
   c. To clear your answer, click on the **Clear Response** button.
   d. To save your answer, you MUST click on the **Save & Next** button

10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is **Marked for Review**, that answer will be considered in the evaluation unless the status is modified by the candidate.*

11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.

12. Note that ONLY Questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.

14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.

15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.

17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.

19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.

20. You can shuffle between different Sections or change the optional Sections any number of times.

GATE 2014 Examination

AG: Agricultural Engineering

Duration: **180 minutes**   *Maximum Marks*: **100**

Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.

2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.

3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.
   The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.

4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.

5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.

6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.

7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.

8. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.

9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.

10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered**by using the virtual keyboard that appears on the monitor and the mouse.

11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of ⅓ marks for a 1-mark question and ⅔ marks for a 2-mark question.

12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.

13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

Q. 1 – Q. 5 carry one mark each.

Q.1   Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss.

(A) experienced   (B) has experienced
(C) is experiencing   (D) experiences

Q.2   Choose the most appropriate word from the options given below to complete the following sentence.

_____ is the key to their happiness; they are satisfied with what they have.

(A) Contentment   (B) Ambition   (C) Perseverance   (D) Hunger

Q.3   Which of the following options is the closest in meaning to the sentence below?

"As a woman, I have no country."

(A) Women have no country.
(B) Women are not citizens of any country.
(C) Women's solidarity knows no national boundaries.
(D) Women of all countries have equal legal rights.

Q.4   In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is ____ years.

Q.5   The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

(A) 3-4 years   (B) 4-5 years   (C) 5-6 years   (D) 6-7 years

Q. 6 – Q. 10 carry two marks each.

Q.6   In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?
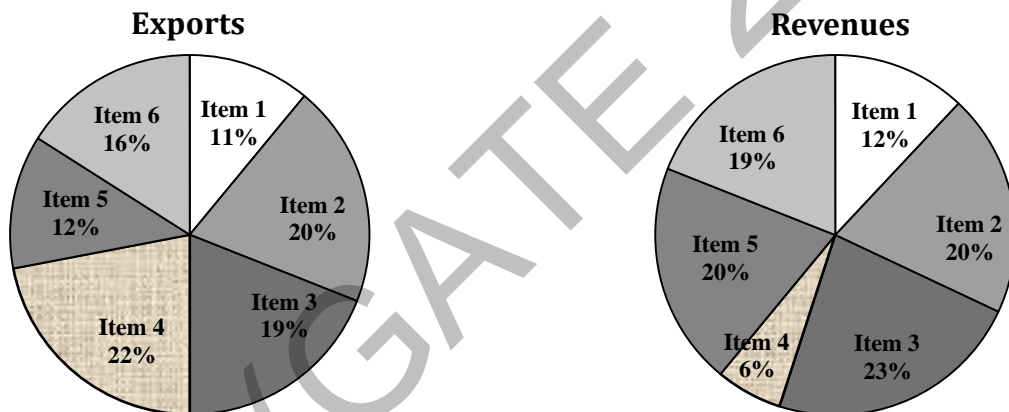**Statements**
1.   Shiv is younger to Riaz.
2.   Shiv is elder to Som.

(A) Statement 1 by itself determines the eldest child.
(B) Statement 2 by itself determines the eldest child.
(C) Statements 1 and 2 are both required to determine the eldest child.
(D) Statements 1 and 2 are not sufficient to determine the eldest child.

Q.7   Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis.
From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier

The <u>main</u> point of the paragraph is:

(A) The twenty-first century is a digital world
(B) Big data is obsessed with exactness
(C) Exactitude is not critical in dealing with big data
(D) Sparse data leads to a bias in the analysis

Q.8   The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?

Exports

Item 6 16%, Item 1 11%, Item 2 20%, Item 3 19%, Item 4 22%, Item 5 12%

Revenues

Item 6 19%, Item 1 12%, Item 2 20%, Item 3 23%, Item 4 6%, Item 5 20%

(A) 1:2   (B) 2:1   (C) 1:4   (D) 4:1

Q.9   X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?

(A) 1   (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2

Q.10   10% of the population in a town is HIV^+. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV^+ individuals 95% of the time, and HIV^- individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1 If two independent variables X and Y are uncorrelated then

(A) $Cov\ (X, Y) = 0$ (B) $Cov\ (X, Y) > 0$

(C) $Cov\ (X, Y) < 0$ (D) $-1 < Cov\ (X, Y) < 1$

Q.2 A partial differential equation containing dependent variable u is given by

$$A\ \frac{\partial^2 u}{\partial x^2} + 2B\ \frac{\partial^2 u}{\partial x \partial y} + C\ \frac{\partial^2 u}{\partial y^2} + D\ \frac{\partial u}{\partial x} + E\ \frac{\partial u}{\partial y} + F\ u + G = 0$$

where A, B, C, D, E, F and G are constants or functions of independent variables x or y only. Also $G \neq 0$. The nature of the equation is

(A) Linear and homogeneous   (B) Non-linear and homogeneous

(C) Linear and non-homogeneous   (D) Non-linear and non-homogeneous

Q.3 If $f(x, y) = 3x^2 - 4xy + 2y^2$, the summation of $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ for $x = 1$ and $y = 2$ is _____.

Q.4 The brake power of a four-cylinder engine is 30 kW with all cylinders firing and 20 kW with any one cylinder cut. The mechanical efficiency of the engine in percent is

(A) 60   (B) 67   (C) 75   (D) 83

Q.5 A tractor is provided with an Ackerman steering gear mechanism. If b is the wheel base, c the distance between the front wheel pivot points, θ the steering angle of the inner wheel and ϕ the steering angle of the outer wheel, the fundamental relationship to be satisfied to avoid skidding of the two front wheels during a turn is given by

(A) $tan\ \phi - tan\ \theta = \frac{c}{b}$ (B) $cot\ \phi - cot\ \theta = \frac{c}{b}$

(C) $tan\ \theta - tan\ \phi = \frac{b}{c}$ (D) $cot\ \phi - cot\ \theta = \frac{b}{c}$

Q.6 Match the processes given in Group-I with the derived products given in Group-II.

	Group-I		Group-II
i.	Transesterification	a.	Producer gas
ii.	Pyrolysis	b.	Ethanol
iii.	Yeast fermentation	c.	Biogas
iv.	Anaerobic digestion	d.	Biodiesel

(A) i-c; ii-c; iii-b; iv-d   (B) i-d; ii-c; iii-b; iv-a

(C) i-b; ii-d; iii-a; iv-c   (D) i-d; ii-a; iii-b; iv-c

Q.7 While operating a pedal thresher, 14 kg of paddy seed remained unthreshed for a throughput of 112 kg. If the quantity of the threshed seed obtained was 70 kg, the threshing efficiency in percent is

(A) 62.50   (B) 80.00   (C) 83.33   (D) 87.50

Q.8 The pitch of the chain used in a chain drive motion is 38 mm. If the number of teeth on one of the sprockets is 35, the pitch circle diameter of the sprocket in m is_____.

Q.9 A tractor tyre contains 31 L of air at a pressure of 190 kPa and a temperature of 30^oC. Using R=8.314 J $(gmol)^{-1}$ K^{-1} and molecular mass of air = 29 g $(gmol)^{-1}$, the mass of air contained in the tyre is M $\times$ 10^{-3} kg. The value of M is_____.

Q.10 A flywheel and clutch assembly weighs 200 N and has a radius of gyration 150 mm. If the engine speed is 3000 rpm, the kinetic energy possessed by the rotating assembly in kJ is_____.

Q.11 A vertical conveyor reaper costing Rs. 75000 has a useful life of 8 years. Taking salvage value of the machine as 10% of the initial cost, the depreciated value after half of its useful life following straight line method will be Rs. _____.

Q.12 For a fully developed laminar flow through a smooth pipe, the relationship between friction factor (*f*) and Reynolds number (*Re*) is

(A) $f \propto (Re)$ (B) $f \propto (Re)^{-1}$ (C) $f \propto (Re)^2$ (D) $f \propto (Re)^{-2}$

Q.13 The process of determining the elevation of different points in a vertical plane is known as

(A) Levelling   (B) Surveying   (C) Contouring   (D) Tacheometry

Q.14 An imaginary surface obtained by joining the water levels in several observation wells driven in a confined aquifer is known as

(A) Phreatic surface   (B) Piezometric surface

(C) Capillary fringe   (D) Water table

Q.15 Several identical sprinkler nozzles, each having discharge *Q* (litre per minute), are spaced in a grid of size *L* (metre) $\times$ *S* (metre). The application rate in mm h^{-1} is

(A) $\dfrac{60\,Q}{L\,S}$ (B) $\dfrac{3600\,Q}{L\,S}$ (C) $\dfrac{L\,S}{60\,Q}$ (D) $\dfrac{L\,S}{3600\,Q}$

Q.16 A 20 m chain used for surveying is found to be actually 19.7 m. If the actual distance is 1200 m, the chain distance in m will be_____.

Q.17 The brake power of a centrifugal pump having an impeller diameter of 200 mm is 1.86 kW. If the impeller is replaced with another impeller of 180 mm diameter, the brake power of the pump in kW will be _____.

Q.18 The discharge of a single suction centrifugal pump operating against a total head of 12 m is 50 L s^{-1}. If the pump is directly connected to a motor operating at 1440 rpm, the specific speed of the pump will be_____.

Q.19 A fat rich food product remains most stable in the water activity (a_w) range of

(A) $a_w < 0.1$ (B) $0.1 < a_w < 0.2$ (C) $0.3 < a_w < 0.4$ (D) $0.5 < a_w < 0.6$

Q.20 Identify the **INCORRECT** statement about the relevance of various dimensionless numbers in transport processes

(A) Reynolds number is relevant in forced convection and Grashof number is relevant in natural convection

(B) Prandtl number is relevant in heat transfer and Schmidt number is relevant in mass transfer

(C) Biot number is relevant in heat transfer and Froude number is relevant in mass transfer

(D) Nusselt number is relevant in heat transfer and Sherwood number is relevant in mass transfer

Q.21 Select the most appropriate option about boiling and condensation processes as expressed by the statements P, Q and R.

   P – The quantities of heat involved in evaporation and condensation of unit mass of fluid are identical
   Q – The boiling and condensation of a single compound normally occur isothermally
   R – The condensation is achieved at or below dew point and boiling occurs at triple point

(A) All P, Q and R are true   (B) Only P and Q are true

(C) Only P is true   (D) Only Q is true

Q.22 With increasing grain height in a deep cylindrical grain bin, the pressure at its base will

(A) decrease initially and then increase

(B) increase initially and then decrease

(C) decrease initially and then remain constant

(D) increase initially and then remain constant

Q.23 The observations recorded in a pulse de-husking operation are:

S. No.	Parameters	Before de-husking	After de-husking
1.	Whole (split) kernel content,%	0.5	72.3
2.	Broken kernel content, %	0.7	11.2
3.	Mealy waste content, %	1.1	16.5

For this operation the effectiveness of wholeness (in decimal) of kernels will be _____.

Q.24 Oil yield (Y_o) of mustard after N days of flowering is expressed as
$$Y_o = -0.0018\,N^2 + 0.1319\,N - 0.743$$

For maximum oil yield, optimum stage of harvesting, in days after flowering is,

(A) 23   (B) 29   (C) 37   (D) 39

Q.25 In a tray drying under adiabatic process, hot air enters the dryer at 50°C dry bulb temperature (DBT) and 10% relative humidity (RH) with enthalpy of 70.2 kJ per kg dry air. The air leaving the dryer gains 20% moisture. Considering saturated water vapour pressure as 12.349 kPa at 50°C DBT, the enthalpy of air leaving the dryer in kJ per kg dry air is _____.

Q. 26 – Q. 55 carry two marks each.

Q.26 The eigenvalues of the matrix $A = \begin{bmatrix} 2 & 2 \\ -1 & 5 \end{bmatrix}$ are

(A) 1 and 2 (B) 2 and 3 (C) 3 and 4 (D) 4 and 5

Q.27 The value of line integral $I = \int_c \{(x^2 y)\, dx + (x - z)dy + (xyz)\, dz\}$, where C is the arc of the parabola $y = x^2$ in the plane $z = 2$ from P (0, 0, 2) to Q (1, 1, 2), is

(A) $-\frac{43}{15}$ (B) $\frac{43}{15}$ (C) $-\frac{17}{15}$ (D) $\frac{17}{15}$

Q.28 Consider the following set of linear equations
$$\begin{aligned} x_1 + x_2 + x_3 &= 6 \\ 2x_1 + 2x_2 + 3x_3 &= 14 \\ 3x_1 + x_2 + 2x_3 &= 14 \end{aligned}$$

The solution for this set exists only when the value of x_2 is _____.

Q.29 If $f(x)$ is a normal distribution with mean 8 and standard deviation 1, the value of $f(x)$ for $x = 10$ is

(A) 0.05 (B) 0.14 (C) 0.25 (D) 0.73

Q.30 The value of $\int_0^{\pi/2} \frac{cos^2 x}{1 + sinx} dx$ is

(A) 0 (B) $\frac{\pi}{2} - 1$ (C) 2 (D) $\frac{\pi}{2} + 1$

Q.31 A four-stroke, four-cylinder diesel engine running at 2000 rpm develops brake power of 60 kW and the fuel consumption is 0.30 kg kW^{-1} h^{-1}. The engine has a bore of 120 mm and stroke of 100 mm. If air-fuel ratio is 15:1 and air density is 1.15 kg m^{-3}, the volumetric efficiency of the engine in percent is

(A) 43.25 (B) 66.32 (C) 75.22 (D) 86.50

Q.32 A four-wheel-drive tractor has a static weight of 50 kN with 40% weight on rear axle and 60% on front axle. The wheel base is 2 m. The tractor is pulling a disc harrow that exerts a level drawbar pull at a hitch height of 0.5 m from the ground. During the operation, when the dynamic reaction on each axle is same, the dynamic traction ratio developed by the tractor is

(A) 0.2 (B) 0.4 (C) 0.5 (D) 0.8

Q.33 A knapsack sprayer is provided with a nozzle having rated delivery of 0.5 L min⁻¹ at a pressure of 270 kPa. For a pressure setting of 210 kPa, the application rate per unit orifice area is 0.24 L cm⁻²s⁻¹. If the coefficient of discharge of the nozzle is 0.75, the diameter of the nozzle orifice in mm is

(A) 1.71   (B) 1.76   (C) 2.28   (D) 2.59

Q.34 The day length (sunshine hours) on 31ˢᵗ May 2014 at a place in India (26°18' N, 73°01' E) will be_____.

Q.35 A tractor gear box has 8 forward speeds. The speed ratios (number of engine revolutions for one revolution of driving wheel) vary in exact geometrical progression. If the speed ratios in highest and lowest gears are 14.9 and 108.8, respectively, the geometric constant is _____.

Q.36 A multi-disc clutch has 4 steel discs and 3 bronze discs. The outside and inside diameters of contact surfaces are 250 mm and 180 mm, respectively. The coefficient of friction is 0.3 and axial force is 400 N. Assuming uniform wear, the power in kW that the clutch can transmit at 1000 rpm is _____.

Q.37 A cultivator with a working width of 1.2 m utilizes 95% of its width due to overlapping while operating at a forward speed of 2 km h⁻¹. If the time lost in turning and other interruptions is 50 minutes per hectare, the field efficiency of the cultivator in percent is

(A) 79.84   (B) 83.34   (C) 86.97   (D) 90.20

Q.38 A two-row horizontal plate potato planter with 0.6 m ridge spacing has 9 cups on each seed plate of 0.4 m diameter. For each revolution of the ground wheel, the seed plate makes half a revolution. The diameter of the ground wheel is 0.5 m. If the planter uses cut tubers each of 25 g mass, the seed rate in kg ha⁻¹ is _____.

Q.39 A hydraulic circuit uses a pump having a fixed displacement volume of 12.5 cm³ rev⁻¹ driven at 1500 rpm. The pump has a volumetric efficiency of 85% and an overall efficiency of 75%. If the system pressure is set at 15 MPa by the relief valve, the power required to drive the pump in kW will be

(A) 2.99   (B) 4.53   (C) 5.31   (D) 7.53

Q.40 A 200 m long horizontal pipe carries a discharge of 50 L s⁻¹. The centre line of the pipe is 5 m above the datum. The diameter of the pipe tapers from 200 mm to 100 mm. Using g = 9.81 m s⁻² and neglecting losses in the pipe, if the pressure at the larger end of the pipe is 100 kPa, the pressure at the other end of the pipe in kPa is _____.

Q.41 A tile drainage system having 200 mm diameter lateral of 400 m length is used to drain an area with a drainage coefficient of 40 mm. Manning's roughness coefficient for the drain pipe is 0.01. Drain pipes are laid at 0.3% slope. The spacing of the tile drain in m is _____.

Q.42   A crop has effective root zone depth of 1200 mm and monthly (30 days) crop evapotranspiration of 260 mm. The effective rainfall during 30 days period is 20 mm. The field capacity and permissible soil moisture depletion (volume basis) are 16% and 8%, respectively. The irrigation interval in days for the crop will be

(A) 30   (B) 18   (C) 12   (D) 8

Q.43   In a citrus orchard, planting is done at a spacing of 5 m × 5 m. The daily pan evaporation of the orchard is 6 mm. The pan coefficient, wetting factor (crop canopy factor) and crop coefficient are 0.8, 0.6 and 0.6, respectively. Four drippers each of 4 L h^{-1} discharge are used to irrigate each plant. The time of operation of drip irrigation system in hours will be

(A) 2.7   (B) 4.5   (C) 16.2   (D) 19.8

Q.44   A 150 mm diameter well is driven fully in a confined aquifer of thickness 12 m. When pumping is done at a constant rate of 150 L min^{-1} for 10 h, the steady-state draw-downs are found to be 2.20 m and 0.02 m at distances of 14 m and 50 m, respectively from the centre of the well. The hydraulic conductivity of the aquifer in m day^{-1} is _____.

Q.45   A triangular 5-hour unit hydrograph (UH$_1$) of a catchment area of 400 km^2 has a peak discharge of 60 m^3 s^{-1}. Another triangular 5-hour unit hydrograph (UH$_2$) having the same base width as UH$_1$ has a peak flow of 90 m^3 s^{-1}. The catchment area corresponding to UH$_2$ in km^2 is

(A) 267   (B) 600   (C) 750   (D) 867

Q.46   A watershed has 1.8 km^2 of cultivated area, 2.2 km^2 of forest land and 1.4 km^2 of grassed area. The runoff coefficient of cultivated area, forest land and grassed area are 0.25, 0.15 and 0.30, respectively. The main drainage channel has a fall of 25 m in the total length of 2.5 km. The Intensity-Duration-Frequency relationship for the watershed is expressed as,

$$I = \frac{70\,T^{\,0.25}}{(t_c + 15)^{0.4}}$$

where, I - intensity in cm h^{-1}, T - recurrence interval in years and t$_c$ - time of concentration in minutes.
For a recurrence interval of 20 years, the peak rate of runoff for the watershed in m^{3}s^{-1} will be _____.

Q.47   Bench terraces are to be constructed on a 15% hill slope. The batter slope is 1:1 and vertical interval is 2.5 m. The earth work in cutting is equal to filling. The quantum of earthwork in m^3 ha^{-1} will be

(A) 2656   (B) 2818   (C) 4248   (D) 5312

Q.48   A triangular shaped grassed waterway with a longitudinal slope of 2.5% is to carry a discharge of 1.5 m^3 s^{-1} with a permissible velocity of 1.2 m s^{-1}. The side slope of the channel is 1.5:1 (Horizontal:Vertical). Without considering free board, the top width of the channel in m is _____.

Q.49 A container having volume 282.7 cm^3 and total surface area 245 cm^2 is completely filled with milk whose initial temperature is 25°C. The continually stirred milk container is suddenly exposed to a steam bath at 100°C. The overall heat transfer coefficient between steam and milk is 1136 W m^{-2} K^{-1}. The properties of milk are: specific heat capacity = 3.9 kJ kg^{-1}K^{-1}, thermal conductivity = 0.54 W m^{-1}K^{-1} and density = 1030 kg m^{-3}. Neglecting thermal resistance and heat capacity of container walls, the necessary time required in seconds to heat milk up to the temperature of 85°C, will be _____.

Q.50 In a continuous belt freezer, fish fillet at a feed rate of 1000 kg h^{-1} is frozen. The unfrozen fish having moisture content of 85% (wet basis) enters the freezer at 25°C and complete frozen fish exits at –20°C. Properties of fish are: latent heat of crystallization = 330 kJ kg^{-1}, fixed freezing point = – 2.5^{o}C, density = 1100 kg m^{-3}, specific heat capacity above freezing point=3.60 kJ kg^{-1} K^{-1} and specific heat capacity below freezing point = 1.97 kJ kg^{-1} K^{-1}. Neglecting other heat losses in the freezer, the power requirement of the compressor (in kW) having a coefficient of performance of 2.50 is,

(A) 43.8   (B) 46.0   (C) 51.5   (D) 61.7

Q.51 A centrifuge with rotational speed of 1440 rpm is used for separating oil from a dispersion in which oil is present in the form of spherical globules of 47 µm diameter. The density of oil is 886 kg m^{-3}. Separation occurs at an effective radius of 4 cm. Viscosity and density of water are 0.705 cP and 1000 kg m^{-3}, respectively. The velocity of oil through water, in mm s^{-1},   is _____.

Q.52 Energy required to grind a given mass of particles from a mean diameter of 12 mm to 4 mm is 12 kJ kg^{-1}. If energy consumed to grind the same mass of particles of 2 mm mean diameter to x mm mean diameter is 252 kJ kg^{-1}, the value of x using Rittinger's Law will be _____.

Q.53 A tray type paddy separator is used to separate paddy from a binary mixture of paddy and brown rice fed at the rate of 1600 kg h^{-1}. Mass fractions of paddy in feed, separated paddy and separated rice are 0.2, 0.7 and 0.02, respectively. The mass of 1000 paddy grains is 24.5 g. Separation effectiveness and number of paddy grains recycled per second, respectively are

(A) 0.35 and 7373   (B) 0.93 and 3733   (C) 0.76 and 3773   (D) 0.83 and 3361

Q.54 M kg of wheat at 9.8% moisture content (wet basis) is conditioned for 6 hours in 75 kg of water. A sample of 25 g conditioned wheat is crushed and dried in hot air oven at 130°C for 1 hour that yields 20.5 g of bone dried material. The value of M is _____.

Q.55 In a food processing plant hot water at 90°C is needed at the rate of 140% of the commodity capacity. Steam at atmospheric pressure is used for heating the water available at 25°C. Latent heat of condensation at atmospheric pressure is 2257 kJ kg^{-1}, net calorific value of hull is 12552 kJ kg^{-1} and specific heat capacity of water is 4.184 kJ kg^{-1} K^{-1}. Steam is generated by utilizing the hulls received as by-product from the same plant at the rate of 22% of the commodity capacity. Assuming 20% heat loss, percentage of hull used with respect to the total available amount of hull is _____.

END OF THE QUESTION PAPER