GATE Geomatics Engineering

Sample Paper – 2

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 set of repeated measurements of a distance are all very close to one another but consistently differ from the true value by a fixed amount. This set is best described as: **[1 mark]**

(A) accurate but not precise

(B) precise but not accurate

(C) both accurate and precise

(D) neither accurate nor precise

Q2. Two angle observations have standard deviations of $\pm 2''$ and $\pm 4''$. Since the weight of an observation is inversely proportional to the square of its standard deviation, the ratio of their weights $w_1 : w_2$ is: **[1 mark]**

(A) $2 : 1$

(B) $4 : 1$

(C) $1 : 4$

(D) $1 : 2$

Q3. The three measured angles of a triangle have independent standard errors of $\pm 2''$, $\pm 3''$ and $\pm 6''$. Taking the errors as combining in quadrature, the standard error of their sum is: **[1 mark]**

(A) $\pm 11''$

(B) $\pm 5''$

(C) $\pm 49''$

(D) $\pm 7''$

Q4. For a normally distributed set of observations, the probable error of a single observation is related to its standard deviation σ approximately by: **[1 mark]**

(A) $1.000\,\sigma$

(B) $0.6745\,\sigma$

(C) $1.4826\,\sigma$

(D) $0.5000\,\sigma$

Q5. A horizontal angle is observed in three sets carrying weights 1, 2 and 3, giving $50°10'12''$, $50°10'18''$ and $50°10'24''$ respectively. The weighted mean of the angle is: **[1 mark]**

(A) $50°10'18''$

(B) $50°10'24''$

(C) $50°10'20''$

(D) $50°10'16''$

Q6. Random (accidental) errors in a large set of measurements follow the normal distribution. The proportion of observations lying within one standard deviation ($\pm\sigma$) of the mean is about: **[1 mark]**

(A) 50%

(B) 95%

(C) 68%

(D) 99.7%

Distance Measurement, Levelling and Contouring

Q7. The combined correction for the Earth's curvature and atmospheric refraction in levelling is taken as $0.0673\,D^2$ metres, with D the sighting distance in kilometres. For a sight length of 2 km this combined correction is nearest to: **[1 mark]**

(A) 0.067 m

(B) 0.135 m

(C) 0.539 m

(D) 0.27 m

Q8. The correction for the Earth's curvature alone is $C = 0.0785\,D^2$ metres, with D in kilometres. Over a sight distance of 3 km the curvature correction is nearest to: **[1 mark]**

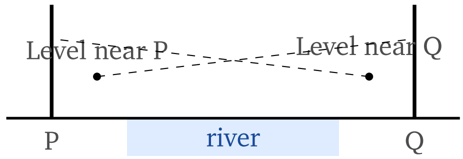
(A) 0.71 m

(B) 0.24 m

(C) 1.41 m

(D) 0.35 m

Q9. In reciprocal levelling across a wide river between bank stations P and Q (see figure), the level is set up close to each staff in turn and the mean of the two apparent differences of level is taken. This procedure eliminates the combined effect of: **[1 mark]**



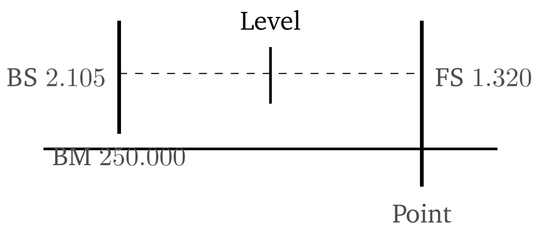
(A) instrument collimation error, curvature and refraction

(B) staff-graduation errors only

(C) tape temperature errors

(D) magnetic declination

Q10. In the differential-levelling set-up shown, the backsight on a benchmark of RL 250.000 m is 2.105 m and the foresight to the next point is 1.320 m. The reduced level of the forepoint is: **[1 mark]**



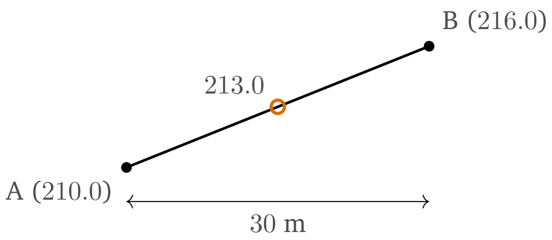
(A) 251.320 m

(B) 248.895 m

(C) 250.785 m

(D) 253.425 m

Q11. Points A and B lie 30 m apart on a uniform slope. A has RL 210.0 m and B has RL 216.0 m, as shown. By linear interpolation the horizontal distance from A to the point where the 213.0 m contour crosses AB is: **[1 mark]**



(A) 10 m

(B) 15 m

(C) 20 m

(D) 7.5 m

Q12. On a map of scale 1:20,000 with a contour interval of 5 m, two adjacent contours are 5 mm apart on the paper. The ground slope (gradient) between them is: **[1 mark]**

(A) 1 in 20

(B) 1 in 10

(C) 1 in 40

(D) 1 in 100

Theodolite, Traverse and Triangulation

Q13. The fore bearing (whole-circle bearing) of a line PQ is $123°45'$. The back bearing of the line is: **[1 mark]**

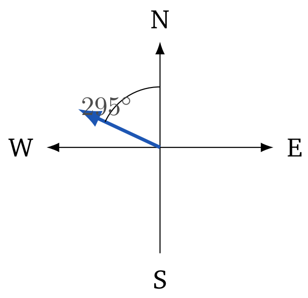
(A) $303°45'$

(B) $123°45'$

(C) $236°15'$

(D) $56°15'$

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



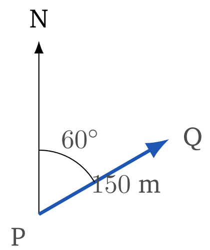
(A) S65°W

(B) N65°E

(C) S65°E

(D) N65°W

Q15. A traverse line PQ of length 150 m has a whole-circle bearing of $60°$, as shown. Its latitude ($L\cos\theta$) and departure ($L\sin\theta$) are respectively: **[1 mark]**



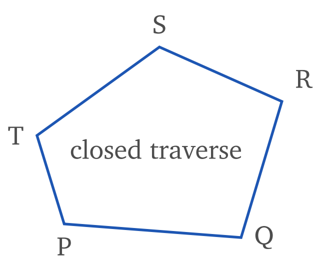
(A) 129.9 m N, 75.0 m E

(B) 75.0 m N, 129.9 m E

(C) 75.0 m N, 75.0 m E

(D) 129.9 m N, 129.9 m E

Q16. A closed traverse (shown schematically) has a total latitude misclosure of $+0.6$ m and a total departure misclosure of $+0.8$ m. The linear closing error of the traverse is: **[1 mark]**



(A) 1.4 m

(B) 1.0 m

(C) 0.2 m

(D) 0.5 m

Q17. In the Bowditch (compass) rule for adjusting a closed traverse, the correction applied to the latitude (or departure) of any side is taken to be proportional to: **[1 mark]**

(A) the length of that side

(B) the latitude of that side

(C) the square of the length of that side

(D) the departure of that side

Q18. In the transit rule of traverse balancing, the correction applied to the latitude of any side is taken to be proportional to: **[1 mark]**

(A) the latitude of that side

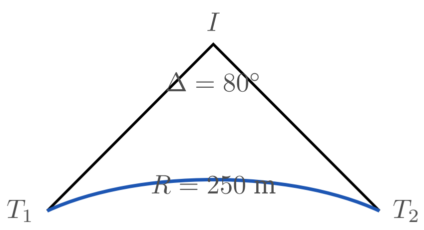
(B) the length of that side

(C) the total perimeter of the traverse

(D) the departure of that side

Curves, Tacheometry and Field Astronomy

Q19. A simple circular curve of radius $R = 250$ m has a deflection angle $\Delta = 80°$ between its tangents, as shown. The tangent length ($T = R\tan(\Delta/2)$) is: **[1 mark]**



(A) 173.6 m

(B) 209.8 m

(C) 300 m

(D) 150 m

Q20. A simple circular curve of radius 300 m subtends a deflection angle of $60°$. The length of the curve, $L = \dfrac{\pi R \Delta}{180°}$, is: **[1 mark]**

(A) 200 m

(B) 628.3 m

(C) 314.2 m

(D) 100 m

Q21. A highway curve of radius 200 m is designed for a speed of 72 km/h. Ignoring the side friction and using the superelevation relation $e = \dfrac{V^2}{127\,R}$ (with V in km/h and R in m), the required superelevation is nearest to: **[2 marks]**

(A) 0.102

(B) 0.408

(C) 0.150

(D) 0.204

Q22. A transition (spiral) curve of length $L = 60$ m is introduced ahead of a circular curve of radius $R = 300$ m. Using the approximate shift relation $S = \dfrac{L^2}{24\,R}$, the shift of the circular curve is: **[2 marks]**

(A) 0.5 m

(B) 1.0 m

(C) 0.25 m

(D) 0.05 m

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

(A) 120.0 m

(B) 116.5 m

(C) 100 m

(D) 117.7 m

Q24. In field astronomy the altitude of the celestial pole above the horizon equals the observer's latitude. For a station at latitude $45°$N, the altitude of the north celestial pole is: **[2 marks]**

(A) $45°$

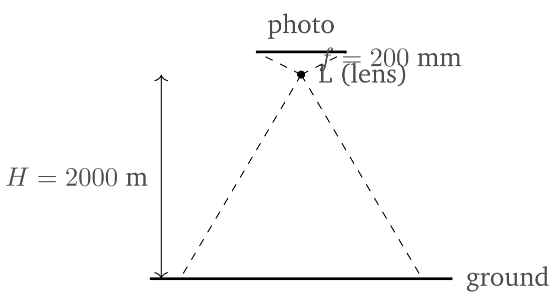
(B) $90°$

(C) $0°$

(D) $55°$

Photogrammetry

Q25. A vertical aerial photograph is taken with a camera of focal length 200 mm from a flying height of 2000 m above flat ground, as shown. The scale of the photograph (f/H) is: **[2 marks]**



(A) 1:10,000

(B) 1:1000

(C) 1:20,000

(D) 1:4000

Q26. A vertical photograph has a scale of 1:12,000 and was taken with a camera of focal length 150 mm. The flying height above the ground datum is: **[2 marks]**

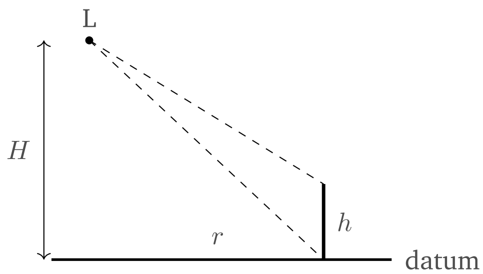
(A) 800 m

(B) 80,000 m

(C) 12,000 m

(D) 1800 m

Q27. On a vertical photograph the relief displacement of the top of a vertical object is $d = \frac{r\,h}{H}$. For radial distance $r = 90$ mm, object height $h = 150$ m and flying height $H = 2700$ m (see figure), the relief displacement is: **[2 marks]**



(A) 5 mm

(B) 2 mm

(C) 10 mm

(D) 3 mm

Q28. During stereoscopic measurement the absolute parallax of a base point is 90.0 mm and that of the top of a building is 92.5 mm. The difference of parallax between the two points is: **[2 marks]**

(A) 182.5 mm

(B) 1.5 mm

(C) 90.0 mm

(D) 2.5 mm

Q29. On a truly vertical photograph a point has a photo coordinate $x = 50$ mm measured from the principal point. If the flying height is $H = 1500$ m and the focal length is $f = 150$ mm, the corresponding ground coordinate $X = \frac{H}{f}x$ is: **[2 marks]**

(A) 50 m

(B) 5000 m

(C) 75 m

(D) 500 m

Q30. A vertical photograph of scale 1:6000 shows a rectangular field measuring 50 mm $\times$ 40 mm on the print. The ground area of the field is: **[2 marks]**

(A) 2.0 ha

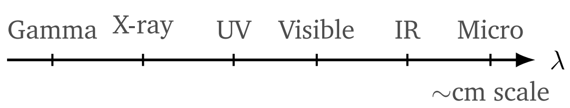
(B) 20 ha

(C) 7.2 ha

(D) 72 ha

Remote Sensing

Q31. Electromagnetic radiation of frequency 3×10^9 Hz travels in vacuum at $c = 3 \times 10^8$ m/s. Its wavelength ($\lambda = c/f$), located in the microwave region of the spectrum below, is: **[2 marks]**



(A) 1 m

(B) 3 m

(C) 0.01 m

(D) 0.1 m

Q32. In optical remote sensing, the wavelength band 0.7–1.3 μm, which is strongly reflected by healthy vegetation, corresponds to which region of the electromagnetic spectrum? **[2 marks]**

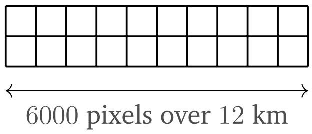
(A) visible

(B) thermal infrared

(C) near infrared

(D) microwave

Q33. A pushbroom sensor images a ground swath of 12 km using 6000 detector pixels across the line, as sketched. The ground sampling distance (spatial resolution) per pixel is: **[2 marks]**



(A) 12 m

(B) 0.5 m

(C) 2 m

(D) 6 m

Q34. A satellite sensor quantizes the brightness of each pixel using 10 bits. The number of discrete grey levels (radiometric resolution) it can represent is: **[2 marks]**

(A) 100

(B) 1024

(C) 512

(D) 10

Q35. The time interval between two successive acquisitions of the same ground area by a satellite, that is, its revisit period, defines the sensor's: **[2 marks]**

(A) temporal resolution

(B) spatial resolution

(C) spectral resolution

(D) radiometric resolution

Q36. For a vegetated pixel the near-infrared reflectance is 0.50 and the red reflectance is 0.20. The Normalised Difference Vegetation Index, NDVI $= \dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$, is nearest to: **[2 marks]**

(A) 0.70

(B) 0.30

(C) 0.43

(D) 0.15

Geographic Information Systems

Q37. In the vector data model of a GIS, a meandering river is most appropriately represented as a: **[2 marks]**

(A) grid of cells each holding a single value

(B) line (polyline) defined by an ordered series of coordinate pairs

(C) single point at its source

(D) solid filled polygon

Q38. In a topological vector GIS the explicitly stored relationships describing how nodes, arcs and polygons connect, that is, connectivity, adjacency and containment, are collectively called: **[2 marks]**

(A) attributes

(B) metadata

(C) projection parameters

(D) topology

Q39. A single-band raster layer has 2000 rows and 2000 columns, with each cell stored as one byte. The uncompressed storage size of the layer is nearest to: **[2 marks]**

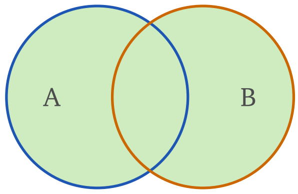
(A) 2 MB

(B) 4 MB

(C) 16 MB

(D) 1 MB

Q40. Two polygon layers A and B are combined using a GIS UNION (logical OR) overlay, as shown by the shaded region. The output layer contains: **[2 marks]**



A ∪ B

(A) only the area common to both A and B

(B) all areas belonging to A or B or both

(C) only the area of A that lies outside B

(D) only the area lying outside both A and B

Q41. A continuous terrain surface is represented in a GIS by a network of non-overlapping, contiguous triangles built directly from irregularly spaced elevation points. This structure is a: **[2 marks]**

(A) regular raster DEM

(B) contour vector layer

(C) triangulated irregular network (TIN)

(D) buffer polygon

GNSS, Cartography and Map Projections

Q42. At a GNSS station the ellipsoidal height obtained from the receiver is $h = 245.60$ m and the geoid–ellipsoid separation (geoid undulation) is $N = -34.20$ m. The orthometric (mean-sea-level) height $H = h - N$ is: **[2 marks]**

(A) 211.40 m

(B) 34.20 m

(C) 245.60 m

(D) 279.80 m

Q43. A GNSS signal takes 0.06 s to travel from a satellite to a ground receiver. Taking the speed of light as 3×10^8 m/s, the (approximate) pseudorange to the satellite is: **[2 marks]**

(A) 1800 km

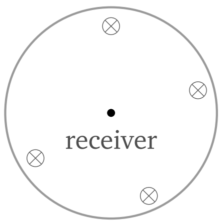
(B) $18{,}000$ km

(C) 3000 km

(D) 180 km

Q44. In GNSS positioning a low (favourable) value of the Geometric Dilution of Precision (GDOP) is obtained when the tracked satellites are (see sky plot): **[2 marks]**

well spread across the sky



(A) clustered close together overhead

(B) all near the horizon in one direction

(C) well distributed across the sky

(D) exactly four in number regardless of position

Q45. The reference ellipsoid traditionally adopted for the Indian horizontal geodetic datum used in Survey of India topographic mapping is the: **[2 marks]**

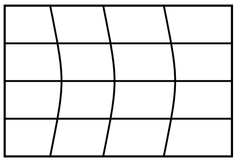
(A) WGS-84 ellipsoid

(B) GRS-80 ellipsoid

(C) Clarke 1866 ellipsoid

(D) Everest ellipsoid

Q46. A map projection on which every small figure on the ground is shown with its true area, although the shapes of features may be distorted (graticule shown), is called: **[2 marks]**



equal-area graticule

(A) an equal-area (equivalent) projection

(B) a conformal projection

(C) an azimuthal projection

(D) a gnomonic projection

Detailed Solutions

Q1.

Solution

Concept – accuracy versus precision: Precision describes how closely repeated measurements agree with one another (their spread). Accuracy describes how close the measurements lie to the true value.

Step 1 – read the behaviour of the set: The readings agree closely with one another, so the scatter is small and the set is precise.

Step 2 – compare with the true value: They all differ from the true value by a fixed amount, so the set is not accurate.

Step 3 – combine the two findings: Small spread but a constant offset means precise but not accurate; the fixed offset is a systematic error that precision alone cannot detect.

Why the other options are wrong:

- A: accurate would require the readings to sit on the true value, which they do not.
- C: they cannot be accurate while carrying a fixed offset.
- D: they are tightly grouped, so they are at least precise.

Final Answer: precise but not accurate $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – weight of an observation: The weight is inversely proportional to the square of the standard deviation, $w \propto \dfrac{1}{\sigma^2}$.

Step 1 – write each weight in proportional form: $w_1 \propto \dfrac{1}{2^2} = \dfrac{1}{4}$

$w_2 \propto \dfrac{1}{4^2} = \dfrac{1}{16}$

Step 2 – form the ratio $w_1 : w_2$: $w_1 : w_2 = \dfrac{1}{4} : \dfrac{1}{16}$

Step 3 – clear the fractions (multiply both by 16): $w_1 : w_2 = 4 : 1$

Step 4 – interpret: The more precise ($\pm 2''$) observation carries four times the weight of the $\pm 4''$ observation.

Final Answer: $w_1 : w_2 = 4 : 1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept – propagation of error in a sum: For independent quantities added together, the standard errors combine in quadrature: $\sigma = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2}$.

Step 1 – square each component error: $\sigma_1^2 = 2^2 = 4$

$\sigma_2^2 = 3^2 = 9$

$\sigma_3^2 = 6^2 = 36$

Step 2 – add the squares: $4 + 9 + 36 = 49$

Step 3 – take the square root: $\sigma = \sqrt{49}$

$\sigma = 7''$

Final Answer: $\sigma = \pm 7'' \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – probable error: The probable error is the deviation on either side of the mean within which one half of the observations are expected to fall.

Step 1 – recall the standard relation for a normal distribution: $\text{PE} = 0.6745\,\sigma$

Step 2 – note the origin of the factor: The multiplier 0.6745 is the value that encloses 50% of the area of the normal curve about the mean.

Step 3 – select the matching option: Only $0.6745\,\sigma$ agrees with this relation.

Why the other options are wrong:

- C, $1.4826\,\sigma$: is the factor that converts the median absolute deviation to σ, not the probable error.
- A and D: are not the recognised probable-error multiplier.

Final Answer: $\text{PE} = 0.6745\,\sigma \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – weighted mean: With weights w_i the weighted mean is $\bar{x} = \dfrac{\sum w_i x_i}{\sum w_i}$. Work with the seconds part above the common $50°10'$.

Step 1 – list the seconds and weights: $x_1 = 12''\,(w_1 = 1)$, $x_2 = 18''\,(w_2 = 2)$, $x_3 = 24''\,(w_3 = 3)$.

Step 2 – form each product $w_i x_i$: $w_1 x_1 = 1 \times 12 = 12$

$w_2 x_2 = 2 \times 18 = 36$

$w_3 x_3 = 3 \times 24 = 72$

Step 3 – add the products: $12 + 36 + 72 = 120$

Step 4 – add the weights: $1 + 2 + 3 = 6$

Step 5 – divide: $\bar{x} = \dfrac{120}{6} = 20''$

Step 6 – add back the common part: $50°10'20''$

Final Answer: $50°10'20'' \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – the normal (Gaussian) error curve: Random errors distribute symmetrically about the mean, and fixed fractions of the observations fall within multiples of the standard deviation.

Step 1 – recall the one-sigma band: Within $\pm 1\sigma$ of the mean lies about 68.3% of the area under the normal curve.

Step 2 – round to the stated figure: This is commonly quoted as roughly 68%.

Why the other options are wrong:

- B, 95%: corresponds to about $\pm 2\sigma$.
- D, 99.7%: corresponds to about $\pm 3\sigma$.
- A, 50%: corresponds to the probable error band ($\pm 0.6745\sigma$).

Final Answer: about $68\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – combined curvature and refraction correction: Over long sights both the Earth's curvature and atmospheric refraction bend the line of sight; their net effect is $C = 0.0673\,D^2$ metres, with D in kilometres.

Step 1 – square the sight distance: $D^2 = 2^2 = 4$

Step 2 – multiply by the coefficient: $C = 0.0673 \times 4$

Step 3 – evaluate: $C = 0.2692$ m

Step 4 – round to the given options: $C \approx 0.27$ m

Final Answer: $C \approx 0.27 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – curvature correction alone: The drop of the level surface below the horizontal line over a distance D (km) is $C = 0.0785\,D^2$ metres.

Step 1 – square the sight distance: $D^2 = 3^2 = 9$

Step 2 – multiply by the coefficient: $C = 0.0785 \times 9$

Step 3 – evaluate: $C = 0.7065$ m

Step 4 – round: $C \approx 0.71$ m

Step 5 – cross-check against the combined value: It exceeds the combined curvature-plus-refraction figure, as expected, because refraction acts in the opposite sense and reduces the net correction.

Final Answer: $C \approx 0.71 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – reciprocal levelling: When a wide obstacle prevents balancing the backsight and foresight, the level is set close to each staff in turn and the two apparent differences are averaged.

Step 1 – identify the errors that depend on sight length: Collimation (line-of-sight) error, Earth's curvature and atmospheric refraction all grow with the distance from instrument to staff.

Step 2 – see why averaging removes them: In one set-up the far staff carries the full error; in the reversed set-up the same error falls on the other staff. Averaging the two apparent differences cancels these equal and opposite effects.

Step 3 – state the result: The mean difference of level is free of collimation, curvature and refraction errors.

Why the other options are wrong:

- B, C, D: staff-graduation, tape-temperature and magnetic-declination errors are unrelated to sight length and are not what reciprocal levelling addresses.

Final Answer: collimation, curvature and refraction $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – reduced level from backsight and foresight: $\text{RL of forepoint} = \text{RL of BM} + \text{BS} - \text{FS}$.

Step 1 – add the backsight to the benchmark RL (gives the line of collimation): $250.000 + 2.105 = 252.105$ m

Step 2 – subtract the foresight: $252.105 - 1.320 = 250.785$ m

Step 3 – interpret: The backsight (2.105) exceeds the foresight (1.320), so the ground has risen; $250.785 > 250.000$, which is consistent.

Final Answer: $\text{RL} = 250.785 \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept – linear interpolation of a contour on a uniform slope: The horizontal distance to a given level is proportional to its height above the lower point.

Step 1 – total rise from A to B: $216.0 - 210.0 = 6.0$ m

Step 2 – rise from A up to the contour: $213.0 - 210.0 = 3.0$ m

Step 3 – form the proportion of the total distance: $\dfrac{3.0}{6.0} = 0.5$

Step 4 – multiply by the horizontal distance AB: $d = 0.5 \times 30$

$d = 15$ m

Final Answer: $d = 15$ m from A $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – ground slope from contour spacing: Slope $= \dfrac{\text{contour interval}}{\text{horizontal ground distance between contours}}$.

Step 1 – convert the map spacing to a ground distance using the scale: $5\text{ mm} \times 20{,}000 = 100{,}000\text{ mm}$

Step 2 – convert to metres: $100{,}000\text{ mm} = 100\text{ m}$

Step 3 – form the slope ratio: slope $= \dfrac{5\text{ m}}{100\text{ m}}$

Step 4 – reduce to 1 in n: $\dfrac{5}{100} = \dfrac{1}{20}$

Final Answer: slope $= 1$ in $20 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – back bearing from fore bearing: Back bearing = fore bearing $\pm 180^\circ$ (add 180° when the fore bearing is below 180°).

Step 1 – note the fore bearing: $\text{FB} = 123^\circ 45'$

Step 2 – since it is less than 180°, add 180°: $\text{BB} = 123^\circ 45' + 180^\circ$

Step 3 – evaluate: $\text{BB} = 303^\circ 45'$

Final Answer: $\text{BB} = 303^\circ 45' \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

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

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

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

Step 3 – attach the quadrant letters: Measured from north towards west, the bearing is N65°W.

Final Answer: N65°W $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept – latitude and departure of a line: Latitude $= L\cos\theta$ (N–S component) and Departure $= L\sin\theta$ (E–W component), with θ measured from north.

Step 1 – compute the latitude: Lat $= 150\cos 60^\circ$

Lat $= 150 \times 0.5$

Lat $= 75.0$ m (northerly)

Step 2 – compute the departure: Dep $= 150\sin 60^\circ$

Dep $= 150 \times 0.8660$

Dep $= 129.9$ m (easterly)

Final Answer: 75.0 m N, 129.9 m E $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – linear closing error of a traverse: $e = \sqrt{(\sum L)^2 + (\sum D)^2}$, where $\sum L$ and $\sum D$ are the total latitude and departure misclosures.

Step 1 – square the latitude misclosure: $(\sum L)^2 = (0.6)^2 = 0.36$

Step 2 – square the departure misclosure: $(\sum D)^2 = (0.8)^2 = 0.64$

Step 3 – add: $0.36 + 0.64 = 1.00$

Step 4 – take the square root: $e = \sqrt{1.00}$

$e = 1.0$ m

Final Answer: $e = 1.0$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – Bowditch (compass) rule: The Bowditch rule assumes that errors in linear and angular measurements are of comparable precision, so misclosure is distributed in proportion to the length of each side.

Step 1 – write the rule: Correction to latitude of a side $= \dfrac{\text{length of that side}}{\text{perimeter}} \times$ (total latitude misclosure).

Step 2 – read off the proportionality: The numerator carries the length of the side, so the correction is proportional to the length of that side.

Why the other options are wrong:

- B and D: making the correction proportional to the latitude or departure of the side is the transit rule, not Bowditch.
- C: no balancing rule uses the square of the length.

Final Answer: proportional to the length of that side $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept – transit rule: The transit rule is preferred when the angular measurements are more precise than the linear ones; misclosure is distributed in proportion to the latitude (or departure) of each side.

Step 1 – write the rule for the latitude correction: Correction to latitude of a side $= \dfrac{|\text{latitude of that side}|}{\text{arithmetic sum of all latitudes}} \times$ (total latitude misclosure).

Step 2 – read off the proportionality: The numerator carries the latitude of the side, so the correction is proportional to the latitude of that side.

Why the other options are wrong:

- B: proportionality to the length of the side is the Bowditch rule.
- C and D: the perimeter or the departure is not what governs the latitude correction in the transit rule.

Final Answer: proportional to the latitude of that side $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept – tangent length of a simple curve: $T = R\tan\left(\frac{\Delta}{2}\right)$.

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

Step 2 – take the tangent: $\tan 40^\circ = 0.8391$

Step 3 – multiply by the radius: $T = 250 \times 0.8391$

Step 4 – evaluate: $T = 209.8$ m

Final Answer: $T \approx 209.8 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept – length of a circular curve: $L = \frac{\pi R \Delta}{180^\circ}$, with Δ in degrees.

Step 1 – substitute the values: $L = \frac{\pi \times 300 \times 60}{180}$

Step 2 – simplify the angle factor: $\frac{60}{180} = \frac{1}{3}$

Step 3 – form the reduced expression: $L = \pi \times 300 \times \frac{1}{3} = 100\pi$

Step 4 – evaluate: $L = 100 \times 3.1416 = 314.2$ m

Final Answer: $L \approx 314.2 \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept – superelevation: Ignoring side friction, the superelevation required to balance the centrifugal effect is $e = \frac{V^2}{127\,R}$, with V in km/h and R in metres.

Step 1 – square the design speed: $V^2 = 72^2 = 5184$

Step 2 – form the denominator: $127 \times R = 127 \times 200 = 25{,}400$

Step 3 – divide: $e = \frac{5184}{25{,}400}$

Step 4 – evaluate: $e = 0.204$

Step 5 – interpret: This is a rise of about 0.204 m per metre of road width, i.e. a superelevation of roughly 20% before any friction allowance.

Final Answer: $e \approx 0.204 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept – shift of a transition curve: Inserting a transition curve shifts the circular curve inward by $S = \dfrac{L^2}{24\,R}$, where L is the transition length and R the circular radius.

Step 1 – square the transition length: $L^2 = 60^2 = 3600$

Step 2 – form the denominator: $24 \times R = 24 \times 300 = 7200$

Step 3 – divide: $S = \dfrac{3600}{7200}$

Step 4 – evaluate: $S = 0.5$ m

Final Answer: $S = 0.5 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept – inclined tacheometric sight: For an anallactic tacheometer the horizontal distance is $D = k\,s\cos^2\theta$ (with $C = 0$).

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

Step 2 – take the cosine of the inclination: $\cos 8° = 0.99027$

Step 3 – square it: $\cos^2 8° = 0.98063$

Step 4 – multiply: $D = 120 \times 0.98063$

Step 5 – evaluate: $D = 117.7$ m

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

Answer: (D) Go Back to Q23

Q24.

Solution

Concept – altitude of the celestial pole: The altitude of the elevated (celestial) pole above the horizon is numerically equal to the observer's latitude.

Step 1 – state the relation: altitude of pole = latitude of station

Step 2 – substitute the given latitude: altitude $= 45^\circ$

Step 3 – sanity check the extremes: At the equator (0°) the pole would sit on the horizon; at the pole (90°) it would be overhead. A latitude of 45° falls midway, giving 45°.

Final Answer: altitude $= 45^\circ \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept – scale of a vertical photograph: For flat ground the photo scale is $\frac{f}{H}$, with f and H in the same unit.

Step 1 – convert the focal length to metres: $f = 200$ mm $= 0.200$ m

Step 2 – form the ratio f/H: scale $= \frac{0.200}{2000}$

Step 3 – simplify: scale $= \frac{1}{10{,}000}$

Step 4 – state the result: 1 cm on the photo represents 100 m on the ground.

Final Answer: $1{:}10{,}000 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – flying height from photo scale: Since scale $= \frac{f}{H}$, the flying height is $H = f \times$ (scale denominator).

Step 1 – convert the focal length to metres: $f = 150$ mm $= 0.150$ m

Step 2 – multiply by the scale denominator: $H = 0.150 \times 12{,}000$

Step 3 – evaluate: $H = 1800$ m

Final Answer: $H = 1800$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept – relief displacement: The outward image shift of the top of a vertical object is $d = \dfrac{r\,h}{H}$, with r the radial distance of the image from the principal point.

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

Step 2 – divide by the flying height: $d = \dfrac{13{,}500}{2700}$

Step 3 – evaluate: $d = 5$ mm

Step 4 – note the unit: Since r was in millimetres and h and H share the metre unit, d comes out in millimetres.

Final Answer: $d = 5 \text{ mm} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept – difference of parallax: The stereoscopic height of an object depends on the difference between the absolute parallax of its top and that of its base, $\Delta p = p_{\text{top}} - p_{\text{base}}$.

Step 1 – write the two parallax values: $p_{\text{top}} = 92.5$ mm, $p_{\text{base}} = 90.0$ mm

Step 2 – subtract: $\Delta p = 92.5 - 90.0$

Step 3 – evaluate: $\Delta p = 2.5$ mm

Step 4 – interpret: The higher point lies closer to the camera, so it carries the larger parallax; the small positive difference is what a parallax bar would measure.

Why the other options are wrong:

- A, 182.5 mm: adds the two parallaxes instead of subtracting them.
- B, 1.5 mm: an arithmetic slip.
- C, 90.0 mm: is the base parallax itself, not the difference.

Final Answer: $\Delta p = 2.5 \text{ mm} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – ground coordinate from a photo coordinate: On a truly vertical photograph the ground coordinate is scaled from the photo coordinate by the height-to-focal-length ratio: $X = \dfrac{H}{f}x$.

Step 1 – put focal length and photo coordinate in the same unit: $f = 150\text{ mm} = 0.150\text{ m}$, $x = 50\text{ mm} = 0.050\text{ m}$

Step 2 – form the scale factor H/f: $\dfrac{H}{f} = \dfrac{1500}{0.150} = 10{,}000$

Step 3 – multiply by the photo coordinate: $X = 10{,}000 \times 0.050$

Step 4 – evaluate: $X = 500\text{ m}$

Final Answer: $X = 500\text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept – ground area from photo dimensions: Each photo length is multiplied by the scale denominator to give the ground length; the ground area is the product of the two ground lengths.

Step 1 – convert the first side to a ground length: $50\text{ mm}\times 6000 = 300{,}000\text{ mm} = 300\text{ m}$

Step 2 – convert the second side: $40\text{ mm} \times 6000 = 240{,}000\text{ mm} = 240\text{ m}$

Step 3 – multiply to get the ground area: $A = 300 \times 240 = 72{,}000\text{ m}^2$

Step 4 – convert to hectares (1 ha $= 10{,}000$ m^2): $A = \dfrac{72{,}000}{10{,}000} = 7.2\text{ ha}$

Final Answer: $A = 7.2\text{ ha} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – wavelength from frequency: $\lambda = \dfrac{c}{f}$, with $c = 3 \times 10^8$ m/s.

Step 1 – substitute the values: $\lambda = \dfrac{3 \times 10^8}{3 \times 10^9}$

Step 2 – divide the coefficients: $\frac{3}{3} = 1$

Step 3 – subtract the powers of ten: $10^{8-9} = 10^{-1}$

Step 4 – combine: $\lambda = 1 \times 10^{-1}$ m $= 0.1$ m

Step 5 – place it on the spectrum: A wavelength of 0.1 m (10 cm) lies in the microwave region, consistent with the figure.

Final Answer: $\lambda = 0.1$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – spectral regions in remote sensing: The optical range is subdivided into visible (0.4–0.7 μm), near infrared (0.7–1.3 μm), short-wave and mid infrared, and thermal infrared.

Step 1 – locate the given band: 0.7–1.3 μm sits just beyond the red end of the visible range.

Step 2 – name the region: This is the near infrared (NIR).

Step 3 – link to the application: Healthy vegetation reflects strongly here, which is why NIR bands dominate vegetation indices.

Why the other options are wrong:

- A, visible: ends at 0.7 μm.
- B, thermal infrared: lies near 8–14 μm.
- D, microwave: spans millimetres to centimetres.

Final Answer: near infrared $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – ground sampling distance: The spatial resolution per pixel is the ground swath width divided by the number of pixels across the line.

Step 1 – convert the swath to metres: 12 km $= 12{,}000$ m

Step 2 – divide by the number of pixels: GSD $= \frac{12{,}000}{6000}$

Step 3 – evaluate: $\text{GSD} = 2$ m

Final Answer: $\text{GSD} = 2 \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept – radiometric resolution: An n-bit sensor represents 2^n discrete grey levels.

Step 1 – identify the bit depth: $n = 10$ bits

Step 2 – raise two to that power: 2^{10}

Step 3 – evaluate: $2^{10} = 1024$

Step 4 – interpret: The brightness of each pixel can be stored as one of 1024 levels, from 0 to 1023.

Why the other options are wrong:

- C, $512 = 2^9$: corresponds to a 9-bit sensor.
- A and D: confuse the number of levels with the bit depth or a round figure.

Final Answer: 1024 grey levels $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept – temporal resolution: The four common resolutions describe different aspects of a sensor: spatial (ground detail), spectral (wavelength bands), radiometric (brightness levels) and temporal (revisit).

Step 1 – read the quantity described: The question refers to the time between two acquisitions of the same area.

Step 2 – match it to a resolution: Repeat coverage over time is the temporal resolution (revisit period).

Why the other options are wrong:

- B, spatial: describes the smallest ground feature resolved.
- C, spectral: describes the width and number of wavelength bands.
- D, radiometric: describes the number of brightness levels.

Final Answer: temporal resolution $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q35

Q36.

Solution

Concept – Normalised Difference Vegetation Index: $\text{NDVI} = \dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$, a ratio that ranges from -1 to $+1$.

Step 1 – form the numerator: $\text{NIR} - \text{Red} = 0.50 - 0.20 = 0.30$

Step 2 – form the denominator: $\text{NIR} + \text{Red} = 0.50 + 0.20 = 0.70$

Step 3 – divide: $\text{NDVI} = \dfrac{0.30}{0.70}$

Step 4 – evaluate: $\text{NDVI} = 0.4286 \approx 0.43$

Step 5 – interpret: A positive value near 0.4 indicates moderately healthy vegetation.

Final Answer: $\text{NDVI} \approx 0.43 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept – vector representation of features: In the vector model, geographic features are stored as points, lines or polygons defined by coordinate pairs, chosen to match the geometry of the feature.

Step 1 – classify the feature: A river has length but negligible width at map scale, so it is a linear feature.

Step 2 – pick the matching primitive: A line (polyline or arc) built from an ordered series of coordinate pairs best represents it.

Why the other options are wrong:

- A: a grid of cells is the raster model, not vector.
- C: a single point cannot capture the course of the river.
- D: a filled polygon would suit a lake or a wide reservoir, not a channel drawn as a line.

Final Answer: a line (polyline) of coordinate pairs $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept – topology in a GIS: Topology is the set of spatial relationships between features that stay unchanged under stretching or bending, stored explicitly so the GIS knows how features connect.

Step 1 – read what is being stored: Connectivity of arcs at nodes, adjacency of polygons across shared arcs, and containment of features are all being described.

Step 2 – name the concept: These relationships together are called topology.

Why the other options are wrong:

- A, attributes: are the descriptive (non-spatial) data attached to features.
- B, metadata: is data about the dataset (source, date, accuracy).
- C, projection parameters: define the coordinate system, not feature relationships.

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

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – uncompressed raster size: Storage $=$ (number of rows) $\times$ (number of columns) $\times$ (bytes per cell).

Step 1 – count the cells: $2000 \times 2000 = 4{,}000{,}000$ cells

Step 2 – multiply by bytes per cell: $4{,}000{,}000 \times 1 = 4{,}000{,}000$ bytes

Step 3 – convert to megabytes (1 MB $\approx 10^6$ bytes): $\dfrac{4{,}000{,}000}{10^6} \approx 4$ MB

Final Answer: about 4 MB $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – UNION overlay: A union combines two polygon layers using a logical OR, keeping every area that belongs to either input.

Step 1 – read the shaded region: Both circles are shaded in full, i.e. the whole of A together with the whole of B.

Step 2 – name the set operation: That shaded region is $A \cup B$, all areas in A or B or both.

Why the other options are wrong:

- A: the area common to both is the intersection ($A \cap B$), a smaller region.
- C: the area of A outside B is the difference (erase), not the union.
- D: the area outside both is the complement of the union.

Final Answer: all areas in A or B or both $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – triangulated irregular network: A TIN models a continuous surface as contiguous, non-overlapping triangles whose vertices are the sampled elevation points.

Step 1 – read the description: Irregularly spaced points are joined into triangles that tile the surface without gaps or overlaps.

Step 2 – name the structure: This is a triangulated irregular network (TIN).

Why the other options are wrong:

- A, raster DEM: uses a regular grid of cells, not irregular triangles.
- B, contour layer: stores lines of equal height, not a triangulated surface.
- D, buffer polygon: is a proximity zone, unrelated to terrain modelling.

Final Answer: triangulated irregular network (TIN) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – geoid, ellipsoid and orthometric height: The three heights are linked by $h = H + N$, where h is the ellipsoidal height, H the orthometric (MSL) height and N the geoid undulation. Rearranged, $H = h - N$.

Step 1 – write the two given quantities: $h = 245.60$ m, $N = -34.20$ m

Step 2 – substitute into $H = h - N$: $H = 245.60 - (-34.20)$

Step 3 – resolve the double negative: $H = 245.60 + 34.20$

Step 4 – evaluate: $H = 279.80$ m

Step 5 – interpret: Here the geoid lies below the ellipsoid (N negative), so the mean-sea-level height is larger than the ellipsoidal height.

Final Answer: $H = 279.80 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept – pseudorange from signal travel time: The range is the signal speed times its travel time, $\rho = ct$.

Step 1 – substitute the values: $\rho = (3 \times 10^8) \times 0.06$

Step 2 – multiply the coefficients: $3 \times 0.06 = 0.18$

Step 3 – write with the power of ten: $\rho = 0.18 \times 10^8$ m

Step 4 – normalise: $\rho = 1.8 \times 10^7$ m

Step 5 – convert to kilometres: $\rho = 1.8 \times 10^4 \text{ km} = 18{,}000$ km

Final Answer: $\rho \approx 18{,}000 \text{ km} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept – Geometric Dilution of Precision: GDOP measures how satellite geometry amplifies ranging errors into position error; a smaller GDOP means a better fix.

Step 1 – link geometry to GDOP: A large, well-spread spatial volume enclosed by the satellite directions gives a small GDOP.

Step 2 – read the sky plot: The satellites are scattered across the sky rather than bunched, which is the favourable case.

Step 3 – state the condition: GDOP is low when the tracked satellites are well distributed across the sky.

Why the other options are wrong:

- A and B: satellites clustered overhead or all in one direction give a thin geometry and a high GDOP.

- D: four is only the minimum number; their arrangement, not the count, controls GDOP.

Final Answer: well distributed across the sky $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – reference ellipsoid of the Indian datum: Every horizontal datum is fixed to a chosen reference ellipsoid; the classical Indian datum used for Survey of India mapping is tied to the Everest ellipsoid.

Step 1 – recall the historical choice: The Everest spheroid, defined by Sir George Everest in the nineteenth century, was best fitted to the Indian subcontinent.

Step 2 – match it to the datum: The Indian geodetic datum therefore adopts the Everest ellipsoid.

Why the other options are wrong:

- A, WGS-84: is the global, Earth-centred ellipsoid used by GNSS.
- B, GRS-80: underlies modern global datums such as ITRF/NAD-83, not the classical Indian datum.
- C, Clarke 1866: was adopted for North American datums.

Final Answer: the Everest ellipsoid $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – equal-area (equivalent) projection: A projection is classified by the property it preserves: area, shape (conformality), distance or direction. No flat map can keep all of them at once.

Step 1 – read the preserved property: Every small ground figure keeps its true area, while shapes may be distorted.

Step 2 – name the class: Preserving area is the defining feature of an equal-area (equivalent) projection.

Why the other options are wrong:

- B, conformal: preserves local angles and shapes, at the expense of area.
- C, azimuthal: names the developable surface (a plane), not the preserved property.
- D, gnomonic: is a specific azimuthal projection on which great circles plot straight, and it preserves neither area nor shape.

Final Answer: an equal-area (equivalent) projection $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q46

Answer Key

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