GATE Agricultural Engineering

Sample Paper – 2

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 tractor diesel engine consumes 6 kg of fuel per hour while developing a brake power of 20 kW. The brake specific fuel consumption (BSFC) of the engine is: **[1 mark]**

(A) 0.20 kg/kW $\cdot$ h

(B) 0.30 kg/kW $\cdot$ h

(C) 3.33 kg/kW $\cdot$ h

(D) 0.15 kg/kW · h

Q2. When a tractor drive wheel makes one revolution under no drawbar load it advances 2.5 m, but under a heavy drawbar load it advances only 2.0 m per revolution. The percentage wheel slip is: **[1 mark]**

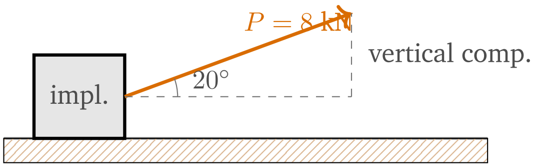
(A) 25%

(B) 80%

(C) 20%

(D) 12.5%

Q3. A trailed implement is pulled by a hitch link inclined at $20°$ above the horizontal, carrying a pull of 8 kN as shown. The vertical (downward) component of this hitch force acting on the drawbar is nearest to (take $\sin 20° = 0.342$): **[1 mark]**



(A) 8.0 kN

(B) 7.52 kN

(C) 4.0 kN

(D) 2.74 kN

Q4. A four-stroke diesel engine has 4 cylinders, each of bore 100 mm and stroke 120 mm. The total swept (piston-displacement) volume of the engine is nearest to: **[1 mark]**

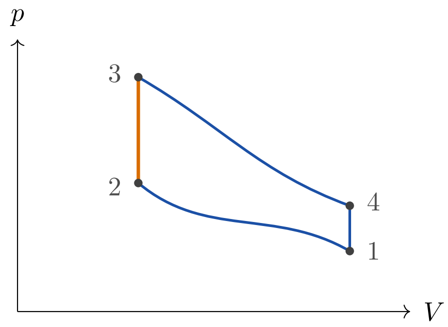
(A) 0.94 L

(B) 1.88 L

(C) 9.42 L

(D) 3.77 L

Q5. The pressure–volume (p–V) diagram shown is the air-standard cycle of a spark-ignition (petrol) engine. The process 2–3 during which heat is added to the working fluid takes place at: **[1 mark]**



(A) constant pressure

(B) constant volume

(C) constant temperature (isothermal)

(D) adiabatic (isentropic) conditions

Q6. The main function of the mouldboard in a mouldboard plough is to: **[1 mark]**

(A) cut the furrow slice horizontally at its bottom

(B) take the side thrust and give the plough stability

(C) lift, invert and turn over the furrow slice

(D) penetrate the soil and take the initial cut

Q7. A 3-bottom mouldboard plough has each bottom cutting a furrow slice 30 cm wide. The total width of cut of the plough in one pass is: **[1 mark]**

(A) 0.30 m

(B) 0.90 m

(C) 1.20 m

(D) 0.60 m

Q8. An implement has a theoretical field capacity of 1.2 ha/h but in the field it actually covers only 0.9 ha/h. The field efficiency of the implement is: **[1 mark]**

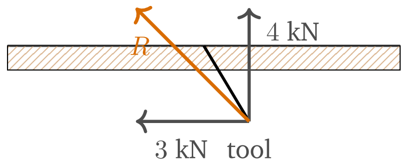
(A) 133%

(B) 75%

(C) 25%

(D) 90%

Q9. A tillage tool experiences a horizontal draft of 3 kN and a vertical soil force of 4 kN acting at the tool point, as shown. The magnitude of the resultant soil reaction on the tool is: **[1 mark]**



(A) 7.0 kN

(B) 1.0 kN

(C) 5.0 kN

(D) 3.5 kN

Q10. A crop is planted at a row-to-row spacing of 0.5 m and a plant-to-plant spacing of 0.2 m within the row. The theoretical plant population per hectare is: **[1 mark]**

(A) 25,000

(B) 40,000

(C) 50,000

(D) 1,00,000

Q11. In a self-propelled grain combine harvester, the component that separates the grain from the straw by allowing the grain to fall through while the straw is walked out at the rear is the: **[1 mark]**

(A) cutter bar

(B) pick-up reel

(C) straw walker

(D) grain-delivery auger

Q12. In a two-stroke-cycle internal-combustion engine, the number of power (expansion) strokes produced per revolution of the crankshaft is: **[1 mark]**

(A) 1

(B) 0.5

(C) 2

(D) 4

Soil & Water Conservation Engineering

Q13. Water flows steadily along an open field channel with a mean velocity of 0.5 m/s through a cross-sectional area of 4 m^2. The discharge carried by the channel is: **[1 mark]**

(A) 8.0 m^3/s

(B) 0.125 m^3/s

(C) 4.5 m^3/s

(D) 2.0 m^3/s

Q14. A rain gauge records 25 mm of rainfall uniformly over a catchment of area 2 km^2. The total volume of rainfall received by the catchment is: **[1 mark]**

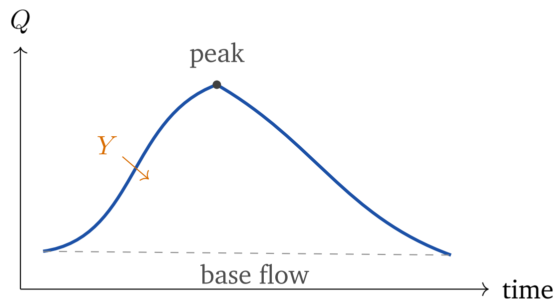
(A) $50{,}000$ m^3

(B) $5{,}000$ m^3

(C) $5{,}00{,}000$ m^3

(D) 12.5 m^3

Q15. In the single-peaked storm hydrograph shown, the portion marked Y (the part of the curve before the peak, where the discharge rises with time) is called the: **[1 mark]**



(A) recession (falling) limb

(B) base flow

(C) rising (concentration) limb

(D) crest segment

Q16. In the Universal Soil Loss Equation $A = R\,K\,LS\,C\,P$, the factor R represents: **[1 mark]**

(A) the rainfall erosivity (the erosive energy–intensity of the rainfall)

(B) the soil erodibility of the field

(C) the combined slope-length and steepness effect

(D) the crop / cover-management practice

Q17. In the Universal Soil Loss Equation, the support-practice factor P is lowered (improved) mainly by field practices such as: **[1 mark]**

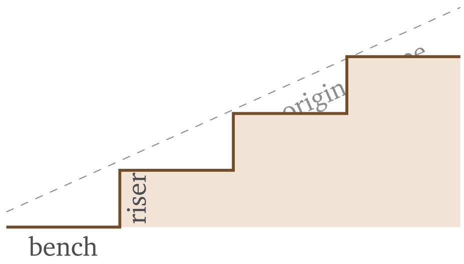
(A) growing a clean-tilled row crop on bare soil

(B) leaving the surface bare through the rainy season

(C) ploughing and planting up and down the slope

(D) contour farming, strip cropping and terracing

Q18. The soil-conservation structure shown in cross-section, in which a steep hill slope is converted into a series of level (or nearly level) steps held up by vertical risers, is called a: **[1 mark]**



(A) graded (channel-type) bund

(B) bench terrace

(C) contour bund

(D) grassed waterway

Q19. The time required for surface runoff to travel from the hydraulically most remote point of a watershed to its outlet is called the: **[1 mark]**

(A) time of concentration

(B) time to peak

(C) basin lag time

(D) time base of the hydrograph

Q20. A natural or constructed channel, kept under a dense cover of grass, that carries surface runoff down a slope without letting the flowing water erode the bed is called a: **[1 mark]**

(A) field (contour) bund

(B) terrace riser

(C) grassed (vegetated) waterway

(D) drop-inlet spillway

Soil & Water Conservation Engineering (continued)

Q21. For a hilly region the vertical interval (VI) between two successive contour bunds is estimated from $\mathrm{VI} = 0.3\left(\frac{S}{3} + 2\right)$ metres, where S is the land slope in percent. For a land slope of $S = 6\%$, the vertical interval is: **[2 marks]**

(A) 2.4 m

(B) 1.2 m

(C) 0.6 m

(D) 3.0 m

Q22. For an agricultural field the Universal Soil Loss Equation factors are $R = 300$, $K = 0.25$, $LS = 2.0$, $C = 0.20$ and $P = 0.80$ (in consistent units). The average annual soil loss A from the field is: **[2 marks]**

(A) 24 t/ha/yr

(B) 30 t/ha/yr

(C) 12 t/ha/yr

(D) 48 t/ha/yr

Q23. A catchment of area 90 ha has a runoff coefficient of 0.50. For a design rainfall intensity of 4 cm/h, the peak runoff estimated by the rational method $\left(Q = CiA/360,\ i \text{ in mm/h},\ A \text{ in ha}\right)$ is nearest to: **[2 marks]**

(A) $12.5\ \text{m}^3/\text{s}$

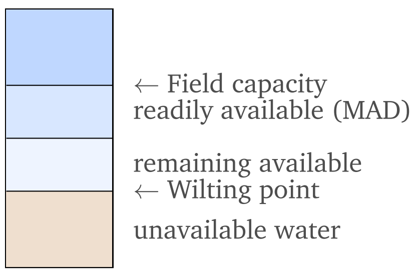
(B) $2.5\ \text{m}^3/\text{s}$

(C) $10.0\ \text{m}^3/\text{s}$

(D) $5.0\ \text{m}^3/\text{s}$

Irrigation & Drainage Engineering

Q24. For the soil-moisture profile shown, the total available water held in the crop root zone is 200 mm. If irrigation is scheduled at a management-allowed depletion (MAD) of 50% of the available water, the net depth of irrigation to be applied at each irrigation is: **[2 marks]**



(A) 200 mm

(B) 400 mm

(C) 100 mm

(D) 50 mm

Q25. A crop uses water at a peak consumptive rate (ET) of 5 mm/day. Each irrigation applies a net depth of 60 mm to the root zone. The irrigation interval (frequency) that just meets the peak demand is: **[2 marks]**

(A) 6 days

(B) 12 days

(C) 300 days

(D) 0.083 days

Q26. The total depth of water (delta) required by a crop is $\Delta = 1.2$ m, delivered over a base period of $B = 120$ days. Using the relation Duty $D = \frac{8.64\,B}{\Delta}$ (with D in ha per cumec, B in days and Δ in metres), the duty of the irrigation water is: **[2 marks]**

(A) 100 ha/cumec

(B) 1200 ha/cumec

(C) 864 ha/cumec

(D) 432 ha/cumec

Q27. During the first hour of a storm, a total (cumulative) depth of 20 mm of water infiltrates into a soil while the rainfall over the same hour is 35 mm. Assuming that all rainfall which does not infiltrate becomes surface runoff (other losses being neglected), the depth of surface runoff is: **[2 marks]**

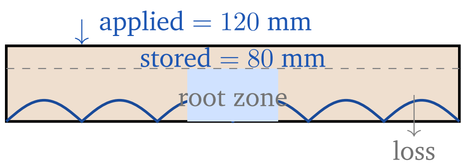
(A) 15 mm

(B) 55 mm

(C) 20 mm

(D) 35 mm

Q28. During a furrow irrigation, 120 mm depth of water is applied. The root zone had a moisture deficit requiring 100 mm to be fully refilled, but only 80 mm was actually stored in the root zone (the rest being lost to deep percolation and tail runoff), as sketched. The water-storage efficiency of the irrigation is: **[2 marks]**



(A) 66.7%

(B) 120%

(C) 100%

(D) 80%

Q29. A pump delivers 50 L/s of water against a total head of 15 m. The water (output) power delivered by the pump is nearest to (take $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2): **[2 marks]**

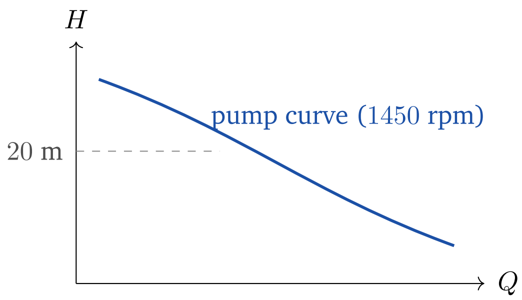
(A) 5.89 kW

(B) 7.36 kW

(C) 9.81 kW

(D) 3.68 kW

Q30. A centrifugal pump running at 1450 rpm develops a head of 20 m, with its head–discharge curve shown. Using the pump affinity laws, if the speed is doubled to 2900 rpm, the corresponding head developed becomes: **[2 marks]**



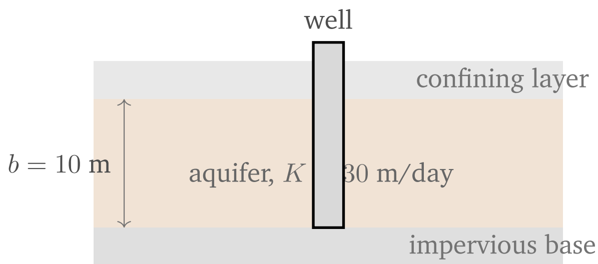
(A) 20 m

(B) 40 m

(C) 10 m

(D) 80 m

Q31. A tube well fully penetrates a confined aquifer of saturated thickness 10 m and hydraulic conductivity 30 m/day, as shown. The transmissivity of the aquifer is: **[2 marks]**



(A) 3.0 m^2/day

(B) 40 m^2/day

(C) 0.3 m^2/day

(D) 300 m^2/day

Q32. Following a rain, 30 mm depth of water percolates down and reaches the water table of a soil whose drainable porosity (specific yield) is 0.10. The resulting rise in the water table is: **[2 marks]**

(A) 300 mm

(B) 30 mm

(C) 3 mm

(D) 150 mm

Q33. In an irrigation project the conveyance efficiency of the canal network is 80% and the field-application efficiency in the fields is 75%. The overall (project) irrigation efficiency is: **[2 marks]**

(A) 77.5%

(B) 60%

(C) 155%

(D) 105%

Q34. Groundwater moves through an aquifer with a Darcy (discharge) velocity of 0.6 m/day. If the porosity of the aquifer material is 0.30, the actual (seepage or pore) velocity of the groundwater is: **[2 marks]**

(A) 0.18 m/day

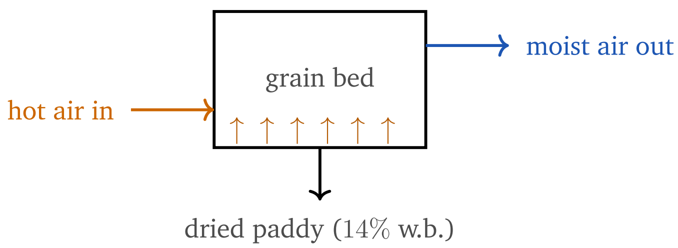
(B) 0.6 m/day

(C) 0.5 m/day

(D) 2.0 m/day

Agricultural Processing & Food Engineering

Q35. A batch of 200 kg of paddy at 24% moisture content (wet basis) is dried to 14% moisture content (wet basis) in the hot-air dryer shown. The mass of water removed during drying is nearest to: **[2 marks]**



(A) 20.0 kg

(B) 30.0 kg

(C) 23.3 kg

(D) 46.5 kg

Q36. A grain 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) 20%

(B) 16.7%

(C) 25%

(D) 80%

Q37. In a rice mill, 100 kg of clean paddy is processed and yields 68 kg of milled rice (whole plus broken). The milling (rice) recovery of the mill is: **[2 marks]**

(A) 100%

(B) 32%

(C) 147%

(D) 68%

Q38. The moisture in a moist food material that exerts a vapour pressure lower than that of pure water at the same temperature, because it is physically or chemically held to the solid, is termed its: **[2 marks]**

(A) bound moisture

(B) free moisture

(C) equilibrium moisture

(D) critical moisture

Q39. According to Kick's law of size reduction, the energy required per unit mass to reduce the size of a solid material is proportional to: **[2 marks]**

(A) the new surface area created during grinding

(B) the reciprocal of the square root of the particle size

(C) the logarithm of the size-reduction ratio, $\ln\left(\frac{d_1}{d_2}\right)$

(D) the square of the feed particle size

Q40. A spiral (inclined-chute) separator is used to separate round-shaped seeds such as mustard from flat or irregular seeds. This separation works by exploiting the difference in the particles': **[2 marks]**

(A) shape and ability to roll (roundness)

(B) colour

(C) terminal (floating) velocity in air

(D) magnetic property

Q41. A bucket elevator lifts grain in buckets, each bucket carrying 2 kg of grain, and the buckets discharge at the rate of 30 buckets per minute. The conveying capacity of the elevator is: **[2 marks]**

(A) 1.8 t/h

(B) 3.6 t/h

(C) 60 t/h

(D) 7.2 t/h

Q42. The heat required to raise the temperature of 50 kg of a food product from 20°C to 80°C, given that its specific heat is 3.5 kJ/kg · K, is: **[2 marks]**

(A) 5250 kJ

(B) 10500 kJ

(C) 21000 kJ

(D) 3500 kJ

Q43. To evaporate 4 kg of water from a food product during drying, the latent heat of vaporization of water being 2260 kJ/kg, the heat energy that must be supplied is: **[2 marks]**

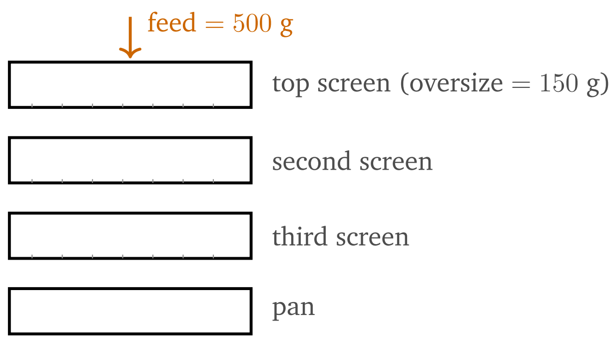
(A) 9040 kJ

(B) 2260 kJ

(C) 4520 kJ

(D) 565 kJ

Q44. A 500 g sample of ground material is placed on the top screen of the test-sieve stack shown; 150 g is retained as oversize on the top screen and the rest passes through it. The fraction of the feed that passes the top screen (the undersize fraction) is: **[2 marks]**



(A) 30%

(B) 70%

(C) 130%

(D) 43%

Q45. The ultra-high-temperature (UHT) process used to sterilize milk for long ambient shelf life is normally carried out at a temperature and holding time of about: **[2 marks]**

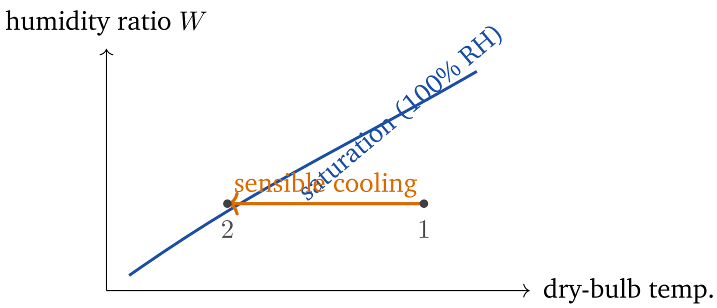
(A) 135°C for 2–4 seconds

(B) 63°C for 30 minutes

(C) 72°C for 15 seconds

(D) 100°C for 10 minutes

Q46. Moist air is cooled at constant humidity ratio (a sensible-cooling process, with no moisture removed), shown as the horizontal line 1–2 moving to the left 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 – brake specific fuel consumption: BSFC is the mass of fuel burned per unit of brake power per hour: BSFC $= \frac{\dot{m}_f}{P_b}$.

Step 1 – list the data: Fuel rate $\dot{m}_f = 6$ kg/h, brake power $P_b = 20$ kW.

Step 2 – write the formula: BSFC $= \frac{\dot{m}_f}{P_b}$

Step 3 – substitute the values: BSFC $= \frac{6}{20}$

Step 4 – evaluate: BSFC $= 0.30$ kg/kW $\cdot$ h

Final Answer: BSFC $= 0.30$ kg/kW $\cdot$ h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – wheel slip: Slip is the fractional loss of forward travel of a driving wheel under load, $s = \frac{d_0 - d_L}{d_0} \times 100\%$, where d_0 is the no-load advance and d_L the loaded advance per revolution.

Step 1 – list the data: No-load advance $d_0 = 2.5$ m, loaded advance $d_L = 2.0$ m per revolution.

Step 2 – find the loss of travel: $d_0 - d_L = 2.5 - 2.0 = 0.5$ m

Step 3 – form the slip ratio: $s = \frac{0.5}{2.5}$

Step 4 – evaluate the ratio: $s = 0.20$

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

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

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – resolving an inclined pull into components: A pull P inclined at angle θ to the horizontal has a vertical component $P_v = P\sin\theta$ and a horizontal component $P_h = P\cos\theta$.

Step 1 – list the data: $P = 8$ kN, $\theta = 20^\circ$, $\sin 20^\circ = 0.342$.

Step 2 – write the vertical component: $P_v = P\sin\theta$

Step 3 – substitute: $P_v = 8 \times 0.342$

Step 4 – evaluate: $P_v = 2.736$ kN

Step 5 – round: $P_v \approx 2.74$ kN

Final Answer: vertical component ≈ 2.74 kN $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q3**

Q4.

Solution

Concept – swept (displacement) volume of a multi-cylinder engine: For one cylinder, swept volume $= \frac{\pi}{4}D^2L$; for n cylinders multiply by n.

Step 1 – list the data: Bore $D = 100$ mm $= 0.10$ m, stroke $L = 120$ mm $= 0.12$ m, number of cylinders $n = 4$.

Step 2 – compute the bore area: $\frac{\pi}{4}D^2 = 0.7854 \times (0.10)^2$

$= 0.7854 \times 0.01$

$= 0.007854 \text{ m}^2$

Step 3 – multiply by the stroke for one cylinder: $V_1 = 0.007854 \times 0.12$

$V_1 = 0.0009425 \text{ m}^3$

Step 4 – multiply by the number of cylinders: $V = 4 \times 0.0009425$

$V = 0.003770 \text{ m}^3$

Step 5 – convert to litres (1 m^3 $= 1000$ L): $V = 3.77$ L

Final Answer: $V \approx 3.77$ L $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q4**

Q5.

Solution

Concept – the ideal Otto (spark-ignition) cycle: The air-standard Otto cycle consists of isentropic compression, constant-volume heat addition, isentropic expansion and constant-volume heat rejection.

Step 1 – identify the heat-addition process: In a petrol engine the mixture is ignited by a spark near the top of the stroke and burns almost instantly, so the piston hardly moves and the volume stays essentially constant during combustion.

Step 2 – match it to the diagram: The vertical segment 2–3 on the p–V diagram (volume constant while pressure rises) is the constant-volume heat-addition process.

Why the other options are wrong:

- A: constant-pressure heat addition is the feature of the diesel cycle, not the Otto cycle.
- C: an isothermal process belongs to the Carnot cycle.
- D: the adiabatic (isentropic) processes are the compression and expansion strokes, during which no heat is added.

Final Answer: heat is added at constant volume $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – parts of a mouldboard plough bottom: A mouldboard plough bottom has a share (that cuts the furrow slice), a landside (that resists side thrust) and a mouldboard (that turns the slice).

Step 1 – recall the role of the mouldboard: The mouldboard is the curved surface that receives the furrow slice from the share, then lifts it, breaks it and rolls it over.

Step 2 – state its purpose: Its job is to invert and turn the furrow slice, which buries surface trash and weeds and exposes fresh soil.

Why the other options are wrong:

- A: cutting the slice at the bottom is done by the share.
- B: resisting the side thrust is the function of the landside.
- D: initial penetration is provided by the share point, not the mouldboard.

Final Answer: the mouldboard lifts, inverts and turns the furrow slice $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – total width of cut of a multi-bottom plough: The total working width equals the number of bottoms times the width of cut of each bottom: $W = n \times w$.

Step 1 – list the data: Number of bottoms $n = 3$, width per bottom $w = 30$ cm $= 0.30$ m.

Step 2 – multiply: $W = 3 \times 0.30$

Step 3 – evaluate: $W = 0.90$ m

Final Answer: total width of cut $= 0.90$ m $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) 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: $\eta_f = \dfrac{\text{EFC}}{\text{TFC}} \times 100\%$.

Step 1 – list the data: Theoretical field capacity TFC $= 1.2$ ha/h, effective field capacity EFC $= 0.9$ ha/h.

Step 2 – form the ratio: $\eta_f = \dfrac{0.9}{1.2}$

Step 3 – evaluate the ratio: $\eta_f = 0.75$

Step 4 – express as a percentage: $\eta_f = 75\%$

Final Answer: field efficiency $= 75\%$ $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – resultant of two perpendicular forces: When the horizontal draft H and the vertical force V act at right angles, the resultant soil reaction is $R = \sqrt{H^2 + V^2}$.

Step 1 – list the data: Horizontal draft $H = 3$ kN, vertical force $V = 4$ kN.

Step 2 – square each component: $H^2 = 3^2 = 9$

$V^2 = 4^2 = 16$

Step 3 – add the squares: $H^2 + V^2 = 9 + 16 = 25$

Step 4 – take the square root: $R = \sqrt{25} = 5$ kN

Final Answer: $R = 5.0$ kN $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept – plant population from spacing: For a rectangular planting pattern, the population per hectare is the area of one hectare divided by the ground area occupied by one plant: $N = \dfrac{10000}{r \times p}$, with r and p in metres.

Step 1 – list the data: Row spacing $r = 0.5$ m, plant spacing $p = 0.2$ m, area of 1 ha $= 10000$ m^2.

Step 2 – find the area per plant: $r \times p = 0.5 \times 0.2 = 0.10$ m^2

Step 3 – divide the hectare 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 $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept – separation of grain from straw in a combine: After threshing, the mixture of grain and straw passes over oscillating straw walkers; the small grains fall through while the long straw is carried out at the rear.

Step 1 – identify the separating element: The straw walker is a set of oscillating, stepped racks that shake the threshed material so the grain works its way down through the straw.

Step 2 – rule out the other parts: The cutter bar cuts the standing crop, the pick-up reel gathers and feeds the crop, and the grain auger conveys the cleaned grain to the tank; none of these separate grain from straw.

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

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – power strokes in a two-stroke engine: In a two-stroke-cycle engine the complete cycle (compression and power) is finished in one revolution of the crankshaft.

Step 1 – count the strokes per cycle: There are two strokes – one up (compression) and one down (power) – and together they take one revolution.

Step 2 – count power strokes per revolution: Every downward stroke is a power stroke, so there is exactly 1 power stroke in every revolution.

Step 3 – contrast with the four-stroke engine: This is twice the firing frequency of a four-stroke engine, which gives one power stroke in two revolutions.

Final Answer: 1 power stroke per revolution $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – continuity equation (discharge): The discharge through a channel section is the product of the cross-sectional area and the mean velocity: $Q = A \times V$.

Step 1 – list the data: Area $A = 4\ \text{m}^2$, mean velocity $V = 0.5$ m/s.

Step 2 – write the formula: $Q = A \times V$

Step 3 – substitute: $Q = 4 \times 0.5$

Step 4 – evaluate: $Q = 2.0\ \text{m}^3/\text{s}$

Final Answer: $Q = 2.0\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – volume of rainfall over an area: The total volume of rainfall equals the rainfall depth times the catchment area, with depth and area in consistent units: $\text{Vol} = d \times A$.

Step 1 – list the data: Depth $d = 25$ mm $= 0.025$ m, area $A = 2\ \text{km}^2 = 2 \times 10^6\ \text{m}^2$.

Step 2 – write the formula: $\text{Vol} = d \times A$

Step 3 – substitute: $\text{Vol} = 0.025 \times 2 \times 10^6$

Step 4 – evaluate: $\text{Vol} = 50{,}000 \text{ m}^3$

Final Answer: $\text{Vol} = 50{,}000 \text{ m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – parts of a storm hydrograph: A single-peaked hydrograph has a rising limb up to the peak, then a falling (recession) limb back towards the base flow.

Step 1 – locate the marked part: Segment Y lies before the peak and rises with time as runoff builds up.

Step 2 – name that segment: The ascending part before the peak is the rising (concentration) limb; its shape depends mainly on the storm and the catchment characteristics.

Why the other options are wrong:

- A: the recession limb is the part after the peak, not before it.
- B: base flow is the low, steady groundwater contribution.
- D: the crest segment is the short region around the peak itself.

Final Answer: Y is the rising (concentration) limb $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept – factors of the Universal Soil Loss Equation: $A = R\,K\,LS\,C\,P$, where each capital letter is a distinct erosion factor.

Step 1 – identify R: R is the rainfall erosivity factor; it measures the capacity of the rainfall and its runoff to cause erosion, based on the storm energy and its maximum intensity.

Step 2 – separate it from the others: K is soil erodibility, LS combines slope length and steepness, C is the cover-management factor and P is the support-practice factor.

Why the other options are wrong:

- B: soil erodibility is the factor K, not R.
- C: the slope-length and steepness effect is the LS factor.
- D: the crop / cover-management effect is the C factor.

Final Answer: R is the rainfall erosivity factor $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept – the support-practice factor P: P compares the soil loss with a given support practice to the soil loss from straight up-and-down-slope tillage; the more effective the practice, the smaller P becomes.

Step 1 – recall which practices lower P: Practices that break or intercept the downslope flow of water – contour farming, strip cropping and terracing – reduce the runoff's erosive power and so lower P.

Step 2 – rule out the practices that do not help: Clean-tilled row crops on bare soil, leaving the surface bare, or tilling up and down the slope all give the reference (worst) condition, for which $P = 1$; they do not reduce P.

Final Answer: contour farming, strip cropping and terracing lower $P \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept – bench terracing: A bench terrace cuts a steep slope into a stair-step of level (or gently sloping) strips called benches, each held up by a steep riser.

Step 1 – read the cross-section: The figure shows a series of level steps rising one above the other, each separated by a short vertical riser – the classic bench-terrace shape.

Step 2 – state its purpose: By flattening the cultivated strips, the terrace reduces the effective slope and slows runoff, controlling erosion on steep land.

Why the other options are wrong:

- A: a graded bund is a single earthen embankment with a small longitudinal grade, not a series of steps.

- C: a contour bund is a small ridge along the contour, not a stepped cross-section.
- D: a grassed waterway is a vegetated channel, not a terraced land form.

Final Answer: the stepped structure is a bench terrace $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept – time of concentration: The time of concentration is the time water takes to flow from the farthest (hydraulically most remote) point of a watershed to its outlet.

Step 1 – interpret the definition: At the time of concentration the whole watershed is contributing runoff to the outlet at the same time, which is why it is used to pick the design rainfall intensity.

Step 2 – separate it from the look-alikes: Time to peak is measured to the hydrograph peak, basin lag is the delay between rainfall and runoff centroids, and time base is the total duration of the runoff hydrograph – none is the travel time from the remotest point.

Final Answer: it is the time of concentration $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – grassed waterway: A grassed waterway is a broad, shallow channel protected by a dense grass cover, built to carry concentrated runoff (for example, terrace and bund outflow) safely to a lower outlet.

Step 1 – recall its function: The grass lining lowers the flow velocity and protects the soil surface, so the water is conveyed without scouring the channel bed.

Step 2 – rule out the others: A field bund and a terrace riser are earth structures that hold or retard water rather than convey it, and a drop-inlet spillway is a masonry/pipe structure to lower water across a large drop.

Final Answer: the grass-lined conveyance channel is a grassed waterway $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept – vertical interval between bunds: The vertical interval is found by substituting the land slope into the given design relation $\text{VI} = 0.3\left(\frac{S}{3}+2\right)$.

Step 1 – list the data: Land slope $S = 6\%$.

Step 2 – evaluate the term $S/3$: $\frac{S}{3} = \frac{6}{3} = 2$

Step 3 – add the constant inside the bracket: $\frac{S}{3} + 2 = 2 + 2 = 4$

Step 4 – multiply by 0.3: $\text{VI} = 0.3 \times 4$

Step 5 – evaluate: $\text{VI} = 1.2$ m

Final Answer: vertical interval $= 1.2$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept – Universal Soil Loss Equation: The average annual soil loss is the product of all six USLE factors: $A = R\,K\,LS\,C\,P$.

Step 1 – list the data: $R = 300$, $K = 0.25$, $LS = 2.0$, $C = 0.20$, $P = 0.80$.

Step 2 – multiply R and K: $300 \times 0.25 = 75$

Step 3 – multiply by LS: $75 \times 2.0 = 150$

Step 4 – multiply by C: $150 \times 0.20 = 30$

Step 5 – multiply by P: $30 \times 0.80 = 24$

Step 6 – state the result: $A = 24$ t/ha/yr

Final Answer: $A = 24$ t/ha/yr $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept – rational method for peak runoff: With intensity i in mm/h and area A in ha, the peak runoff is $Q = \frac{C\,i\,A}{360}$ m^3/s.

Step 1 – list the data: $C = 0.50$, $i = 4$ cm/h, $A = 90$ ha.

Step 2 – convert the intensity to mm/h: $i = 4$ cm/h $= 40$ mm/h

Step 3 – form the numerator $C\,i\,A$: $0.50 \times 40 = 20$

$20 \times 90 = 1800$

Step 4 – divide by 360: $Q = \dfrac{1800}{360}$

Step 5 – evaluate: $Q = 5.0\ \text{m}^3/\text{s}$

Final Answer: $Q = 5.0\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept – management-allowed depletion (MAD): The net irrigation depth applied at each irrigation equals the fraction of the total available water that the crop is allowed to deplete: $d_{net} = \text{MAD} \times \text{(total available water)}$.

Step 1 – list the data: Total available water in the root zone $= 200$ mm, MAD $= 50\% = 0.50$.

Step 2 – write the formula: $d_{net} = \text{MAD} \times \text{TAW}$

Step 3 – substitute: $d_{net} = 0.50 \times 200$

Step 4 – evaluate: $d_{net} = 100$ mm

Step 5 – interpret: The soil is refilled after 100 mm of the 200 mm available water has been used by the crop.

Final Answer: net irrigation depth $= 100$ mm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept – irrigation interval: The irrigation interval is the net depth applied divided by the daily crop water use: $I = \dfrac{d_{net}}{\text{ET}}$.

Step 1 – list the data: Net depth $d_{net} = 60$ mm, peak ET $= 5$ mm/day.

Step 2 – write the formula: $I = \dfrac{d_{net}}{\text{ET}}$

Step 3 – substitute: $I = \dfrac{60}{5}$

Step 4 – evaluate: $I = 12$ days

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

Answer: (B) Go Back to Q25

Q26.

Solution

Concept – duty of irrigation water: Duty relates the base period B and the delta Δ through $D = \dfrac{8.64\,B}{\Delta}$, giving the area (ha) that a continuous supply of 1 $\mathrm{m^3/s}$ can irrigate.

Step 1 – list the data: Base period $B = 120$ days, delta $\Delta = 1.2$ m.

Step 2 – write the formula: $D = \dfrac{8.64\,B}{\Delta}$

Step 3 – form the numerator: $8.64 \times 120 = 1036.8$

Step 4 – divide by the delta: $D = \dfrac{1036.8}{1.2}$

Step 5 – evaluate: $D = 864$ ha/cumec

Final Answer: duty $= 864$ ha/cumec $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept – rainfall separated into infiltration and runoff: When other losses are ignored, the rainfall either infiltrates or runs off, so runoff $=$ rainfall $-$ infiltration.

Step 1 – list the data: Rainfall over the hour $= 35$ mm, cumulative infiltration over the hour $= 20$ mm.

Step 2 – write the water balance: Runoff $=$ Rainfall $-$ Infiltration

Step 3 – substitute: Runoff $= 35 - 20$

Step 4 – evaluate: Runoff $= 15$ mm

Final Answer: surface runoff $= 15$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept – water-storage efficiency: Water-storage efficiency measures how well the irrigation refills the root-zone deficit: $E_s = \dfrac{\text{water stored in root zone}}{\text{water needed to fill the root zone}} \times 100\%$.

Step 1 – list the data: Water stored in root zone $= 80$ mm, water needed to refill the deficit $= 100$ mm (applied depth 120 mm is not used here).

Step 2 – write the formula: $E_s = \dfrac{\text{stored}}{\text{needed}}$

Step 3 – substitute: $E_s = \dfrac{80}{100}$

Step 4 – evaluate: $E_s = 0.80$

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

Note: do not confuse this with application efficiency, which would be stored/applied $= 80/120 = 66.7\%$; the question asks specifically about storage (refilling the deficit).

Final Answer: water-storage efficiency $= 80\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – water (output) power of a pump: The useful power imparted to the water is $P = \rho_w\, g\, Q\, H$, with Q in m^3/s and H the total head in metres.

Step 1 – list the data: $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2, $Q = 50$ L/s $= 0.050$ m^3/s, $H = 15$ m.

Step 2 – write the formula: $P = \rho_w\, g\, Q\, H$

Step 3 – substitute the values: $P = 1000 \times 9.81 \times 0.050 \times 15$

Step 4 – multiply Q and H: $0.050 \times 15 = 0.75$

Step 5 – multiply by g: $9.81 \times 0.75 = 7.3575$

Step 6 – multiply by ρ_w: $1000 \times 7.3575 = 7357.5$ W

Step 7 – convert to kilowatts: $P = 7.36$ kW

Final Answer: water power ≈ 7.36 kW $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

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

Step 1 – list the data: $H_1 = 20$ m, $N_1 = 1450$ rpm, $N_2 = 2900$ rpm.

Step 2 – form the speed ratio: $\dfrac{N_2}{N_1} = \dfrac{2900}{1450} = 2$

Step 3 – square the speed ratio: $\left(\dfrac{N_2}{N_1}\right)^2 = 2^2 = 4$

Step 4 – apply the affinity law: $H_2 = H_1 \times 4$

Step 5 – substitute and evaluate: $H_2 = 20 \times 4 = 80$ m

Final Answer: new head $= 80$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

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

Step 1 – list the data: Hydraulic conductivity $K = 30$ m/day, saturated thickness $b = 10$ m.

Step 2 – write the formula: $T = K \times b$

Step 3 – substitute: $T = 30 \times 10$

Step 4 – evaluate: $T = 300\ \text{m}^2/\text{day}$

Final Answer: transmissivity $= 300\ \text{m}^2/\text{day} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – water-table rise from recharge: When a depth of water d recharges an unconfined aquifer, it fills only the drainable pore space, so the water table rises by $\Delta h = \dfrac{d}{S_y}$, where S_y is the drainable porosity (specific yield).

Step 1 – list the data: Recharge depth $d = 30$ mm, drainable porosity $S_y = 0.10$.

Step 2 – write the formula: $\Delta h = \dfrac{d}{S_y}$

Step 3 – substitute: $\Delta h = \dfrac{30}{0.10}$

Step 4 – evaluate: $\Delta h = 300$ mm

Step 5 – interpret: Because only one-tenth of the soil volume can hold the added water, the water table rises ten times the recharge depth.

Final Answer: water-table rise $= 300$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q32

Q33.

Solution

Concept – overall irrigation efficiency: The overall (project) efficiency is the product of the conveyance efficiency and the field-application efficiency: $\eta_o = \eta_c \times \eta_a$.

Step 1 – list the data: Conveyance efficiency $\eta_c = 80\% = 0.80$, application efficiency $\eta_a = 75\% = 0.75$.

Step 2 – write the formula: $\eta_o = \eta_c \times \eta_a$

Step 3 – substitute: $\eta_o = 0.80 \times 0.75$

Step 4 – evaluate: $\eta_o = 0.60$

Step 5 – express as a percentage: $\eta_o = 60\%$

Final Answer: overall efficiency $= 60\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept – seepage (pore) velocity versus Darcy velocity: The Darcy velocity is spread over the whole cross-section, but water actually flows only through the pores, so the seepage velocity is $v_s = \dfrac{v}{n}$, where n is the porosity.

Step 1 – list the data: Darcy velocity $v = 0.6$ m/day, porosity $n = 0.30$.

Step 2 – write the formula: $v_s = \dfrac{v}{n}$

Step 3 – substitute: $v_s = \dfrac{0.6}{0.30}$

Step 4 – evaluate: $v_s = 2.0$ m/day

Step 5 – interpret: The pore velocity is larger than the Darcy velocity because the flow is squeezed into the fraction of the area that is actually open pore space.

Final Answer: seepage velocity $= 2.0$ m/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – water removed in drying (dry-matter balance): During drying the bone-dry matter stays constant. Wet-basis moisture content is $M = \frac{\text{water}}{\text{total mass}}$, so the dry matter is $(1 - M)$ of the total mass.

Step 1 – list the data: Initial mass $W_1 = 200$ kg at $M_1 = 24\% = 0.24$ (w.b.); final $M_2 = 14\% = 0.14$ (w.b.).

Step 2 – find the constant dry matter from the initial state: Dry matter $= W_1(1 - M_1)$

$= 200 \times (1 - 0.24)$

$= 200 \times 0.76$

$= 152$ kg

Step 3 – find the final total mass from the dry matter: $W_2 = \dfrac{\text{Dry matter}}{1 - M_2}$

$= \dfrac{152}{1 - 0.14}$

$= \dfrac{152}{0.86}$

$= 176.74$ kg

Step 4 – find the water removed: $\Delta W = W_1 - W_2$

$= 200 - 176.74$

$= 23.26$ kg

Step 5 – round: $\Delta W \approx 23.3$ kg

Final Answer: water removed ≈ 23.3 kg $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept – converting wet basis to dry basis: The two moisture bases are related by $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$, where the moisture contents are fractions.

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

Step 2 – write the formula: $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$

Step 3 – form the denominator: $1 - 0.20 = 0.80$

Step 4 – substitute: $M_{db} = \dfrac{0.20}{0.80}$

Step 5 – evaluate: $M_{db} = 0.25$

Step 6 – express as a percentage: $M_{db} = 25\%$

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

Answer: (C) Go Back to Q36

Q37.

Solution

Concept – milling (rice) recovery: Milling recovery is the mass of milled rice obtained as a percentage of the mass of paddy processed: Recovery $= \dfrac{\text{milled rice}}{\text{paddy}} \times 100\%$.

Step 1 – list the data: Paddy processed $= 100$ kg, milled rice obtained $= 68$ kg.

Step 2 – write the formula: Recovery $= \dfrac{68}{100} \times 100\%$

Step 3 – evaluate the ratio: $\dfrac{68}{100} = 0.68$

Step 4 – express as a percentage: Recovery $= 68\%$

Final Answer: milling recovery $= 68\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept – bound moisture: Bound moisture is water held so tightly to the solid (by adsorption, capillarity or solution) that it exerts a vapour pressure below that of free water at the same temperature.

Step 1 – match the definition: The lowered vapour pressure and the physical/chemical binding described are exactly the defining features of bound moisture.

Step 2 – separate it from the others: Free moisture is the removable moisture above the equilibrium value, equilibrium moisture is the value the solid reaches with a fixed surrounding air, and critical moisture marks the change from constant-rate to falling-rate drying – none exerts a reduced vapour pressure by binding.

Final Answer: it is bound 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 per unit mass to reduce size is proportional to the logarithm of the size-reduction ratio: $E = K_K \ln\left(\frac{d_1}{d_2}\right)$.

Step 1 – recall the three grinding laws: Rittinger's law makes energy proportional to the new surface area created; Kick's law makes it proportional to $\ln(d_1/d_2)$; Bond's law makes it proportional to $1/\sqrt{d}$.

Step 2 – pick the correct proportionality for Kick: For Kick's law the energy is proportional to $\ln(d_1/d_2)$, so it depends only on the ratio of feed to product size, not on the absolute sizes.

Why the other options are wrong:

- A: proportionality to the new surface area is Rittinger's law.
- B: the $1/\sqrt{d}$ dependence corresponds to Bond's law.
- D: no standard grinding law makes energy proportional to the square of the feed size.

Final Answer: energy $\propto \ln(d_1/d_2) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept – spiral (inclined-chute) separator: A spiral separator sorts a mixture by the way particles move down an inclined helical chute: round seeds roll and gain speed, throwing themselves outward, while flat or irregular seeds slide and stay on the inner track.

Step 1 – identify the property used: The separation depends on shape, in particular the ability of round seeds to roll, which the flat/irregular seeds cannot do.

Step 2 – rule out the others: Colour is used by optical/electronic sorters, terminal velocity is used by aspiration/air separation, and magnetic property is used by magnetic separators – none of these drives a spiral separator.

Final Answer: it works on particle shape / roundness $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q40

Q41.

Solution

Concept – capacity of a bucket elevator: The conveying capacity is the mass carried per bucket times the number of buckets discharging per unit time.

Step 1 – list the data: Grain per bucket $= 2$ kg, discharge rate $= 30$ buckets/min.

Step 2 – find the mass flow per minute: $2 \times 30 = 60$ kg/min

Step 3 – convert to kg per hour: $60 \times 60 = 3600$ kg/h

Step 4 – convert to tonnes per hour (1 t $= 1000$ kg): $\dfrac{3600}{1000} = 3.6$ t/h

Final Answer: conveying capacity $= 3.6$ t/h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – sensible heat to change temperature: The heat needed to change the temperature of a mass without a phase change is $Q = m\,c\,\Delta T$.

Step 1 – list the data: Mass $m = 50$ kg, specific heat $c = 3.5$ kJ/kg·K, temperature rise $\Delta T = 80 - 20 = 60$ K.

Step 2 – write the formula: $Q = m\,c\,\Delta T$

Step 3 – substitute: $Q = 50 \times 3.5 \times 60$

Step 4 – multiply the first two factors: $50 \times 3.5 = 175$

Step 5 – multiply by ΔT: $175 \times 60 = 10500$

Step 6 – state the result: $Q = 10500$ kJ

Final Answer: $Q = 10500 \text{ kJ} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – latent heat of vaporization: The heat needed to evaporate a mass of water at constant temperature is $Q = m\,L$, where L is the latent heat of vaporization.

Step 1 – list the data: Mass of water $m = 4$ kg, latent heat $L = 2260$ kJ/kg.

Step 2 – write the formula: $Q = m\,L$

Step 3 – substitute: $Q = 4 \times 2260$

Step 4 – evaluate: $Q = 9040$ kJ

Final Answer: $Q = 9040 \text{ kJ} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – undersize fraction on a screen: The undersize (passing) fraction is the mass that passes through the screen divided by the mass of feed placed on it.

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

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

Step 3 – form the passing fraction: Fraction $= \dfrac{350}{500}$

Step 4 – evaluate: Fraction $= 0.70$

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

Final Answer: undersize (passing) fraction $= 70\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept – UHT sterilization of milk: The ultra-high-temperature process heats milk to about 135–140°C for only a few seconds and then rapidly cools and aseptically packs it, giving a long shelf life at room temperature.

Step 1 – recall the UHT condition: UHT holds milk at roughly 135°C for 2 to 4 seconds, a much higher temperature and shorter time than pasteurization.

Step 2 – separate it from the pasteurization settings: 63°C for 30 min is the LTLT (holder) pasteurization and 72°C for 15 s is HTST pasteurization; both only pasteurize (they do not sterilize), and 100°C for 10 min is not a standard milk process.

Final Answer: UHT is about 135°C for 2–4 s $\Rightarrow \boxed{\text{A}}$

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 falls, the saturation vapour pressure of the air decreases, 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 if cooling continues, the air eventually reaches saturation at its dew point).

Why the other options are wrong:

- B: RH would fall on heating, not on cooling.
- C: RH is not constant, because the saturation capacity changes with temperature even though W does not.
- D: the trend is monotonic (a steady increase) for pure sensible cooling above

the dew point.

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