GATE Agricultural Engineering

Sample Paper – 5

Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Agricultural Engineering** subject of the GATE paper conducted by the IITs and IISc (General Aptitude and Engineering Mathematics are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Take $g = 9.81$ m/s^2, density of water $\rho_w = 1000$ kg/m^3 and unit weight of water $\gamma_w = 9.81$ kN/m^3 unless stated otherwise.

Farm Machinery & Power

Q1. A flat-belt drive on a stationary thresher runs with a tight-side tension of 900 N and a slack-side tension of 300 N. If the belt travels at a linear speed of 10 m/s, the power transmitted by the belt is: **[1 mark]**

(A) 12 kW

(B) 9 kW

(C) 6 kW

(D) 3 kW

Q2. A single-cylinder diesel engine develops a brake power of 20 kW while its friction power is 5 kW. The mechanical efficiency of the engine is: **[1 mark]**

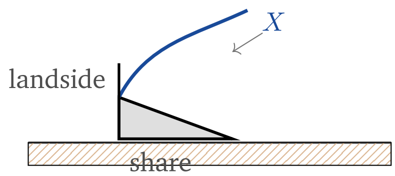
(A) 80%

(B) 25%

(C) 125%

(D) 20%

Q3. In the mouldboard-plough bottom shown, the working part marked X that receives the furrow slice from the share and turns it over (inverting and pulverising it) is the: **[1 mark]**



(A) share

(B) landside

(C) frog

(D) mouldboard

Q4. During a field test the rear driving wheel of a tractor makes exactly 10 revolutions. With no slip the tractor should advance 15 m, but it actually advances only 12 m. The wheel slip is: **[1 mark]**

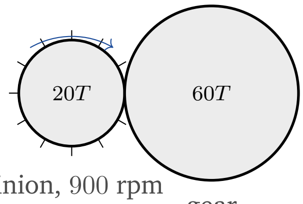
(A) 12%

(B) 25%

(C) 20%

(D) 80%

Q5. A spur-gear reduction in a tractor transmission has a pinion of 20 teeth driving a gear of 60 teeth, as shown. If the pinion turns at 900 rpm, the output speed of the driven gear is: **[1 mark]**



(A) 2700 rpm

(B) 900 rpm

(C) 300 rpm

(D) 100 rpm

Q6. A tractor-mounted implement whose entire weight is carried by the tractor through the three-point linkage (nothing rests on the ground during transport) uses a: **[1 mark]**

(A) trailed hitch

(B) mounted (integral) hitch

(C) semi-mounted hitch

(D) drawbar hitch

Q7. A tractor consumes diesel at a rate of 5 litres per hour while delivering 15 kW of useful power. The specific fuel consumption of the engine is: **[1 mark]**

(A) 3.0 L/kWh

(B) 75 L/kWh

(C) 0.75 L/kWh

(D) 0.333 L/kWh

Q8. A tractor-drawn cultivator has a theoretical field capacity of 1.25 ha/h, but its measured effective field capacity is only 1.0 ha/h. The field efficiency of the operation is: [1 mark]

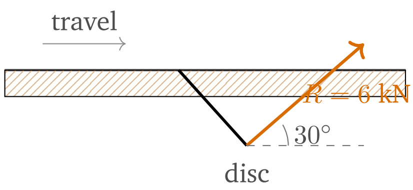
(A) 125%

(B) 80%

(C) 20%

(D) 25%

Q9. A disc plough experiences a total soil reaction of 6 kN inclined at 30° above the horizontal direction of travel, as shown. The vertical component of this reaction (the downward suck acting on the disc) is nearest to (take $\sin 30° = 0.50$): [1 mark]



(A) 5.2 kN

(B) 3.0 kN

(C) 6.0 kN

(D) 1.5 kN

Q10. A crop is planted with a row-to-row spacing of 50 cm and a plant-to-plant spacing of 20 cm within each row. The plant population that can be accommodated in one hectare is: [1 mark]

(A) 1,00,000 plants/ha

(B) 10,000 plants/ha

(C) 1000 plants/ha

(D) 50,000 plants/ha

Q11. In a self-propelled grain combine, the component that separates the loose grain from the bulky straw after threshing, letting the grain fall through while the straw is walked out of the machine, is the: [1 mark]

(A) straw walker

(B) cutter bar

(C) pick-up reel

(D) grain-delivery auger

Q12. A single-cylinder four-stroke-cycle engine runs at a steady speed of 1800 rpm. The number of power (expansion) strokes produced by the engine per minute is: **[1 mark]**

(A) 3600

(B) 1800

(C) 900

(D) 450

Soil & Water Conservation Engineering

Q13. A soil has a particle (solid) density of 2.65 g/cm^3 and a dry bulk density of 1.325 g/cm^3. The porosity of the soil is: **[1 mark]**

(A) 50%

(B) 100%

(C) 25%

(D) 40%

Q14. The porosity of a soil sample is 0.40. The corresponding void ratio of the soil is: **[1 mark]**

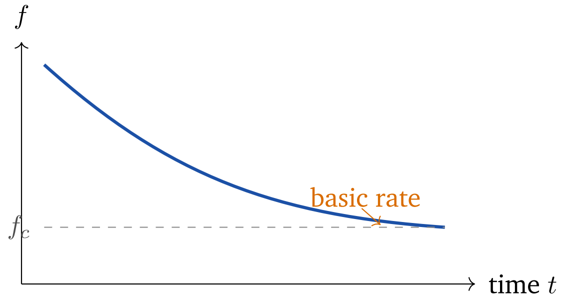
(A) 0.40

(B) 1.50

(C) 0.60

(D) 0.667

Q15. The infiltration-capacity curve of a soil is shown, decreasing with time towards a steady value f_c. This constant rate that the curve approaches at large time is called the: **[1 mark]**



(A) initial infiltration capacity

(B) sorptivity

(C) basic (final) infiltration rate

(D) percolation index

Q16. The slow downward movement of water through the soil profile, below the crop root zone towards the groundwater table, is termed: **[1 mark]**

(A) infiltration

(B) percolation

(C) interception

(D) transpiration

Q17. While designing a grassed waterway, the flow velocity is kept below a certain permissible limit. The main reason for limiting this velocity is to prevent: **[1 mark]**

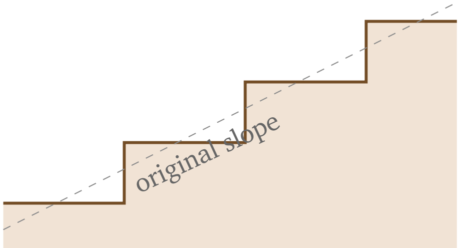
(A) waterlogging of the field

(B) excessive evaporation losses

(C) seepage below the channel

(D) scouring (erosion) of the channel bed and sides

Q18. The soil-conservation measure shown, in which a steeply sloping hillside is cut into a series of nearly level steps to reduce the effective slope and control erosion, is called: **[1 mark]**



level benches

(A) contour bunding

(B) strip cropping

(C) bench terracing

(D) gully plugging

Q19. A storm of 100 mm rainfall depth falls on a catchment whose runoff coefficient is 0.25. The depth of direct surface runoff produced from the catchment is: **[1 mark]**

(A) 25 mm

(B) 100 mm

(C) 75 mm

(D) 400 mm

Q20. The ratio of the sediment that is trapped and retained in a reservoir to the total sediment that flows into it is called the: **[1 mark]**

(A) sediment delivery ratio

(B) trap efficiency

(C) sediment yield

(D) drainage density

Soil & Water Conservation Engineering (continued)

Q21. In the SCS curve-number method, the potential maximum retention S (in mm) is related to the curve number CN by $S = \dfrac{25400}{CN} - 254$. For a catchment with $CN = 80$, the value of S is: **[2 marks]**

(A) 63.5 mm

(B) 254 mm

(C) 80 mm

(D) 317.5 mm

Q22. A spherical silt particle of diameter 0.02 mm settles in still water under Stokes' law, $v = \dfrac{g\,d^2(\rho_s - \rho_w)}{18\,\mu}$. Taking particle density $\rho_s = 2650$ kg/m^3, $\rho_w = 1000$ kg/m^3 and dynamic viscosity $\mu = 1 \times 10^{-3}$ Pa $\cdot$ s, the terminal settling velocity is nearest to: **[2 marks]**

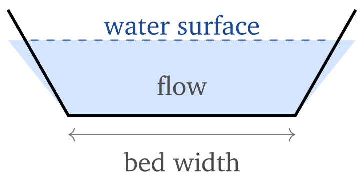
(A) 3.6×10^{-2} m/s

(B) 3.6×10^{-3} m/s

(C) 3.6×10^{-5} m/s

(D) 3.6×10^{-4} m/s

Q23. Water flows in the lined trapezoidal grassed waterway shown. Using Manning's equation $V = \dfrac{1}{n}R^{2/3}S^{1/2}$ with roughness $n = 0.02$, hydraulic radius $R = 1.0$ m and bed slope $S = 0.0004$, the mean flow velocity is: **[2 marks]**



(A) 0.5 m/s

(B) 1.0 m/s

(C) 2.0 m/s

(D) 50 m/s

Irrigation & Drainage Engineering

Q24. A crop root zone 1.0 m deep sits in a soil whose field capacity is 30% and permanent wilting point is 15% (both on a volume basis). If irrigation is scheduled when 40% of the total available water has been depleted, the net irrigation depth to be applied is: **[2 marks]**

(A) 150 mm

(B) 60 mm

(C) 90 mm

(D) 15 mm

Q25. For a certain crop the net irrigation depth to be replenished at each irrigation is 60 mm, and the crop uses water at a peak rate of 5 mm/day. The irrigation interval (frequency) is: **[2 marks]**

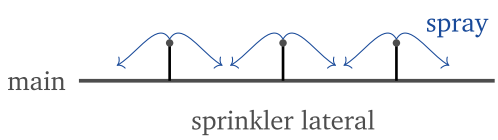
(A) 300 days

(B) 5 days

(C) 6 days

(D) 12 days

Q26. A sprinkler system, sketched below, must store a net depth of 45 mm of water in the crop root zone. If the water-application efficiency of the system is 75%, the gross depth of water that must be applied at the sprinklers is: **[2 marks]**



(A) 33.75 mm

(B) 45 mm

(C) 90 mm

(D) 60 mm

Q27. A rotating sprinkler discharges 0.5 L/s and wets a rectangular area governed by a spacing of 10 m along the lateral and 12 m between laterals. The application rate of the sprinkler is: **[2 marks]**

(A) 30 mm/h

(B) 15 mm/h

(C) 7.5 mm/h

(D) 60 mm/h

Q28. A drip-irrigation layout provides each plant with 4 emitters, and each emitter discharges 4 L/h. If the system is operated for 3 hours a day, the volume of water applied per plant per day is: **[2 marks]**

(A) 16 L/day

(B) 12 L/day

(C) 4 L/day

(D) 48 L/day

Q29. A centrifugal pump lifts 50 L/s of water against a total head of 12 m. The useful (water) power output delivered by the pump is nearest to (take $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2): **[2 marks]**

(A) 11.77 kW

(B) 7.85 kW

(C) 5.89 kW

(D) 2.94 kW

Q30. A centrifugal pump running at 1450 rpm develops a head of 15 m. Using the pump affinity laws, if its speed is reduced to 725 rpm, the head developed by the pump becomes: **[2 marks]**

(A) 3.75 m

(B) 7.5 m

(C) 30 m

(D) 60 m

Q31. A confined aquifer has a hydraulic conductivity of 30 m/day and a saturated thickness of 20 m. The transmissivity of the aquifer is: **[2 marks]**

(A) $1.5\ \text{m}^2/\text{day}$

(B) $50\ \text{m}^2/\text{day}$

(C) $10\ \text{m}^2/\text{day}$

(D) $600\ \text{m}^2/\text{day}$

Q32. To control soil salinity, the leaching requirement is defined as $LR = \dfrac{EC_{iw}}{EC_{dw}}$, the ratio of the electrical conductivity of the irrigation water to that of the drainage water the crop can tolerate. If $EC_{iw} = 1.5$ dS/m and $EC_{dw} = 6$ dS/m, the leaching requirement is: **[2 marks]**

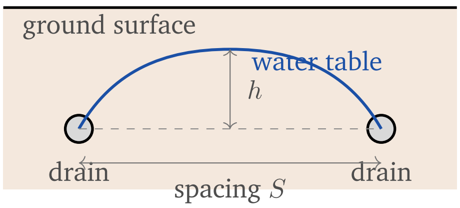
(A) 4.0

(B) 40%

(C) 25%

(D) 15%

Q33. In the parallel subsurface drainage system shown, the water table rises to its highest point h midway between two drains. For a given steady rate of recharge and the same soil, this midpoint water-table height above the drains can be lowered by: **[2 marks]**



(A) increasing the drain spacing

(B) decreasing the drain spacing

(C) reducing the depth of the drains

(D) using a soil of lower hydraulic conductivity

Q34. Groundwater moves through a soil of porosity 0.40 with a Darcy (discharge) velocity of 0.6 m/day. The actual (seepage) velocity of the water through the pore space is: **[2 marks]**

(A) 0.24 m/day

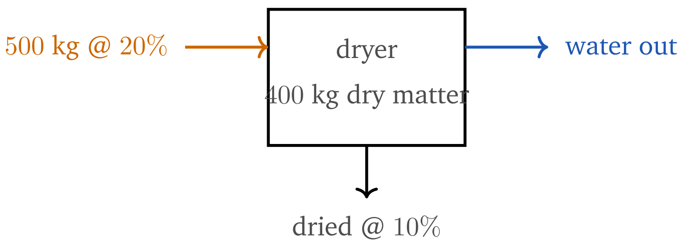
(B) 0.6 m/day

(C) 2.4 m/day

(D) 1.5 m/day

Agricultural Processing & Food Engineering

Q35. A 500 kg lot of grain at 20% moisture content (wet basis) is dried to 10% moisture content (wet basis) in the dryer sketched below. The weight of the dried grain is: **[2 marks]**



(A) 250 kg

(B) 400 kg

(C) 444.4 kg

(D) 555.6 kg

Q36. A batch of 1000 kg of freshly harvested paddy at 24% moisture content (wet basis) is dried down to 14% moisture content (wet basis). The mass of water that must be removed during drying is nearest to: **[2 marks]**

(A) 100 kg

(B) 116.3 kg

(C) 86 kg

(D) 240 kg

Q37. A grain sample has a moisture content of 20% on a wet basis. The equivalent moisture content of the grain on a dry basis is: **[2 marks]**

(A) 25%

(B) 20%

(C) 16.7%

(D) 80%

Q38. In a moist solid being dried, the portion of water that exerts a vapour pressure equal to that of pure water at the same temperature, and therefore behaves like free water on the surface, is called: **[2 marks]**

(A) unbound moisture

(B) bound moisture

(C) equilibrium moisture

(D) critical moisture

Q39. Kick's law of size reduction states that the energy required to reduce a solid material is directly proportional to: **[2 marks]**

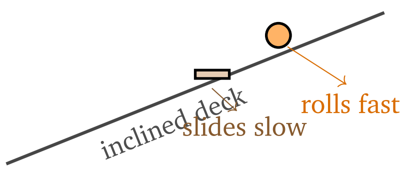
(A) the new surface area created

(B) the reciprocal of the product particle diameter

(C) the square root of the diameter ratio

(D) the natural logarithm of the size-reduction ratio (feed diameter ÷ product diameter)

Q40. The seed-cleaning device shown is a smooth inclined deck with no moving parts. Round seeds roll rapidly down and are thrown clear, while flat or irregular seeds slide slowly and stay back. This separation is based on differences in the seeds': **[2 marks]**



(A) shape and ability to roll

(B) colour

(C) electrical charge

(D) terminal velocity

Q41. A rice mill is fed 1000 kg of clean paddy and produces 650 kg of total milled rice (head rice plus brokens). The milling yield (rice recovery) of the mill is: **[2 marks]**

(A) 35%

(B) 65%

(C) 100%

(D) 15%

Q42. In a food plant, 50 kg of water is to be heated from 20°C to 80°C. Taking the specific heat of water as 4.18 kJ/kg · K, the quantity of heat required is: **[2 marks]**

(A) 6270 kJ

(B) 12540 kJ

(C) 16720 kJ

(D) 3135 kJ

Q43. During the drying of a food product, 5 kg of water has to be evaporated. If the latent heat of vaporization of water is 2260 kJ/kg, the heat energy required just to evaporate this water is: **[2 marks]**

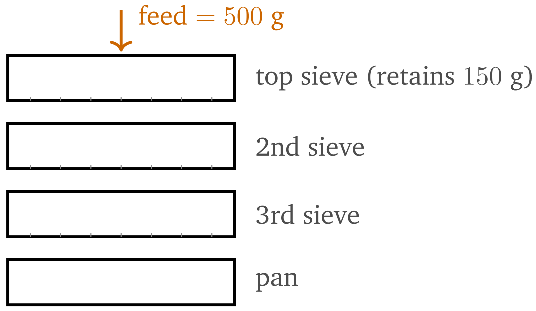
(A) 452 kJ

(B) 2260 kJ

(C) 11300 kJ

(D) 5650 kJ

Q44. In the sieve-analysis test stack shown, a 500 g feed sample is placed on the top sieve, which retains 150 g of oversize material. The fraction of the feed that passes through the top sieve (the undersize) is: **[2 marks]**



(A) 30%

(B) 150%

(C) 70%

(D) 43%

Q45. The unit operation in which a food is first frozen and then dried by sublimating the ice directly to vapour under vacuum, giving a porous, high-quality dried product, is called: **[2 marks]**

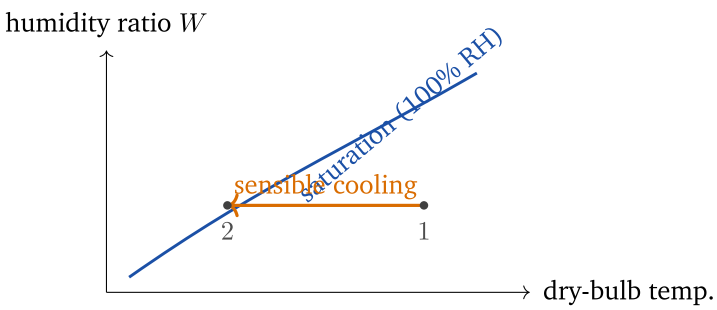
(A) freeze drying (lyophilization)

(B) spray drying

(C) high-temperature short-time pasteurization

(D) blanching

Q46. Moist air is cooled at constant humidity ratio (sensible cooling), shown as the horizontal line 1–2 moving to the left towards the saturation curve on the psychrometric sketch. During this process the relative humidity of the air: **[2 marks]**



(A) increases

(B) decreases

(C) remains constant

(D) first decreases and then increases

Detailed Solutions

Q1.

Solution

Concept – power transmitted by a belt drive: The power a belt transmits is the net driving force times the belt speed, $P = (T_1 - T_2)\,v$, where T_1 is the tight-side tension and T_2 the slack-side tension.

Step 1 – list the data: $T_1 = 900$ N, $T_2 = 300$ N, $v = 10$ m/s.

Step 2 – find the net driving force: $T_1 - T_2 = 900 - 300$

$T_1 - T_2 = 600$ N

Step 3 – apply the power formula: $P = (T_1 - T_2)\,v$

$P = 600 \times 10$

Step 4 – evaluate: $P = 6000$ W

Step 5 – convert to kilowatts: $P = 6$ kW

Final Answer: $P = 6$ kW $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – mechanical efficiency of an engine: Mechanical efficiency is the ratio of brake power (useful output at the shaft) to indicated power (power developed inside the cylinder), $\eta_m = \dfrac{\text{BP}}{\text{IP}}$, and indicated power equals brake power plus friction power.

Step 1 – list the data: Brake power BP $= 20$ kW, friction power FP $= 5$ kW.

Step 2 – find the indicated power: $\text{IP} = \text{BP} + \text{FP}$

$\text{IP} = 20 + 5$

$\text{IP} = 25$ kW

Step 3 – form the efficiency ratio: $\eta_m = \dfrac{\text{BP}}{\text{IP}} = \dfrac{20}{25}$

Step 4 – evaluate: $\eta_m = 0.80$

Step 5 – express as a percentage: $\eta_m = 80\%$

Final Answer: $\eta_m = 80\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – parts of a mouldboard-plough bottom: A plough bottom has a share that cuts the furrow slice horizontally, a mouldboard that lifts and inverts the slice, a landside that takes the side thrust, and a frog that ties the parts to the beam.

Step 1 – trace the flow of soil: The share slices the furrow loose at the bottom, then the slice rides up onto the curved surface behind it.

Step 2 – identify part X: The curved surface marked X that receives the slice, lifts it, twists it and turns it over is the mouldboard.

Why the other options are wrong:

- A: the share is the cutting edge at the bottom, not the curved turning surface.
- B: the landside is the flat plate that presses against the furrow wall and resists side thrust.
- C: the frog is the base block to which the share, mouldboard and landside are bolted; it does no turning.

Final Answer: part X is the mouldboard $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – wheel slip: Wheel slip is the fraction by which the actual travel falls short of the theoretical (no-slip) travel, $s = \dfrac{d_t - d_a}{d_t} \times 100\%$.

Step 1 – list the data: Theoretical travel $d_t = 15$ m, actual travel $d_a = 12$ m.

Step 2 – find the shortfall: $d_t - d_a = 15 - 12$

$d_t - d_a = 3$ m

Step 3 – divide by the theoretical travel: $s = \dfrac{3}{15}$

Step 4 – evaluate: $s = 0.20$

Step 5 – express as a percentage: $s = 20\%$

Final Answer: wheel slip $= 20\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – speed ratio of a gear pair: For a meshing pair, speed is inversely proportional to the number of teeth: $N_g = N_p \times \frac{T_p}{T_g}$, where the subscripts p and g denote pinion and gear.

Step 1 – list the data: Pinion teeth $T_p = 20$, gear teeth $T_g = 60$, pinion speed $N_p = 900$ rpm.

Step 2 – write the tooth ratio: $\frac{T_p}{T_g} = \frac{20}{60}$

$\frac{T_p}{T_g} = \frac{1}{3}$

Step 3 – apply the speed relation: $N_g = 900 \times \frac{1}{3}$

Step 4 – evaluate: $N_g = 300$ rpm

Final Answer: $N_g = 300$ rpm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – classification of hitch systems: Implements are attached by trailed (pull-type), semi-mounted or fully mounted hitches. In a fully mounted hitch the implement hangs entirely on the tractor's three-point linkage.

Step 1 – match the description: Because the whole implement weight is carried by the tractor and none rests on the ground during transport, this is a fully mounted (integral) hitch.

Why the other options are wrong:

- A: a trailed implement rides on its own wheels and is only pulled by the tractor.
- C: a semi-mounted implement carries part of its weight on the tractor and part on its own rear wheel.
- D: a drawbar hitch is a single-point pull connection, used for trailed loads.

Final Answer: it is a mounted (integral) hitch $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept – specific fuel consumption: Specific fuel consumption is the fuel used per unit of power output per unit time, $\text{SFC} = \dfrac{\text{fuel rate}}{\text{power}}$.

Step 1 – list the data: Fuel rate $= 5$ L/h, power $= 15$ kW.

Step 2 – write the ratio: $\text{SFC} = \dfrac{5 \text{ L/h}}{15 \text{ kW}}$

Step 3 – simplify: $\text{SFC} = \dfrac{5}{15}$ L/kWh

Step 4 – evaluate: $\text{SFC} = 0.333$ L/kWh

Final Answer: $\text{SFC} = 0.333$ L/kWh $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – field efficiency: Field efficiency is the ratio of the effective (actual) field capacity to the theoretical field capacity, $\eta_f = \dfrac{\text{EFC}}{\text{TFC}}$.

Step 1 – list the data: Theoretical field capacity TFC $= 1.25$ ha/h, effective field capacity EFC $= 1.0$ ha/h.

Step 2 – form the ratio: $\eta_f = \dfrac{1.0}{1.25}$

Step 3 – evaluate: $\eta_f = 0.80$

Step 4 – express as a percentage: $\eta_f = 80\%$

Final Answer: field efficiency $= 80\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – resolving the soil reaction: The vertical component of the soil reaction on the disc is $V = R\sin\theta$, where θ is the angle the reaction makes with the horizontal.

Step 1 – list the data: $R = 6$ kN, $\theta = 30°$, with $\sin 30° = 0.50$.

Step 2 – write the vertical component: $V = R\sin\theta$

Step 3 – substitute: $V = 6 \times 0.50$

Step 4 – evaluate: $V = 3.0$ kN

Final Answer: $V = 3.0$ kN $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept – plant population from spacing: The number of plants per unit area is the area divided by the ground area occupied by one plant, $N = \dfrac{A}{s_r \times s_p}$, where s_r is the row spacing and s_p the plant spacing.

Step 1 – list the data: Row spacing $s_r = 50$ cm $= 0.50$ m, plant spacing $s_p = 20$ cm $= 0.20$ m, area $A = 1$ ha $= 10000$ m^2.

Step 2 – find the area per plant: $s_r \times s_p = 0.50 \times 0.20$

$s_r \times s_p = 0.10$ m^2

Step 3 – divide the field area by the area per plant: $N = \dfrac{10000}{0.10}$

Step 4 – evaluate: $N = 1{,}00{,}000$ plants/ha

Final Answer: $N = 1{,}00{,}000$ plants/ha $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – separation in a combine harvester: After the cylinder and concave thresh the crop, the mixture of grain and straw must be separated. This is the job of the straw walkers.

Step 1 – describe the action: The straw walkers are oscillating racks; the loose grain falls through their openings onto the cleaning shoe while the straw is progressively walked backwards and thrown out of the rear of the machine.

Why the other options are wrong:

- B: the cutter bar only cuts the standing crop at the front.
- C: the pick-up reel gathers the crop and feeds it to the cutter bar.
- D: the grain auger conveys the already-cleaned grain to the tank; it does not separate grain from straw.

Final Answer: the straw walker separates grain from straw $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept – power strokes in a four-stroke engine: In a four-stroke-cycle engine one power stroke occurs for every two crankshaft revolutions, so the number of power strokes per minute is half the engine speed in rpm.

Step 1 – list the data: Engine speed $N = 1800$ rpm, one power stroke per 2 revolutions.

Step 2 – write the relation: Power strokes per minute $= \dfrac{N}{2}$

Step 3 – substitute: $= \dfrac{1800}{2}$

Step 4 – evaluate: $= 900$ power strokes per minute

Final Answer: 900 power strokes per minute $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – porosity from bulk and particle density: Porosity is the fraction of the soil volume that is pore space, $n = 1 - \dfrac{\rho_b}{\rho_s}$, where ρ_b is the dry bulk density and ρ_s the particle density.

Step 1 – list the data: $\rho_s = 2.65$ g/cm^3, $\rho_b = 1.325$ g/cm^3.

Step 2 – form the density ratio: $\dfrac{\rho_b}{\rho_s} = \dfrac{1.325}{2.65}$

$\dfrac{\rho_b}{\rho_s} = 0.50$

Step 3 – subtract from one: $n = 1 - 0.50$

$n = 0.50$

Step 4 – express as a percentage: $n = 50\%$

Final Answer: porosity $= 50\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept – relation between void ratio and porosity: The void ratio is the volume of voids per unit volume of solids, and it relates to porosity by $e = \dfrac{n}{1-n}$.

Step 1 – list the data: Porosity $n = 0.40$.

Step 2 – find $1 - n$**:** $1 - n = 1 - 0.40$

$1 - n = 0.60$

Step 3 – form the ratio: $e = \dfrac{0.40}{0.60}$

Step 4 – evaluate: $e = 0.667$

Final Answer: void ratio $= 0.667 \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q14**

Q15.

Solution

Concept – the infiltration-capacity curve: When rain falls on dry soil, the infiltration rate starts high and falls with time as the soil wets, finally levelling off at a steady rate.

Step 1 – read the curve: The curve drops from a high initial value and flattens out along the dashed line marked f_c.

Step 2 – name this steady value: The constant rate reached at large time is the basic (final) infiltration rate, controlled by the saturated permeability of the soil.

Why the other options are wrong:

- A: the initial infiltration capacity is the high value at $t = 0$, not the steady value.
- B: sorptivity describes the early, capillarity-driven part of infiltration, not the final rate.
- D: the percolation index is not a term for the steady infiltration rate.

Final Answer: it is the basic (final) infiltration rate $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q15**

Q16.

Solution

Concept – movement of water in the soil: Water first enters the soil surface (infiltration) and then moves downward through the profile under gravity.

Step 1 – identify the described process: The slow downward travel of water within the profile, below the root zone towards the water table, is percolation (deep percolation).

Why the other options are wrong:

- A: infiltration is specifically the entry of water across the soil surface.
- C: interception is rainfall caught by plant foliage before it reaches the ground.
- D: transpiration is the loss of water vapour from the plant leaves, an upward, not downward, movement.

Final Answer: the process is percolation $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – permissible velocity in a grassed waterway: A grassed waterway carries concentrated runoff safely to an outlet. Its design velocity is capped at a permissible value the grass lining can withstand.

Step 1 – state the purpose of the limit: If the velocity exceeds the permissible value, the flow scours and erodes the channel bed and side slopes, damaging the grass lining.

Step 2 – conclude: So the velocity is limited to prevent erosion (scouring) of the channel.

Why the other options are wrong:

- A: waterlogging is a drainage issue, not the reason for a velocity cap in a conveyance channel.
- B: evaporation loss is negligible for fast-moving runoff and is not the design concern.
- C: seepage is controlled by the channel lining and soil, not by capping the velocity.

Final Answer: to prevent scouring (erosion) of the channel $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept – bench terracing: On steep cultivable hillsides, the slope is reshaped into a flight of level or nearly level steps, each with a riser and a flat bench.

Step 1 – match the figure: The stepped profile shown, converting the steep original slope into a series of flat benches, is bench terracing.

Step 2 – state its effect: Each level bench shortens the slope length and reduces runoff velocity, so erosion is greatly reduced.

Why the other options are wrong:

- A: contour bunding builds small earthen bunds along the contour without cutting the slope into steps.
- B: strip cropping alternates strips of crops across the slope; it does not reshape the land into steps.
- D: gully plugging places small barriers in gullies and is unrelated to terracing a whole slope.

Final Answer: the measure is bench terracing $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept – runoff depth from the runoff coefficient: The depth of direct runoff is the fraction of the rainfall that runs off, $Q = C \times P$, where C is the runoff coefficient and P the rainfall depth.

Step 1 – list the data: Rainfall depth $P = 100$ mm, runoff coefficient $C = 0.25$.

Step 2 – apply the relation: $Q = C \times P$

$Q = 0.25 \times 100$

Step 3 – evaluate: $Q = 25$ mm

Final Answer: runoff depth $= 25$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – trap efficiency of a reservoir: Trap efficiency is the proportion of the incoming sediment load that settles out and is retained in the reservoir, $\eta_t = \dfrac{\text{sediment retained}}{\text{sediment inflow}}$.

Step 1 – match the definition: The ratio of the sediment trapped and held in the reservoir to the total sediment inflow is exactly the trap efficiency.

Why the other options are wrong:

- A: the sediment delivery ratio compares sediment delivered at the outlet to the gross erosion in the watershed, not to reservoir inflow.
- C: sediment yield is a total quantity (mass), not a ratio.
- D: drainage density is a channel-length-per-area measure, unrelated to sediment retention.

Final Answer: the quantity is trap efficiency $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – potential maximum retention in the SCS-CN method: The curve number is converted to the potential maximum retention S (in mm) by $S = \dfrac{25400}{CN} - 254$.

Step 1 – list the data: $CN = 80$.

Step 2 – evaluate the first term: $\dfrac{25400}{80} = 317.5$

Step 3 – subtract 254**:** $S = 317.5 - 254$

Step 4 – evaluate: $S = 63.5$ mm

Final Answer: $S = 63.5$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept – Stokes' law settling velocity: A small particle falling in still water reaches a terminal velocity $v = \dfrac{g\,d^2(\rho_s - \rho_w)}{18\,\mu}$.

Step 1 – list the data: $d = 0.02$ mm $= 2 \times 10^{-5}$ m, $\rho_s = 2650$ kg/m^3, $\rho_w = 1000$ kg/m^3, $\mu = 1 \times 10^{-3}$ Pa · s, $g = 9.81$ m/s^2.

Step 2 – square the diameter: $d^2 = (2 \times 10^{-5})^2$

$d^2 = 4 \times 10^{-10}$ m^2

Step 3 – find the density difference: $\rho_s - \rho_w = 2650 - 1000$

$\rho_s - \rho_w = 1650$ kg/m^3

Step 4 – build the numerator: $g\,d^2(\rho_s - \rho_w) = 9.81 \times 4 \times 10^{-10} \times 1650$

$9.81 \times 4 \times 10^{-10} = 3.924 \times 10^{-9}$

$3.924 \times 10^{-9} \times 1650 = 6.475 \times 10^{-6}$

Step 5 – build the denominator: $18\,\mu = 18 \times 1 \times 10^{-3}$

$18\,\mu = 0.018$

Step 6 – divide: $v = \dfrac{6.475 \times 10^{-6}}{0.018}$

$v = 3.6 \times 10^{-4}$ m/s

Final Answer: $v \approx 3.6 \times 10^{-4}$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept – Manning's velocity equation: The mean velocity in an open channel is $V = \dfrac{1}{n} R^{2/3} S^{1/2}$, with n the roughness, R the hydraulic radius and S the bed slope.

Step 1 – list the data: $n = 0.02$, $R = 1.0$ m, $S = 0.0004$.

Step 2 – evaluate $R^{2/3}$: $R^{2/3} = (1.0)^{2/3} = 1.0$

Step 3 – evaluate $S^{1/2}$: $S^{1/2} = \sqrt{0.0004} = 0.02$

Step 4 – evaluate the leading factor: $\dfrac{1}{n} = \dfrac{1}{0.02} = 50$

Step 5 – multiply the three factors: $V = 50 \times 1.0 \times 0.02$

Step 6 – evaluate: $V = 1.0$ m/s

Final Answer: $V = 1.0$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – net irrigation depth: The total available water in the root zone is $d_{av} = (\theta_{fc} - \theta_{pwp}) \times D$ on a volume basis, and the net irrigation depth is the allowable-depletion fraction of it.

Step 1 – list the data: $\theta_{fc} = 30\% = 0.30$, $\theta_{pwp} = 15\% = 0.15$, root depth $D = 1.0$ m $= 1000$ mm, allowable depletion $p = 0.40$.

Step 2 – find the moisture range: $\theta_{fc} - \theta_{pwp} = 0.30 - 0.15$

$\theta_{fc} - \theta_{pwp} = 0.15$

Step 3 – find the total available water depth: $d_{av} = 0.15 \times 1000$

$d_{av} = 150$ mm

Step 4 – apply the allowable depletion: $d_n = 0.40 \times 150$

Step 5 – evaluate: $d_n = 60$ mm

Final Answer: net irrigation depth $= 60$ mm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept – irrigation interval: The irrigation interval is the number of days the stored net depth of water lasts at the crop's daily use rate, $I = \dfrac{d_n}{ET}$.

Step 1 – list the data: Net irrigation depth $d_n = 60$ mm, peak use rate $ET = 5$ mm/day.

Step 2 – form the ratio: $I = \dfrac{60}{5}$

Step 3 – evaluate: $I = 12$ days

Final Answer: irrigation interval $= 12$ days $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept – gross depth from application efficiency: Application efficiency is the stored (net) depth divided by the gross depth applied, so the gross depth is $d_g = \dfrac{d_n}{\eta_a}$.

Step 1 – list the data: Net depth to store $d_n = 45$ mm, application efficiency $\eta_a = 75\% = 0.75$.

Step 2 – write the relation: $d_g = \dfrac{d_n}{\eta_a}$

Step 3 – substitute: $d_g = \dfrac{45}{0.75}$

Step 4 – evaluate: $d_g = 60$ mm

Final Answer: gross depth $= 60$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept – sprinkler application rate: The application rate is the sprinkler discharge spread over the area it wets, $I = \dfrac{Q}{S_l \times S_m}$, expressed as a depth per unit time.

Step 1 – list the data: $Q = 0.5$ L/s, spacing along lateral $S_l = 10$ m, spacing between laterals $S_m = 12$ m.

Step 2 – find the wetted area: $A = 10 \times 12$

$A = 120 \text{ m}^2$

Step 3 – convert the discharge to m^3/h: $Q = 0.5 \text{ L/s} = 0.5 \times 10^{-3} \text{ m}^3/\text{s}$

$Q = 0.5 \times 10^{-3} \times 3600 = 1.8 \text{ m}^3/\text{h}$

Step 4 – divide the discharge by the area: $I = \dfrac{1.8}{120}$

$I = 0.015$ m/h

Step 5 – convert to mm/h: $I = 15$ mm/h

Final Answer: application rate $= 15$ mm/h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – drip water application per plant: The daily volume delivered to a plant is the number of emitters times the discharge of each emitter times the operating hours, $V = n \times q \times t$.

Step 1 – list the data: Emitters per plant $n = 4$, emitter discharge $q = 4$ L/h, operating time $t = 3$ h/day.

Step 2 – multiply the emitters by the discharge: $n \times q = 4 \times 4 = 16$ L/h per plant

Step 3 – multiply by the operating time: $V = 16 \times 3$

Step 4 – evaluate: $V = 48$ L/day

Final Answer: water applied $= 48$ L/day per plant $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – water (output) power of a pump: The useful power delivered to the water is $P = \rho_w\, g\, Q\, H$, with Q the discharge and H the total head.

Step 1 – list the data: $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2, $Q = 50$ L/s $= 0.05$ m^3/s, $H = 12$ m.

Step 2 – multiply ρ_w and g: $\rho_w\, g = 1000 \times 9.81 = 9810$

Step 3 – multiply by the discharge: $9810 \times 0.05 = 490.5$

Step 4 – multiply by the head: $P = 490.5 \times 12$

$P = 5886$ W

Step 5 – convert to kilowatts: $P = 5.89$ kW

Final Answer: water power $= 5.89$ kW $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept – pump affinity law for head: For a given pump, the head varies as the square of the rotational speed, $\frac{H_2}{H_1} = \left(\frac{N_2}{N_1}\right)^2$.

Step 1 – list the data: $N_1 = 1450$ rpm, $H_1 = 15$ m, $N_2 = 725$ rpm.

Step 2 – form the speed ratio: $\frac{N_2}{N_1} = \frac{725}{1450} = 0.5$

Step 3 – square the ratio: $(0.5)^2 = 0.25$

Step 4 – apply it to the head: $H_2 = 15 \times 0.25$

Step 5 – evaluate: $H_2 = 3.75$ m

Final Answer: $H_2 = 3.75\text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept – transmissivity of an aquifer: Transmissivity is the product of the hydraulic conductivity and the saturated thickness of the aquifer, $T = K\,b$.

Step 1 – list the data: $K = 30$ m/day, $b = 20$ m.

Step 2 – apply the relation: $T = K\,b$

$T = 30 \times 20$

Step 3 – evaluate: $T = 600\text{ m}^2/\text{day}$

Final Answer: $T = 600\text{ m}^2/\text{day} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – leaching requirement: The leaching requirement is the fraction of applied water that must pass below the root zone to keep salts in check, $LR = \frac{EC_{iw}}{EC_{dw}}$.

Step 1 – list the data: $EC_{iw} = 1.5$ dS/m, $EC_{dw} = 6$ dS/m.

Step 2 – form the ratio: $LR = \frac{1.5}{6}$

Step 3 – evaluate: $LR = 0.25$

Step 4 – express as a percentage: $LR = 25\%$

Final Answer: leaching requirement $= 25\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – water-table height between parallel drains: Under steady recharge, the water table bulges to its maximum height midway between two parallel drains. Drainage theory (the ellipse/Hooghoudt equation) shows this midpoint height grows with the square of the drain spacing.

Step 1 – see how spacing acts: Because the midpoint height rises steeply with spacing, drains placed closer together give the water less horizontal distance to travel, so the mid-spacing bulge is smaller.

Step 2 – conclude: Therefore, decreasing the drain spacing lowers the peak water-table height between the drains.

Why the other options are wrong:

- A: increasing the spacing raises the midpoint water table, the opposite of what is wanted.
- C: making the drains shallower leaves the water table higher, not lower.
- D: a lower hydraulic conductivity makes the soil drain more slowly, raising the water table.

Final Answer: decrease the drain spacing $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept – seepage (actual) velocity: The Darcy velocity is a discharge per gross area, but water actually moves only through the pores, so the true seepage velocity is $v_s = \frac{v}{n}$, where n is the porosity.

Step 1 – list the data: Darcy velocity $v = 0.6$ m/day, porosity $n = 0.40$.

Step 2 – write the relation: $v_s = \frac{v}{n}$

Step 3 – substitute: $v_s = \frac{0.6}{0.40}$

Step 4 – evaluate: $v_s = 1.5$ m/day

Final Answer: seepage velocity $= 1.5$ m/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – mass balance in grain drying: During drying only water leaves; the bone-dry matter is conserved. So the dry-matter mass computed from the wet grain equals the dry-matter mass in the dried grain.

Step 1 – list the data: Initial mass $= 500$ kg at 20% moisture (wet basis), final moisture $= 10\%$ (wet basis).

Step 2 – find the dry matter in the wet grain: Dry-matter fraction $= 1 - 0.20 = 0.80$

Dry matter $= 500 \times 0.80 = 400$ kg

Step 3 – relate dry matter to the dried mass: In the dried grain the dry matter is $(1 - 0.10) = 0.90$ of the total, so dried mass $= \dfrac{\text{dry matter}}{0.90}$

Step 4 – substitute: dried mass $= \dfrac{400}{0.90}$

Step 5 – evaluate: dried mass $= 444.4$ kg

Final Answer: dried grain $= 444.4$ kg $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept – water removed in drying (wet-basis): For drying at constant dry matter, the water removed is $W_r = W_i \dfrac{M_i - M_f}{100 - M_f}$, with moistures on a wet basis in percent.

Step 1 – list the data: Initial mass $W_i = 1000$ kg, initial moisture $M_i = 24\%$, final moisture $M_f = 14\%$.

Step 2 – find the moisture drop: $M_i - M_f = 24 - 14 = 10$

Step 3 – find the denominator: $100 - M_f = 100 - 14 = 86$

Step 4 – substitute into the formula: $W_r = 1000 \times \dfrac{10}{86}$

Step 5 – evaluate: $W_r = \dfrac{10000}{86}$

$W_r = 116.3$ kg

Final Answer: water removed $= 116.3$ kg $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – converting wet basis to dry basis: Moisture content on a dry basis relates to that on a wet basis by $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$.

Step 1 – list the data: $M_{wb} = 20\% = 0.20$.

Step 2 – find the denominator: $1 - M_{wb} = 1 - 0.20 = 0.80$

Step 3 – form the ratio: $M_{db} = \dfrac{0.20}{0.80}$

Step 4 – evaluate: $M_{db} = 0.25$

Step 5 – express as a percentage: $M_{db} = 25\%$

Final Answer: $M_{db} = 25\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept – bound and unbound moisture: In a wet solid, unbound moisture behaves like free water: it exerts the full vapour pressure of pure water at that temperature. Bound moisture is held in fine capillaries or in solution and exerts a lower vapour pressure.

Step 1 – match the description: The moisture that exerts a vapour pressure equal to that of pure water, and so behaves like free surface water, is the unbound moisture.

Why the other options are wrong:

- B: bound moisture exerts a vapour pressure lower than that of pure water, so it is harder to remove.
- C: equilibrium moisture is what remains in balance with a given air condition; it does not describe free water.
- D: critical moisture is the value at which drying shifts from the constant-rate to the falling-rate period.

Final Answer: it is unbound moisture $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept – Kick's law of size reduction: Kick's law states that the energy needed for size reduction is proportional to the logarithm of the size-reduction ratio, $E = K_K \ln\left(\frac{d_1}{d_2}\right)$, where d_1 and d_2 are the feed and product diameters.

Step 1 – recall the three laws: Rittinger's law ties energy to new surface area; Kick's law ties it to the logarithm of the size-reduction ratio; Bond's law ties it to the difference of the reciprocals of the square roots of the diameters.

Step 2 – select Kick's form: For Kick's law the energy is proportional to $\ln(d_1/d_2)$, i.e. to the logarithm of the ratio of feed diameter to product diameter.

Why the other options are wrong:

- A: proportionality to new surface area is Rittinger's law.
- B: the reciprocal of the product diameter alone is not Kick's law.
- C: the square-root form belongs to Bond's law, not Kick's.

Final Answer: proportional to $\ln(d_1/d_2) \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept – shape-based (roll) separation: On a smooth inclined deck, round or spherical seeds roll and gather speed, so they are thrown well clear at the lower edge, whereas flat or angular seeds slide slowly and are held back. The separation depends on the seeds' shape and their ability to roll.

Step 1 – match the figure: The round seed rolls fast and is thrown out, the flat seed slides slowly, exactly the behaviour of a shape (roll) separator.

Why the other options are wrong:

- B: a colour separator uses optical sensors, not an inclined deck.
- C: electrostatic separation uses an electric charge, which this passive deck does not apply.
- D: terminal velocity governs air (pneumatic) separation, not rolling on a deck.

Final Answer: separation is by shape and rolling ability $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q40

Q41.

Solution

Concept – milling yield (rice recovery): Milling yield is the mass of total milled rice obtained as a fraction of the paddy fed, $\eta = \dfrac{\text{milled rice}}{\text{paddy fed}}$.

Step 1 – list the data: Paddy fed $= 1000$ kg, total milled rice $= 650$ kg.

Step 2 – form the ratio: $\eta = \dfrac{650}{1000}$

Step 3 – evaluate: $\eta = 0.65$

Step 4 – express as a percentage: $\eta = 65\%$

Final Answer: milling yield $= 65\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – sensible heat to raise temperature: The heat needed to warm a mass without any phase change is $Q = m\,c\,\Delta T$, with c the specific heat and ΔT the temperature rise.

Step 1 – list the data: $m = 50$ kg, $c = 4.18$ kJ/kg $\cdot$ K, $\Delta T = 80 - 20 = 60$ K.

Step 2 – substitute into the formula: $Q = 50 \times 4.18 \times 60$

Step 3 – multiply the first two factors: $50 \times 4.18 = 209$

Step 4 – multiply by the temperature rise: $Q = 209 \times 60$

Step 5 – evaluate: $Q = 12540$ kJ

Final Answer: $Q = 12540$ kJ $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – latent heat of vaporization: The heat needed to evaporate water at its boiling point is $Q = m\,h_{fg}$, with h_{fg} the latent heat of vaporization.

Step 1 – list the data: $m = 5$ kg, $h_{fg} = 2260$ kJ/kg.

Step 2 – substitute into the formula: $Q = 5 \times 2260$

Step 3 – evaluate: $Q = 11300$ kJ

Final Answer: $Q = 11300$ kJ $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q43

Q44.

Solution

Concept – undersize fraction through a screen: The material passing a screen (undersize) is the feed minus the oversize retained, and its fraction is that passing mass divided by the feed.

Step 1 – list the data: Feed $= 500$ g, oversize retained on the top sieve $= 150$ g.

Step 2 – find the mass passing through: $500 - 150 = 350$ g

Step 3 – form the fraction passing: $\frac{350}{500}$

Step 4 – simplify: $= 0.70$

Step 5 – express as a percentage: $= 70\%$

Final Answer: undersize fraction $= 70\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – freeze drying (lyophilization): In freeze drying, the food is first frozen so that its water becomes ice, and then, under high vacuum, the ice sublimates directly to vapour without passing through the liquid state.

Step 1 – match the description: Freezing followed by sublimation of the ice under vacuum, leaving a porous high-quality dried product, is exactly freeze drying.

Why the other options are wrong:

- B: spray drying atomises a liquid into hot air; there is no freezing or sublimation.

- C: HTST pasteurization is a heat treatment of liquids, not a drying operation.
- D: blanching is a brief hot-water or steam treatment to inactivate enzymes, not a drying method.

Final Answer: the operation is freeze drying (lyophilization) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q45

Q46.

Solution

Concept – sensible cooling on the psychrometric chart: In sensible cooling no moisture is added or removed, so the humidity ratio W stays constant while the dry-bulb temperature falls (a horizontal line to the left).

Step 1 – track the humidity ratio: W is unchanged, so the actual amount of water vapour per kg of dry air is the same at states 1 and 2.

Step 2 – track the saturation capacity: As the temperature drops, the saturation vapour pressure of the air falls, so the air can now hold much less moisture than before.

Step 3 – combine the two effects: Relative humidity is the ratio of the actual vapour present to the saturation amount. With the numerator fixed and the denominator shrinking, this ratio rises.

Step 4 – state the conclusion: Therefore the relative humidity increases during sensible cooling, and the state point moves towards the saturation curve.

Why the other options are wrong:

- B: RH would fall on heating, not cooling.
- C: RH is not constant, because the saturation capacity changes with temperature even though W does not.
- D: the trend is monotonic for pure sensible cooling; there is no reversal.

Final Answer: the relative humidity increases $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	D	4	C	5	C
6	B	7	D	8	B	9	B	10	A
11	A	12	C	13	A	14	D	15	C
16	B	17	D	18	C	19	A	20	B
21	A	22	D	23	B	24	B	25	D
26	D	27	B	28	D	29	C	30	A
31	D	32	C	33	B	34	D	35	C
36	B	37	A	38	A	39	D	40	A
41	B	42	B	43	C	44	C	45	A
46	A								