# GATE Agricultural Engineering

## Sample Paper – 10

**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 rope-brake dynamometer applies a net brake load of $200$ N at an effective drum radius of $0.5$ m to an engine running at $1500$ rpm. The brake power developed by the engine is nearest to: **[1 mark]**

(A) $15.71$ kW

(B) $31.42$ kW

(C) $7.85$ kW

(D) 10.47 kW

**Q2.** An engine develops an indicated power of 20 kW and a brake power of 16 kW. The mechanical efficiency of the engine is: **[1 mark]**

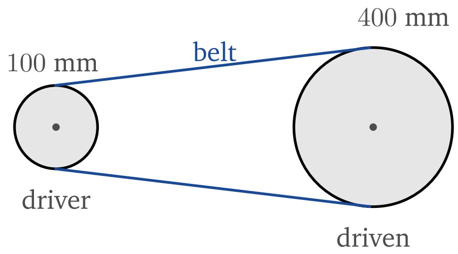
(A) 80%

(B) 125%

(C) 20%

(D) 90%

**Q3.** In the open belt drive shown, the driver pulley has a diameter of 100 mm and runs at 1440 rpm, while the driven pulley has a diameter of 400 mm. Neglecting belt slip, the speed of the driven pulley is: **[1 mark]**




(A) 5760 rpm

(B) 360 rpm

(C) 144 rpm

(D) 1440 rpm

**Q4.** A diesel engine develops a brake power of 10 kW while consuming 2.5 kg of fuel per hour. The brake specific fuel consumption (BSFC) of the engine is: **[1 mark]**

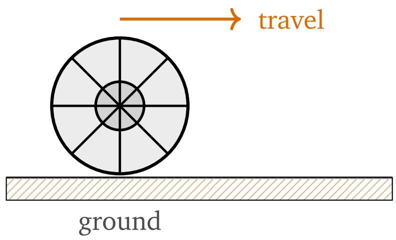
(A) 4.0 kg/kWh

(B) 25 kg/kWh

(C) 0.25 kg/kWh

(D) 2.5 kg/kWh

**Q5.** A tractor drive wheel, shown below, covers 40 m in 10 revolutions when running without load, but only 34 m in 10 revolutions while pulling a loaded implement. The wheel slip is: **[1 mark]**




(A) 17.6%

(B) 15%

(C) 6%

(D) 85%

**Q6.** Which one of the following is used for *deep primary tillage* to break a compacted sub-surface hardpan? **[1 mark]**

(A) Spike-tooth harrow

(B) Rotavator

(C) Puddler

(D) Subsoiler

**Q7.** A tractor-drawn implement of 3 m working width operating at 5 km/h actually covers 1.2 ha in one hour of field work. The field efficiency of the operation is: **[1 mark]**

(A) 125%

(B) 80%

(C) 75%

(D) 24%

**Q8.** A field of 2 ha is to be cultivated by an implement whose effective field capacity is 0.5 ha/h. The time required to cover the whole field is: **[1 mark]**

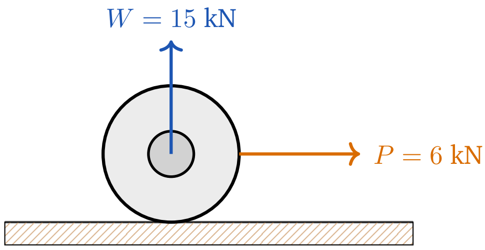
(A) 1 h

(B) 0.25 h

(C) 2 h

(D) 4 h

**Q9.** A tractor develops a drawbar pull of 6 kN while the dynamic vertical load carried by its two rear driving wheels is 15 kN, as shown in the free-body sketch. The coefficient of traction of the driving wheels is: **[1 mark]**




(A) 0.25

(B) 0.40

(C) 2.5

(D) 0.60

**Q10.** A crop is sown 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 per hectare is: **[1 mark]**

(A) 50,000

(B) 100,000

(C) 10,000

(D) 200,000

**Q11.** In a mouldboard plough bottom, the part that receives the furrow slice from the share and turns (inverts) it to one side is the: **[1 mark]**

(A) mouldboard

(B) share

(C) landside

(D) frog

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

(A) 2

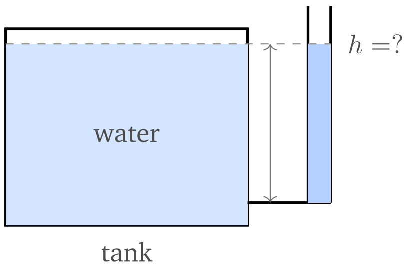
(B) 1

(C) 0.5

(D) 4

## Soil & Water Conservation Engineering

**Q13.** A pressure gauge fitted at the bottom of a tank reads a gauge pressure of 49.05 kPa, as indicated by the piezometer sketch. The equivalent head of still water corresponding to this pressure is (take $\gamma_w = 9.81$ kN/m$^3$): **[1 mark]**




(A) 2 m

(B) 10 m

(C) 5 m

(D) 4.9 m

**Q14.** Water flows steadily through a pipe of cross-sectional area 0.01 m$^2$ at a mean velocity of 2 m/s. The volumetric discharge carried by the pipe is: **[1 mark]**

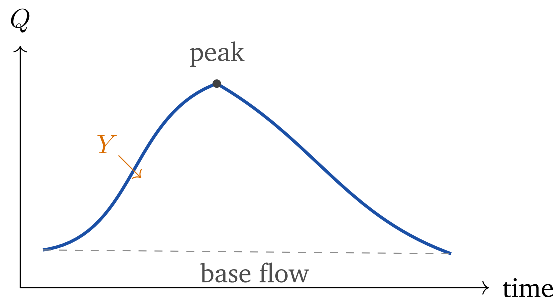
(A) 0.20 m$^3$/s

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

(C) $0.005 \text{ m}^3/\text{s}$

(D) $0.02 \text{ m}^3/\text{s}$

**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) rising limb

(B) recession (falling) limb

(C) base flow

(D) crest segment

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

(A) the soil erodibility

(B) the slope length and steepness

(C) the crop / cover management effect

(D) the rainfall erosivity

**Q17.** In the Universal Soil Loss Equation, conservation measures such as contour bunding, strip cropping and terracing are accounted for by which factor? **[1 mark]**

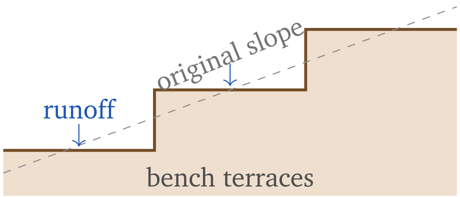
(A) the cover-management factor $C$

(B) the support-practice factor $P$

(C) the soil erodibility factor $K$

(D) the slope length–steepness factor $LS$

**Q18.** A bench terrace, sketched below, converts a steep hillside into a series of nearly level steps separated by risers. Its primary soil- and water-conservation function is to: **[1 mark]**




(A) lengthen the path of overland flow

(B) act only as a foot path along the hill

(C) reduce the effective slope length and steepness, cutting runoff velocity and erosion

(D) store rainwater permanently on each step

**Q19.** A rectangular watershed is $4$ km long and $2$ km wide, and the total length of all the streams within it is $12$ km. The drainage density of the watershed is: **[1 mark]**

(A) $0.67$ km/km$^2$

(B) $1.5$ km/km$^2$

(C) $3.0$ km/km$^2$

(D) $6.0$ km/km$^2$

**Q20.** The ratio of the mass of sediment trapped and retained in a reservoir to the total mass of sediment entering it 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 $R = 150$, $K = 0.25$, $LS = 2.0$, $C = 0.50$ and $P = 0.40$ (in consistent units). The average annual soil loss $A$ from the field is: **[2 marks]**

(A) 30 t/ha/yr

(B) 7.5 t/ha/yr

(C) 37.5 t/ha/yr

(D) 15 t/ha/yr

**Q22.** A catchment of area 90 ha has a runoff coefficient of 0.40. 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) 16 $\text{m}^3/\text{s}$

(B) 2.88 $\text{m}^3/\text{s}$

(C) 8 $\text{m}^3/\text{s}$

(D) 32 $\text{m}^3/\text{s}$

**Q23.** A storm of 40 mm rainfall depth falls over a 25 ha watershed whose runoff coefficient is 0.50. The total volume of direct surface runoff produced is: **[2 marks]**

(A) 10000 $\text{m}^3$

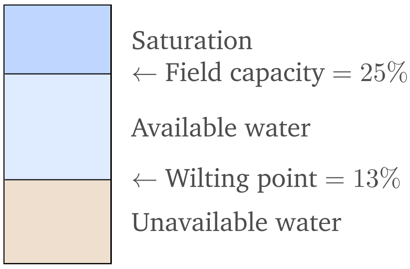
(B) 2000 $\text{m}^3$

(C) 5000 $\text{m}^3$

(D) 500 $\text{m}^3$

## Irrigation & Drainage Engineering

**Q24.** For a soil the field capacity is 25% and the permanent wilting point is 13% (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 1.5 g/cm$^3$, the total available water depth in the root zone is: **[2 marks]**




(A) 180 mm

(B) 120 mm

(C) 270 mm

(D) 90 mm

**Q25.** A field of 2 ha is to be given an irrigation of 5 cm depth using a stream of 30 L/s delivered at the field. The time for which the stream must run to apply this depth is nearest to: **[2 marks]**

(A) 18.5 h

(B) 3.7 h

(C) 9.26 h

(D) 5.5 h

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

(A) 45 mm

(B) 120 mm

(C) 80 mm

(D) 60 mm

**Q27.** A crop has a base period of 120 days and is served by a canal system with a duty of 960 ha/cumec at the field. The depth of water (delta) required by the crop over its base period, using $\Delta = \dfrac{8.64\,B}{D}$ (with $B$ in days, $D$ in ha/cumec, $\Delta$ in metres), is: **[2 marks]**

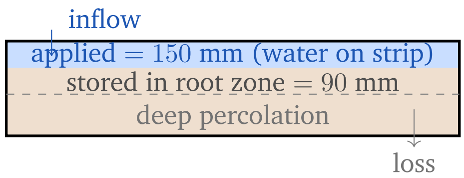
(A) 0.54 m

(B) 1.08 m

(C) 2.16 m

(D) 8.64 m

**Q28.** In a border irrigation, 150 mm depth of water is applied to a 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) 167%

(B) 90%

(C) 75%

(D) 60%

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

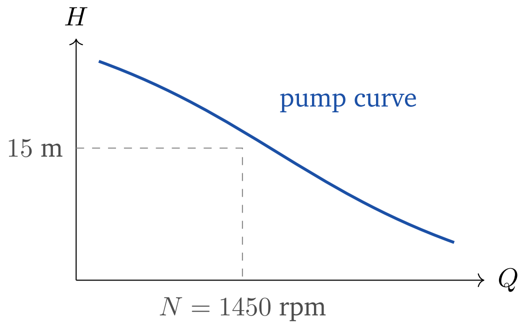
(A) 5.89 kW

(B) 7.85 kW

(C) 11.77 kW

(D) 2.94 kW

**Q30.** A centrifugal pump develops a head of 15 m when driven at 1450 rpm, as shown by its head–discharge curve. If the speed is increased to 2900 rpm, the head developed at the corresponding point, predicted by the pump affinity laws, becomes: **[2 marks]**




(A) 15 m

(B) 30 m

(C) 7.5 m

(D) 60 m

**Q31.** A tube well is pumped at a steady discharge of $0.02$ m$^3$/s and settles to a steady drawdown of 4 m at the well. The specific capacity of the well is: **[2 marks]**

(A) 0.5 L/s per m

(B) 50 L/s per m

(C) 5.0 L/s per m

(D) 0.05 L/s per m

**Q32.** A drainage coefficient of 1 cm/day is to be provided for a low-lying agricultural area of 300 ha. The design discharge capacity of the drainage system is nearest to: **[2 marks]**

(A) 0.347 m$^3$/s

(B) 0.174 m$^3$/s

(C) 3.47 m$^3$/s

(D) 0.116 m$^3$/s

**Q33.** An irrigation project has a conveyance efficiency of $80\%$ and a water-application efficiency of $75\%$. The overall (project) irrigation efficiency is: **[2 marks]**

(A) $80\%$

(B) $75\%$

(C) $155\%$

(D) $60\%$

**Q34.** Groundwater flows through a confined aquifer of hydraulic conductivity $30$ m/day under a hydraulic gradient of $0.01$. If the effective porosity of the aquifer is $0.30$, the actual (seepage) velocity of the groundwater is: **[2 marks]**

(A) $0.30$ m/day

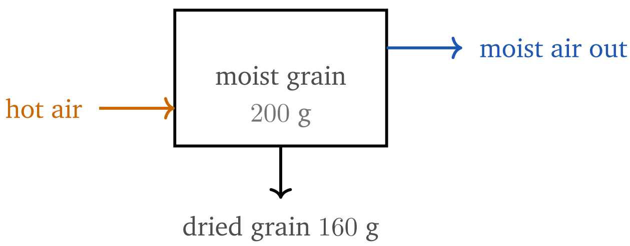
(B) $0.09$ m/day

(C) $1.0$ m/day

(D) $0.003$ m/day

## Agricultural Processing & Food Engineering

**Q35.** A grain sample weighs $200$ g in its moist state and $160$ 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) $40\%$

(C) $16.67\%$

(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) $25\%$

(D) $150\%$

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

(A) $20\%$

(B) $25\%$

(C) $16.7\%$

(D) $40\%$

**Q38.** During the drying of a moist solid, the moisture content at which the drying behaviour changes from the constant-rate period to the falling-rate period is termed the: **[2 marks]**

(A) equilibrium moisture content

(B) bound moisture content

(C) free moisture content

(D) critical moisture content

**Q39.** According to Kick's law of size reduction, the energy required per unit mass to reduce a solid from feed size $d_1$ to product size $d_2$ is proportional to: **[2 marks]**

(A) the new surface area created

(B) the square of the feed particle size

(C) the difference $\left(\frac{1}{d_2} - \frac{1}{d_1}\right)$

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

**Q40.** An indented-cylinder separator is used to grade a mixture of grains and seeds. The property on which this separator makes its separation is the particles': **[2 marks]**

(A) width

(B) length

(C) density

(D) colour

**Q41.** A belt conveyor carries grain such that the mass of grain per metre length of the loaded belt is $10$ kg/m, and the belt moves at a linear speed of $1.5$ m/s. The conveying capacity of the belt is: **[2 marks]**

(A) $54$ t/h

(B) $15$ t/h

(C) $27$ t/h

(D) $108$ t/h

**Q42.** Heat is conducted steadily through a plane wall of thickness $0.1$ m and thermal conductivity $0.8$ W/m·K. The wall has a face area of $2$ m$^2$, and its two faces are held at $80°$C and $30°$C. The rate of heat conduction through the wall is: **[2 marks]**

(A) $800$ W

(B) $400$ W

(C) $1600$ W

(D) $200$ 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 $50$ W/m$^2\cdot$K and a surface-to-air temperature difference of $20°$C. The rate of convective heat transfer is: **[2 marks]**

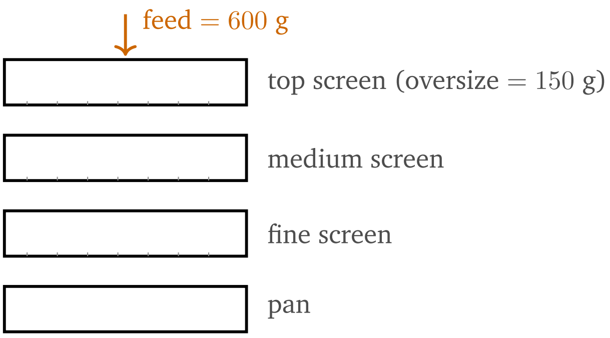
(A) 4000 W

(B) 2000 W

(C) 1000 W

(D) 500 W

**Q44.** A 600 g sample of cleaned grain is fed to the top screen of the test sieve stack shown; 150 g is retained on the top screen as oversize, while the remainder passes through it. The fraction of the feed that passes through (undersize on) the top screen is: **[2 marks]**




(A) 25%

(B) 133%

(C) 75%

(D) 40%

**Q45.** The Low-Temperature-Long-Time (LTLT / holder) method for the pasteurization of milk is normally carried out at a temperature and holding time of: **[2 marks]**

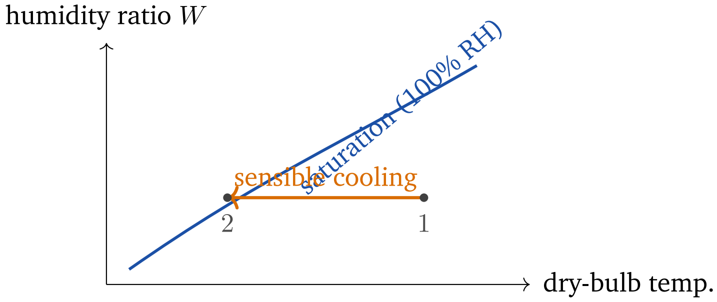
(A) 63°C for 30 minutes

(B) 72°C for 15 seconds

(C) 100°C for 1 minute

(D) 145°C for 3 seconds

**Q46.** Moist air at a dry-bulb temperature of 30°C and 50% 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) increases

(B) decreases

(C) remains constant

(D) first decreases and then increases

## Detailed Solutions

### Q1.

**Solution**

**Concept – brake power from a brake dynamometer:** The brake torque is $T = W \times r$, and the brake power is $P = \dfrac{2\pi NT}{60}$, with $N$ in rpm and $T$ in $\mathrm{N \cdot m}$.

**Step 1 – list the data:** Net brake load $W = 200$ N, drum radius $r = 0.5$ m, $N = 1500$ rpm.

**Step 2 – find the brake torque:** $T = W \times r$

$T = 200 \times 0.5$

$T = 100\ \mathrm{N \cdot m}$

**Step 3 – write the power formula:** $P = \dfrac{2\pi NT}{60}$

**Step 4 – substitute the values:** $P = \dfrac{2\pi \times 1500 \times 100}{60}$

**Step 5 – simplify** $1500/60$**:** $\dfrac{1500}{60} = 25$

$P = 2\pi \times 25 \times 100$

**Step 6 – multiply the numbers:** $P = 2\pi \times 2500$

$P = 15707.96$ W

**Step 7 – convert to kilowatts:** $P = 15.71$ kW

**Final Answer:** $P \approx 15.71$ kW $\Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q1

### Q2.

**Solution**

**Concept – mechanical efficiency of an engine:** Mechanical efficiency is the ratio of brake power delivered at the shaft to the indicated power developed in the cylinder: $\eta_m = \dfrac{\text{BP}}{\text{IP}}$.

**Step 1 – list the data:** Indicated power IP $= 20$ kW, brake power BP $= 16$ kW.

**Step 2 – write the ratio:** $\eta_m = \dfrac{\text{BP}}{\text{IP}}$

**Step 3 – substitute:** $\eta_m = \dfrac{16}{20}$

**Step 4 – simplify:** $\eta_m = 0.80$

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

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

Answer: (A) Go Back to Q2

## Q3.

**Solution**

**Concept – speed ratio of a belt drive:** With no slip the belt has the same linear speed on both pulleys, so $N_1 D_1 = N_2 D_2$, giving $N_2 = N_1 \dfrac{D_1}{D_2}$.

**Step 1 – list the data:** $D_1 = 100$ mm, $N_1 = 1440$ rpm, $D_2 = 400$ mm.

**Step 2 – write the relation:** $N_2 = N_1 \times \dfrac{D_1}{D_2}$

**Step 3 – substitute:** $N_2 = 1440 \times \dfrac{100}{400}$

**Step 4 – simplify the diameter ratio:** $\dfrac{100}{400} = 0.25$

$N_2 = 1440 \times 0.25$

**Step 5 – evaluate:** $N_2 = 360$ rpm

**Final Answer:** $N_2 = 360 \text{ rpm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

## Q4.

**Solution**

**Concept – brake specific fuel consumption:** BSFC is the mass of fuel used per unit of brake power per hour: $\text{BSFC} = \dfrac{\dot{m}_f}{\text{BP}}$.

**Step 1 – list the data:** Brake power BP $= 10$ kW, fuel rate $\dot{m}_f = 2.5$ kg/h.

**Step 2 – write the formula:** $\text{BSFC} = \dfrac{\dot{m}_f}{\text{BP}}$

**Step 3 – substitute:** $\text{BSFC} = \dfrac{2.5 \text{ kg/h}}{10 \text{ kW}}$

**Step 4 – evaluate:** $\text{BSFC} = 0.25$ kg/kWh

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

Answer: (C) Go Back to Q4

## Q5.

### Solution

**Concept – wheel slip:** Slip is the fractional loss of forward travel caused by the wheel spinning against the soil: $s = \dfrac{S_0 - S_L}{S_0}$, where $S_0$ is the no-load distance and $S_L$ the loaded distance for the same number of revolutions.

**Step 1 – list the data:** No-load distance $S_0 = 40$ m, loaded distance $S_L = 34$ m (both for 10 revolutions).

**Step 2 – write the slip formula:** $s = \dfrac{S_0 - S_L}{S_0}$

**Step 3 – find the numerator:** $S_0 - S_L = 40 - 34 = 6$ m

**Step 4 – substitute:** $s = \dfrac{6}{40}$

**Step 5 – simplify:** $s = 0.15$

**Step 6 – express as a percentage:** $s = 15\%$

**Final Answer:** $s = 15\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

## Q6.

### Solution

**Concept – primary tillage for hardpan:** Primary tillage opens and loosens the soil at depth. A subsoiler runs a narrow shank well below the normal plough layer to shatter a compacted hardpan without inverting the topsoil.

**Step 1 – classify the options:** The spike-tooth harrow and the rotavator are shallow, secondary-tillage / seedbed tools; the puddler works flooded soil for paddy.

**Step 2 – pick the deep primary implement:** The subsoiler is designed for deep primary tillage that breaks a sub-surface hardpan.

**Final Answer:** the subsoiler $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

## Q7.

### Solution

**Concept – field efficiency:** Field efficiency is the ratio of the effective (actual) field capacity to the theoretical field capacity: $\eta_f = \dfrac{\text{EFC}}{\text{TFC}}$, with $\text{TFC} = \dfrac{W \times S}{10}$ (ha/h, $W$ in m, $S$ in km/h).

**Step 1 – list the data:** $W = 3$ m, $S = 5$ km/h, actual area $= 1.2$ ha in $1$ h, so

EFC $= 1.2$ ha/h.

**Step 2 – compute the theoretical field capacity:** TFC $= \dfrac{3 \times 5}{10}$

TFC $= \dfrac{15}{10} = 1.5$ ha/h

**Step 3 – form the efficiency ratio:** $\eta_f = \dfrac{1.2}{1.5}$

**Step 4 – simplify:** $\eta_f = 0.80$

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

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

Answer: (B) Go Back to Q7

## Q8.

### Solution

**Concept – time from area and field capacity:** The time to cover a field is the area divided by the effective field capacity: $t = \dfrac{A}{\text{EFC}}$.

**Step 1 – list the data:** Area $A = 2$ ha, effective field capacity EFC $= 0.5$ ha/h.

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

**Step 3 – substitute:** $t = \dfrac{2}{0.5}$

**Step 4 – evaluate:** $t = 4$ h

**Final Answer:** $t = 4$ h $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

## Q9.

### Solution

**Concept – coefficient of traction:** The coefficient of traction is the ratio of the drawbar pull developed to the dynamic vertical load on the driving wheels: $\mu = \dfrac{P}{W}$.

**Step 1 – list the data:** Drawbar pull $P = 6$ kN, load on driving wheels $W = 15$ kN.

**Step 2 – write the ratio:** $\mu = \dfrac{P}{W}$

**Step 3 – substitute:** $\mu = \dfrac{6}{15}$

**Step 4 – simplify:** $\mu = 0.40$

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

Answer: (B) Go Back to Q9

## Q10.

### Solution

**Concept – plant population per hectare:** For a uniform grid, the number of plants per hectare is the hectare area divided by the ground area occupied by one plant: $N = \dfrac{10000}{R \times P}$, with row spacing $R$ and plant spacing $P$ in metres.

**Step 1 – list the data:** Row spacing $R = 0.5$ m, plant spacing $P = 0.2$ m.

**Step 2 – find the area per plant:** $R \times P = 0.5 \times 0.2$

$R \times P = 0.1\ \text{m}^2$

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

**Step 4 – evaluate:** $N = 100000$ plants/ha

**Final Answer:** $N = 100{,}000$ plants/ha $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

## Q11.

### Solution

**Concept – parts of a mouldboard plough bottom:** The share cuts the furrow slice, the mouldboard receives and inverts it, the landside takes the side thrust, and the frog is the base to which the parts are bolted.

**Step 1 – identify the inverting part:** The curved mouldboard lifts, twists and turns the furrow slice over to one side, which is the pulverising and inverting action.

**Step 2 – rule out the others:** The share only makes the horizontal cut, the landside resists side thrust, and the frog is merely the mounting body.

**Final Answer:** the mouldboard inverts the slice $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

**Q12.**

**Solution**

**Concept – power strokes in a two-stroke engine:** In a two-stroke engine one complete cycle (suction–compression on one stroke, power–exhaust on the next) is finished in a single crankshaft revolution.

**Step 1 – count strokes per revolution:** There are two piston strokes in one revolution of the crankshaft.

**Step 2 – relate to power strokes:** Every revolution includes one expansion (power) stroke.

**Step 3 – state the count:** Hence there is exactly 1 power stroke per revolution.

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

**Answer: (B)** Go Back to Q12

**Q13.**

**Solution**

**Concept – pressure head:** The head of water equivalent to a pressure is $h = \dfrac{p}{\gamma_w}$.

**Step 1 – list the data:** $p = 49.05$ kPa $= 49.05$ kN/m$^2$, $\gamma_w = 9.81$ kN/m$^3$.

**Step 2 – write the formula:** $h = \dfrac{p}{\gamma_w}$

**Step 3 – substitute:** $h = \dfrac{49.05}{9.81}$

**Step 4 – evaluate:** $h = 5$ m

**Final Answer:** $h = 5 \text{ m} \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q13

**Q14.**

**Solution**

**Concept – discharge from the continuity equation:** The volumetric discharge is the product of the cross-sectional area and the mean velocity: $Q = A \times v$.

**Step 1 – list the data:** $A = 0.01$ m$^2$, $v = 2$ m/s.

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

**Step 3 – substitute:** $Q = 0.01 \times 2$

**Step 4 – evaluate:** $Q = 0.02$ m$^3$/s

**Final Answer:** $Q = 0.02\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

## Q15.

### Solution

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

**Step 1 – locate the marked part:** Segment $Y$ lies before the peak and climbs upward from the start of direct runoff.

**Step 2 – name that segment:** The ascending part leading up to the peak is the rising limb, shaped mainly by the storm's build-up and the catchment response.

**Why the other options are wrong:**

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

**Final Answer:** $Y$ is the rising limb $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q15

## Q16.

### Solution

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

**Step 1 – identify $R$:** $R$ is the rainfall erosivity factor; it measures the erosive power of the rainfall through its energy and intensity.

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

**Why the other options are wrong:**

- A: soil erodibility is the factor $K$, not $R$.
- B: slope length and steepness are captured by $LS$.
- C: the crop / cover effect is the factor $C$.

**Final Answer:** $R$ is the rainfall erosivity $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q16

## Q17.

### Solution

**Concept – support-practice factor in USLE:** The factor $P$ accounts for conservation-support practices that change the pattern of runoff and thereby reduce erosion relative to up-and-down cultivation.

**Step 1 – match the practices to a factor:** Contour bunding, strip cropping and terracing are all support practices, so they are represented by $P$.

**Step 2 – separate it from $C$:** The cover-management factor $C$ deals with crop cover and residue, not with the layout of conservation structures.

**Why the other options are wrong:**

- A: $C$ is the cover-management factor, tied to vegetation and residue.
- C: $K$ is a soil property, independent of the practice adopted.
- D: $LS$ is fixed by topography, not by the support practice.

**Final Answer:** the support-practice factor $P$ $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q17

## Q18.

### Solution

**Concept – purpose of a bench terrace:** A bench terrace cuts a long steep slope into a stair of short, nearly level steps, so overland flow travels only a short, flat distance on each step.

**Step 1 – see the effect on the slope:** By replacing one long slope with many short level benches, the effective slope length and steepness experienced by the runoff are sharply reduced.

**Step 2 – link to erosion:** Shorter, flatter flow paths mean lower runoff velocity, so the water's power to detach and carry soil is greatly reduced.

**Why the other options are wrong:**

- A: terracing shortens, not lengthens, the overland-flow path.
- B: a bench terrace is a soil-conservation structure, not merely a footpath.

- D: it drains excess water safely; it does not pond rainwater permanently.

**Final Answer:** it cuts the effective slope length and steepness, 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 divided by the drainage area: $D_d = \dfrac{\sum L}{A}$.

**Step 1 – find the watershed area:** $A = \text{length} \times \text{width} = 4 \times 2$

$A = 8 \text{ km}^2$

**Step 2 – note the total stream length:** $\sum L = 12 \text{ km}$

**Step 3 – write the formula:** $D_d = \dfrac{\sum L}{A}$

**Step 4 – substitute:** $D_d = \dfrac{12}{8}$

**Step 5 – evaluate:** $D_d = 1.5 \text{ km/km}^2$

**Final Answer:** $D_d = 1.5 \text{ km/km}^2 \Rightarrow \boxed{\text{B}}$

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

## Q20.

### Solution

**Concept – trap efficiency:** Trap efficiency is the fraction of the incoming sediment that a reservoir captures and retains: $\eta_t = \dfrac{\text{sediment trapped}}{\text{sediment inflow}}$.

**Step 1 – read the definition given:** The quantity described is the mass trapped divided by the mass entering.

**Step 2 – name it:** This ratio is the trap efficiency of the reservoir.

**Why the other options are wrong:**

- A: the sediment delivery ratio compares sediment reaching the outlet with gross erosion in the watershed, not reservoir capture.
- B: the runoff coefficient relates runoff to rainfall, not sediment.
- D: the erodibility index describes the soil, not the reservoir's 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 five factors: $A = R\,K\,LS\,C\,P$.

**Step 1 – list the data:** $R = 150$, $K = 0.25$, $LS = 2.0$, $C = 0.50$, $P = 0.40$.

**Step 2 – multiply $R$ and $K$:** $R \times K = 150 \times 0.25 = 37.5$

**Step 3 – multiply by $LS$:** $37.5 \times 2.0 = 75$

**Step 4 – multiply by $C$:** $75 \times 0.50 = 37.5$

**Step 5 – multiply by $P$:** $37.5 \times 0.40 = 15$

**Step 6 – state the result:** $A = 15$ t/ha/yr

**Final Answer:** $A = 15$ t/ha/yr $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

## Q22.

**Solution**

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

**Step 1 – list the data:** $C = 0.40$, $i = 8$ cm/h, $A = 90$ ha.

**Step 2 – convert the intensity to mm/h:** $i = 8 \times 10 = 80$ mm/h

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

**Step 4 – substitute:** $Q = \dfrac{0.40 \times 80 \times 90}{360}$

**Step 5 – multiply the numerator step by step:** $0.40 \times 80 = 32$

$32 \times 90 = 2880$

**Step 6 – divide by $360$:** $Q = \dfrac{2880}{360}$

$Q = 8$ m$^3$/s

**Final Answer:** $Q = 8$ m$^3$/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

## Q23.

**Solution**

**Concept – volume of direct runoff:** The runoff depth is the runoff coefficient times the rainfall depth, and the runoff volume is that depth times the catchment area: $V = C \times P \times A$.

**Step 1 – list the data:** Rainfall depth $P = 40$ mm $= 0.04$ m, area $A = 25$ ha $= 25 \times 10^4$ m$^2$, $C = 0.50$.

**Step 2 – find the runoff depth:** Runoff depth $= C \times P = 0.50 \times 0.04$

Runoff depth $= 0.02$ m

**Step 3 – express the area in m$^2$:** $A = 250000$ m$^2$

**Step 4 – multiply depth by area:** $V = 0.02 \times 250000$

**Step 5 – evaluate:** $V = 5000$ m$^3$

**Final Answer:** $V = 5000$ m$^3 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

## Q24.

**Solution**

**Concept – available water in the root zone:** The depth of available water is $d = \dfrac{\text{FC} - \text{PWP}}{100} \times \dfrac{\gamma_b}{\gamma_w} \times D$, where FC and PWP are on a mass basis and $\gamma_b/\gamma_w$ is the ratio of dry bulk density to water density.

**Step 1 – list the data:** FC $= 25\%$, PWP $= 13\%$, dry bulk density $\gamma_b = 1.5$ g/cm$^3$, $\gamma_w = 1.0$ g/cm$^3$, root depth $D = 1.0$ m.

**Step 2 – find the moisture difference (fraction):** $\dfrac{25 - 13}{100} = \dfrac{12}{100} = 0.12$

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

**Step 4 – substitute into the formula:** $d = 0.12 \times 1.5 \times 1.0$

**Step 5 – multiply step by step:** $0.12 \times 1.5 = 0.18$

$0.18 \times 1.0 = 0.18$ m

**Step 6 – convert to millimetres:** $d = 0.18 \times 1000 = 180$ mm

**Final Answer:** $d = 180$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

## Q25.

**Solution**

**Concept – irrigation time from applied volume and stream size:** The volume to be applied is depth times area, and the run time is that volume divided by the stream discharge: $t = \dfrac{d \times A}{Q}$.

**Step 1 – list the data:** Depth $d = 5$ cm $= 0.05$ m, area $A = 2$ ha $= 2 \times 10^4$ m$^2$, stream $Q = 30$ L/s $= 0.03$ m$^3$/s.

**Step 2 – find the volume to apply:** $V = d \times A = 0.05 \times 20000$

$V = 1000$ m$^3$

**Step 3 – divide by the discharge:** $t = \dfrac{1000}{0.03}$

$t = 33333.3$ s

**Step 4 – convert seconds to hours:** $t = \dfrac{33333.3}{3600}$

$t = 9.26$ h

**Final Answer:** $t \approx 9.26$ h $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q25

## Q26.

**Solution**

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

**Step 1 – list the data:** Net depth $d_n = 60$ mm, application efficiency $\eta_a = 0.75$.

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

**Step 3 – substitute:** $d_g = \dfrac{60}{0.75}$

**Step 4 – evaluate:** $d_g = 80$ mm

**Final Answer:** $d_g = 80$ mm $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q26

## Q27.

### Solution

**Concept – delta (depth of water) from base period and duty:** The delta is related to the base period $B$ and the duty $D$ by $\Delta = \frac{8.64\,B}{D}$ (with $B$ in days, $D$ in ha/cumec, $\Delta$ in metres).

**Step 1 – list the data:** $B = 120$ days, $D = 960$ ha/cumec.

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

**Step 3 – substitute:** $\Delta = \dfrac{8.64 \times 120}{960}$

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

**Step 5 – divide by the duty:** $\Delta = \dfrac{1036.8}{960}$

$\Delta = 1.08$ m

**Final Answer:** $\Delta = 1.08 \text{ m} \Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q27

## Q28.

### Solution

**Concept – water-application efficiency:** The application efficiency is the depth of water stored in the root zone divided by the depth applied to the field: $\eta_a = \frac{d_{\text{stored}}}{d_{\text{applied}}}$.

**Step 1 – list the data:** Applied depth $= 150$ mm, stored depth $= 90$ mm.

**Step 2 – write the ratio:** $\eta_a = \dfrac{90}{150}$

**Step 3 – simplify:** $\eta_a = 0.60$

**Step 4 – express as a percentage:** $\eta_a = 60\%$

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

**Answer: (D)** Go Back to Q28

## Q29.

### Solution

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

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

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

**Step 3 – substitute:** $P = 1000 \times 9.81 \times 0.05 \times 12$

**Step 4 – multiply step by step:** $1000 \times 9.81 = 9810$

$9810 \times 0.05 = 490.5$

$490.5 \times 12 = 5886$ W

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

**Final Answer:** $P \approx 5.89 \text{ kW} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

## Q30.

### Solution

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

**Step 1 – list the data:** $H_1 = 15$ m, $N_1 = 1450$ rpm, $N_2 = 2900$ rpm.

**Step 2 – find the speed ratio:** $\frac{N_2}{N_1} = \frac{2900}{1450} = 2$

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

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

**Step 5 – substitute and evaluate:** $H_2 = 15 \times 4 = 60$ m

**Final Answer:** $H_2 = 60 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

## Q31.

### Solution

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

**Step 1 – list the data:** $Q = 0.02$ m$^3$/s, drawdown $s = 4$ m.

**Step 2 – write the formula:** $S_c = \frac{Q}{s}$

**Step 3 – substitute:** $S_c = \frac{0.02}{4}$

**Step 4 – evaluate in m$^3$/s per m:** $S_c = 0.005$ m$^3$/s per m

**Step 5 – convert to L/s per m:** $S_c = 0.005 \times 1000 = 5.0$ L/s per m

**Final Answer:** $S_c = 5.0$ L/s per m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

## Q32.

### Solution

**Concept – drainage design discharge:** The design discharge is the drainage coefficient (a depth of water removed per day) spread over the area, converted to m$^3$/s: $Q = \dfrac{d \times A}{t}$.

**Step 1 – list the data:** Drainage coefficient $d = 1$ cm/day $= 0.01$ m/day, area $A = 300$ ha $= 300 \times 10^4$ m$^2$.

**Step 2 – find the daily volume:** $V = d \times A = 0.01 \times 3000000$

$V = 30000$ m$^3$/day

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

**Step 4 – divide the volume by the seconds in a day:** $Q = \dfrac{30000}{86400}$

**Step 5 – evaluate:** $Q = 0.347$ m$^3$/s

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

Answer: (A) Go Back to Q32

## Q33.

### Solution

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

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

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

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

**Step 4 – evaluate:** $\eta_o = 0.60$

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

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

Answer: (D) Go Back to Q33

## Q34.

**Solution**

**Concept – Darcy velocity and seepage velocity:** The Darcy (discharge) velocity is $v = K\,i$, and the actual seepage velocity through the pores is $v_s = \frac{v}{n}$, where $n$ is the effective porosity.

**Step 1 – list the data:** $K = 30$ m/day, $i = 0.01$, $n = 0.30$.

**Step 2 – find the Darcy velocity:** $v = K \times i = 30 \times 0.01$

$v = 0.30$ m/day

**Step 3 – write the seepage-velocity relation:** $v_s = \frac{v}{n}$

**Step 4 – substitute:** $v_s = \frac{0.30}{0.30}$

**Step 5 – evaluate:** $v_s = 1.0$ m/day

**Final Answer:** $v_s = 1.0$ m/day $\Rightarrow \boxed{\text{C}}$

Answer: (C) 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: $M_{wb} = \frac{m_{\text{moist}} - m_{\text{dry}}}{m_{\text{moist}}}$.

**Step 1 – list the data:** Moist mass $= 200$ g, bone-dry mass $= 160$ g.

**Step 2 – find the mass of water:** $m_w = 200 - 160 = 40$ g

**Step 3 – divide by the moist mass:** $M_{wb} = \frac{40}{200}$

**Step 4 – simplify:** $M_{wb} = 0.20$

**Step 5 – 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: $M_{db} = \frac{m_w}{m_{\text{dry}}}$.

**Step 1 – list the data:** Water $m_w = 60$ g, bone-dry matter $m_{\text{dry}} = 150$ g.

**Step 2 – write the ratio:** $M_{db} = \dfrac{60}{150}$

**Step 3 – simplify:** $M_{db} = 0.40$

**Step 4 – 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 wet basis to dry basis:** The two moisture bases are related by $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$, with the moisture contents as fractions.

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

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

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

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

**Step 5 – simplify:** $M_{db} = 0.25$

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

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

**Answer: (B)** Go Back to Q37

## Q38.

### Solution

**Concept – drying-rate periods:** During drying, the rate first stays roughly constant (constant-rate period) while free surface moisture evaporates, then falls (falling-rate period) once the surface can no longer be kept wet.

**Step 1 – identify the transition point:** The moisture content at the change-over from the constant-rate to the falling-rate period is the critical moisture content.

**Step 2 – separate it from the others:** Below the critical value the internal movement of moisture controls the process, giving the falling-rate behaviour.

**Why the other options are wrong:**

- A: equilibrium moisture content is the final value reached at the end of drying, not the transition.

- B: bound moisture is water held by the solid below its vapour pressure, a different idea.
- C: free moisture is the moisture above the equilibrium value that can be removed, not the transition point.

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

**Answer: (D)** Go Back to Q38

## Q39.

**Solution**

**Concept – Kick's law of size reduction:** Kick's law states that the energy required per unit mass is proportional to the logarithm of the ratio of feed size to product size: $E = K_K \ln\left(\dfrac{d_1}{d_2}\right)$.

**Step 1 – recall the three laws:** Rittinger's law ties energy to new surface created; Bond's law ties it to $\left(\dfrac{1}{\sqrt{d_2}} - \dfrac{1}{\sqrt{d_1}}\right)$; Kick's law ties it to the size-reduction ratio.

**Step 2 – match Kick's law:** Kick's law makes the energy proportional to $\ln(d_1/d_2)$, the logarithm of the size-reduction ratio.

**Why the other options are wrong:**

- A: proportionality to new surface area is Rittinger's law.
- B: the square of the feed size is not the basis of any of the three standard laws.
- C: the term $\left(\dfrac{1}{d_2} - \dfrac{1}{d_1}\right)$ is the surface-based Rittinger form, not Kick's law.

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

**Answer: (D)** Go Back to Q39

## Q40.

**Solution**

**Concept – principle of an indented-cylinder separator:** An indented cylinder has small pockets (indents) that lift short particles out of the mass and drop them into a trough, while long particles ride over and stay in the cylinder.

**Step 1 – identify the distinguishing property:** The pockets pick up only particles short enough to fit, so the separation is governed by particle length.

**Step 2 – rule out the others:** Width, density and colour are used by other machines (width by slotted sieves, density by gravity/spiral separators, colour by optical sorters), not by the indented cylinder.

**Final Answer:** separation is by length $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

## Q41.

**Solution**

**Concept – capacity of a belt conveyor:** The mass flow rate is the mass carried per metre of belt times the belt speed: $\dot{m} = q \times v$.

**Step 1 – list the data:** Load per metre $q = 10$ kg/m, belt speed $v = 1.5$ m/s.

**Step 2 – write the formula:** $\dot{m} = q \times v$

**Step 3 – substitute:** $\dot{m} = 10 \times 1.5$

**Step 4 – evaluate in kg/s:** $\dot{m} = 15$ kg/s

**Step 5 – convert to kg/h:** $\dot{m} = 15 \times 3600 = 54000$ kg/h

**Step 6 – convert to tonnes per hour:** $\dot{m} = \dfrac{54000}{1000} = 54$ t/h

**Final Answer:** $\dot{m} = 54$ t/h $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

## Q42.

**Solution**

**Concept – steady conduction through a plane wall (Fourier's law):** The rate of heat conduction is $Q = \dfrac{k\,A\,\Delta T}{L}$, with $k$ the conductivity, $A$ the area, $\Delta T$ the temperature difference and $L$ the thickness.

**Step 1 – list the data:** $k = 0.8$ W/m·K, $A = 2$ m$^2$, $L = 0.1$ m, $\Delta T = 80 - 30 = 50$ K.

**Step 2 – write the formula:** $Q = \dfrac{k\,A\,\Delta T}{L}$

**Step 3 – substitute:** $Q = \dfrac{0.8 \times 2 \times 50}{0.1}$

**Step 4 – multiply the numerator step by step:** $0.8 \times 2 = 1.6$

$1.6 \times 50 = 80$

**Step 5 – divide by the thickness:** $Q = \dfrac{80}{0.1}$

$Q = 800$ W

**Final Answer:** $Q = 800\text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q42

## Q43.

**Solution**

**Concept – convective heat transfer (Newton's law of cooling):** The rate of convective heat transfer is $Q = h\,A\,\Delta T$, with $h$ the convective coefficient, $A$ the surface area and $\Delta T$ the surface-to-fluid temperature difference.

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

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

**Step 3 – substitute:** $Q = 50 \times 2 \times 20$

**Step 4 – multiply step by step:** $50 \times 2 = 100$

$100 \times 20 = 2000$

**Step 5 – state the result:** $Q = 2000\text{ W}$

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

Answer: (B) Go Back to Q43

## Q44.

**Solution**

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

**Step 1 – list the data:** Feed $= 600$ g, oversize retained $= 150$ g.

**Step 2 – find the mass passing through:** Passing $= 600 - 150 = 450$ g

**Step 3 – form the ratio:** Fraction $= \dfrac{450}{600}$

**Step 4 – simplify:** Fraction $= 0.75$

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

**Final Answer:** undersize 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 / holder) 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:**

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

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

**Answer: (A)** Go Back to Q45

## Q46.

**Solution**

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

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

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

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

**Step 4 – state the conclusion:** Therefore the relative humidity increases during sensible cooling.

**Why the other options are wrong:**

- B: RH would fall on heating, not cooling.
- C: RH is not constant, because the saturation capacity changes with temperature even though $W$ does not.
- D: there is no reversal; for pure sensible cooling the trend is monotonic (and if cooled to saturation the RH simply reaches $100\%$).

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

**Answer: (A)** **Go Back to Q46**

# Answer Key

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