























**GATE 2022 Agricultural Engineering (AG)**

**Q.11 – Q.35 Carry ONE mark Each**

Q.11	Determinant of a matrix remains unaltered if _____.
(A)	its columns and rows are interchanged
(B)	two parallel lines are identical
(C)	two parallel lines intersect
(D)	each element of a line is multiplied by the same factor
Q.12	The probability of having 53 Sundays in a randomly selected leap year is _____.
(A)	1/7
(B)	1/4
(C)	2/7
(D)	4/7



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Q.13	Function $f(x)$ by Maclaurin's series (as an infinite series) can be expressed as
(A)	$f(x) = f(1) + x f'(1) + \frac{x^2}{2!} f''(1) + \frac{x^3}{3!} f'''(1) + \dots + \infty$
(B)	$f(x) = f(0) + x f'(0) + \frac{x^2}{2!} f''(0) + \frac{x^3}{3!} f'''(0) + \dots + \infty$
(C)	$f(x) = f(1) - x f'(1) + \frac{x^2}{2!} f''(1) - \frac{x^3}{3!} f'''(1) + \dots + \infty$
(D)	$f(x) = f(0) - x f'(0) + \frac{x^2}{2!} f''(0) - \frac{x^3}{3!} f'''(0) + \dots + \infty$
Q.14	The lowest temperature at which the fuel ceases to flow is known as _____.
(A)	Pour point
(B)	Cloud point
(C)	Flash point
(D)	Boiling point



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Q.15	Complement of the Solar Altitude angle is _____.
(A)	Zenith angle
(B)	Azimuth angle
(C)	Hour angle
(D)	Profile angle
Q.16	Annual cost of owning (fixed cost) a particular combine harvester is Rs. 3,00,000 whereas, operating it would cost additional Rs. 6,000 per hectare. If an entrepreneur wishes to offer the machine for custom hiring, the combination of annual use (ha) and custom rate (Rs. ha <sup>-1</sup> ), respectively, that would fetch him the break-even condition is _____.
(A)	200 and 7,500
(B)	210 and 6,300
(C)	180 and 9,200
(D)	250 and 6,100



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Q.17	In construction of gravel packed wells, the pack-aquifer ratio is generally defined as _____.
(A)	$\frac{50\% \text{ of the size of gravel pack}}{50\% \text{ of the size of aquifer}}$
(B)	$\frac{60\% \text{ of the size of gravel pack}}{10\% \text{ of the size of aquifer}}$
(C)	$\frac{50\% \text{ of the size of aquifer}}{50\% \text{ of the size of gravel pack}}$
(D)	$\frac{60\% \text{ of the size of aquifer}}{10\% \text{ of the size of gravel pack}}$
Q.18	The shape of falling limb of a hydrograph is dependent on _____.
(A)	basin and storm characteristics
(B)	storm characteristics only
(C)	basin characteristics only
(D)	direction of the rainfall only



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Q.19	Energy requirement ( $E$ ) to produce a change ( $dX$ ) in dimension $X$ of a particular size can be expressed as $\frac{dE}{dX} = -\frac{c}{X^n}$ where, $c$ is constant and $n$ according to Rittinger's law is _____.
(A)	$\frac{1}{2}$
(B)	$\sqrt{2}$
(C)	$\frac{3}{2}$
(D)	2
Q.20	The ratio of inertial forces to viscous forces is known as _____.
(A)	Froude number
(B)	Reynolds number
(C)	Power number
(D)	Biot number
Q.21	The root of the equation $\sin x - 4x + 1 = 0$ after its first iteration, using Newton-Raphson method with an initial guess of $x_0 = 0.2$ , is _____. [round off to three decimal places]
Q.22	The slope of the function $f(x) = 2x^4 - 3x^2 + 5x$ at $x = 2$ is _____. [Answer in integer]



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Q.28	A stream of $200 \text{ L s}^{-1}$ is diverted from a canal to irrigate a wheat field in 8 hours. If the runoff from the field is $500 \text{ m}^3$ and the conveyance efficiency is 75%, the application efficiency in per cent is _____. [ <i>round off to two decimal places</i> ]
Q.29	The flow rate per unit width of a wide rectangular clean-earth channel is $20 \text{ m}^3 \text{ s}^{-1} \text{ m}^{-1}$ . The calculated critical flow depth in meter will be _____. [ <i>round off to two decimal places</i> ]  (Take $g = 9.81 \text{ m s}^{-2}$ )
Q.30	The ratio of soil loss from the field plot length to that from the unit plot with a slope length of 22.13 m is 0.5. If the slope length from the watershed divide is 600 m and the slope gradient is 8%, the topographic factor in the Universal Soil Loss Equation is _____. [ <i>round off to two decimal places</i> ]
Q.31	The area of a rectangular field was measured using a 30 m survey chain, which was later found to be 5 cm short. If the length and width of the field measured using this chain were 542 m and 554 m, respectively, the true area of the field in ha is _____. [ <i>round off to two decimal places</i> ]
Q.32	In a triple effect feed forward evaporator, pineapple juice is entering at the rate of $6.3 \text{ kg s}^{-1}$ and leaving the last effect as 50% concentrate. The system is using saturated steam of $2.48 \text{ kg s}^{-1}$ at $121.1 \text{ }^\circ\text{C}$ . If vapour transferred from the first to the second effect, second to third effect and third to ambient are 5675, 6053 and $6416 \text{ kg h}^{-1}$ , respectively, the steam economy of the evaporator is _____. [ <i>round off to two decimal places</i> ]





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Q.33	If an osmo-dehydrated fruit slice has 72% moisture content on wet basis, the moisture content of the same fruit slice on dry basis in per cent is _____. [round off to one decimal place]
Q.34	If the specific heat capacity ( $c_p$ ) of solids in potato is $837.36 \text{ J kg}^{-1} \text{ K}^{-1}$ , then the specific heat capacity of potatoes in $\text{J kg}^{-1} \text{ K}^{-1}$ with 85% moisture content (wet basis) is _____. [round off to two decimal places]
Q.35	A milk sample contains $4 \times 10^5$ spores of <i>C. botulinum</i> (D value of 1.2 min at $121.1^\circ\text{C}$ ) and $7 \times 10^6$ spores of <i>L. monocytogenes</i> (D value of 0.9 min at $121.1^\circ\text{C}$ ) per mL. If the milk is heated at a uniform temperature of $121.1^\circ\text{C}$ to obtain a probability of spoilage of 1 in 1000 cans, the minimum heating duration in minutes is _____. [round off to two decimal places]



**GATE 2022 Agricultural Engineering (AG)**

**Q.36 – Q.65 Carry TWO marks Each**

Q.36	The function $(x - 2)^2(x + 2)^2$ has
(A)	minima at +2 and maxima at -2
(B)	minima at -2 and maxima at +2
(C)	minima at -2 and +2
(D)	maxima at -2 and +2
Q.37	The matrix $\begin{bmatrix} (3-x) & 2 & 2 \\ 2 & (4-x) & 1 \\ -2 & -4 & (-1-x) \end{bmatrix}$ is singular for the following values of $x$
(A)	$x = 0$ and $x = 3$
(B)	$x = 0$ and $x = -3$
(C)	$x = 0$ and $x = 6$
(D)	$x = 0$ and $x = -6$







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Q.42	<p>A parabolic shaped grass-waterway is to be designed to carry a flow of <math>2.85 \text{ m}^3 \text{ s}^{-1}</math> down the slope of 3%. The permissible velocity of water in the waterway is <math>1.78 \text{ m s}^{-1}</math>. If the freeboard depth is excluded, the most appropriate top width in m and depth in m, respectively are</p> <p>(Take Manning's roughness coefficient = 0.04)</p>
(A)	4 and 0.6
(B)	6 and 0.4
(C)	7 and 0.5
(D)	5.5 and 0.6
Q.43	<p>The pressure drop through a well-designed constriction is to be used for measuring the velocity of flow through a circular pipe. If the pressure drop from a 0.1 m diameter section to a 0.05 m diameter section of the pipe is 7.5 kPa, the velocity in <math>\text{m s}^{-1}</math> in the 0.1 m diameter section of the pipe is _____.</p> <p>(Take density of liquid = <math>1000 \text{ kg m}^{-3}</math>)</p>
(A)	0.5
(B)	1.0
(C)	1.5
(D)	2.0



**GATE 2022 Agricultural Engineering (AG)**

Q.44	<p>The water activity of potato is 0.942. As per Raoult's law, the most efficient solution for osmotic dehydration of potato is _____.</p> <p>(Molar mass of sucrose = 342 g mole<sup>-1</sup>, and NaCl = 58.5 g mole<sup>-1</sup>)</p>
(A)	20% sucrose solution
(B)	20% NaCl solution
(C)	10% sucrose solution + 10% NaCl solution
(D)	15% sucrose solution + 5% NaCl solution
Q.45	<p>The mass fraction retained on the i<sup>th</sup> sieve is x<sub>i</sub> and <math>\overline{D}_{pi}</math> is the average opening size of i<sup>th</sup> and (i-1)<sup>th</sup> sieves. The volume surface mean diameter (<math>\overline{D}_s</math>) of particles retained on n number of sieves is _____.</p>
(A)	$\overline{D}_s = \frac{1}{\sum_{i=1}^n \left( \frac{x_i}{\overline{D}_{pi}} \right)}$
(B)	$\overline{D}_s = \sum_{i=1}^n x_i \overline{D}_{pi}$
(C)	$\overline{D}_s = \left[ \frac{1}{\sum_{i=1}^n \left( \frac{x_i}{\overline{D}_{pi}^3} \right)} \right]^{1/3}$
(D)	$\overline{D}_s = \left[ \frac{1}{\sum_{i=1}^n \left( \frac{x_i}{\overline{D}_{pi}^3} \right)} \right]^{2/3}$



**GATE 2022 Agricultural Engineering (AG)**

Q.46	<p>Match the following reactants in Column I with the most appropriate purpose used in processing as mentioned in Column II</p> <table border="1"> <thead> <tr> <th></th> <th>Column I</th> <th></th> <th>Column II</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Vitamin E</td> <td>P</td> <td>fumigant for insect killing</td> </tr> <tr> <td>II</td> <td>Calcium salts</td> <td>Q</td> <td>reduces shrinkage losses</td> </tr> <tr> <td>III</td> <td>Edible waxes</td> <td>R</td> <td>antioxidant with vitamin A in oils</td> </tr> <tr> <td>IV</td> <td>Methyl Bromide</td> <td>S</td> <td>firming agent in fruits</td> </tr> </tbody> </table>		Column I		Column II	I	Vitamin E	P	fumigant for insect killing	II	Calcium salts	Q	reduces shrinkage losses	III	Edible waxes	R	antioxidant with vitamin A in oils	IV	Methyl Bromide	S	firming agent in fruits
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(A)	I-P, II-S, III-Q, IV-R																				
(B)	I-R, II-Q, III-S, IV-P																				
(C)	I-P, II-Q, III-S, IV-R																				
(D)	I-R, II-S, III-Q, IV-P																				
Q.47	<p>Work done by a moving particle in the force field <math>\vec{F} = 6x^2\hat{i} + (3xz + y)\hat{j} + 4z\hat{k}</math>, moving along the straight line from (0,0,0) to (1,2,3) is _____. [Answer in integer]</p>																				
Q.48	<p>The power consumption readings (in watt) by an instrument at fixed intervals of time (in seconds) are tabulated below:</p> <table border="1"> <thead> <tr> <th>Time (s)</th> <th>0.0</th> <th>0.6</th> <th>1.2</th> <th>1.8</th> <th>2.4</th> <th>3.0</th> <th>3.6</th> </tr> </thead> <tbody> <tr> <th>Power consumption (W)</th> <td>8.6</td> <td>9.2</td> <td>7.8</td> <td>6.4</td> <td>7.2</td> <td>8.6</td> <td>11.2</td> </tr> </tbody> </table> <p>Using Simpson's 1/3<sup>rd</sup> rule, the energy expenditure of the instrument in joule is _____. [round off to two decimal places]</p>	Time (s)	0.0	0.6	1.2	1.8	2.4	3.0	3.6	Power consumption (W)	8.6	9.2	7.8	6.4	7.2	8.6	11.2				
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Q.49	<p>The root mean square acceleration for mechanical vibration of a tractor is <math>3.15 \text{ m s}^{-2}</math> and its frequency is 80 Hz. The root mean square amplitude of the vibration in <math>\mu\text{m}</math> is _____. [<i>round off to two decimal places</i>]</p> <p>(Take <math>\pi = 3.14</math>)</p>
Q.50	<p>The static weight on front and rear axles of a two-wheel drive tractor are 3 kN and 9 kN, respectively. The wheel-base of the tractor is 2.1 m and the tractor pulls a load of 7.5 kN. The perpendicular distance from the front wheel ground contact point to the line of pull is 680 mm. Neglecting the wheel contact off-set on the ground, the weight transfer onto the rear axle in kN is _____. [<i>round off to two decimal places</i>]</p>
Q.51	<p>The crank radius and connecting rod length of an IC engine are 250 mm and 1000 mm, respectively. If the crank turns <math>100^\circ</math> from the head dead centre and the net force acting on the piston along its direction of motion is 35 kN, the turning moment of the crank shaft at that instant in kN m is _____. [<i>round off to two decimal places</i>]</p>
Q.52	<p>An engine develops 42 kW brake power when it runs with B20 fuel (80% biodiesel and 20% diesel by volume) with a brake thermal efficiency of 24%. The heating value of the fuel is <math>46.15 \text{ MJ kg}^{-1}</math> and its density is <math>0.845 \text{ kg L}^{-1}</math>. The fuel consumption of the engine in <math>\text{L h}^{-1}</math> will be _____. [<i>round off to two decimal places</i>]</p>
Q.53	<p>A tractor operated <math>12 \times 60 \text{ cm}</math> boom sprayer had an overlap of 30 cm between the successive passes during field operation at an average speed of <math>4.2 \text{ km h}^{-1}</math>. A total time loss of <math>7.5 \text{ min ha}^{-1}</math> was observed during turnings. Assuming no overlap of spray material between adjacent nozzles, the field efficiency of the sprayer in per cent is _____. [<i>round off to two decimal places</i>]</p>



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<p>Q.54</p>	<p>A mild steel flange-mounted single shear pin (Ultimate shear strength = 42 MPa) of 10 mm diameter is used in a flange. The perpendicular distance between the axis of driving shaft and the shear pin axis is 100 mm. If the speed of the driving shaft is 300 rpm, the maximum power the shaft could transmit in kW before the failure of the pin is _____. [<i>round off to two decimal places</i>]</p> <p>[Take <math>\pi = 3.14</math>]</p>															
<p>Q.55</p>	<p>In a subsurface drainage network, 12 lateral drains each of 100 m long are laid at a spacing of 50 m. These lateral drains are connected to a collector drain. When the water table dropped 50 cm below the soil surface in 4 days, the average discharge at the outlet of the collector drain was found to be <math>12 \text{ L s}^{-1}</math>. The average drainable porosity of soil in per cent is _____. [<i>round off to two decimal places</i>]</p>															
<p>Q.56</p>	<p>A watershed with various land uses (as specified in the table below) receives a rainfall of 152.4 mm. If an initial abstraction (<math>I_a</math>) is 0.2 times the potential maximum retention (S), and the antecedent moisture content (AMC) of averaged condition is assumed, the depth of runoff volume in mm is _____. [<i>round off to two decimal places</i>]</p>															
	<table border="1"> <thead> <tr> <th>Land use (%)</th> <th>Soil group</th> <th>Curve number</th> </tr> </thead> <tbody> <tr> <td>Residential, 40%</td> <td>C</td> <td>83</td> </tr> <tr> <td>Open space- good condition, 25%</td> <td>D</td> <td>80</td> </tr> <tr> <td>Commercial and business, 20%</td> <td>C</td> <td>94</td> </tr> <tr> <td>Industrial, 15%</td> <td>D</td> <td>93</td> </tr> </tbody> </table>	Land use (%)	Soil group	Curve number	Residential, 40%	C	83	Open space- good condition, 25%	D	80	Commercial and business, 20%	C	94	Industrial, 15%	D	93
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<p>Q.57</p>	<p>A trapezoidal weir has a side slope of 1 horizontal unit to 4 vertical units. The length of the weir is less than the width of the channel. If the head over the weir is 70 cm and the discharge is <math>0.85 \text{ m}^3 \text{ s}^{-1}</math>, the length of the weir in m is _____. [<i>round off to two decimal places</i>]</p> <p>(Take coefficient of discharge = 0.62 and <math>g = 9.81 \text{ m s}^{-2}</math>)</p>															



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<p>Q.62</p>	<p>Parboiled paddy is to be dried in a tray dryer under steady state conditions from an initial free moisture content of <math>0.40 \text{ kg H}_2\text{O (kg dry solid)}^{-1}</math> to final free moisture content of <math>0.02 \text{ kg H}_2\text{O (kg dry solid)}^{-1}</math>. The dry solid mass is <math>99.8 \text{ kg}</math> and the top surface area for drying is <math>4.654 \text{ m}^2</math>. The drying is occurring in both constant and falling rate periods. If constant drying rate of <math>1.51 \text{ kg H}_2\text{O m}^{-2} \text{ h}^{-1}</math> is followed up to a critical moisture content of <math>0.195 \text{ kg H}_2\text{O (kg dry solid)}^{-1}</math>, then the total drying time in hour will be _____. [round off to two decimal places]</p>									
<p>Q.63</p>	<p>Sweet sorghum with an initial average particle size of <math>4.0 \text{ mm}</math> was pulverized using a burr mill at two different gap settings between stones. The average feed rate of the material is <math>200 \text{ kg h}^{-1}</math>. The resultant flour was analyzed by IS sieves for particle size determination and was found to be <math>0.336 \text{ mm}</math> and <math>0.306 \text{ mm}</math> for the first and second gap settings, respectively. Using Kick's law, if the power required to grind the sorghum at first setting is <math>7.2 \text{ kW}</math>, the power requirement in kW with the second setting is _____. [round off to two decimal places]</p>									
<p>Q.64</p>	<p>A walk-in deep freezer wall is made of <math>120 \text{ mm}</math> thick brick layer on the outside followed by <math>75 \text{ mm}</math> thick concrete and <math>50 \text{ mm}</math> thick cork layers inside. The mean temperatures measured over inside and outside wall surfaces are <math>-18 \text{ }^\circ\text{C}</math> and <math>24 \text{ }^\circ\text{C}</math>, respectively. The thermal conductivity of brick, concrete and cork are <math>0.69</math>, <math>0.76</math> and <math>0.043 \text{ W m}^{-1} \text{ K}^{-1}</math>, respectively. Considering one square meter wall surface area, the heat transfer rate in W is _____. [round off to one decimal place]</p>									
<p>Q.65</p>	<p>In an effort to conserve energy, a grain dryer is being modified to reuse a part (<math>10 \text{ m}^3 \text{ s}^{-1}</math>) of the exhaust airflow at <math>70 \text{ }^\circ\text{C}</math> and <math>30\%</math> relative humidity. This part of exhaust is mixed with <math>20 \text{ m}^3 \text{ s}^{-1}</math> of ambient air at <math>30 \text{ }^\circ\text{C}</math> and <math>60 \%</math> relative humidity. The details of the two air-stream conditions are given below.</p> <table border="1"> <thead> <tr> <th>Temperature (<math>^\circ\text{C}</math>)</th> <th>Relative humidity (%)</th> <th>Absolute humidity (<math>\text{kg H}_2\text{O (kg dry air)}^{-1}</math>)</th> </tr> </thead> <tbody> <tr> <td>70</td> <td>30</td> <td><math>63.35 \times 10^{-3}</math></td> </tr> <tr> <td>30</td> <td>60</td> <td><math>16 \times 10^{-3}</math></td> </tr> </tbody> </table> <p>The absolute humidity of the mixed air will be _____. [round off to three decimal places]</p>	Temperature ( $^\circ\text{C}$ )	Relative humidity (%)	Absolute humidity ( $\text{kg H}_2\text{O (kg dry air)}^{-1}$ )	70	30	$63.35 \times 10^{-3}$	30	60	$16 \times 10^{-3}$
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