GATE Geomatics Engineering

Sample Paper – 6

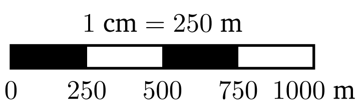
Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Geomatics 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. Unless stated otherwise take the speed of light $c = 3 \times 10^8$ m/s and the coefficient of thermal expansion of steel $\alpha = 11.7 \times 10^{-6}\ ^\circ\mathrm{C}^{-1}$.

Principles of Surveying and Error Theory

Q1. A map is drawn to a representative fraction of $1{:}25{,}000$, as indicated by the scale bar below. A straight road that measures 4 cm on the map has a ground length of: **[1 mark]**



(A) 1 km

(B) 10 km

(C) 100 m

(D) 6.25 km

Q2. The probable error of a single observation is $E_s = 0.6745\,\sigma$, where σ is the standard deviation. For a set of observations with $\sigma = 4.0$ mm, the probable error of a single observation is nearest to: **[1 mark]**

(A) 2.70 mm

(B) 6.75 mm

(C) 4.00 mm

(D) 0.67 mm

Q3. The probable error of the arithmetic mean of n equally reliable observations is $E_m = E_s/\sqrt{n}$. If the probable error of a single observation is $E_s = \pm 6$ mm and $n = 9$ observations are taken, the probable error of the mean is: **[1 mark]**

(A) ± 18 mm

(B) ± 6 mm

(C) ± 0.67 mm

(D) ± 2 mm

Q4. Accidental (random) errors that remain after mistakes and systematic errors have been removed are best described as errors that: **[1 mark]**

(A) all have the same sign and steadily accumulate

(B) can be removed completely by one fixed correction

(C) are equally likely to be positive or negative and tend to compensate

(D) arise only from a maladjusted instrument

Q5. A line of length 500 m is measured with a standard error of ± 25 mm. The relative precision (degree of accuracy) of the measurement is: **[1 mark]**

(A) 1 in 2000

(B) 1 in 5000

(C) 1 in 20,000

(D) 1 in 200

Q6. Which one of the following is an example of an accidental (random) error in chaining? **[1 mark]**

(A) using a tape whose standardized length is permanently in error

(B) small errors made in estimating the fractional part of the last graduation

(C) recording 6 m in place of 9 m by miswriting the field note

(D) consistently ignoring the sag correction on every bay

Distance Measurement, Levelling and Contouring

Q7. A 30 m steel tape of cross-sectional area $A = 6$ mm^2 and modulus $E = 2 \times 10^5$ N/mm^2 is standardized at a pull of 100 N but is used in the field at a pull of 160 N. The pull (tension) correction $C_p = \dfrac{(P - P_0)L}{AE}$ for one tape length is: **[1 mark]**

(A) $+15$ mm

(B) $+0.15$ mm

(C) $+3.0$ mm

(D) $+1.5$ mm

Q8. A chain of nominal length 20 m is found on testing to be 20.10 m long (too long). A survey line measured with this chain reads 450 m. The true (corrected) length of the line is: **[1 mark]**

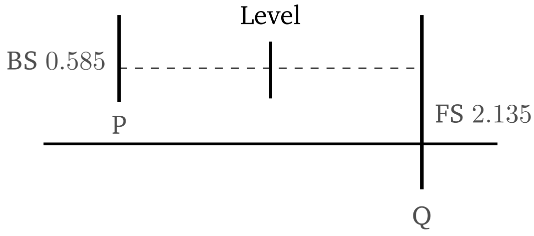
(A) 452.25 m

(B) 447.75 m

(C) 450.00 m

(D) 490.00 m

Q9. From a single instrument set-up, a backsight of 0.585 m is read on point P and a foresight of 2.135 m is read on point Q, as shown. Relative to P, point Q is: **[1 mark]**



(A) 1.55 m higher

(B) 2.72 m lower

(C) 1.55 m lower

(D) 2.135 m lower

Q10. The method of indirect contouring in which a grid of squares is set out on the ground, spot levels are taken at the grid corners, and contours are then interpolated between them, is called the: **[1 mark]**

(A) grid (squares) method of contouring

(B) direct method by tracing out each contour on the ground

(C) radial-line method usable only on isolated hills

(D) longitudinal-section method along a single road

Q11. A digital terrain model (DTM) stores spot heights at the corners of a regular square grid. To estimate the height of an arbitrary point lying inside one grid cell from its four corner heights, the simplest interpolation commonly used is: **[1 mark]**

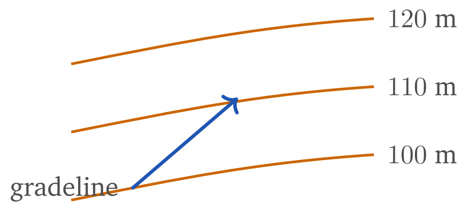
(A) nearest-neighbour rounding to the closest corner

(B) a quintic (degree-five) spline surface

(C) ordinary kriging with a fitted variogram

(D) bilinear interpolation of the four corner values

Q12. On a map of scale 1:20,000 with a contour interval of 10 m, a uniform gradient (gradeline) of 1 in 25 is to be set out, as sketched on the contour map. The horizontal ground distance between two successive contours along this gradeline is: **[1 mark]**



(A) 250 m

(B) 25 m

(C) 2500 m

(D) 400 m

Theodolite, Traverse and Triangulation

Q13. From a station O the whole-circle bearings of two lines OA and OB are observed as $40°30'$ and $110°15'$ respectively. The included angle $\angle AOB$ is: **[1 mark]**

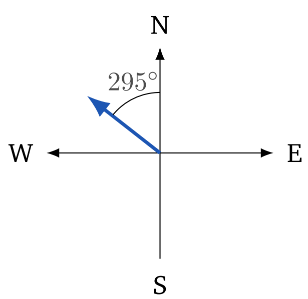
(A) $69°45'$

(B) $150°45'$

(C) $70°15'$

(D) $69°15'$

Q14. The whole-circle bearing of a survey line is $295°$, as shown on the compass diagram. Its reduced (quadrantal) bearing is: **[1 mark]**



(A) N65°E

(B) N65°W

(C) S65°W

(D) S65°E

Q15. In theodolite work, the method of repetition (measuring a horizontal angle several times and accumulating it on the graduated circle) is used mainly to: **[1 mark]**

(A) measure vertical angles more quickly

(B) set out a right angle without a prism

(C) increase the precision of a horizontal angle beyond the least count of the instrument

(D) measure horizontal distances tacheometrically

Q16. A closed traverse has a total perimeter length of 1200 m and a linear misclosure (closing error) of 0.24 m. Its relative error of closure is: **[1 mark]**

(A) 1 in 1200

(B) 1 in 5000

(C) 1 in 500

(D) 1 in $50{,}000$

Q17. In triangulation, the "strength of figure" of a chain of triangles depends chiefly on: **[1 mark]**

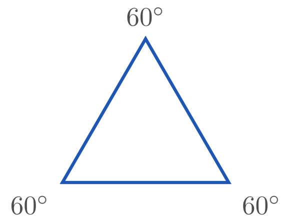
(A) the length of the measured base line alone

(B) the size and distribution of the angles, i.e. how well-conditioned the triangles are

(C) the number of observers employed in the field

(D) the colour chosen for the survey signals

Q18. A well-conditioned triangle in triangulation is one in which no angle is very small or very large (roughly between 30° and 120°), so that computed sides are least affected by angular error. The ideal, most strongly conditioned triangle is: **[1 mark]**



(A) a right-angled triangle with a 90° angle

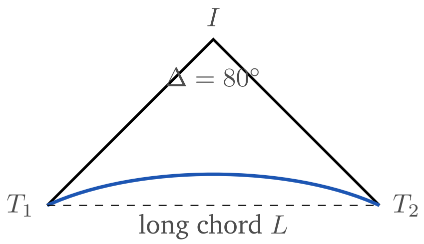
(B) a triangle containing a 20° angle

(C) a strongly obtuse triangle with a 140° angle

(D) an equilateral triangle with all three angles equal to 60°

Curves, Tacheometry and Field Astronomy

Q19. A simple circular curve of radius $R = 250$ m has a deflection angle $\Delta = 80^\circ$ between its tangents, as shown. The length of its long chord, $L = 2R\sin(\Delta/2)$, is: **[1 mark]**



(A) 321.4 m

(B) 160.7 m

(C) 500 m

(D) 383.0 m

Q20. A circular curve is to be set out by offsets measured from its long chord. The central (mid) ordinate is $O_0 = R - \sqrt{R^2 - (L/2)^2}$. For radius $R = 200$ m and long chord $L = 120$ m, the mid ordinate is nearest to: **[1 mark]**

(A) 18.4 m

(B) 4.6 m

(C) 9.21 m

(D) 30.0 m

Q21. A circular curve is set out by the method of offsets from the chords produced. The first offset is $O_1 = \dfrac{C_1^2}{2R}$, where C_1 is the length of the first sub-chord. For $C_1 = 20$ m and $R = 400$ m, the first offset O_1 is: **[2 marks]**

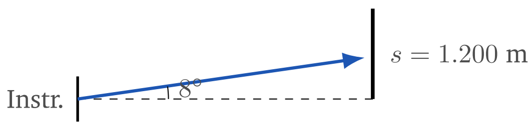
(A) 2.0 m

(B) 0.25 m

(C) 0.5 m

(D) 1.0 m

Q22. A tacheometer (multiplying constant $k = 100$, additive constant $C = 0$) reads a staff intercept of 1.200 m with the line of sight inclined at 8° above the horizontal, as shown. The vertical component of the distance, $V = k\,s\left(\frac{1}{2}\sin 2\theta\right)$, is nearest to: **[2 marks]**



(A) 120 m

(B) 33.1 m

(C) 8.3 m

(D) 16.5 m

Q23. For the same tacheometric observation ($k = 100$, $C = 0$, staff intercept 1.200 m, line of sight inclined at 8°), the horizontal distance to the staff, $D = k\,s\cos^2\theta$, is nearest to: **[2 marks]**

(A) 117.7 m

(B) 120 m

(C) 16.5 m

(D) 100 m

Q24. In field astronomy, the astronomical (PZS) spherical triangle used to relate a body's position to the observer has as its three vertices the celestial pole P, the observer's zenith Z, and: **[2 marks]**

(A) the centre of the Sun only

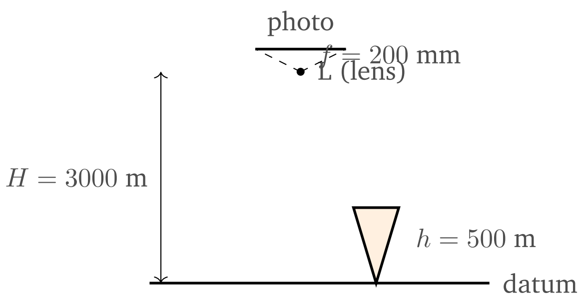
(B) the observer's nadir

(C) the celestial body (star) S being observed

(D) the First Point of Aries

Photogrammetry

Q25. A vertical aerial photograph is taken with a camera of focal length 200 mm from a flying height of 3000 m above the datum, as shown. The scale of the photograph at a hill top of elevation 500 m, given by $f/(H - h)$, is: **[2 marks]**



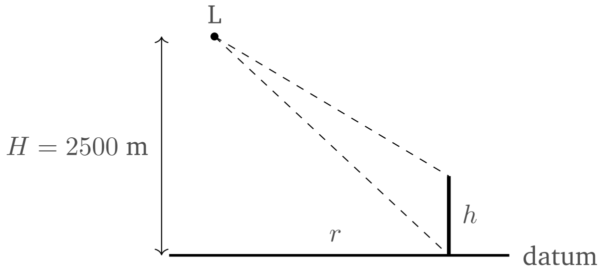
(A) 1:15,000

(B) 1:10,000

(C) 1:12,500

(D) 1:6000

Q26. On a vertical photograph taken from a flying height of 2500 m above the ground, a vertical tower shows a relief displacement of $d = 5$ mm and its top image lies at a radial distance $r = 100$ mm from the principal point, as shown. The height of the tower, $h = \frac{d\,H}{r}$, is: **[2 marks]**



(A) 125 m

(B) 250 m

(C) 50 m

(D) 500 m

Q27. On a vertical photograph the relief displacement of the top of a vertical object is $d = \dfrac{r\,h}{H}$. For radial distance $r = 90$ mm, object height $h = 150$ m and flying height $H = 3000$ m, the relief displacement is: **[2 marks]**

(A) 9.0 mm

(B) 4.5 mm

(C) 2.25 mm

(D) 6.0 mm

Q28. From a stereopair the height of an object is obtained as $h = \dfrac{H\,\Delta p}{P + \Delta p}$, where P is the mean absolute parallax at the base and Δp is the parallax difference. For $H = 2000$ m, $P = 90$ mm and $\Delta p = 1.8$ mm, the object height is nearest to: **[2 marks]**

(A) 40.0 m

(B) 39.2 m

(C) 78.4 m

(D) 20.0 m

Q29. In aerial photography for stereoscopic mapping, the standard side (lateral) overlap between photographs of two adjacent flight strips is normally kept at about: **[2 marks]**

(A) 60%

(B) 90%

(C) 10%

(D) 30%

Q30. Vertical photographs of scale 1:10,000 are taken on a 230 mm $\times$ 230 mm format with a forward (end) overlap of 60%. The ground distance between two successive exposure stations (the air base) is: **[2 marks]**

(A) 1380 m

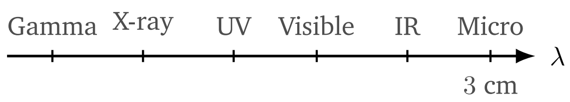
(B) 2300 m

(C) 1150 m

(D) 920 m

Remote Sensing

Q31. A microwave remote-sensing radar operates at a wavelength of 3 cm, in the band marked on the spectrum below. Taking $c = 3 \times 10^8$ m/s, the corresponding frequency ($f = c/\lambda$) is: **[2 marks]**



(A) 1 GHz

(B) 10 GHz

(C) 100 GHz

(D) 0.1 GHz

Q32. The Normalized Difference Vegetation Index is defined as NDVI $= \dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$. For a healthy crop with near-infrared reflectance 0.50 and red reflectance 0.10, the NDVI is: **[2 marks]**

(A) 0.40

(B) 0.67

(C) 0.20

(D) 0.80

Q33. By its definition NDVI $= \dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$, the values of the NDVI must always lie within the range: **[2 marks]**

(A) -1 to $+1$

(B) 0 to 1

(C) 0 to 255

(D) -100 to $+100$

Q34. A simple band ratio (for example the near-infrared to red ratio, NIR/Red) is widely used in vegetation mapping mainly because forming the ratio: **[2 marks]**

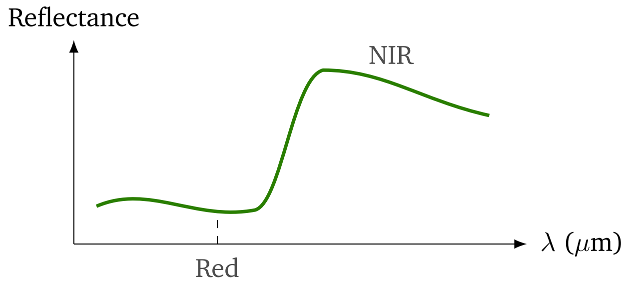
(A) suppresses illumination and topographic (slope–aspect) effects while enhancing spectral contrast

(B) increases the spatial resolution (pixel size) of the image

(C) completely removes all atmospheric water-vapour absorption

(D) merges every spectral band into a single panchromatic image

Q35. The spectral signature of healthy green vegetation, plotted below, dips to a low reflectance in the red band. This low red reflectance occurs because leaf chlorophyll: **[2 marks]**



(A) reflects red light very strongly

(B) absorbs red light strongly for use in photosynthesis

(C) is completely transparent to all visible wavelengths

(D) emits red light by thermal radiation

Q36. A satellite sensor records 1024 distinct grey levels for each pixel. Its radiometric resolution, expressed as the number of bits per pixel, is: **[2 marks]**

(A) 10 bits

(B) 8 bits

(C) 12 bits

(D) 1024 bits

Geographic Information Systems

Q37. In Inverse Distance Weighting (IDW) spatial interpolation, the weight given to each measured sample point when estimating the value at an unknown location is: **[2 marks]**

(A) the same (equal) for every sample point regardless of distance

(B) directly proportional to its distance from the unknown point

(C) inversely proportional to a power of its distance from the unknown point

(D) proportional to the elevation of the sample point

Q38. Unlike IDW, kriging is a geostatistical interpolation technique. Its distinctive feature compared with deterministic methods is that kriging: **[2 marks]**

(A) ignores the geographic location of the sample points altogether

(B) always returns exactly the same surface as nearest-neighbour interpolation

(C) needs no sample measurements at all to build the surface

(D) uses a fitted variogram (modelled spatial autocorrelation) and also yields an estimate of the prediction uncertainty

Q39. Two sample points carry values of 30 and 60 units and lie at distances of 2 m and 4 m respectively from an unknown location. Using IDW with power 1 (weight $= 1/d$), the estimated value at the unknown location is: **[2 marks]**

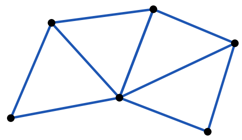
(A) 45

(B) 40

(C) 50

(D) 30

Q40. A Triangulated Irregular Network (TIN), shown schematically below, represents a terrain surface as: **[2 marks]**



(A) a regular grid of equal-sized square cells

(B) a set of contiguous, non-overlapping triangles with elevation values stored at the vertices

(C) a single best-fit plane covering the whole study area

(D) a collection of unconnected spot heights with no surface between them

Q41. To convert a set of scattered rain-gauge point measurements into a continuous rainfall surface over a region, the most appropriate GIS operation is: **[2 marks]**

(A) network shortest-path routing between the gauges

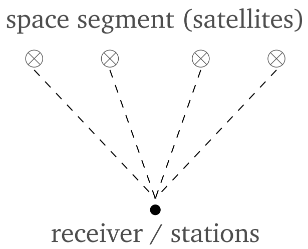
(B) generating a fixed-distance buffer around each gauge

(C) a topological polygon-on-polygon overlay

(D) spatial interpolation of the point values (e.g. IDW or kriging)

GNSS, Cartography and Map Projections

Q42. The GPS is organised into three segments. The master control station and the worldwide network of monitor stations that track the satellites, compute orbits and upload updated navigation data belong to the: **[2 marks]**



(A) space segment

(B) control segment

(C) user segment

(D) atmospheric segment

Q43. A GPS signal is measured to take 0.068 s to travel from a satellite to a ground receiver. Taking $c = 3 \times 10^8$ m/s, the pseudorange to the satellite is approximately: **[2 marks]**

(A) 2040 km

(B) 204 km

(C) $20{,}400$ km

(D) 20.4 km

Q44. The distance a GPS receiver derives from a satellite signal is called a "pseudorange" (rather than a true range) because it is contaminated by an unknown quantity, chiefly the: **[2 marks]**

(A) curvature of the Earth between the satellite and receiver

(B) mass of the orbiting satellite

(C) local magnetic declination at the receiver

(D) offset (bias) of the receiver clock relative to GPS system time

Q45. A map projection that is neither conformal nor equal-area, but which preserves true scale (correct distance) along certain selected lines such as the meridians, is classified as an: **[2 marks]**

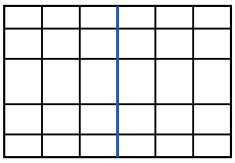
(A) conformal (orthomorphic) projection

(B) equal-area (equivalent) projection

(C) equidistant projection

(D) gnomonic (central) projection

Q46. In the Universal Transverse Mercator (UTM) projection whose graticule is sketched below, the line scale factor applied along the central meridian of each 6° zone is deliberately made: **[2 marks]**



central meridian

(A) exactly 1.0000

(B) 1.0004

(C) 0.9990

(D) 0.9996

Detailed Solutions

Q1.

Solution

Concept – reading ground distance from a representative fraction: An RF of 1:25,000 means one unit on the map equals 25,000 of the same units on the ground.

Step 1 – write what one map centimetre equals on the ground: $1 \text{ cm} = 25{,}000 \text{ cm}$

Step 2 – convert that ground distance to metres: $25{,}000 \text{ cm} = 250 \text{ m}$

Step 3 – scale up to the measured map length of 4 cm: $4 \text{ cm} \Rightarrow 4 \times 250 \text{ m}$

Step 4 – evaluate: $4 \times 250 = 1000 \text{ m}$

Step 5 – express in kilometres: $1000 \text{ m} = 1 \text{ km}$

Final Answer: $1 \text{ km} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – probable error of a single observation: The probable error is a fixed fraction of the standard deviation, $E_s = 0.6745\,\sigma$.

Step 1 – write the formula: $E_s = 0.6745\,\sigma$

Step 2 – substitute $\sigma = 4.0$ mm: $E_s = 0.6745 \times 4.0$

Step 3 – multiply: $0.6745 \times 4.0 = 2.698$

Step 4 – round to a sensible figure: $E_s \approx 2.70 \text{ mm}$

Final Answer: $E_s \approx 2.70 \text{ mm} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – probable error of the mean: Averaging n equally reliable observations reduces the probable error by a factor $\sqrt{n}$: $E_m = E_s/\sqrt{n}$.

Step 1 – write the formula: $E_m = \dfrac{E_s}{\sqrt{n}}$

Step 2 – take the square root of n: $\sqrt{9} = 3$

Step 3 – substitute the values: $E_m = \dfrac{6}{3}$

Step 4 – evaluate: $E_m = 2$ mm

Final Answer: $E_m = \pm 2$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – nature of accidental (random) errors: Random errors are the small residual errors left when blunders and systematic effects have been removed.

Step 1 – recall their sign behaviour: They occur by chance, so positive and negative deviations of the same size are equally likely.

Step 2 – state the consequence: Because they are equally likely either way, they partly cancel (compensate) when many observations are averaged and they follow the normal (Gaussian) law.

Why the other options are wrong:

- A: constant sign and steady growth describe a systematic error.
- B: a single fixed correction removes a systematic error, not a random one.
- D: a maladjusted instrument gives a systematic bias, not a random error.

Final Answer: equally likely $\pm$ and tend to compensate $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – relative precision: The relative precision is the ratio of the error to the measured length, reduced to the form 1 in n, with both quantities in the same unit.

Step 1 – put the error and the length in the same unit: 25 mm $= 0.025$ m, length $= 500$ m.

Step 2 – form the ratio: $\dfrac{0.025}{500}$

Step 3 – divide: $\dfrac{0.025}{500} = 0.00005$

Step 4 – write as 1 in n: $0.00005 = \dfrac{1}{20{,}000}$

Final Answer: 1 in 20,000 $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – identifying an accidental error: An accidental (random) error is small, unavoidable, and equally likely to be positive or negative; it is not a fixed offset and not a gross mistake.

Step 1 – test each candidate: Estimating the fractional part beyond the last graduation is a small judgement that varies randomly from reading to reading.

Step 2 – confirm the class: Such variation has no fixed sign and averages out over many readings, so it is a genuine accidental error.

Why the other options are wrong:

- A: a wrong standardized length is a constant systematic error.
- C: writing 6 for 9 is a blunder (gross mistake), not a random error.
- D: always omitting a real correction is a systematic error.

Final Answer: estimating the fractional part of the last graduation $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept – pull (tension) correction to a tape: When the field pull exceeds the standard pull the tape stretches; the correction is $C_p = \dfrac{(P - P_0)L}{AE}$ and is additive.

Step 1 – find the excess pull: $P - P_0 = 160 - 100 = 60$ N

Step 2 – express the tape length in millimetres: $L = 30$ m $= 30{,}000$ mm

Step 3 – form the denominator AE: $AE = 6\text{ mm}^2 \times 2 \times 10^5\text{ N/mm}^2 = 1.2 \times 10^6$ N

Step 4 – substitute into the formula: $C_p = \dfrac{60 \times 30{,}000}{1.2 \times 10^6}$

Step 5 – evaluate the numerator: $60 \times 30{,}000 = 1.8 \times 10^6$

Step 6 – divide: $C_p = \dfrac{1.8 \times 10^6}{1.2 \times 10^6} = 1.5$ mm

Step 7 – fix the sign: The field pull is larger than standard, so the tape is longer and the correction is added: $C_p = +1.5$ mm.

Final Answer: $C_p = +1.5 \text{ mm} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – true length with an incorrect chain: True length $= \dfrac{\text{actual chain length}}{\text{nominal chain length}} \times$ measured length. A chain that is too long makes the true length greater than the measured value.

Step 1 – form the length ratio: $\dfrac{20.10}{20} = 1.005$

Step 2 – multiply by the measured length: True length $= 1.005 \times 450$

Step 3 – evaluate: $1.005 \times 450 = 452.25$ m

Step 4 – sense check: The chain is too long, so each laid length covers more ground; the true length must exceed 450 m, which it does.

Final Answer: $452.25 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – difference of level from a single set-up: The change in level from the backsight point to the foresight point is BS − FS; a positive value is a rise and a negative value is a fall.

Step 1 – subtract the foresight from the backsight: $0.585 - 2.135 = -1.55$ m

Step 2 – interpret the sign: The result is negative, so the second point Q is lower than P.

Step 3 – state the magnitude: The fall is 1.55 m, so Q is 1.55 m lower than P.

Why the other options are wrong:

- A: the sign shows a fall, not a rise.
- B and D: 2.72 and 2.135 are not the difference BS − FS.

Final Answer: $1.55 \text{ m lower} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept – indirect contouring by squares: In indirect contouring the ground is not traced along each contour; instead spot levels are taken on a pattern and contours are interpolated afterwards.

Step 1 – match the description to a method: Setting out a grid of squares and levelling their corners is the grid (or block-levelling) method.

Step 2 – note why it is indirect: The contours are drawn later by interpolating between the corner spot levels, not walked out in the field.

Why the other options are wrong:

- B: the direct method traces each contour on the ground, the opposite of this.
- C: the radial method suits isolated hills, not a general grid.
- D: a single longitudinal section is for route surveys, not area contouring.

Final Answer: grid (squares) method $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – interpolating a height inside a grid cell of a DTM: When the four corner heights of a square cell are known, the value at an interior point is found by interpolating in two directions.

Step 1 – interpolate along the two horizontal edges: Along the top and bottom edges the height varies linearly with the x-position.

Step 2 – interpolate between those two results in y: The two edge values are then interpolated linearly in the y-direction to reach the interior point.

Step 3 – name the combined operation: Two linear interpolations at right angles together form a bilinear interpolation.

Why the other options are wrong:

- A: nearest-neighbour ignores three of the four corners and gives a blocky surface.
- B: a quintic spline is far more elaborate than the "simplest" method asked for.
- C: kriging is a geostatistical method needing a variogram, not the simple cell method.

Final Answer: bilinear interpolation $\Rightarrow$ $\boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q11

Q12.

Solution

Concept – ground distance for a given gradient between contours: For a grade-line of grade 1 in s, a rise equal to the contour interval h needs a horizontal ground distance $D = s \times h$.

Step 1 – identify the rise between successive contours: The contour interval is $h = 10$ m.

Step 2 – read the required grade: 1 in 25 means 1 unit rise per 25 units horizontal.

Step 3 – multiply the grade run by the contour interval: $D = 25 \times 10$

Step 4 – evaluate: $D = 250$ m

Step 5 – note the scale is not needed for the ground distance: The map scale (1:20,000) would only be used to convert this to a paper spacing; the ground distance is 250 m.

Final Answer: 250 m $\Rightarrow$ $\boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q12

Q13.

Solution

Concept – included angle from two whole-circle bearings: The angle between two lines from a common station is the difference of their whole-circle bearings.

Step 1 – write the two bearings: OB $= 110°15'$, OA $= 40°30'$

Step 2 – subtract, borrowing one degree ($= 60'$) for the minutes: $110°15' = 109°75'$

$109°75' - 40°30' = 69°45'$

Step 3 – state the included angle: $\angle AOB = 69°45'$

Final Answer: $69°45'$ $\Rightarrow$ $\boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q13

Q14.

Solution

Concept – whole-circle to reduced bearing in the NW quadrant: A whole-circle bearing between $270°$ and $360°$ lies in the fourth (north-west) quadrant, with RB $= 360° - \text{WCB}$, measured from north towards west.

Step 1 – identify the quadrant: $295°$ is between $270°$ and $360°$, i.e. the NW quadrant.

Step 2 – subtract from $360°$: $360° - 295° = 65°$

Step 3 – attach the quadrant letters: Measured from north towards west, the bearing is N$65°$W.

Final Answer: N$65°$W $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept – purpose of the repetition method: In the method of repetition a horizontal angle is turned several times, its values accumulating on the circle, and the total is divided by the number of repetitions.

Step 1 – see what accumulation achieves: Dividing the accumulated reading by the number of repetitions gives the angle to a finer resolution than a single reading of the vernier.

Step 2 – note the error reduction: Repeating also tends to cancel errors of reading, bisection and graduation.

Step 3 – state the aim: The purpose is therefore to obtain the horizontal angle more precisely than the least count of the instrument.

Why the other options are wrong:

- A: repetition is a horizontal-angle technique, not a vertical-angle one.
- B: setting out a right angle does not need repetition.
- D: distances are found by tacheometry (stadia), unrelated to repetition.

Final Answer: increase precision beyond the least count $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept – relative (fractional) error of closure: The relative error of closure is the linear misclosure divided by the total length of the traverse, expressed as 1 in n.

Step 1 – write the ratio: $\dfrac{\text{misclosure}}{\text{perimeter}} = \dfrac{0.24}{1200}$

Step 2 – divide: $\dfrac{0.24}{1200} = 0.0002$

Step 3 – write as 1 in n: $0.0002 = \dfrac{1}{5000}$

Final Answer: 1 in $5000 \Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q16**

Q17.

Solution

Concept – strength of figure in triangulation: The strength of figure measures how accurately the length of an unknown side can be computed from a measured side through the triangle's angles.

Step 1 – recall the controlling quantity: Computed sides use the sine rule, so the reliability depends on the sines of the angles and how the angles are distributed.

Step 2 – state the result: Well-conditioned triangles (no very small or very large angles) give a strong figure; poorly shaped ones give a weak figure.

Step 3 – conclude: Hence the strength of figure depends mainly on the size and distribution of the angles.

Why the other options are wrong:

- A: the base length sets scale but not the figure's angular strength.
- C and D: number of observers and signal colour do not enter the strength-of-figure computation.

Final Answer: size and distribution of the angles $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q17**

Q18.

Solution

Concept – the ideal well-conditioned triangle: A triangle is best conditioned when its angles are as far as possible from 0° and 180°, so that a small angular error produces the least error in the computed sides.

Step 1 – recall the sine-rule sensitivity: The error in a computed side is smallest when the sines of the angles are large and balanced, which happens when the angles are equal.

Step 2 – find the equal-angle case: Three equal angles of a triangle are each 60°, giving an equilateral triangle.

Step 3 – conclude: The equilateral triangle is the most strongly conditioned figure.

Why the other options are wrong:

- A: a right-angled triangle has a small side poorly determined.
- B and C: a 20° or a 140° angle makes the triangle ill-conditioned.

Final Answer: equilateral triangle, all angles $60^\circ \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – long chord of a circular curve: The long chord joins the two tangent points and equals $L = 2R\sin(\Delta/2)$.

Step 1 – halve the deflection angle: $\dfrac{\Delta}{2} = \dfrac{80^\circ}{2} = 40^\circ$

Step 2 – take the sine: $\sin 40^\circ = 0.6428$

Step 3 – substitute into the formula: $L = 2 \times 250 \times 0.6428$

Step 4 – multiply step by step: $2 \times 250 = 500$

$500 \times 0.6428 = 321.4$ m

Final Answer: $L \approx 321.4$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – mid ordinate for setting out by offsets from the long chord: The central ordinate (versine) is $O_0 = R - \sqrt{R^2 - (L/2)^2}$.

Step 1 – halve the long chord: $\frac{L}{2} = \frac{120}{2} = 60$ m

Step 2 – square the radius and the half-chord: $R^2 = 200^2 = 40{,}000$

$(L/2)^2 = 60^2 = 3600$

Step 3 – subtract inside the root: $40{,}000 - 3600 = 36{,}400$

Step 4 – take the square root: $\sqrt{36{,}400} = 190.79$ m

Step 5 – subtract from the radius: $O_0 = 200 - 190.79 = 9.21$ m

Final Answer: $O_0 \approx 9.21$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept – first offset in the "offsets from chords produced" method: The first offset from the initial tangent is $O_1 = \frac{C_1^2}{2R}$, half the value of the later full-chord offsets.

Step 1 – square the first chord: $C_1^2 = 20^2 = 400$

Step 2 – form the denominator: $2R = 2 \times 400 = 800$

Step 3 – divide: $O_1 = \frac{400}{800}$

Step 4 – evaluate: $O_1 = 0.5$ m

Final Answer: $O_1 = 0.5$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – vertical component in inclined tacheometry: With an anallactic telescope the vertical component of the stadia distance is $V = k\,s\left(\frac{1}{2}\sin 2\theta\right)$.

Step 1 – form the multiplied constant term: $k\,s = 100 \times 1.200 = 120$

Step 2 – double the inclination angle: $2\theta = 2 \times 8^\circ = 16^\circ$

Step 3 – take the sine and halve it: $\sin 16^\circ = 0.2756$

$\frac{1}{2}\sin 16^\circ = 0.1378$

Step 4 – multiply: $V = 120 \times 0.1378$

Step 5 – evaluate: $V = 16.54 \approx 16.5$ m

Final Answer: $V \approx 16.5 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept – horizontal distance in inclined tacheometry: The horizontal distance is $D = k\,s\cos^2\theta$.

Step 1 – form the multiplied constant term: $k\,s = 100 \times 1.200 = 120$

Step 2 – take the cosine of the inclination: $\cos 8^\circ = 0.9903$

Step 3 – square the cosine: $\cos^2 8^\circ = 0.9806$

Step 4 – multiply: $D = 120 \times 0.9806$

Step 5 – evaluate: $D = 117.7$ m

Final Answer: $D \approx 117.7 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – the astronomical (PZS) triangle: The spherical triangle used in position and time computations is formed on the celestial sphere by three specific points.

Step 1 – name the first two vertices: The celestial pole P and the observer's zenith Z.

Step 2 – name the third vertex: The heavenly body (star or Sun) S being observed.

Step 3 – confirm the sides: The three sides are the co-latitude, the polar distance (co-declination) and the zenith distance (co-altitude), consistent with the vertices P, Z and S.

Why the other options are wrong:

- A: it need not be the Sun; any observed body serves as S.
- B: the nadir is not a vertex of the triangle.

- D: the First Point of Aries is a reference for right ascension, not a vertex of the PZS triangle.

Final Answer: the celestial body (star) $S \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept – photo scale over raised ground: The scale of a vertical photograph at a point of elevation h is $\dfrac{f}{H-h}$, using the height of the lens above that point.

Step 1 – find the flying height above the hill top: $H - h = 3000 - 500 = 2500$ m

Step 2 – write the focal length in metres: $f = 200$ mm $= 0.2$ m

Step 3 – form the scale ratio: Scale $= \dfrac{0.2}{2500}$

Step 4 – reduce to $1{:}n$**:** $\dfrac{0.2}{2500} = \dfrac{1}{12{,}500}$

Final Answer: $1{:}12{,}500 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept – object height from relief displacement: Rearranging $d = \dfrac{r\,h}{H}$ gives the height $h = \dfrac{d\,H}{r}$.

Step 1 – keep d **and** r **in the same unit (mm):** $d = 5$ mm, $r = 100$ mm.

Step 2 – substitute into the formula: $h = \dfrac{5 \times 2500}{100}$

Step 3 – evaluate the numerator: $5 \times 2500 = 12{,}500$

Step 4 – divide: $h = \dfrac{12{,}500}{100} = 125$ m

Final Answer: $h = 125$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept – relief displacement on a vertical photograph: The outward shift of the image of a tall object is $d = \dfrac{r\,h}{H}$.

Step 1 – form the numerator: $r\,h = 90 \times 150 = 13{,}500$

Step 2 – divide by the flying height: $d = \dfrac{13{,}500}{3000}$

Step 3 – evaluate: $d = 4.5$ mm

Step 4 – note the unit: Because r was in mm, d comes out in mm.

Final Answer: $d = 4.5 \text{ mm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – height of an object from parallax difference: Using $h = \dfrac{H\,\Delta p}{P + \Delta p}$, where P is the base parallax and Δp the parallax difference.

Step 1 – form the numerator: $H\,\Delta p = 2000 \times 1.8 = 3600$

Step 2 – form the denominator: $P + \Delta p = 90 + 1.8 = 91.8$

Step 3 – divide: $h = \dfrac{3600}{91.8}$

Step 4 – evaluate: $h = 39.2$ m

Why the other options are wrong:

- A: 40.0 m ignores the Δp added in the denominator.
- C: 78.4 m doubles the true value.
- D: 20.0 m halves it.

Final Answer: $h \approx 39.2 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept – standard photographic overlaps: Aerial photographs are flown with a large forward overlap along a strip and a smaller side overlap between adjacent strips.

Step 1 – recall the forward overlap: Along the flight line the end (forward) overlap is about 60%, to give full stereo coverage.

Step 2 – recall the side overlap: Between adjacent strips the side (lateral) overlap is about 30%, just enough to prevent gaps.

Step 3 – pick the value asked for: The question asks for the side overlap, which is 30%.

Why the other options are wrong:

- A: 60% is the forward, not the side, overlap.
- B and C: 90% and 10% are neither standard value.

Final Answer: 30% side overlap $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept – air base from format, scale and overlap: The ground covered by one photo side is $\dfrac{\text{format}}{\text{scale fraction}}$, and the air base is the part not overlapped, $B = (1 - \text{overlap}) \times \text{ground coverage}$.

Step 1 – find the ground coverage of one photo side: $0.230 \text{ m} \times 10{,}000 = 2300$ m

Step 2 – find the fraction not overlapped: $1 - 0.60 = 0.40$

Step 3 – multiply to get the air base: $B = 0.40 \times 2300$

Step 4 – evaluate: $B = 920$ m

Final Answer: air base $B = 920$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept – frequency from wavelength: Frequency and wavelength are linked by $f = c/\lambda$.

Step 1 – convert the wavelength to metres: 3 cm $= 0.03$ m

Step 2 – substitute into the formula: $f = \dfrac{3 \times 10^8}{0.03}$

Step 3 – divide the mantissas and powers: $\dfrac{3}{0.03} = 100$, so $f = 100 \times 10^8 = 1 \times 10^{10}$ Hz

Step 4 – express in gigahertz: 1×10^{10} Hz $= 10$ GHz

Final Answer: $f = 10$ GHz $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – computing NDVI: $\text{NDVI} = \dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$.

Step 1 – form the numerator: $\text{NIR} - \text{Red} = 0.50 - 0.10 = 0.40$

Step 2 – form the denominator: $\text{NIR} + \text{Red} = 0.50 + 0.10 = 0.60$

Step 3 – divide: $\text{NDVI} = \dfrac{0.40}{0.60}$

Step 4 – evaluate: $\text{NDVI} = 0.667 \approx 0.67$

Step 5 – sanity check: A high positive value near 0.7 is typical of vigorous, healthy vegetation.

Final Answer: $\text{NDVI} \approx 0.67 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q32

Q33.

Solution

Concept – theoretical range of NDVI: Because both NIR and Red reflectances are non-negative, the ratio $\dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$ is bounded.

Step 1 – take the extreme where Red is zero: Then $\text{NDVI} = \dfrac{\text{NIR}}{\text{NIR}} = +1$.

Step 2 – take the extreme where NIR is zero: Then $\text{NDVI} = \dfrac{-\text{Red}}{\text{Red}} = -1$.

Step 3 – state the range: NDVI therefore always lies between -1 and $+1$.

Why the other options are wrong:

- B: 0 to 1 omits the negative values found over water and cloud.
- C: 0 to 255 is the range of an 8-bit digital number, not of NDVI.
- D: -100 to $+100$ is not the defined range.

Final Answer: -1 to $+1 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept – why band ratios are used: Dividing one band by another cancels factors that affect both bands equally.

Step 1 – identify the common factor: Terrain slope and aspect change the illumination, scaling the brightness of every band by nearly the same amount.

Step 2 – see the effect of the ratio: When one band is divided by another, that common illumination factor cancels, so shadowed and sunlit slopes of the same cover give similar ratios.

Step 3 – state the benefit: The ratio suppresses topographic and illumination effects and enhances the spectral contrast between materials.

Why the other options are wrong:

- B: a ratio does not change the pixel size.
- C: it does not remove atmospheric water-vapour absorption.
- D: it does not collapse all bands into one panchromatic image.

Final Answer: suppresses illumination/topographic effects and enhances contrast $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept – red reflectance of healthy vegetation: The spectral signature of green vegetation is controlled by leaf pigments in the visible region.

Step 1 – identify the pigment: Chlorophyll is the dominant pigment in a healthy leaf.

Step 2 – recall its absorption: Chlorophyll absorbs strongly in the blue and the red for photosynthesis, reflecting relatively more green.

Step 3 – link to the curve: Strong red absorption is exactly why the signature dips to low reflectance in the red band, before the sharp rise into the near-infrared.

Why the other options are wrong:

- A: strong red reflectance would raise, not lower, the curve there.
- C: the leaf is not transparent to visible light.
- D: the dip is due to absorption, not thermal emission.

Final Answer: chlorophyll absorbs red for photosynthesis $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – bits from the number of grey levels: The number of grey levels G and the bit depth b are related by $G = 2^b$.

Step 1 – write the relation: $2^b = 1024$

Step 2 – express 1024 **as a power of two:** $1024 = 2^{10}$

Step 3 – equate the exponents: $b = 10$

Final Answer: 10 bits $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept – weighting in IDW interpolation: Inverse Distance Weighting assumes that nearer samples resemble the unknown point more than distant ones.

Step 1 – write the weight form: The weight of a sample is $w_i = \frac{1}{d_i^p}$, where d_i is its distance and p the power.

Step 2 – read off the dependence: As distance grows the weight falls; the weight is inversely proportional to a power of distance.

Why the other options are wrong:

- A: equal weights would ignore distance entirely.
- B: weight proportional to distance would give far points more influence, the opposite of IDW.
- D: the weight depends on distance, not on the sample's elevation.

Final Answer: inversely proportional to a power of the distance $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept – what makes kriging geostatistical: Kriging models how sample values are spatially correlated and uses that model to weight the samples optimally.

Step 1 – recall the variogram: Kriging first fits a variogram describing how similarity decreases with separation distance.

Step 2 – use it for weighting: The fitted variogram gives weights that minimise the estimation variance, unlike the fixed distance weights of IDW.

Step 3 – note the extra output: Kriging also produces a kriging (prediction) variance, an estimate of the uncertainty at each point.

Why the other options are wrong:

- A: kriging depends heavily on the sample locations.
- B: it does not reduce to nearest-neighbour in general.
- C: it certainly needs sample data.

Final Answer: uses a fitted variogram and yields prediction uncertainty $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – IDW estimate with power 1**:** The estimate is the weighted average $\hat{z} = \dfrac{\sum w_i z_i}{\sum w_i}$ with $w_i = 1/d_i$.

Step 1 – compute the two weights: $w_1 = \dfrac{1}{2} = 0.5$, $w_2 = \dfrac{1}{4} = 0.25$

Step 2 – form each weighted value: $w_1 z_1 = 0.5 \times 30 = 15$

$w_2 z_2 = 0.25 \times 60 = 15$

Step 3 – add the weighted values: $15 + 15 = 30$

Step 4 – add the weights: $0.5 + 0.25 = 0.75$

Step 5 – divide: $\hat{z} = \dfrac{30}{0.75} = 40$

Final Answer: estimated value $= 40 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – the TIN surface model: A TIN builds a continuous surface directly from irregularly spaced sample points.

Step 1 – describe the construction: The sample points become vertices, joined into triangles (usually by Delaunay triangulation) that do not overlap and leave no gaps.

Step 2 – describe the surface within a triangle: Each triangular facet is a plane defined by the three vertex elevations, so heights vary linearly across it.

Step 3 – state the representation: Hence a TIN represents the terrain as contiguous, non-overlapping triangles carrying elevations at their vertices.

Why the other options are wrong:

- A: a regular square grid is the raster/DEM model, not a TIN.
- C: a single plane cannot follow varied terrain.
- D: unconnected spot heights give no continuous surface.

Final Answer: contiguous non-overlapping triangles with vertex elevations $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – turning scattered points into a continuous surface: Estimating values at unmeasured locations from surrounding measured points is spatial interpolation.

Step 1 – describe the data: Rain gauges give values only at scattered discrete points.

Step 2 – state the requirement: A continuous rainfall surface is needed over the whole region.

Step 3 – match the operation: Filling the gaps between points is done by spatial interpolation, such as IDW or kriging.

Why the other options are wrong:

- A: routing works on a connected network, not a rainfall field.
- B: buffering just makes zones around each gauge, not a smooth surface.
- C: a polygon overlay combines existing polygons, it does not create the surface.

Final Answer: spatial interpolation of the point values $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q41

Q42.

Solution

Concept – the three GPS segments: GPS is divided into the space segment (satellites), the control segment (ground tracking and command) and the user segment (receivers).

Step 1 – describe the stated facilities: Master control and monitor stations track the satellites, compute their orbits and clock corrections, and upload fresh navigation data.

Step 2 – match to a segment: These ground command-and-tracking facilities are the control segment.

Why the other options are wrong:

- A: the space segment is the constellation of satellites themselves.
- C: the user segment is the receivers held by users.
- D: there is no separate "atmospheric segment" in GPS.

Final Answer: control segment $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – pseudorange from signal travel time: The range is the speed of light times the measured travel time, $\rho = c\,t$.

Step 1 – substitute the values: $\rho = (3 \times 10^8) \times (0.068)$

Step 2 – multiply the mantissas: $3 \times 0.068 = 0.204$

Step 3 – attach the power of ten: $\rho = 0.204 \times 10^8$ m

Step 4 – normalise: $\rho = 2.04 \times 10^7$ m

Step 5 – convert to kilometres: $\rho = 2.04 \times 10^4$ km $= 20{,}400$ km

Final Answer: $\rho \approx 20{,}400$ km $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q43

Q44.

Solution

Concept – why the measured range is a "pseudo" range: GPS ranges come from the signal travel time multiplied by c, but the receiver clock is cheap and not perfectly synchronised with GPS time.

Step 1 – identify the dominant error: The receiver clock is offset from GPS system time by an unknown bias, so every measured travel time is in error by that same amount.

Step 2 – see its effect on the range: Multiplying the biased travel time by c adds an unknown distance to each range, making it a pseudorange.

Step 3 – link to the fourth satellite: This is exactly why a fourth satellite is needed, to solve for the clock bias along with X, Y, Z.

Why the other options are wrong:

- A: Earth curvature is handled by the geometry, not the "pseudo" term.
- B: satellite mass does not enter the range measurement.
- C: magnetic declination is irrelevant to GPS ranging.

Final Answer: receiver clock offset from GPS time $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q44

Q45.

Solution

Concept – classifying map projections by the property preserved: Projections are grouped as conformal (angles true), equal-area (areas true) or equidistant (true scale along chosen lines).

Step 1 – read the property described: True scale is kept only along certain selected lines, such as the meridians, not everywhere and not for area or angle in general.

Step 2 – match the class: Preserving correct distance along particular lines defines an equidistant projection.

Why the other options are wrong:

- A: a conformal projection preserves angles, not distance.
- B: an equal-area projection preserves area, not distance.
- D: a gnomonic projection is defined by its perspective geometry (great circles as straight lines), not by equidistance.

Final Answer: equidistant projection $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept – central-meridian scale factor of UTM: To spread the scale error evenly across a 6° zone, UTM applies a slight reduction of scale on the central meridian.

Step 1 – recall the design value: The scale factor on the central meridian is set to 0.9996 (a reduction of 1 part in 2500).

Step 2 – see the benefit: This makes the scale factor slightly less than 1 at the centre and slightly more than 1 near the zone edges, keeping the maximum distortion small and balanced, with two lines of true scale where the factor equals 1.0000.

Why the other options are wrong:

- A: exactly 1.0000 on the central meridian would give larger errors at the zone edges.

- B and C: 1.0004 and 0.9990 are not the standard UTM value.

Final Answer: $0.9996 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q46

Answer Key

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