GATE Agricultural Engineering

Sample Paper – 4

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's driving wheel covers 40 m in 10 revolutions when the tractor runs without load, and only 32 m in 10 revolutions while pulling a loaded implement. The wheel slip is: **[1 mark]**

(A) 25%

(B) 20%

(C) 16.67%

(D) 8%

Q2. An agricultural engine consumes 5 kg of diesel per hour while developing a brake power of 20 kW. The brake specific fuel consumption (BSFC) of the engine is: **[1 mark]**

(A) 0.25 kg/kWh

(B) 4.0 kg/kWh

(C) 0.20 kg/kWh

(D) 100 kg/kWh

Q3. The indicated power developed inside the cylinders of a tractor engine is 25 kW, of which 5 kW is lost to internal friction. The mechanical efficiency of the engine is: **[1 mark]**

(A) 80%

(B) 125%

(C) 20%

(D) 25%

Q4. A four-cylinder, four-stroke-cycle diesel engine runs at 1500 rpm. The total number of power (expansion) strokes produced by the engine per minute is: **[1 mark]**

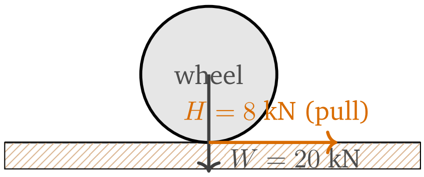
(A) 6000

(B) 1500

(C) 3000

(D) 750

Q5. A tractor driving wheel carries a dynamic vertical load of 20 kN and develops a net traction (pull) of 8 kN at the soil surface, as shown in the free-body sketch. The coefficient of traction of the wheel–soil system is: **[1 mark]**



(A) 2.5

(B) 0.5

(C) 0.25

(D) 0.4

Q6. Which one of the following is a *primary* tillage implement? **[1 mark]**

(A) Mouldboard plough

(B) Spike-tooth harrow

(C) Cultivator

(D) Planker (float)

Q7. A tractor-drawn cultivator has an effective field capacity of 0.8 ha/h. The time it will take to work a rectangular field of area 4 ha (including all headland and turning losses already built into the field capacity) is: **[1 mark]**

(A) 3.2 h

(B) 0.2 h

(C) 5.0 h

(D) 4.0 h

Q8. A rotary tiller has a theoretical field capacity of 1.2 ha/h, but its measured effective field capacity is only 0.9 ha/h. The field efficiency of the tiller is: **[1 mark]**

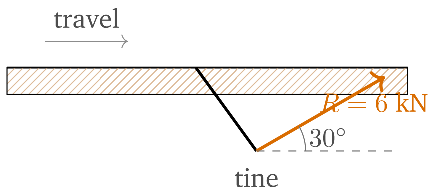
(A) 133%

(B) 75%

(C) 25%

(D) 90%

Q9. A narrow tillage tine experiences a total soil reaction of 6 kN inclined at 30° to the horizontal direction of travel, as shown. The vertical component of this reaction (the part that tends to keep the tool in the ground) is nearest to (take $\sin 30^\circ = 0.50$): **[1 mark]**



(A) 5.2 kN

(B) 3.0 kN

(C) 6.0 kN

(D) 1.5 kN

Q10. A crop is planted at a row-to-row spacing of 0.5 m and a plant-to-plant spacing of 0.2 m within the row. The plant population that can be accommodated in one hectare (10000 m^2) is: **[1 mark]**

(A) 20000

(B) 50000

(C) 40000

(D) 100000

Q11. In a self-propelled grain combine harvester, the unit that separates the light chaff and broken straw from the sound grain using oscillating sieves and a blast of air is the: **[1 mark]**

(A) cutter bar

(B) threshing cylinder

(C) cleaning shoe (sieves and fan)

(D) pick-up reel

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

(A) 1

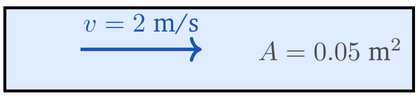
(B) 2

(C) 4

(D) 0.5

Soil & Water Conservation Engineering

Q13. Water flows through a field pipe whose internal cross-sectional area is $0.05\ \text{m}^2$ at a mean velocity of $2\ \text{m/s}$, as shown. By the continuity equation the volumetric discharge carried by the pipe is: **[1 mark]**



pipe

(A) $0.025\ \text{m}^3/\text{s}$

(B) $40\ \text{m}^3/\text{s}$

(C) $0.10\ \text{m}^3/\text{s}$

(D) $10\ \text{m}^3/\text{s}$

Q14. In the Universal Soil Loss Equation $A = R\,K\,LS\,C\,P$, the factor R represents: **[1 mark]**

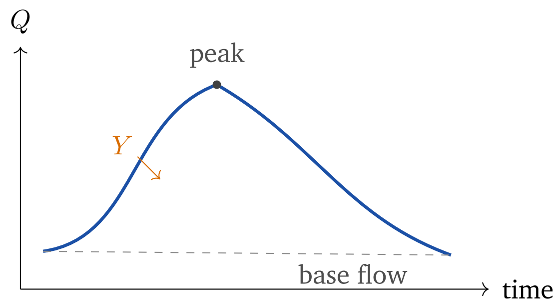
(A) the soil erodibility of the field

(B) the rainfall erosivity index

(C) the combined slope length and steepness

(D) the support (conservation) practice adopted

Q15. In the single-peaked storm hydrograph shown, the portion marked Y (the part of the curve that rises from the start of direct runoff up to the peak) is called the: **[1 mark]**



(A) recession (falling) limb

(B) rising limb

(C) base flow

(D) crest segment

Q16. In storm-runoff analysis, the constant loss rate (in cm/h) which, when subtracted from the rainfall hyetograph, makes the resulting rainfall excess volume equal to the observed runoff volume is called the: **[1 mark]**

(A) infiltration capacity

(B) runoff coefficient

(C) ϕ-index

(D) time of concentration

Q17. A grassed waterway is provided on agricultural land primarily to: **[1 mark]**

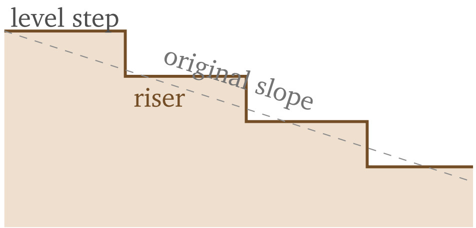
(A) store irrigation water permanently on the field

(B) convey concentrated surface runoff safely at a non-erosive velocity

(C) recharge the groundwater by ponding the runoff

(D) serve only as a permanent farm access road

Q18. On a steeply sloping cultivated hillside a bench terrace is constructed as a series of level (or nearly level) steps separated by risers, as sketched. The main purpose of bench terracing is to: **[1 mark]**



(A) increase the overland-flow length of the slope

(B) provide a permanent pond for storing runoff

(C) act as a farm access road only

(D) reduce the effective land slope by creating level steps, controlling erosion

Q19. A watershed has a drainage area of 24 km^2 and the length of its main stream (basin length) is 6 km. The form factor of the watershed, defined as $F_f = A/L^2$, is: **[1 mark]**

(A) 4.0

(B) 0.667

(C) 1.5

(D) 0.25

Q20. The fraction of the sediment entering a reservoir that is retained (deposited) within the reservoir rather than passing out through the outlet is called the: **[1 mark]**

(A) sediment delivery ratio

(B) runoff coefficient

(C) trap efficiency

(D) erodibility index

Soil & Water Conservation Engineering (continued)

Q21. For an agricultural field the Universal Soil Loss Equation factors are $R = 300$, $K = 0.25$, $LS = 2.0$, $C = 0.50$ and $P = 0.40$ (in consistent units). The average annual soil loss A from the field is: **[2 marks]**

(A) 60 t/ha/yr

(B) 15 t/ha/yr

(C) 30 t/ha/yr

(D) 12 t/ha/yr

Q22. A watershed of area 90 ha has a runoff coefficient of 0.50. For a design rainfall intensity of 8 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: **[2 marks]**

(A) 20 m^3/s

(B) 5 m^3/s

(C) 40 m^3/s

(D) 10 m^3/s

Q23. On land with a uniform slope of 2%, contour bunds are to be laid out with a vertical interval of 1.0 m between successive bunds. The horizontal spacing (horizontal interval) between two adjacent bunds is: **[2 marks]**

(A) 50 m

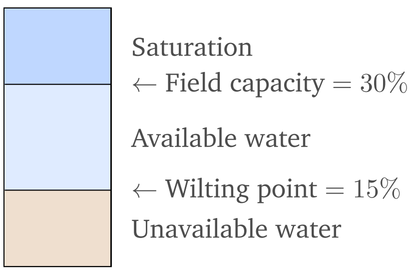
(B) 25 m

(C) 100 m

(D) 2 m

Irrigation & Drainage Engineering

Q24. For a soil the field capacity is 30% and the permanent wilting point is 15% (both on mass basis), as marked on the moisture profile shown. For a crop root-zone depth of 1.0 m and a dry bulk density of 1.4 g/cm^3, the total available water depth stored in the root zone is: **[2 marks]**



(A) 105 mm

(B) 420 mm

(C) 150 mm

(D) 210 mm

Q25. A crop occupies the field for a base period of 120 days and is served by a duty of 800 ha/cumec at the field. The depth of water (Δ, the delta) required by the crop over the base period, using $\Delta = 8.64\,B/D$ (with Δ in metres, B in days and D in ha/cumec), is: **[2 marks]**

(A) 129.6 cm

(B) 64.8 cm

(C) 12.96 cm

(D) 100 cm

Q26. A crop needs a net irrigation depth of 60 mm to refill its root zone. If the water-application efficiency of the irrigation method is 75%, the gross depth of water that must be applied at the field is: **[2 marks]**

(A) 45 mm

(B) 80 mm

(C) 60 mm

(D) 100 mm

Q27. A sprinkler irrigation system has sprinklers each discharging 1.0 m^3/h, arranged on a rectangular grid with a sprinkler-to-sprinkler spacing of 10 m along the lateral and 10 m between laterals. The application rate of the system is: **[2 marks]**

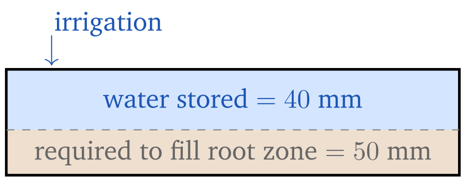
(A) 5 mm/h

(B) 20 mm/h

(C) 10 mm/h

(D) 1 mm/h

Q28. In one irrigation, 50 mm depth of water is required to refill the crop root zone to field capacity, and the water actually stored in the root zone by the irrigation is 40 mm, as sketched. The water-storage efficiency of the irrigation is: **[2 marks]**



(A) 80%

(B) 125%

(C) 60%

(D) 90%

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

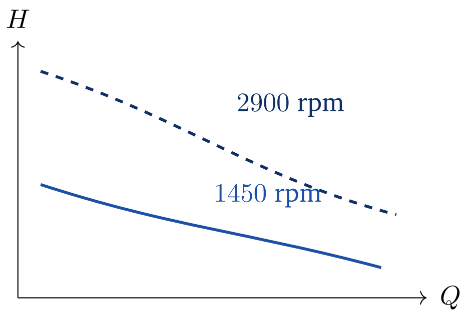
(A) 9.81 kW

(B) 5.0 kW

(C) 7.36 kW

(D) 3.68 kW

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



(A) 20 m

(B) 40 m

(C) 10 m

(D) 80 m

Q31. A confined aquifer has a hydraulic conductivity of 20 m/day and a uniform saturated thickness of 10 m. The transmissivity of the aquifer is: **[2 marks]**

(A) 2 m^2/day

(B) 0.5 m^2/day

(C) 50 m^2/day

(D) 200 m^2/day

Q32. Irrigation water of electrical conductivity 1.5 dS/m is applied to a field, and to keep the root zone from accumulating salt the drainage water is allowed to reach an electrical conductivity of 6 dS/m. The leaching requirement (fraction of applied water that must pass below the root zone) is: **[2 marks]**

(A) 25%

(B) 4%

(C) 40%

(D) 75%

Q33. An irrigation system has a conveyance efficiency of 80% in its channels and a water-application efficiency of 75% in the field. The overall (project) irrigation efficiency of the system is: **[2 marks]**

(A) 155%

(B) 80%

(C) 75%

(D) 60%

Q34. Groundwater flows through a confined aquifer of hydraulic conductivity 15 m/day under a hydraulic gradient of 0.03, across a flow cross-section of 200 m^2. The volumetric discharge through the section, by Darcy's law, is: **[2 marks]**

(A) 0.45 m^3/day

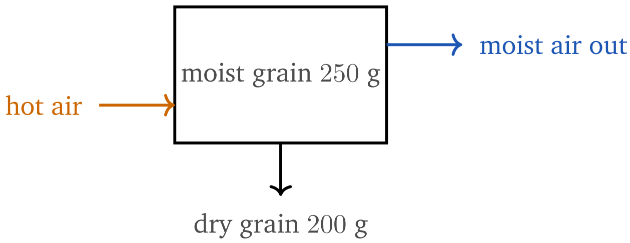
(B) 90 m^3/day

(C) 9 m^3/day

(D) 4.5 m^3/day

Agricultural Processing & Food Engineering

Q35. A grain sample weighs 250 g in its moist state and 200 g after it has been dried completely (bone dry) in a hot-air dryer, as sketched. The moisture content of the original sample on a wet basis is: **[2 marks]**



(A) 25%

(B) 33.3%

(C) 40%

(D) 20%

Q36. A paddy sample is found to contain 60 g of water and 150 g of bone-dry matter. The moisture content of the sample on a dry basis is: **[2 marks]**

(A) 40%

(B) 28.6%

(C) 66.7%

(D) 150%

Q37. A grain has a moisture content of 30% on a dry basis. The equivalent moisture content of the grain on a wet basis is nearest to: **[2 marks]**

(A) 30%

(B) 42.9%

(C) 15%

(D) 23.1%

Q38. In the drying of a moist solid, the moisture present in excess of the equilibrium moisture content (i.e. the moisture that can still be removed by continued drying under the given air conditions) is termed the: **[2 marks]**

(A) free moisture content

(B) equilibrium moisture content

(C) bound moisture content

(D) critical moisture content

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

(A) the new surface area created, i.e. to $\left(\frac{1}{d_2} - \frac{1}{d_1}\right)$

(B) the logarithm of the size-reduction ratio, i.e. to $\ln\left(\frac{d_1}{d_2}\right)$

(C) the square of the feed particle size

(D) the total volume of the feed material

Q40. An indented-cylinder (disc) separator is used to grade a mixture of seeds. This machine separates the seeds mainly on the basis of their: **[2 marks]**

(A) length

(B) colour

(C) electrical charge

(D) terminal (floating) velocity

Q41. A bucket elevator carries grain in buckets that each hold 2 kg of grain. The buckets are spaced 0.4 m apart along a belt that moves at 1.2 m/s. The conveying capacity of the elevator is: **[2 marks]**

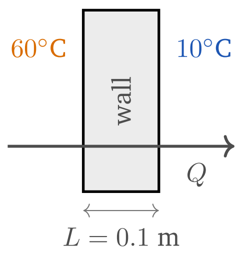
(A) 21.6 t/h

(B) 6 t/h

(C) 43.2 t/h

(D) 10.8 t/h

Q42. Heat is conducted steadily through a plane wall of a cold-store panel of thickness 0.1 m and thermal conductivity 0.8 W/m $\cdot$ K, as shown. The wall has a face area of 5 m^2, and its two faces are held at $60°$C and $10°$C. The rate of heat conduction through the wall is: **[2 marks]**



(A) 400 W

(B) 1000 W

(C) 2000 W

(D) 800 W

Q43. In a food-processing duct, heat is transferred by convection from a hot surface of area 3 m^2 to air, with a convective heat-transfer coefficient of 50 W/m$^2 \cdot$K and a surface-to-air temperature difference of $20°$C. The rate of convective heat transfer is: **[2 marks]**

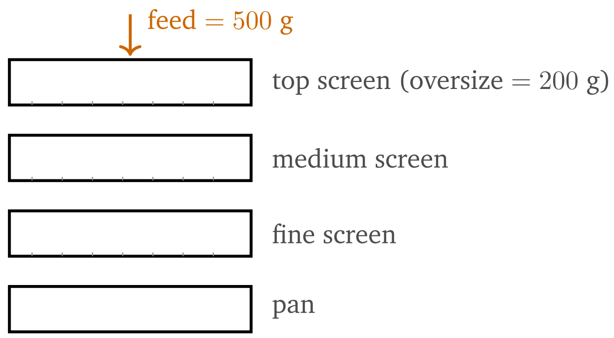
(A) 3000 W

(B) 1500 W

(C) 6000 W

(D) 750 W

Q44. A 500 g sample of cleaned grain is fed to the top screen of the test sieve stack shown, and 200 g is retained on that screen as oversize while the remainder passes through, as sketched. The fraction of the feed reporting as undersize (passing through the top screen) is: **[2 marks]**



(A) 40%

(B) 250%

(C) 60%

(D) 25%

Q45. The low-temperature long-time (LTLT), or holder, process for the pasteurization of milk is normally carried out at a temperature and holding time of: **[2 marks]**

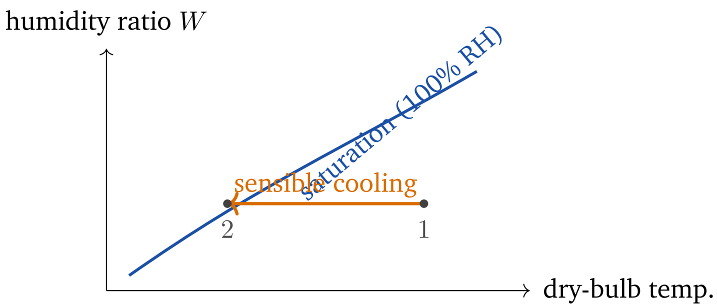
(A) 72°C for 15 seconds

(B) 145°C for 3 seconds

(C) 100°C for 1 minute

(D) 63°C for 30 minutes

Q46. Moist air at a dry-bulb temperature of 30°C and 40% relative humidity is cooled by a sensible cooling process (no moisture added or removed), shown as the horizontal line 1–2 on the psychrometric sketch. During this process the relative humidity of the air: **[2 marks]**



(A) decreases

(B) increases

(C) remains constant

(D) first decreases and then increases

Detailed Solutions

Q1.

Solution

Concept – wheel slip: Wheel slip compares the distance the wheel would travel with no slip (its no-load travel) with the distance it actually travels under load: slip $= \frac{S_0 - S_L}{S_0} \times 100\%$.

Step 1 – list the data: No-load distance $S_0 = 40$ m in 10 revolutions, loaded distance $S_L = 32$ m in 10 revolutions.

Step 2 – write the slip formula: slip $= \frac{S_0 - S_L}{S_0} \times 100\%$

Step 3 – form the numerator: $S_0 - S_L = 40 - 32 = 8$ m

Step 4 – substitute: slip $= \frac{8}{40} \times 100\%$

Step 5 – simplify the fraction: $\frac{8}{40} = 0.20$

Step 6 – convert to a percentage: slip $= 20\%$

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

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – brake specific fuel consumption: BSFC is the mass of fuel consumed per unit of brake power per hour: BSFC $= \frac{\dot{m}_f}{P_b}$.

Step 1 – list the data: Fuel rate $\dot{m}_f = 5$ 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 $= \frac{5 \text{ kg/h}}{20 \text{ kW}}$

Step 4 – divide: BSFC $= 0.25$ kg/kWh

Final Answer: BSFC $= 0.25$ kg/kWh $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – mechanical efficiency of an engine: Mechanical efficiency is the ratio of brake power to indicated power: $\eta_m = \dfrac{P_b}{P_i}$. The brake power is the indicated power less the friction power.

Step 1 – list the data: Indicated power $P_i = 25$ kW, friction power $P_f = 5$ kW.

Step 2 – find the brake power: $P_b = P_i - P_f$

$P_b = 25 - 5 = 20$ kW

Step 3 – write the efficiency formula: $\eta_m = \dfrac{P_b}{P_i}$

Step 4 – substitute: $\eta_m = \dfrac{20}{25}$

Step 5 – simplify: $\eta_m = 0.80$

Step 6 – express as a percentage: $\eta_m = 80\%$

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

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – power strokes of a multi-cylinder four-stroke engine: In a four-stroke engine each cylinder fires once every two revolutions, so the power strokes per minute $= \dfrac{n \times N}{2}$, where n is the number of cylinders and N the speed in rpm.

Step 1 – list the data: Cylinders $n = 4$, speed $N = 1500$ rpm.

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

Step 3 – substitute: $= \dfrac{4 \times 1500}{2}$

Step 4 – multiply the numerator: $4 \times 1500 = 6000$

Step 5 – divide by two: $= \dfrac{6000}{2} = 3000$

Final Answer: 3000 power strokes per minute $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – coefficient of traction: The coefficient of traction is the ratio of the net pull (horizontal tractive force) developed at the wheel to the dynamic vertical load carried by that wheel: $\mu = \frac{H}{W}$.

Step 1 – list the data: Net traction $H = 8$ kN, dynamic vertical load $W = 20$ kN.

Step 2 – write the formula: $\mu = \frac{H}{W}$

Step 3 – substitute: $\mu = \frac{8}{20}$

Step 4 – simplify: $\mu = 0.40$

Final Answer: $\mu = 0.40 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – primary versus secondary tillage: Primary tillage is the first, deeper working of the soil that cuts and inverts it (ploughs); secondary tillage is the lighter follow-up that pulverises and levels the seedbed (harrows, cultivators, plankers).

Step 1 – classify each option: The spike-tooth harrow, the cultivator and the planker all work the already-ploughed soil to refine the seedbed, so they are secondary-tillage tools.

Step 2 – pick the primary implement: The mouldboard plough cuts, lifts and inverts the soil to a good depth as the first operation, so it is a primary-tillage implement.

Final Answer: the mouldboard plough is a primary-tillage implement $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – time from field capacity: The effective field capacity (ha/h) already accounts for turning and overlap losses, so the working time equals the area divided by the effective field capacity: $t = \frac{\text{area}}{\text{EFC}}$.

Step 1 – list the data: Area $= 4$ ha, effective field capacity EFC $= 0.8$ ha/h.

Step 2 – write the formula: $t = \dfrac{\text{area}}{\text{EFC}}$

Step 3 – substitute: $t = \dfrac{4}{0.8}$

Step 4 – divide: $t = 5.0$ h

Final Answer: $t = 5.0 \text{ h} \Rightarrow \boxed{\text{C}}$

Answer: (C) 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 $= 1.2$ ha/h, effective field capacity EFC $= 0.9$ ha/h.

Step 2 – write the formula: $\eta_f = \dfrac{\text{EFC}}{\text{TFC}}$

Step 3 – substitute: $\eta_f = \dfrac{0.9}{1.2}$

Step 4 – simplify: $\eta_f = 0.75$

Step 5 – express as a percentage: $\eta_f = 75\%$

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

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – resolving the soil reaction into components: The vertical component of the soil reaction is $V = R\sin\theta$, where θ is the angle of the reaction to 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: $V = 3.0 \text{ kN} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

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

Step 1 – list the data: Row spacing $s_r = 0.5$ m, plant spacing $s_p = 0.2$ m, area $= 10000$ m^2.

Step 2 – find the area per plant: $s_r \times s_p = 0.5 \times 0.2$

$s_r \times s_p = 0.1$ m^2

Step 3 – divide the field area by the area per plant: $N = \dfrac{10000}{0.1}$

Step 4 – evaluate: $N = 100000$

Final Answer: $N = 100000$ plants per hectare $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept – cleaning in a combine harvester: After threshing, the mixture of grain, chaff and short straw must be cleaned. This is done in the cleaning shoe, where oscillating sieves grade the material by size while a fan blows away the light chaff.

Step 1 – identify the cleaning element: The cleaning shoe (the sieves plus the fan) lifts and carries away the light chaff and lets the heavier grain fall through to the grain pan.

Step 2 – rule out the other parts: The cutter bar cuts the standing crop, the threshing cylinder detaches the grain from the ear head, and the pick-up reel gathers the crop and feeds it to the cutter bar.

Final Answer: the cleaning shoe separates chaff from grain $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – power strokes in the two-stroke cycle: In a two-stroke engine the complete cycle is finished in one revolution of the crankshaft, so there is one power stroke for every revolution.

Step 1 – count power strokes per revolution: Two-stroke $\Rightarrow$ 1 power stroke per revolution.

Step 2 – scale to two revolutions: 1 power stroke/rev $\times$ 2 rev $=$ 2 power strokes.

Step 3 – state the result: Hence there are 2 power strokes in every two revolutions (twice as many as a four-stroke engine for the same speed).

Final Answer: 2 power strokes per two revolutions $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – continuity equation: For steady incompressible flow the discharge is the product of the cross-sectional area and the mean velocity: $Q = A \times v$.

Step 1 – list the data: $A = 0.05\ \text{m}^2$, $v = 2$ m/s.

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

Step 3 – substitute: $Q = 0.05 \times 2$

Step 4 – evaluate: $Q = 0.10\ \text{m}^3/\text{s}$

Final Answer: $Q = 0.10\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

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

Step 1 – identify R: R is the rainfall erosivity factor; it measures the erosive power of rainfall and its associated runoff.

Step 2 – separate it from the others: K is the 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:

- A: soil erodibility is the factor K.
- C: slope length and steepness together form LS.
- D: the conservation-practice factor is P.

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

Answer: (B) Go Back to Q14

Q15.

Solution

Concept – parts of a storm hydrograph: A single-peaked hydrograph rises from the start of direct runoff up to the peak along the rising limb, then falls back towards base flow along the recession limb.

Step 1 – locate the marked part: Segment Y lies before the peak and climbs from the base flow up to the peak.

Step 2 – name that segment: The ascending part up to the peak is the rising limb (also called the concentration curve), shaped by the buildup of runoff reaching the outlet.

Why the other options are wrong:

- A: the recession limb is the falling part after the peak, not before it.
- C: 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 limb $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – the ϕ-index: The ϕ-index is a constant average loss rate over a storm; the rainfall in excess of ϕ becomes the direct runoff, and ϕ is fixed so that the excess volume matches the observed runoff volume.

Step 1 – interpret the definition: A constant loss rate that, when removed from the rainfall hyetograph, leaves a rainfall-excess volume equal to the runoff volume is exactly the ϕ-index.

Step 2 – confirm its units: It is expressed in cm/h (or mm/h), the same units as rainfall intensity.

Why the other options are wrong:

- A: infiltration capacity varies with time during a storm; the ϕ-index deliberately replaces that variation by a single average value.
- B: the runoff coefficient is a dimensionless ratio, not a loss rate.
- D: the time of concentration is a travel time, not a loss rate.

Final Answer: it is the ϕ-index $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept – purpose of a grassed waterway: A grassed waterway is a natural or shaped channel lined with vegetation that carries concentrated runoff off the field.

Step 1 – role of the grass lining: The grass cover protects the channel bed, keeping the flow velocity below the erosive limit for the soil.

Step 2 – state the purpose: Its purpose is therefore to convey the concentrated surface runoff safely, without scouring the channel, to a stable outlet.

Why the other options are wrong:

- A: it is a conveyance channel, not a storage structure.
- C: it disposes of runoff safely; recharge is not its design intent.
- D: any use as a path is incidental, not the design purpose.

Final Answer: it conveys runoff safely at a non-erosive velocity $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept – purpose of bench terracing: A bench terrace cuts a steep slope into a series of level (or gently sloping) steps separated by vertical or steep risers.

Step 1 – effect on slope: Each step is nearly level, so the long steep slope is replaced by short flat benches; the effective land slope over which runoff moves is greatly reduced.

Step 2 – effect on erosion: With the slope broken into level steps, runoff cannot gain erosive velocity, so soil detachment and transport are controlled and much of the water infiltrates.

Why the other options are wrong:

- A: terracing shortens, not lengthens, the effective flow slope.
- B: a bench terrace is a cultivation surface, not a permanent pond.
- C: use as a road is incidental, not the design purpose.

Final Answer: it reduces the effective slope by creating level steps, controlling erosion $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – form factor of a watershed: The form factor is the ratio of the basin area to the square of the basin length: $F_f = \dfrac{A}{L^2}$.

Step 1 – list the data: Area $A = 24$ km^2, basin length $L = 6$ km.

Step 2 – square the length: $L^2 = 6^2 = 36$ km^2

Step 3 – form the ratio: $F_f = \dfrac{24}{36}$

Step 4 – simplify: $F_f = 0.667$

Final Answer: $F_f = 0.667 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept – trap efficiency of a reservoir: Trap efficiency is the fraction of the incoming sediment that settles out and is retained within the reservoir, rather than passing on through the outlet.

Step 1 – interpret the definition: Sediment deposited and held in the reservoir divided by the sediment inflow gives the trap efficiency.

Why the other options are wrong:

- A: the sediment delivery ratio compares sediment delivered at a watershed outlet with the gross erosion in the watershed, a different quantity.

- B: the runoff coefficient relates runoff to rainfall, not sediment.
- D: the erodibility index describes a soil's susceptibility to erosion, not reservoir trapping.

Final Answer: it is the trap efficiency $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

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

Step 1 – list the data: $R = 300$, $K = 0.25$, $LS = 2.0$, $C = 0.50$, $P = 0.40$.

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: $150 \times 0.50 = 75$

Step 5 – multiply by P: $75 \times 0.40 = 30$

Step 6 – state the result: $A = 30$ t/ha/yr

Final Answer: $A = 30$ t/ha/yr $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – rational method for peak runoff: $Q = \dfrac{C\,i\,A}{360}$, with i in mm/h and A in ha gives Q in m^3/s.

Step 1 – list the data: $C = 0.50$, $i = 8$ cm/h, $A = 90$ ha.

Step 2 – convert the intensity to mm/h: $i = 8$ cm/h $= 80$ mm/h

Step 3 – write the formula: $Q = \dfrac{C\,i\,A}{360}$

Step 4 – substitute: $Q = \dfrac{0.50 \times 80 \times 90}{360}$

Step 5 – multiply the numerator: $0.50 \times 80 = 40$

$40 \times 90 = 3600$

Step 6 – divide by 360: $Q = \dfrac{3600}{360} = 10$ m^3/s

Final Answer: $Q = 10$ m^3/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept – vertical interval and horizontal spacing of bunds: On a uniform slope the horizontal spacing HI between bunds is the vertical interval VI divided by the land slope expressed as a fraction: $\mathrm{HI} = \dfrac{\mathrm{VI}}{S}$.

Step 1 – list the data: Vertical interval VI $= 1.0$ m, land slope $= 2\%$.

Step 2 – write the slope as a fraction: $S = \dfrac{2}{100} = 0.02$

Step 3 – write the formula: $\mathrm{HI} = \dfrac{\mathrm{VI}}{S}$

Step 4 – substitute: $\mathrm{HI} = \dfrac{1.0}{0.02}$

Step 5 – evaluate: $\mathrm{HI} = 50$ m

Final Answer: $\mathrm{HI} = 50 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – total available water in the root zone: The available water depth is $d = (\theta_{FC} - \theta_{PWP}) \times \dfrac{\rho_b}{\rho_w} \times D$, where the moisture contents are on a mass basis, ρ_b is the dry bulk density and D is the root-zone depth.

Step 1 – list the data: $\theta_{FC} = 30\% = 0.30$, $\theta_{PWP} = 15\% = 0.15$, $\rho_b = 1.4$ g/cm^3, $\rho_w = 1.0$ g/cm^3, $D = 1.0$ m.

Step 2 – find the available moisture fraction: $\theta_{FC} - \theta_{PWP} = 0.30 - 0.15 = 0.15$

Step 3 – form the bulk-density ratio: $\dfrac{\rho_b}{\rho_w} = \dfrac{1.4}{1.0} = 1.4$

Step 4 – multiply the fraction by the ratio: $0.15 \times 1.4 = 0.21$

Step 5 – multiply by the root-zone depth: $d = 0.21 \times 1.0 \text{ m} = 0.21 \text{ m}$

Step 6 – convert to millimetres: $d = 210$ mm

Final Answer: $d = 210 \text{ mm} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – delta from base period and duty: The delta (total depth of water used by a crop over its base period) is $\Delta = \dfrac{8.64\,B}{D}$ metres, with B in days and the duty D in ha/cumec.

Step 1 – list the data: Base period $B = 120$ days, duty $D = 800$ ha/cumec.

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

Step 3 – substitute: $\Delta = \dfrac{8.64 \times 120}{800}$

Step 4 – multiply the numerator: $8.64 \times 120 = 1036.8$

Step 5 – divide by the duty: $\Delta = \dfrac{1036.8}{800} = 1.296$ m

Step 6 – convert to centimetres: $\Delta = 129.6$ cm

Final Answer: $\Delta = 129.6 \text{ cm} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – gross depth from net depth and application efficiency: The water-application efficiency links the net depth stored to the gross depth applied: $\eta_a = \dfrac{d_{net}}{d_{gross}}$, so $d_{gross} = \dfrac{d_{net}}{\eta_a}$.

Step 1 – list the data: Net depth $d_{net} = 60$ mm, application efficiency $\eta_a = 75\% = 0.75$.

Step 2 – write the formula: $d_{gross} = \dfrac{d_{net}}{\eta_a}$

Step 3 – substitute: $d_{gross} = \dfrac{60}{0.75}$

Step 4 – evaluate: $d_{gross} = 80$ mm

Final Answer: $d_{gross} = 80 \text{ mm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – application rate of a sprinkler grid: The application rate is the discharge of one sprinkler spread over the ground area it serves, which is the product of the two spacings: $\text{AR} = \dfrac{q}{s_l \times s_m}$.

Step 1 – list the data: Sprinkler discharge $q = 1.0\ \text{m}^3/\text{h}$, spacings $s_l = 10$ m and $s_m = 10$ m.

Step 2 – find the area served by one sprinkler: $s_l \times s_m = 10 \times 10 = 100\ \text{m}^2$

Step 3 – write the rate as a depth per hour: $\text{AR} = \dfrac{q}{s_l \times s_m} = \dfrac{1.0\ \text{m}^3/\text{h}}{100\ \text{m}^2}$

Step 4 – evaluate the depth: $\text{AR} = 0.01\ \text{m/h}$

Step 5 – convert to millimetres per hour: $\text{AR} = 10\ \text{mm/h}$

Final Answer: $\text{AR} = 10\ \text{mm/h} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept – water-storage efficiency: The water-storage efficiency is the ratio of the water actually stored in the root zone during the irrigation to the water needed to fill the root zone to field capacity: $\eta_s = \dfrac{\text{water stored}}{\text{water needed}}$.

Step 1 – list the data: Water stored $= 40$ mm, water needed to fill the root zone $= 50$ mm.

Step 2 – write the formula: $\eta_s = \dfrac{40}{50}$

Step 3 – simplify: $\eta_s = 0.80$

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

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

Answer: (A) Go Back to Q28

Q29.

Solution

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

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

Step 2 – convert the discharge to m^3/s: $Q = 50$ L/s $= 0.05$ m^3/s

Step 3 – write the formula: $P = \rho_w \, g \, Q \, H$

Step 4 – substitute: $P = 1000 \times 9.81 \times 0.05 \times 15$

Step 5 – multiply step by step: $1000 \times 9.81 = 9810$

$9810 \times 0.05 = 490.5$

$490.5 \times 15 = 7357.5$ W

Step 6 – convert to kilowatts: $P = 7.36$ kW

Final Answer: $P \approx 7.36$ kW $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept – pump affinity law for head: For the same 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 – multiply the original head: $H_2 = H_1 \times 4 = 20 \times 4$

Step 5 – evaluate: $H_2 = 80$ m

Final Answer: $H_2 = 80$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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: $K = 20$ m/day, $b = 10$ m.

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

Step 3 – substitute: $T = 20 \times 10$

Step 4 – evaluate: $T = 200$ m^2/day

Final Answer: $T = 200\ \text{m}^2/\text{day} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – leaching requirement: For steady-state salt balance the leaching requirement is the ratio of the electrical conductivity of the irrigation water to that of the drainage water: $\text{LR} = \dfrac{EC_{iw}}{EC_{dw}}$.

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

Step 2 – write the formula: $\text{LR} = \dfrac{EC_{iw}}{EC_{dw}}$

Step 3 – substitute: $\text{LR} = \dfrac{1.5}{6}$

Step 4 – simplify: $\text{LR} = 0.25$

Step 5 – express as a percentage: $\text{LR} = 25\%$

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

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 water-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 – multiply: $\eta_o = 0.60$

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

Final Answer: $\eta_o = 60\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept – Darcy's law for discharge: The volumetric flow through a porous cross-section is $Q = K\,i\,A$, where K is the hydraulic conductivity, i the hydraulic gradient and A the flow area.

Step 1 – list the data: $K = 15$ m/day, $i = 0.03$, $A = 200$ m^2.

Step 2 – write the formula: $Q = K\,i\,A$

Step 3 – substitute: $Q = 15 \times 0.03 \times 200$

Step 4 – multiply the first two factors: $15 \times 0.03 = 0.45$

Step 5 – multiply by the area: $0.45 \times 200 = 90$

Step 6 – state the result: $Q = 90$ m^3/day

Final Answer: $Q = 90$ m^3/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept – moisture content on a wet basis: The wet-basis moisture content is the mass of water divided by the total (moist) mass: $M_{wb} = \dfrac{W_m - W_d}{W_m}$, where W_m is the moist mass and W_d the dry mass.

Step 1 – list the data: Moist mass $W_m = 250$ g, dry mass $W_d = 200$ g.

Step 2 – find the mass of water: $W_m - W_d = 250 - 200 = 50$ g

Step 3 – write the formula: $M_{wb} = \dfrac{W_m - W_d}{W_m}$

Step 4 – substitute: $M_{wb} = \dfrac{50}{250}$

Step 5 – simplify: $M_{wb} = 0.20$

Step 6 – express as a percentage: $M_{wb} = 20\%$

Final Answer: $M_{wb} = 20\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept – moisture content on a dry basis: The dry-basis moisture content is the mass of water divided by the mass of bone-dry matter: $M_{db} = \frac{W_w}{W_d}$.

Step 1 – list the data: Mass of water $W_w = 60$ g, mass of dry matter $W_d = 150$ g.

Step 2 – write the formula: $M_{db} = \frac{W_w}{W_d}$

Step 3 – substitute: $M_{db} = \frac{60}{150}$

Step 4 – simplify: $M_{db} = 0.40$

Step 5 – express as a percentage: $M_{db} = 40\%$

Final Answer: $M_{db} = 40\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept – converting dry basis to wet basis: $M_{wb} = \frac{M_{db}}{1 + M_{db}}$, with both moisture contents as fractions.

Step 1 – list the data: $M_{db} = 30\% = 0.30$.

Step 2 – write the conversion formula: $M_{wb} = \frac{M_{db}}{1 + M_{db}}$

Step 3 – form the denominator: $1 + 0.30 = 1.30$

Step 4 – substitute: $M_{wb} = \frac{0.30}{1.30}$

Step 5 – divide: $M_{wb} = 0.2308$

Step 6 – express as a percentage: $M_{wb} = 23.1\%$

Final Answer: $M_{wb} \approx 23.1\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept – free moisture content: For a given air temperature and humidity the solid reaches an equilibrium moisture content. Any moisture the solid holds above this equilibrium value can still be driven off by drying and is called the free moisture.

Step 1 – interpret the definition: Free moisture = total moisture − equilibrium moisture; it is the removable part of the moisture under the given conditions.

Why the other options are wrong:

- B: the equilibrium moisture content is the limiting value the solid approaches, not the removable excess.
- C: bound moisture is held by the solid at a lowered vapour pressure and is harder to remove; it is not the defined excess.
- D: the critical moisture content marks the change from constant-rate to falling-rate drying, a different idea.

Final Answer: it is the free moisture content $\Rightarrow \boxed{\text{A}}$

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 ratio of the feed size to the product size: $E = K_K \ln\left(\frac{d_1}{d_2}\right)$.

Step 1 – interpret the law: The energy depends only on the size-reduction ratio d_1/d_2, through its logarithm, not on the individual sizes.

Why the other options are wrong:

- A: proportionality to the new surface area created, i.e. to $\left(\frac{1}{d_2} - \frac{1}{d_1}\right)$, is Rittinger's law, not Kick's.
- C: no size-reduction law makes the energy proportional to the square of the feed size.
- D: the energy is not taken proportional to the feed volume.

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

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – indented-cylinder (disc) separator: An indented-cylinder or disc separator has pockets sized so that only short seeds are lifted and carried over, while long seeds ride past. The separation therefore depends on the length of the seeds.

Step 1 – identify the distinguishing property: The pockets pick up particles by their length, so length is the property that governs the separation.

Why the other options are wrong:

- B: colour is used by optical/electronic colour sorters, not by a disc separator.
- C: electrical charge is exploited in electrostatic separation, not here.
- D: terminal velocity is the basis of pneumatic (aspiration) separation, not the indented-cylinder machine.

Final Answer: it separates by length $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q40

Q41.

Solution

Concept – capacity of a bucket elevator: The conveying capacity is the grain carried per bucket multiplied by the number of buckets passing per unit time; the buckets pass at a rate of (belt speed)/(bucket spacing).

Step 1 – list the data: Grain per bucket $= 2$ kg, bucket spacing $= 0.4$ m, belt speed $= 1.2$ m/s.

Step 2 – find the number of buckets passing per second: $\dfrac{\text{speed}}{\text{spacing}} = \dfrac{1.2}{0.4} = 3$ buckets/s

Step 3 – find the mass flow rate: $\dot{m} = 2 \text{ kg} \times 3 \text{ buckets/s} = 6 \text{ kg/s}$

Step 4 – convert to kg per hour: $\dot{m} = 6 \times 3600 = 21600$ kg/h

Step 5 – convert to tonnes per hour: $\dot{m} = 21.6$ t/h

Final Answer: capacity $= 21.6$ t/h $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept – Fourier's law of steady conduction: $Q = \frac{k\,A\,\Delta T}{L}$, with k the thermal conductivity, A the area, ΔT the temperature difference across the wall and L the thickness.

Step 1 – list the data: $k = 0.8$ W/m $\cdot$ K, $A = 5$ m^2, $L = 0.1$ m, faces at $60°$C and $10°$C.

Step 2 – find the temperature difference: $\Delta T = 60 - 10 = 50$ K

Step 3 – write the formula: $Q = \frac{k\,A\,\Delta T}{L}$

Step 4 – substitute: $Q = \frac{0.8 \times 5 \times 50}{0.1}$

Step 5 – multiply the numerator: $0.8 \times 5 = 4$

$4 \times 50 = 200$

Step 6 – divide by the thickness: $Q = \frac{200}{0.1} = 2000$ W

Final Answer: $Q = 2000 \text{ W} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept – Newton's law of convective cooling: $Q = h\,A\,\Delta T$, with h the convective coefficient, A the area and ΔT the surface-to-fluid temperature difference.

Step 1 – list the data: $h = 50$ W/m$^2 \cdot$ K, $A = 3$ m^2, $\Delta T = 20$ K.

Step 2 – write the formula: $Q = h\,A\,\Delta T$

Step 3 – substitute: $Q = 50 \times 3 \times 20$

Step 4 – multiply step by step: $50 \times 3 = 150$

$150 \times 20 = 3000$

Step 5 – state the result: $Q = 3000$ W

Final Answer: $Q = 3000 \text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – undersize fraction on a screen: The undersize fraction is the mass passing through the screen divided by the mass of feed placed on it. The mass passing equals the feed minus the oversize retained.

Step 1 – list the data: Feed $= 500$ g, oversize retained $= 200$ g.

Step 2 – find the mass passing through: Undersize $= 500 - 200 = 300$ g

Step 3 – form the ratio: Fraction $= \dfrac{300}{500}$

Step 4 – simplify: Fraction $= 0.60$

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

Final Answer: undersize fraction $= 60\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – pasteurization time–temperature combinations: Pasteurization can use a low temperature for a long time (LTLT, the holder process) or a high temperature for a short time (HTST); both deliver the same lethality.

Step 1 – recall the LTLT condition: The LTLT (holder) process for milk holds it at about 63°C for 30 minutes.

Step 2 – separate it from HTST: The HTST process uses about 72°C for 15 seconds; that is the short-time alternative, not LTLT.

Why the other options are wrong:

- A: 72°C for 15 s is the HTST process.
- B: 145°C for a few seconds corresponds to UHT sterilization, not pasteurization.
- C: 100°C for 1 min is not a standard milk-pasteurization setting.

Final Answer: LTLT is 63°C for 30 min $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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.

Why the other options are wrong:

- A: 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: there is no reversal; the trend is monotonic for pure sensible cooling (until saturation is reached).

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

Answer: (B) Go Back to Q46

Answer Key

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