GATE Agricultural Engineering

Sample Paper – 1

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. The power take-off (PTO) shaft of a tractor rotates at 540 rpm and transmits a torque of 300 N $\cdot$ m. The PTO power delivered is nearest to: **[1 mark]**

(A) 8.48 kW

(B) 16.96 kW

(C) 33.93 kW

(D) 5.40 kW

Q2. A tractor develops a drawbar pull of 12 kN while moving at a uniform forward speed of 5 km/h. The drawbar power developed is nearest to: **[1 mark]**

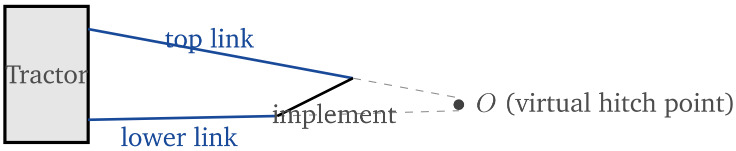
(A) 16.67 kW

(B) 60.0 kW

(C) 2.40 kW

(D) 12.0 kW

Q3. The lines of the top link and the two lower links of a tractor three-point hitch are extended until they meet at the virtual hitch point O, as shown. As the implement bites deeper and the draft increases, this geometry causes: **[1 mark]**



(A) no change in either axle load

(B) weight transfer onto the rear (driving) wheels, increasing their traction

(C) complete lift-off of the rear wheels

(D) weight transfer onto the front wheels, reducing rear traction

Q4. The air-standard Otto cycle of a spark-ignition engine operates with a compression ratio of 8. Taking the ratio of specific heats $\gamma = 1.4$, the air-standard (thermal) efficiency of the cycle is nearest to: **[1 mark]**

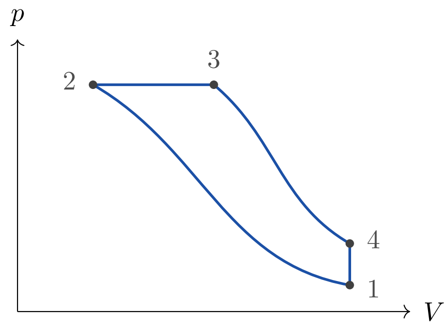
(A) 43.5%

(B) 50.0%

(C) 56.5%

(D) 60.0%

Q5. The pressure–volume (p–V) diagram shown is the air-standard cycle of a compression-ignition (diesel) 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. Which one of the following is a *secondary* tillage implement? **[1 mark]**

(A) Mouldboard plough

(B) Disc harrow

(C) Subsoiler

(D) Disc plough

Q7. A mouldboard plough cuts a furrow slice 200 mm wide and 150 mm deep and requires a draft of 3.6 kN. The unit draft (specific draft) of the soil is: **[1 mark]**

(A) 120 kN/m^2

(B) 12 kN/m^2

(C) 240 kN/m^2

(D) 24 kN/m^2

Q8. A tractor-drawn implement has an effective working width of 2.5 m and operates at a forward speed of 4 km/h. If the field efficiency is 80%, the effective field capacity of the implement is: **[1 mark]**

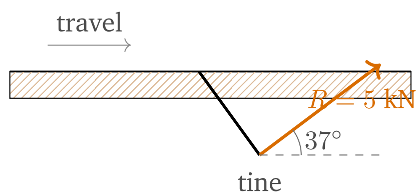
(A) 1.00 ha/h

(B) 1.25 ha/h

(C) 0.64 ha/h

(D) 0.80 ha/h

Q9. A narrow tillage tine experiences a total soil reaction of 5 kN inclined at $37°$ to the horizontal direction of travel, as shown. The horizontal component of this reaction, i.e. the draft of the tool, is nearest to (take $\cos 37° = 0.80$): **[1 mark]**



(A) 3.0 kN

(B) 4.0 kN

(C) 5.0 kN

(D) 2.5 kN

Q10. A seed drill is fitted with 11 furrow openers spaced uniformly at 200 mm centre to centre. The width of coverage (working width) of the drill in one pass is: **[1 mark]**

(A) 2.0 m

(B) 5.5 m

(C) 2.2 m

(D) 1.1 m

Q11. In a self-propelled grain combine harvester, the unit that detaches the grains from the ear heads or panicles is the: **[1 mark]**

(A) cylinder and concave (threshing unit)

(B) cutter bar

(C) pick-up reel

(D) grain-delivery auger

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

(A) 4

(B) 2

(C) 1

(D) 0.5

Soil & Water Conservation Engineering

Q13. The gauge pressure at a depth of 3 m below the free surface of a body of still water is (take $\gamma_w = 9.81$ kN/m^3): **[1 mark]**

(A) 3.00 kPa

(B) 9.81 kPa

(C) 294.3 kPa

(D) 29.43 kPa

Q14. Water of kinematic viscosity 1×10^{-6} m^2/s flows through a pipe of internal diameter 50 mm at a mean velocity of 0.02 m/s. The Reynolds number of the flow is: **[1 mark]**

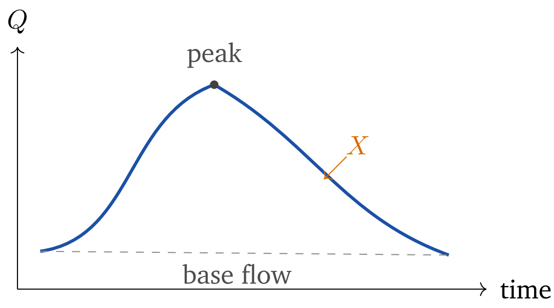
(A) 100

(B) 1000

(C) 10000

(D) 500

Q15. In the single-peaked storm hydrograph shown, the portion marked X (the part of the curve that lies after the peak and falls back towards the base flow) is called the: **[1 mark]**



(A) rising limb

(B) crest segment

(C) base flow

(D) recession (falling) limb

Q16. In the rational formula for peak runoff, $Q = C\,i\,A$, the coefficient C represents: **[1 mark]**

(A) the runoff coefficient, i.e. the fraction of rainfall that appears as surface runoff

(B) the infiltration capacity of the soil

(C) the time of concentration of the catchment

(D) the rainfall intensity for the design storm

Q17. In the Universal Soil Loss Equation $A = R\,K\,LS\,C\,P$, the factor K represents: **[1 mark]**

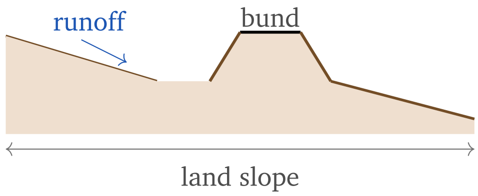
(A) the rainfall erosivity

(B) the crop / cover management factor

(C) the support (conservation) practice factor

(D) the soil erodibility factor

Q18. A graded bund of trapezoidal cross-section is built across the land slope as shown. The main purpose of such a bund on cultivated sloping land is to: **[1 mark]**



(A) increase the length of overland flow

(B) store irrigation water permanently on the field

(C) intercept the runoff and reduce the effective slope length, thereby controlling soil erosion

(D) serve only as a farm access road

Q19. A watershed has a total length of all its streams equal to 40 km and a drainage area of 20 km^2. The drainage density of the watershed is: **[1 mark]**

(A) 2.0 km/km^2

(B) 0.5 km/km^2

(C) 800 km/km^2

(D) 20 km/km^2

Q20. The ratio of the sediment actually delivered at the outlet of a watershed to the gross erosion produced within the watershed is called the: **[1 mark]**

(A) sediment delivery ratio

(B) trap efficiency

(C) erodibility index

(D) runoff coefficient

Soil & Water Conservation Engineering (continued)

Q21. For an agricultural field the Universal Soil Loss Equation factors are $R = 200$, $K = 0.30$, $LS = 1.5$, $C = 0.40$ and $P = 0.50$ (in consistent units). The average annual soil loss A from the field is: **[2 marks]**

(A) 36 t/ha/yr

(B) 90 t/ha/yr

(C) 9 t/ha/yr

(D) 18 t/ha/yr

Q22. A watershed of area 150 ha has a runoff coefficient of 0.35. For a design rainfall intensity of 6 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) 17.5 m^3/s

(B) 8.75 m^3/s

(C) 3.15 m^3/s

(D) 26.25 m^3/s

Q23. A storm of 50 mm rainfall depth falls over a 10 ha watershed whose runoff coefficient is 0.40. The total volume of direct surface runoff produced is: **[2 marks]**

(A) 2000 m^3

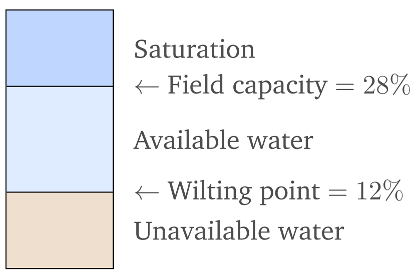
(B) 5000 m^3

(C) 500 m^3

(D) 20000 m^3

Irrigation & Drainage Engineering

Q24. For a soil the field capacity is 28% and the permanent wilting point is 12% (both on mass basis), as marked on the moisture profile shown. For a crop root-zone depth of 0.9 m and a dry bulk density of 1.5 g/cm^3, the total available water depth in the root zone is: **[2 marks]**



(A) 144 mm

(B) 216 mm

(C) 240 mm

(D) 108 mm

Q25. A crop has a peak evapotranspiration demand of 6 mm/day over a command area of 500 ha. The stream size (discharge) that must be supplied continuously to just meet this peak demand is nearest to: **[2 marks]**

(A) 3.47 m^3/s

(B) 0.694 m^3/s

(C) 0.174 m^3/s

(D) 0.347 m^3/s

Q26. A crop requires a total of 500 mm of water over its growing season. The effective rainfall during the season is 200 mm, and the overall irrigation efficiency is 60%. The gross irrigation water requirement of the crop is: **[2 marks]**

(A) 300 mm

(B) 500 mm

(C) 833 mm

(D) 180 mm

Q27. The infiltration into a soil follows Horton's equation $f = f_c + (f_0 - f_c)\, e^{-kt}$, with initial infiltration capacity $f_0 = 30$ mm/h, final capacity $f_c = 6$ mm/h and decay constant $k = 2$ h^{-1}. The infiltration rate at $t = 1$ h is nearest to (take $e^{-2} = 0.135$): **[2 marks]**

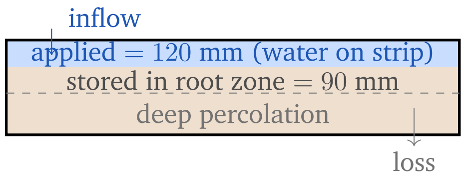
(A) 6.0 mm/h

(B) 9.25 mm/h

(C) 30.0 mm/h

(D) 12.5 mm/h

Q28. In a border irrigation, 120 mm depth of water is applied to a border strip, of which 90 mm is retained and stored in the crop root zone while the rest is lost to deep percolation and tail runoff, as sketched. The water-application efficiency is: **[2 marks]**



(A) 60%

(B) 133%

(C) 75%

(D) 90%

Q29. A centrifugal pump lifts 30 L/s of water against a total head of 20 m. If the overall efficiency of the pump is 75%, the input (shaft) power required to drive the pump is nearest to (take $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2): **[2 marks]**

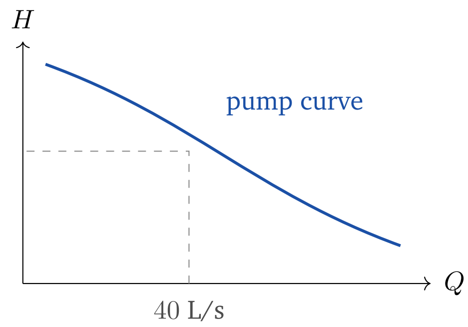
(A) 5.89 kW

(B) 7.85 kW

(C) 4.42 kW

(D) 10.5 kW

Q30. A centrifugal pump delivers 40 L/s of water when driven at 1450 rpm, with its characteristic (head–discharge) curve shown. If the speed is increased to 2900 rpm, the discharge delivered by the pump, predicted by the pump affinity laws, becomes: **[2 marks]**



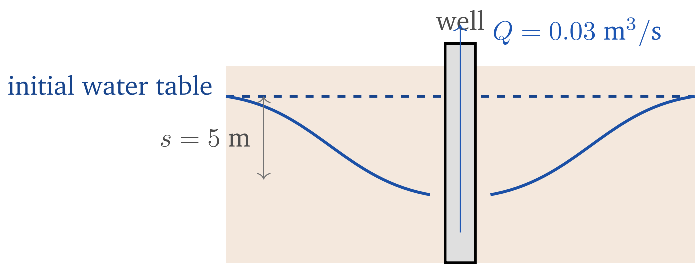
(A) 40 L/s

(B) 20 L/s

(C) 80 L/s

(D) 160 L/s

Q31. A tube well is pumped at a steady discharge of 0.03 m^3/s and reaches a steady drawdown of 5 m at the well, forming the cone of depression shown. The specific capacity of the well is: **[2 marks]**



(A) 0.6 L/s per m

(B) 6.0 L/s per m

(C) 0.06 L/s per m

(D) 60 L/s per m

Q32. A drainage coefficient of 1 cm/day is to be provided for a low-lying agricultural area of 200 ha. The design discharge capacity of the drainage system is nearest to: **[2 marks]**

(A) 2.31 m^3/s

(B) 0.463 m^3/s

(C) 0.231 m^3/s

(D) 0.116 m^3/s

Q33. Water is drawn into a field channel at the head at a rate of 5 m^3/s, and 4 m^3/s reaches the field after conveyance losses. The conveyance efficiency of the channel is: **[2 marks]**

(A) 125%

(B) 80%

(C) 20%

(D) 90%

Q34. Water flows through a confined aquifer whose hydraulic conductivity is 25 m/day under a hydraulic gradient of 0.02. The Darcy (discharge) velocity of the groundwater is: **[2 marks]**

(A) 0.5 m/day

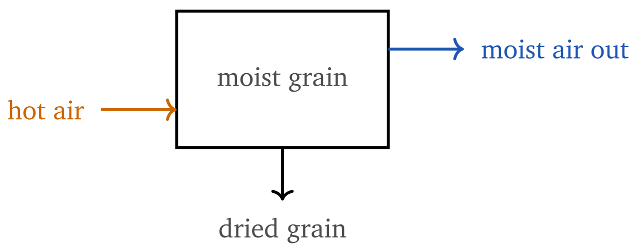
(B) 1.25 m/day

(C) 12.5 m/day

(D) 0.02 m/day

Agricultural Processing & Food Engineering

Q35. A grain sample weighs 120 g in its moist state and 100 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) 20%

(B) 25%

(C) 16.67%

(D) 12%

Q36. A paddy sample is found to contain 30 g of water and 120 g of bone-dry matter. The moisture content of the sample on a dry basis is: **[2 marks]**

(A) 25%

(B) 20%

(C) 30%

(D) 150%

Q37. A grain has a moisture content of 25% on a dry basis. The equivalent moisture content of the grain on a wet basis is: **[2 marks]**

(A) 25%

(B) 33.3%

(C) 20%

(D) 12.5%

Q38. The moisture content that a grain finally attains when it is exposed for a long time to air kept at a fixed temperature and relative humidity is termed its: **[2 marks]**

(A) critical moisture content

(B) free moisture content

(C) bound moisture content

(D) equilibrium moisture content

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

(A) the size-reduction ratio only

(B) the volume of the feed material

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

(D) the square of the feed particle size

Q40. In an air-screen grain cleaner, the light chaff and dust are separated from the heavier sound grain by an upward stream of air. This aspiration-based separation exploits the difference in the particles': **[2 marks]**

(A) colour

(B) length

(C) electrical conductivity

(D) terminal (floating) velocity

Q41. A belt conveyor carries grain such that the mass of grain per metre length of the loaded belt is 15 kg/m, and the belt moves at a linear speed of 2 m/s. The conveying capacity of the belt is: **[2 marks]**

(A) 30 t/h

(B) 15 t/h

(C) 54 t/h

(D) 108 t/h

Q42. Heat is conducted steadily through a plane wall of thickness 0.2 m and thermal conductivity 0.5 W/m $\cdot$ K. The wall has a face area of 4 m^2, and its two faces are held at $100°$C and $40°$C. The rate of heat conduction through the wall is: **[2 marks]**

(A) 600 W

(B) 300 W

(C) 1200 W

(D) 150 W

Q43. In a food-processing duct, heat is transferred by convection from a hot surface of area 2 m^2 to air, with a convective heat-transfer coefficient of 25 W/m$^2 \cdot$K and a surface-to-air temperature difference of $30°$C. The rate of convective heat transfer is: **[2 marks]**

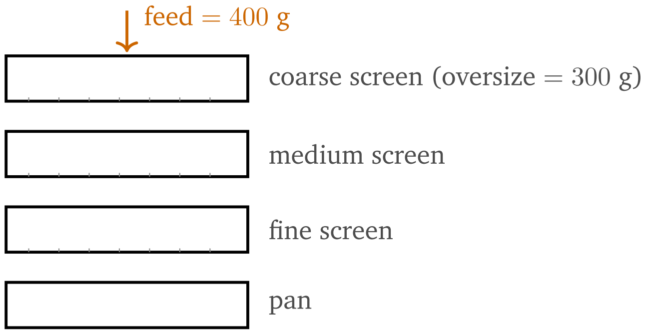
(A) 1500 W

(B) 750 W

(C) 3000 W

(D) 375 W

Q44. A 400 g sample of cleaned grain is fed to the top screen of the test sieve stack shown, and 300 g is retained on that screen as oversize. The fraction of the feed reporting as oversize on the top screen is: **[2 marks]**



(A) 25%

(B) 133%

(C) 75%

(D) 43%

Q45. The high-temperature short-time (HTST) process for the pasteurization of milk is normally carried out at a temperature and holding time of: **[2 marks]**

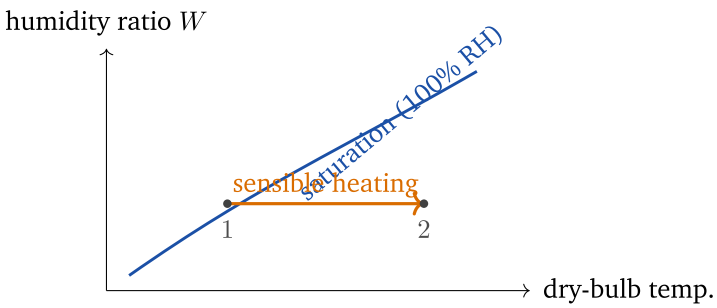
(A) 63°C for 30 minutes

(B) 100°C for 1 minute

(C) 145°C for 3 seconds

(D) 72°C for 15 seconds

Q46. Moist air at a dry-bulb temperature of 30°C and 50% relative humidity is heated by a sensible heating 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) increases

(B) first increases and then decreases

(C) remains constant

(D) decreases

Detailed Solutions

Q1.

Solution

Concept – rotary power from torque and speed: The power transmitted by a rotating shaft is $P = \dfrac{2\pi NT}{60}$, with N in rpm and T in $\text{N}\cdot\text{m}$.

Step 1 – list the data: $N = 540$ rpm, $T = 300\ \text{N}\cdot\text{m}$.

Step 2 – write the formula: $P = \dfrac{2\pi NT}{60}$

Step 3 – substitute the values: $P = \dfrac{2\pi \times 540 \times 300}{60}$

Step 4 – simplify $540/60$**:** $\dfrac{540}{60} = 9$

$P = 2\pi \times 9 \times 300$

Step 5 – multiply the numbers: $P = 2\pi \times 2700$

$P = 16964.6$ W

Step 6 – convert to kilowatts: $P = 16.96$ kW

Final Answer: $P \approx 16.96\ \text{kW} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – drawbar power is pull times speed: $P = F \times v$, with the pull F in newtons and the speed v in m/s.

Step 1 – list the data: $F = 12\ \text{kN} = 12000$ N, $v = 5$ km/h.

Step 2 – convert the speed to m/s: $v = 5 \times \dfrac{1000}{3600}$

$v = \dfrac{5000}{3600}$

$v = 1.389$ m/s

Step 3 – apply the power formula: $P = 12000 \times 1.389$

Step 4 – evaluate: $P = 16667$ W

Step 5 – convert to kilowatts: $P = 16.67$ kW

Final Answer: $P \approx 16.67\ \text{kW} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – the converging-link (virtual hitch point) principle: Extending the top and lower links to their meeting point O locates the virtual hitch point. The implement's draft acts along a line that passes below this point, so it produces a moment about the tractor's rear axle.

Step 1 – see how the draft acts: As the tool digs deeper, the horizontal soil resistance (draft) grows and its line of action passes under the virtual hitch point O.

Step 2 – resolve the moment about the rear axle: This draft, acting below O, tends to rotate the tractor about its rear axle, pressing the rear of the tractor down.

Step 3 – interpret the effect on the wheels: The reaction transfers part of the implement and soil load onto the rear (driving) wheels of the tractor.

Step 4 – state the consequence: More vertical load on the driving wheels means more available traction, which is exactly the self-adjusting benefit the geometry is designed to give.

Why the other options are wrong:

- A: the whole purpose of the converging geometry is to redistribute the axle loads, so "no change" is incorrect.
- C: the rear wheels are loaded more, not lifted off.
- D: the transfer is onto the rear driving wheels, not the front wheels.

Final Answer: weight transfers onto the rear driving wheels $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – air-standard efficiency of the Otto cycle: $\eta = 1 - \dfrac{1}{r^{\gamma-1}}$, where r is the compression ratio and γ the ratio of specific heats.

Step 1 – list the data: $r = 8$, $\gamma = 1.4$.

Step 2 – form the exponent $\gamma - 1$: $\gamma - 1 = 1.4 - 1 = 0.4$

Step 3 – evaluate $r^{\gamma-1}$: $8^{0.4} = 2.2974$

Step 4 – take the reciprocal: $\dfrac{1}{2.2974} = 0.4353$

Step 5 – subtract from one: $\eta = 1 - 0.4353 = 0.5647$

Step 6 – express as a percentage: $\eta = 56.5\%$

Final Answer: $\eta \approx 56.5\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

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

Step 1 – identify the heat-addition process: In the diesel cycle the fuel burns as it is injected while the piston moves out, so the pressure is held nearly constant during combustion.

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

Why the other options are wrong:

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

Final Answer: heat is added at constant pressure $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept – primary versus secondary tillage: Primary tillage opens and inverts the soil at greater depth (ploughs, subsoilers); secondary tillage follows to pulverise clods, level and prepare the seedbed (harrows, cultivators).

Step 1 – classify each option: The mouldboard plough, the disc plough and the subsoiler are all primary-tillage implements that cut and turn the soil deeply.

Step 2 – pick the secondary implement: The disc harrow works the tilled soil to break clods and refine the seedbed, which is a secondary-tillage operation.

Final Answer: the disc harrow is a secondary-tillage implement $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept – specific (unit) draft: Specific draft is the draft force divided by the cross-sectional area of the furrow slice: $D_s = \dfrac{D}{w \times d}$.

Step 1 – list the data: Draft $D = 3.6$ kN, width $w = 200$ mm $= 0.20$ m, depth $d = 150$ mm $= 0.15$ m.

Step 2 – compute the furrow cross-sectional area: $A = w \times d = 0.20 \times 0.15$

$A = 0.03\ \text{m}^2$

Step 3 – divide the draft by the area: $D_s = \dfrac{3.6}{0.03}$

Step 4 – evaluate: $D_s = 120\ \text{kN/m}^2$

Final Answer: $D_s = 120\ \text{kN/m}^2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept – theoretical and effective field capacity: Theoretical field capacity $\text{TFC} = \dfrac{W \times S}{10}$ (ha/h, with W in m and S in km/h); effective field capacity $\text{EFC} = \text{TFC} \times \eta_f$.

Step 1 – list the data: $W = 2.5$ m, $S = 4$ km/h, field efficiency $\eta_f = 0.80$.

Step 2 – compute the theoretical field capacity: $\text{TFC} = \dfrac{2.5 \times 4}{10}$

$\text{TFC} = \dfrac{10}{10} = 1.0\ \text{ha/h}$

Step 3 – apply the field efficiency: $\text{EFC} = 1.0 \times 0.80$

Step 4 – evaluate: $\text{EFC} = 0.80\ \text{ha/h}$

Final Answer: $\text{EFC} = 0.80\ \text{ha/h} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept – resolving the soil reaction into horizontal and vertical parts: The draft is the horizontal component of the soil reaction, $D = R\cos\theta$, where θ is the angle of the reaction to the horizontal.

Step 1 – list the data: $R = 5$ kN, $\theta = 37°$, with $\cos 37° = 0.80$.

Step 2 – write the horizontal component: $D = R\cos\theta$

Step 3 – substitute: $D = 5 \times 0.80$

Step 4 – evaluate: $D = 4.0$ kN

Final Answer: $D = 4.0$ kN $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept – working width of a row-crop machine: For a machine with equally spaced units, the width of coverage equals the number of units times the spacing between them: $W = n \times s$.

Step 1 – list the data: Number of openers $n = 11$, spacing $s = 200$ mm $= 0.20$ m.

Step 2 – multiply: $W = 11 \times 0.20$

Step 3 – evaluate: $W = 2.2$ m

Final Answer: $W = 2.2$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept – function of the combine components: A combine harvester reaps, threshes and cleans in one pass. Threshing is the detachment of grain from the ear head or panicle.

Step 1 – identify the threshing element: Threshing is done by the rotating cylinder working against the stationary concave; the impact and rubbing knock the grains loose.

Step 2 – rule out the other parts: The cutter bar cuts the standing crop, the pick-up reel gathers and feeds the crop to the cutter bar, and the grain auger conveys already-threshed grain to the tank.

Final Answer: the cylinder and concave detach the grain $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept – strokes in the four-stroke cycle: One complete four-stroke cycle (suction, compression, power, exhaust) takes two crankshaft revolutions.

Step 1 – count the strokes per cycle: There are four strokes, but only one of them, the expansion (power) stroke, delivers work.

Step 2 – relate strokes to revolutions: The four strokes span two revolutions of the crankshaft.

Step 3 – count power strokes per two revolutions: Hence there is exactly 1 power stroke in every two revolutions.

Final Answer: 1 power stroke per two revolutions $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – hydrostatic pressure at depth: The gauge pressure at a depth h below a free water surface is $p = \gamma_w\, h$.

Step 1 – list the data: $\gamma_w = 9.81$ kN/m^3, $h = 3$ m.

Step 2 – substitute into $p = \gamma_w h$: $p = 9.81 \times 3$

Step 3 – evaluate: $p = 29.43$ kN/m^2

Step 4 – write in kPa: $p = 29.43$ kPa

Final Answer: $p = 29.43$ kPa $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – Reynolds number for pipe flow: $Re = \dfrac{v\,D}{\nu}$, with v the mean velocity, D the diameter and ν the kinematic viscosity.

Step 1 – list the data: $v = 0.02$ m/s, $D = 50$ mm $= 0.05$ m, $\nu = 1 \times 10^{-6}$ m^2/s.

Step 2 – form the numerator vD: $vD = 0.02 \times 0.05 = 0.001$ m^2/s

Step 3 – divide by ν: $Re = \dfrac{0.001}{1 \times 10^{-6}}$

Step 4 – evaluate: $Re = 1000$

Step 5 – interpret: Since $Re < 2000$, the flow is laminar, which is consistent with the very low velocity given.

Final Answer: $Re = 1000 \Rightarrow \boxed{\text{B}}$

Answer: (B) 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 X lies after the peak and descends towards the base flow.

Step 2 – name that segment: The descending part after the peak is the recession (falling) limb, controlled largely by the emptying of catchment storage.

Why the other options are wrong:

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

Final Answer: X is the recession (falling) limb $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept – meaning of C in the rational formula: In $Q = CiA$, the peak runoff equals the runoff coefficient times the rainfall intensity times the catchment area.

Step 1 – interpret C: C is the fraction of the rainfall that runs off the surface rather than infiltrating, evaporating or being stored.

Step 2 – confirm its range: It is a dimensionless number between 0 and 1; higher for impervious surfaces and lower for permeable ones.

Why the other options are wrong:

- B: infiltration capacity has units of mm/h and is a loss, not the runoff fraction C.
- C: the time of concentration fixes the design intensity i; it is not C.
- D: the rainfall intensity is the separate term i in the same equation.

Final Answer: C is the runoff coefficient $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

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 K: K is the soil erodibility factor; it measures how readily a given soil is detached and transported by rainfall and runoff.

Step 2 – separate it from the others: R is rainfall erosivity, 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: rainfall erosivity is the factor R.
- B: the crop/cover management factor is C.
- C: the support-practice factor is P.

Final Answer: K is the soil erodibility factor $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept – purpose of a graded bund/terrace across a slope: Bunds and terraces are mechanical soil-conservation measures placed across the slope to break up the flow of runoff.

Step 1 – see the effect on slope length: By dividing a long slope into shorter segments, the bund shortens the distance over which runoff can gather speed.

Step 2 – see the effect on runoff: The bund intercepts and safely leads away the runoff, so the water leaves the field at a non-erosive velocity.

Step 3 – state the outcome: Shorter slope length and controlled runoff together reduce the erosive power of the water, controlling soil loss.

Why the other options are wrong:

- A: the bund shortens, not lengthens, the effective overland-flow path.
- B: a graded bund drains excess water; it is not a permanent storage structure.
- D: acting as a farm road is at best incidental, not the design purpose.

Final Answer: it intercepts runoff and reduces slope length, controlling erosion $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q18**

Q19.

Solution

Concept – drainage density: Drainage density is the total length of all streams in a basin divided by the basin area: $D_d = \dfrac{\sum L}{A}$.

Step 1 – list the data: $\sum L = 40$ km, $A = 20$ km^2.

Step 2 – substitute: $D_d = \dfrac{40}{20}$

Step 3 – evaluate: $D_d = 2.0 \text{ km/km}^2$

Final Answer: $D_d = 2.0 \text{ km/km}^2 \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q19**

Q20.

Solution

Concept – sediment delivery ratio: The sediment delivery ratio (SDR) is the fraction of the gross erosion in a watershed that actually reaches the outlet.

Step 1 – write the definition: $\text{SDR} = \dfrac{\text{sediment yield at the outlet}}{\text{gross erosion in the watershed}}$.

Step 2 – match it to the wording: The question describes exactly this ratio, so the quantity is the sediment delivery ratio.

Why the other options are wrong:

- B: trap efficiency is the fraction of incoming sediment retained by a reservoir, a different idea.
- C: erodibility index rates how easily a soil erodes; it is not a delivered/gross ratio.
- D: runoff coefficient concerns water, not sediment.

Final Answer: the quantity is the sediment delivery ratio $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – Universal Soil Loss Equation: $A = R \times K \times LS \times C \times P$; simply multiply the five factors.

Step 1 – list the factors: $R = 200$, $K = 0.30$, $LS = 1.5$, $C = 0.40$, $P = 0.50$.

Step 2 – multiply R and K: $200 \times 0.30 = 60$

Step 3 – multiply by LS: $60 \times 1.5 = 90$

Step 4 – multiply by C: $90 \times 0.40 = 36$

Step 5 – multiply by P: $36 \times 0.50 = 18$

Step 6 – state the result: $A = 18$ t/ha/yr

Final Answer: $A = 18$ t/ha/yr $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept – rational method in practical units: When i is in mm/h and A in hectares, the peak runoff in m^3/s is $Q = \frac{C\,i\,A}{360}$.

Step 1 – list the data: $C = 0.35$, $i = 6$ cm/h, $A = 150$ ha.

Step 2 – convert the intensity to mm/h: $i = 6$ cm/h $= 60$ mm/h

Step 3 – form the numerator $C\,i\,A$**:** $0.35 \times 60 = 21$

$21 \times 150 = 3150$

Step 4 – divide by 360**:** $Q = \frac{3150}{360}$

Step 5 – evaluate: $Q = 8.75\ \text{m}^3/\text{s}$

Final Answer: $Q = 8.75\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – runoff volume from a storm: Volume of direct runoff $= C \times P \times A$, where P is the rainfall depth and A the area, all in consistent units.

Step 1 – list the data and convert: $C = 0.40$, $P = 50$ mm $= 0.05$ m, $A = 10$ ha $= 10 \times 10000 = 100000\ \text{m}^2$.

Step 2 – compute the depth of runoff: Runoff depth $= C \times P = 0.40 \times 0.05 = 0.02$ m

Step 3 – multiply by the area: $V = 0.02 \times 100000$

Step 4 – evaluate: $V = 2000\ \text{m}^3$

Final Answer: $V = 2000\ \text{m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – available water depth in the root zone: $d = (\theta_{fc} - \theta_{pwp}) \times \frac{\gamma_b}{\gamma_w} \times D$, where the moisture contents are on a mass basis and γ_b/γ_w converts to volume.

Step 1 – list the data: $\theta_{fc} = 28\% = 0.28$, $\theta_{pwp} = 12\% = 0.12$, $D = 0.9$ m, $\gamma_b = 1.5\ \text{g/cm}^3$, $\gamma_w = 1.0\ \text{g/cm}^3$.

Step 2 – find the available moisture fraction: $\theta_{fc} - \theta_{pwp} = 0.28 - 0.12 = 0.16$

Step 3 – apply the bulk-density ratio: $\dfrac{\gamma_b}{\gamma_w} = \dfrac{1.5}{1.0} = 1.5$

Step 4 – substitute into the depth formula: $d = 0.16 \times 1.5 \times 0.9$

Step 5 – multiply step by step: $0.16 \times 1.5 = 0.24$

$0.24 \times 0.9 = 0.216$ m

Step 6 – convert to millimetres: $d = 0.216$ m $= 216$ mm

Final Answer: $d = 216$ mm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept – discharge to meet an evapotranspiration demand: The water volume needed per day is the ET depth times the area; dividing by the seconds in a day gives the continuous discharge.

Step 1 – list the data and convert: $ET = 6$ mm/day $= 0.006$ m/day, $A = 500$ ha $= 500 \times 10000 = 5{,}000{,}000$ m^2.

Step 2 – compute the daily water volume: $V = 0.006 \times 5{,}000{,}000$

$V = 30{,}000$ m^3/day

Step 3 – convert one day to seconds: 1 day $= 86400$ s

Step 4 – divide to get the discharge: $Q = \dfrac{30{,}000}{86400}$

Step 5 – evaluate: $Q = 0.347$ m^3/s

Final Answer: $Q \approx 0.347$ m^3/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept – net and gross irrigation requirement: The net irrigation requirement is the crop demand minus the effective rainfall; the gross requirement divides the net by the irrigation efficiency.

Step 1 – list the data: Crop demand $= 500$ mm, effective rainfall $= 200$ mm, efficiency $\eta = 0.60$.

Step 2 – compute the net irrigation requirement: NIR $= 500 - 200 = 300$ mm

Step 3 – divide by the efficiency for the gross requirement: $\text{GIR} = \frac{300}{0.60}$

Step 4 – evaluate: $\text{GIR} = 500$ mm

Final Answer: $\text{GIR} = 500 \text{ mm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – Horton's infiltration equation: $f = f_c + (f_0 - f_c)\, e^{-kt}$, the rate decaying from f_0 towards f_c.

Step 1 – list the data: $f_0 = 30$ mm/h, $f_c = 6$ mm/h, $k = 2\ \text{h}^{-1}$, $t = 1$ h.

Step 2 – compute the difference $f_0 - f_c$: $f_0 - f_c = 30 - 6 = 24$ mm/h

Step 3 – evaluate the exponential term: $e^{-kt} = e^{-2\times 1} = e^{-2} = 0.135$

Step 4 – multiply the decaying part: $(f_0 - f_c)\, e^{-kt} = 24 \times 0.135 = 3.24$ mm/h

Step 5 – add the final capacity: $f = 6 + 3.24 = 9.24 \approx 9.25$ mm/h

Final Answer: $f \approx 9.25 \text{ mm/h} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – water-application efficiency: $E_a = \frac{\text{water stored in the root zone}}{\text{water applied to the field}} \times 100$.

Step 1 – list the data: Water applied $= 120$ mm, water stored in the root zone $= 90$ mm.

Step 2 – form the ratio: $E_a = \frac{90}{120}$

Step 3 – simplify: $E_a = 0.75$

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

Final Answer: $E_a = 75\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept – pump input power: The water (output) power is $\rho g Q H$; dividing by the efficiency gives the input (shaft) power $P = \dfrac{\rho g Q H}{\eta}$.

Step 1 – list the data and convert: $Q = 30$ L/s $= 0.030$ m^3/s, $H = 20$ m, $\eta = 0.75$, $\rho = 1000$ kg/m^3, $g = 9.81$ m/s^2.

Step 2 – compute the water power numerator: $\rho g Q H = 1000 \times 9.81 \times 0.030 \times 20$

Step 3 – multiply step by step: $0.030 \times 20 = 0.6$

$9.81 \times 0.6 = 5.886$

$5.886 \times 1000 = 5886$ W

Step 4 – divide by the efficiency: $P = \dfrac{5886}{0.75}$

Step 5 – evaluate: $P = 7848$ W $= 7.85$ kW

Final Answer: $P \approx 7.85$ kW $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept – pump affinity law for discharge: For a given pump, the discharge is proportional to the rotational speed: $\dfrac{Q_2}{Q_1} = \dfrac{N_2}{N_1}$.

Step 1 – list the data: $Q_1 = 40$ L/s, $N_1 = 1450$ rpm, $N_2 = 2900$ rpm.

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

Step 3 – apply the affinity law: $Q_2 = Q_1 \times \dfrac{N_2}{N_1} = 40 \times 2$

Step 4 – evaluate: $Q_2 = 80$ L/s

Final Answer: $Q_2 = 80$ L/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – specific capacity of a well: Specific capacity is the discharge produced per unit drawdown: $S_c = \dfrac{Q}{s}$.

Step 1 – list the data and convert: $Q = 0.03$ m^3/s $= 30$ L/s, drawdown $s = 5$ m.

Step 2 – form the ratio: $S_c = \dfrac{30}{5}$

Step 3 – evaluate: $S_c = 6$ L/s per m

Final Answer: $S_c = 6.0$ L/s per m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – drain design discharge from a drainage coefficient: The design discharge is the drainage coefficient (a depth per day) multiplied by the area, converted to m^3/s.

Step 1 – list the data and convert: Drainage coefficient $= 1$ cm/day $= 0.01$ m/day, $A = 200$ ha $= 200 \times 10000 = 2{,}000{,}000$ m^2.

Step 2 – compute the daily volume: $V = 0.01 \times 2{,}000{,}000$

$V = 20{,}000$ m^3/day

Step 3 – convert one day to seconds: 1 day $= 86400$ s

Step 4 – divide to get the discharge: $Q = \dfrac{20{,}000}{86400}$

Step 5 – evaluate: $Q = 0.231$ m^3/s

Final Answer: $Q \approx 0.231$ m^3/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – conveyance efficiency: $E_c = \dfrac{\text{water delivered to the field}}{\text{water taken in at the head}} \times 100.$

Step 1 – list the data: Water at the head $= 5$ m^3/s, water reaching the field $= 4$ m^3/s.

Step 2 – form the ratio: $E_c = \dfrac{4}{5}$

Step 3 – simplify: $E_c = 0.80$

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

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

Answer: (B) Go Back to Q33

Q34.

Solution

Concept – Darcy's law: The Darcy (discharge) velocity is $v = K\,i$, the product of hydraulic conductivity and hydraulic gradient.

Step 1 – list the data: $K = 25$ m/day, hydraulic gradient $i = 0.02$.

Step 2 – substitute into $v = Ki$: $v = 25 \times 0.02$

Step 3 – evaluate: $v = 0.5$ m/day

Final Answer: $v = 0.5$ m/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept – moisture content on a wet basis: $M_{wb} = \dfrac{\text{mass of water}}{\text{total (wet) mass}} \times 100.$

Step 1 – list the data: Wet mass $= 120$ g, bone-dry mass $= 100$ g.

Step 2 – find the mass of water: Mass of water $= 120 - 100 = 20$ g

Step 3 – divide by the wet mass: $M_{wb} = \dfrac{20}{120}$

Step 4 – evaluate: $M_{wb} = 0.1667$

Step 5 – express as a percentage: $M_{wb} = 16.67\%$

Final Answer: $M_{wb} = 16.67\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept – moisture content on a dry basis: $M_{db} = \dfrac{\text{mass of water}}{\text{mass of bone-dry matter}} \times 100.$

Step 1 – list the data: Mass of water $= 30$ g, mass of dry matter $= 120$ g.

Step 2 – form the ratio: $M_{db} = \dfrac{30}{120}$

Step 3 – simplify: $M_{db} = 0.25$

Step 4 – express as a percentage: $M_{db} = 25\%$

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

Answer: (A) Go Back to Q36

Q37.

Solution

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

Step 1 – express the given value as a fraction: $M_{db} = 25\% = 0.25$

Step 2 – form the denominator: $1 + M_{db} = 1 + 0.25 = 1.25$

Step 3 – substitute into the formula: $M_{wb} = \dfrac{0.25}{1.25}$

Step 4 – evaluate: $M_{wb} = 0.20$

Step 5 – express as a percentage: $M_{wb} = 20\%$

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

Answer: (C) Go Back to Q37

Q38.

Solution

Concept – equilibrium moisture content (EMC): When a hygroscopic material such as grain is held long enough in air of fixed temperature and relative humidity, its moisture content stops changing and reaches equilibrium with the air.

Step 1 – identify the steady value: That final, unchanging moisture content is the equilibrium moisture content.

Step 2 – note its importance: The EMC governs safe storage, since a grain will neither gain nor lose moisture when stored in air at its EMC condition.

Why the other options are wrong:

- A: the critical moisture content marks the change from constant-rate to falling-rate drying, not equilibrium with air.
- B: free moisture is the moisture above the EMC that can still be removed.
- C: bound moisture is water held by the solid at a vapour pressure below that of pure water; it is not the equilibrium value itself.

Final Answer: it is the equilibrium moisture content $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – Rittinger's law of size reduction: Rittinger's law states that the energy required for size reduction is proportional to the new surface area created.

Step 1 – relate surface area to particle size: The surface area of a mass of particles varies inversely with particle diameter, so the new surface created is proportional to $\left(\frac{1}{d_2} - \frac{1}{d_1}\right)$.

Step 2 – write the law: $E = K_R\left(\frac{1}{d_2} - \frac{1}{d_1}\right)$, where d_1 and d_2 are the feed and product sizes.

Why the other options are wrong:

- A: the reduction ratio alone does not set the energy in Rittinger's law.
- B: energy is linked to surface, not to the feed volume.
- D: Kick's and Bond's laws use other size dependences; none uses the square of the feed size in this way.

Final Answer: energy $\propto$ new surface area $\left(\frac{1}{d_2} - \frac{1}{d_1}\right) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept – aspiration (pneumatic) separation: In an air-screen cleaner an upward air stream lifts and carries away particles whose terminal velocity is less than the air velocity, while heavier grain falls through.

Step 1 – recall the terminal velocity idea: Each particle has a terminal (floating) velocity at which the drag from the rising air balances its weight.

Step 2 – see how separation occurs: Light chaff has a low terminal velocity and is blown out; sound grain has a higher terminal velocity and settles, so the two separate on this difference.

Why the other options are wrong:

- A: colour separation needs an optical sorter, not an air stream.
- B: length grading is done by indented cylinders/discs, not by aspiration.
- C: electrical conductivity is not the property used in air cleaning.

Final Answer: separation is by difference in terminal velocity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept – capacity of a belt conveyor: The mass flow rate is the mass of material per unit length of belt times the belt speed: $\dot{m} = m_L \times v$.

Step 1 – list the data: $m_L = 15$ kg/m, $v = 2$ m/s.

Step 2 – compute the mass flow rate: $\dot{m} = 15 \times 2 = 30$ kg/s

Step 3 – convert kg/s to tonnes per hour: Multiply by 3600 s/h and divide by 1000 kg/t.

$$\dot{m} = 30 \times \frac{3600}{1000}$$

Step 4 – evaluate: $\dot{m} = 30 \times 3.6 = 108$ t/h

Final Answer: capacity $= 108$ t/h $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q41

Q42.

Solution

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

Step 1 – list the data: $k = 0.5$ W/m·K, $A = 4$ m^2, $L = 0.2$ m, $\Delta T = 100 - 40 = 60$ K.

Step 2 – write the numerator $kA\Delta T$: $kA\Delta T = 0.5 \times 4 \times 60$

Step 3 – multiply step by step: $0.5 \times 4 = 2$

$2 \times 60 = 120$

Step 4 – divide by the thickness: $Q = \dfrac{120}{0.2}$

Step 5 – evaluate: $Q = 600$ W

Final Answer: $Q = 600 \text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) 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: $h = 25$ W/m$^2 \cdot$ K, $A = 2$ m^2, $\Delta T = 30$ K.

Step 2 – substitute into $Q = hA\Delta T$: $Q = 25 \times 2 \times 30$

Step 3 – multiply step by step: $25 \times 2 = 50$

$50 \times 30 = 1500$

Step 4 – state the result: $Q = 1500$ W

Final Answer: $Q = 1500 \text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

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

Step 1 – list the data: Feed $= 400$ g, oversize retained $= 300$ g.

Step 2 – form the ratio: Fraction $= \dfrac{300}{400}$

Step 3 – simplify: Fraction $= 0.75$

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

Final Answer: oversize fraction $= 75\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

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

Step 1 – recall the HTST condition: The HTST process for milk holds it at about $72°$C for 15 seconds.

Step 2 – separate it from LTLT: The LTLT (holder) process uses about $63°$C for 30 minutes; that is the long-time alternative, not HTST.

Why the other options are wrong:

- A: $63°$C for 30 min is the LTLT process.
- B: $100°$C for 1 min is not a standard milk-pasteurization setting.
- C: $145°$C for a few seconds corresponds to UHT sterilization, not HTST pasteurization.

Final Answer: HTST is $72°$C for 15 s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

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

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 rises, the saturation vapour pressure of the air increases, so the air can now hold much more 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 growing, this ratio falls.

Step 4 – state the conclusion: Therefore the relative humidity decreases during sensible heating.

Why the other options are wrong:

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

Final Answer: the relative humidity decreases $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q46

Answer Key

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