GATE Geomatics Engineering

Sample Paper – 1

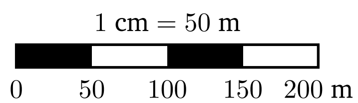
Duration: 128 Minutes **Maximum Marks: 72**

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 $\alpha = 11.7 \times 10^{-6}$ °C^{-1}.

Principles of Surveying and Error Theory

Q1. A topographic map is drawn to a scale of 1 cm $= 50$ m, as indicated by the scale bar below. The representative fraction (RF) of the map is: **[1 mark]**



(A) $1/500$

(B) $1/50$

(C) $1/5000$

(D) $1/50000$

Q2. Four equally reliable measurements of a horizontal distance gave 100.02 m, 100.06 m, 100.04 m and 100.08 m. The most probable value (arithmetic mean) of the distance is: **[1 mark]**

(A) 100.04 m

(B) 100.06 m

(C) 100.05 m

(D) 100.20 m

Q3. A survey line is measured in three independent sections whose standard errors are ± 3 mm, ± 4 mm and ± 12 mm. Taking the errors as combining in quadrature, the standard error of the total length is: **[1 mark]**

(A) ± 13 mm

(B) ± 19 mm

(C) ± 5 mm

(D) ± 169 mm

Q4. In surveying, the guiding principle "work from the whole to the part" is followed mainly to: **[1 mark]**

(A) increase the total number of survey stations

(B) prevent the accumulation of errors and control their spread over the survey

(C) reduce the cost of the instruments used

(D) avoid the use of triangulation altogether

Q5. A horizontal angle is observed in three sets carrying weights 1, 2 and 3, giving $40°20'10''$, $40°20'16''$ and $40°20'12''$ respectively. The weighted mean of the angle is: **[1 mark]**

(A) $40°20'12''$

(B) $40°20'16''$

(C) $40°20'13''$

(D) $40°20'10''$

Q6. A steel tape is uniformly too short by a fixed amount and is used to measure many lengths. The error it introduces into every measured length is best classified as a: **[1 mark]**

(A) random (accidental) error

(B) mistake or blunder by the observer

(C) compensating error that cancels out

(D) systematic (cumulative) error

Distance Measurement, Levelling and Contouring

Q7. A 30 m steel tape standardized at $20°$C is used in the field at $40°$C. With coefficient of thermal expansion $\alpha = 11.7 \times 10^{-6}\ °\mathrm{C}^{-1}$, the temperature correction to be applied to one tape length is nearest to: **[1 mark]**

(A) $+7.0$ mm

(B) $+3.5$ mm

(C) -7.0 mm

(D) $+0.7$ mm

Q8. A distance of 100 m is measured along a slope, the two ends differing in level by 6 m. Using the approximate slope correction $-\dfrac{h^2}{2L}$, the correction to reduce the length to the horizontal is: **[1 mark]**

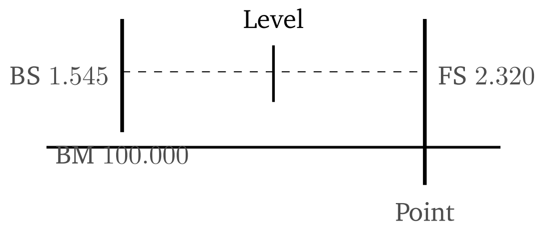
(A) -0.36 m

(B) -0.18 m

(C) -0.06 m

(D) -0.09 m

Q9. In the differential-levelling set-up shown, the backsight on a benchmark of RL 100.000 m is 1.545 m and the foresight to the next point is 2.320 m. The reduced level of the forepoint is: **[1 mark]**



(A) 100.775 m

(B) 103.865 m

(C) 98.135 m

(D) 99.225 m

Q10. During levelling the line of collimation (height of instrument) is at RL 152.400 m. A staff reading of 1.200 m is taken on an intermediate point. The reduced level of that point is: **[1 mark]**

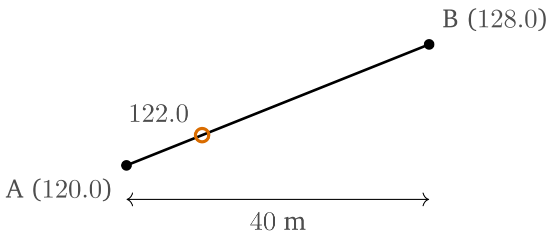
(A) 153.600 m

(B) 152.400 m

(C) 150.000 m

(D) 151.200 m

Q11. Points A and B lie 40 m apart on a uniform slope. A has RL 120.0 m and B has RL 128.0 m, as shown. By linear interpolation the horizontal distance from A to the point where the 122.0 m contour crosses AB is: **[1 mark]**



(A) 10 m

(B) 20 m

(C) 5 m

(D) 15 m

Q12. On a map of scale 1:10,000 with a contour interval of 5 m, two adjacent contours are 8 mm apart on the paper. The ground slope (gradient) between them is: **[1 mark]**

(A) 1 in 16

(B) 1 in 8

(C) 1 in 40

(D) 1 in 625

Theodolite, Traverse and Triangulation

Q13. The fore bearing (whole-circle bearing) of a line AB is $60°30'$. The back bearing of the line is: **[1 mark]**

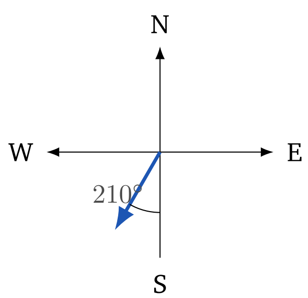
(A) $60°30'$

(B) $240°30'$

(C) $120°30'$

(D) $299°30'$

Q14. The whole-circle bearing of a survey line is $210°$, as shown on the compass diagram. Its reduced (quadrantal) bearing is: **[1 mark]**



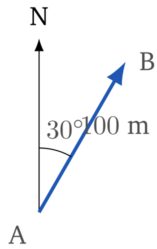
(A) N30°E

(B) N30°W

(C) S30°E

(D) S30°W

Q15. A traverse line AB of length 100 m has a whole-circle bearing of $30°$, as shown. Its latitude ($L\cos\theta$) and departure ($L\sin\theta$) are respectively: **[1 mark]**



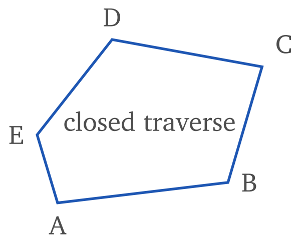
(A) 50.0 m N, 86.6 m E

(B) 86.6 m N, 100 m E

(C) 86.6 m N, 50.0 m E

(D) 50.0 m N, 50.0 m E

Q16. A closed traverse (shown schematically) has a total latitude misclosure of $+0.3$ m and a total departure misclosure of -0.4 m. The linear closing error of the traverse is: **[1 mark]**



(A) 0.7 m

(B) 0.5 m

(C) 0.1 m

(D) 0.35 m

Q17. For a closed polygon traverse having 6 sides, the theoretical sum of the interior angles, given by $(2n-4)\times 90°$, is: **[1 mark]**

(A) 540°

(B) 720°

(C) 900°

(D) 1080°

Q18. According to Bowditch's rule for balancing a traverse, the correction applied to the departure (or latitude) of any side is proportional to: **[1 mark]**

(A) the departure of that side

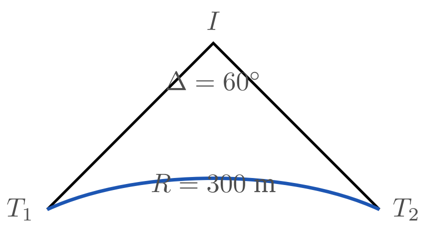
(B) the square of the length of that side

(C) the latitude of that side

(D) the length of that side

Curves, Tacheometry and Field Astronomy

Q19. A simple circular curve of radius $R = 300$ m has a deflection angle $\Delta = 60^\circ$ between its tangents, as shown. The tangent length ($T = R\tan(\Delta/2)$) is: **[1 mark]**



(A) 173.2 m

(B) 300 m

(C) 519.6 m

(D) 150 m

Q20. A simple circular curve of radius 200 m subtends a deflection angle of 90°. The length of the curve, $L = \dfrac{\pi R\Delta}{180^\circ}$, is: **[1 mark]**

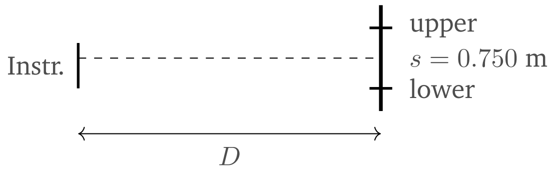
(A) 200 m

(B) 100 m

(C) 628.3 m

(D) 314.2 m

Q21. In a tacheometric observation with an anallactic telescope (multiplying constant $k = 100$, additive constant $C = 0$) the staff intercept is 0.750 m with the line of sight horizontal, as shown. The horizontal distance to the staff is: **[2 marks]**



(A) 750 m

(B) 75.0 m

(C) 7.5 m

(D) 100.75 m

Q22. A simple circular curve has radius 400 m and deflection angle $30°$. The mid-ordinate, $M = R\big(1 - \cos(\Delta/2)\big)$, is nearest to: **[2 marks]**

(A) 27.3 m

(B) 6.8 m

(C) 100 m

(D) 13.6 m

Q23. A tacheometer ($k = 100$, $C = 0$) reads a staff intercept of 1.000 m with the line of sight inclined at $10°$ to the horizontal. The horizontal distance, $D = k\, s \cos^2 \theta$, is nearest to: **[2 marks]**

(A) 100 m

(B) 98.5 m

(C) 97.0 m

(D) 85.5 m

Q24. In field astronomy the altitude of the celestial pole above the horizon equals the observer's latitude. For a station at latitude $28°$N, the altitude of the north celestial pole is: **[2 marks]**

(A) $62°$

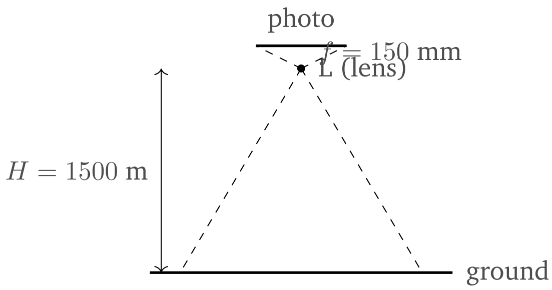
(B) $28°$

(C) $90°$

(D) $0°$

Photogrammetry

Q25. A vertical aerial photograph is taken with a camera of focal length 150 mm from a flying height of 1500 m above flat ground, as shown. The scale of the photograph (f/H) is: **[2 marks]**



(A) 1:10,000

(B) 1:1000

(C) 1:15,000

(D) 1:100,000

Q26. A vertical photograph has a scale of $1{:}8000$ and was taken with a camera of focal length 200 mm. The flying height above the ground datum is: **[2 marks]**

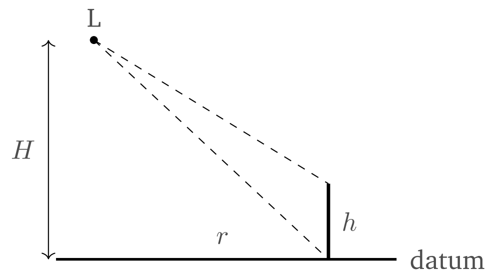
(A) 400 m

(B) $40{,}000$ m

(C) 1600 m

(D) 8000 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 $r = 80$ mm, object height $h = 100$ m and flying height $H = 2000$ m (see figure), the relief displacement is: **[2 marks]**



(A) 1 mm

(B) 2 mm

(C) 4 mm

(D) 8 mm

Q28. A straight line on the ground is 500 m long. On a vertical photograph of scale 1:$10{,}000$ the corresponding image length is: **[2 marks]**

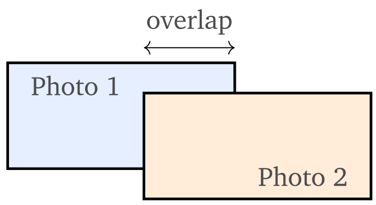
(A) 50 mm

(B) 5 mm

(C) 500 mm

(D) 5 m

Q29. For stereoscopic coverage of a strip, successive vertical photographs along a flight line are taken with a standard forward (end) overlap of about (see the overlap sketch): **[2 marks]**



(A) 60%

(B) 30%

(C) 20%

(D) 90%

Q30. A vertical photograph of scale 1:5000 shows a rectangular field measuring 40 mm $\times$ 30 mm on the print. The ground area of the field is: **[2 marks]**

(A) 1.2 ha

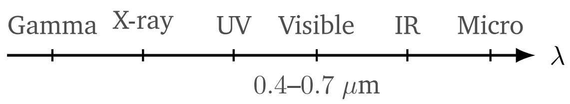
(B) 12 ha

(C) 3 ha

(D) 30 ha

Remote Sensing

Q31. Electromagnetic radiation of frequency 6×10^{14} Hz travels in vacuum at $c = 3 \times 10^8$ m/s. Its wavelength ($\lambda = c/f$), located on the spectrum below, is: **[2 marks]**



(A) 2 μm

(B) 5 μm

(C) 0.5 μm

(D) 50 μm

Q32. In optical remote sensing, the wavelength band 0.4–0.7 μm corresponds to which region of the electromagnetic spectrum? **[2 marks]**

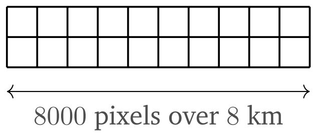
(A) thermal infrared

(B) microwave

(C) near infrared

(D) visible

Q33. A pushbroom sensor images a ground swath of 8 km using 8000 detector pixels across the line, as sketched. The ground sampling distance (spatial resolution) per pixel is: **[2 marks]**



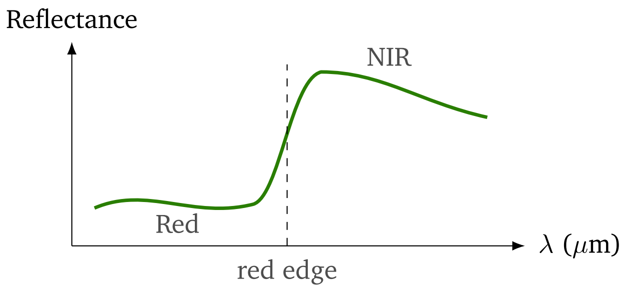
(A) 8 m

(B) 0.1 m

(C) 1 m

(D) 10 m

Q34. The spectral signature of healthy green vegetation (plotted below) shows a sharp rise in reflectance across the boundary between the red and near-infrared bands. This characteristic feature is known as the: **[2 marks]**



(A) blue shift

(B) thermal emission peak

(C) water absorption band

(D) red edge

Q35. The ability of a remote-sensing system to distinguish between two adjacent (narrow) wavelength intervals is called its: **[2 marks]**

(A) spectral resolution

(B) spatial resolution

(C) temporal resolution

(D) radiometric resolution

Q36. A satellite sensor records each pixel with 8 bits of data. The number of discrete grey levels (radiometric resolution) it can represent is: **[2 marks]**

(A) 8

(B) 256

(C) 512

(D) 64

Geographic Information Systems

Q37. In a GIS, the raster data model (illustrated by the value grid below) represents geographic space as: **[2 marks]**

2	2	5	5
2	3	5	6
1	3	4	6
1	1	4	4

(A) a network of nodes joined by edges

(B) a matrix of grid cells, each cell holding a single value

(C) a set of points, lines and polygons defined by coordinate pairs

(D) a triangulated irregular network of vertices

Q38. A single-band raster layer has 1000 rows and 1000 columns, with each cell stored as one byte. The uncompressed storage size of the layer is nearest to: **[2 marks]**

(A) 1 MB

(B) 1 KB

(C) 1 GB

(D) 8 MB

Q39. A 50 m buffer is generated around a straight road segment in a GIS, as shown. The buffer operation produces: **[2 marks]**

buffer polygon

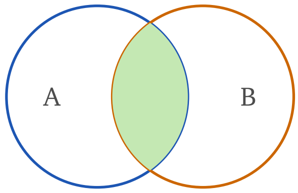
(A) a new polygon enclosing all locations within 50 m of the road

(B) a raster grid of elevation values

(C) a single point at the centre of the road

(D) a contour line following the road

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



A ∩ B

(A) all areas that lie in either A or B

(B) the area of A that lies outside B

(C) the area common to both A and B

(D) all areas lying outside both A and B

Q41. A GIS query such as "find all schools located within 2 km of a highway" is an example of a: **[2 marks]**

(A) purely attribute (non-spatial) query

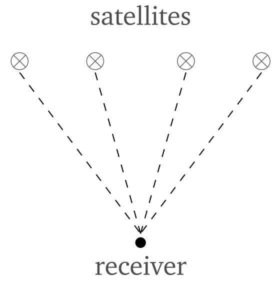
(B) proximity-based spatial query

(C) network shortest-path query

(D) raster reclassification operation

GNSS, Cartography and Map Projections

Q42. For a GNSS receiver to compute a three-dimensional position (X, Y, Z) together with its own clock error, the minimum number of satellites that must be simultaneously tracked is (see geometry): **[2 marks]**



(A) 3

(B) 4

(C) 5

(D) 2

Q43. A GNSS signal takes 0.07 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]**

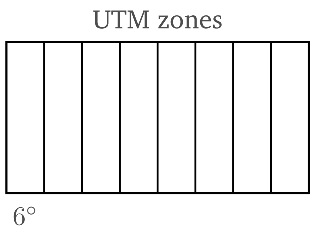
(A) 300 km

(B) 3000 km

(C) 2100 km

(D) 21,000 km

Q44. The Universal Transverse Mercator (UTM) system divides the globe into numbered longitudinal zones (see graticule). Each UTM zone spans: **[2 marks]**



(A) 6° of longitude

(B) 3° of longitude

(C) 8° of longitude

(D) 10° of longitude

Q45. The reference surface on which the WGS-84 datum defines geodetic latitude, longitude and ellipsoidal height is: **[2 marks]**

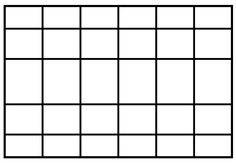
(A) the geoid (mean sea level equipotential surface)

(B) an Earth-centred reference ellipsoid

(C) a flat horizontal reference plane

(D) the physical topographic surface of the Earth

Q46. The Mercator projection (graticule shown) is widely used for marine navigation because it is a conformal projection. Conformality means the projection: **[2 marks]**



meridians and parallels cross at right angles

(A) preserves true area everywhere on the map

(B) preserves true ground distance in all directions

(C) preserves the true relative sizes of the continents

(D) preserves local angles and the shapes of small features

Detailed Solutions

Q1.

Solution

Concept – representative fraction: The RF is the ratio of a map distance to the corresponding ground distance, both in the same unit.

Step 1 – write what one map centimetre equals on the ground: $1 \text{ cm} = 50 \text{ m}$

Step 2 – convert the ground distance to centimetres: $50 \text{ m} = 50 \times 100 \text{ cm}$

$50 \text{ m} = 5000 \text{ cm}$

Step 3 – form the ratio in the same unit: $\text{RF} = \dfrac{1 \text{ cm}}{5000 \text{ cm}}$

Step 4 – simplify: $\text{RF} = \dfrac{1}{5000}$

Final Answer: $\text{RF} = 1/5000 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – most probable value of equally reliable observations: The most probable value is the arithmetic mean of the observations.

Step 1 – add the four readings: $100.02 + 100.06 = 200.08$

$200.08 + 100.04 = 300.12$

$300.12 + 100.08 = 400.20$

Step 2 – divide by the number of readings: $\bar{x} = \dfrac{400.20}{4}$

Step 3 – evaluate: $\bar{x} = 100.05 \text{ m}$

Final Answer: $\bar{x} = 100.05 \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

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

Step 1 – square each component error: $\sigma_1^2 = 3^2 = 9$

$\sigma_2^2 = 4^2 = 16$

$\sigma_3^2 = 12^2 = 144$

Step 2 – add the squares: $9 + 16 + 144 = 169$

Step 3 – take the square root: $\sigma = \sqrt{169}$

$\sigma = 13$ mm

Final Answer: $\sigma = \pm 13$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – the "whole to part" principle: A survey is first fixed by a few high-precision control points covering the whole area; the detail is then filled in between them.

Step 1 – recall the purpose: Establishing an accurate framework first means any small errors in the later detail work stay local.

Step 2 – state the effect: Errors are not allowed to build up and propagate across the entire survey.

Why the other options are wrong:

- A: the number of stations is not the aim; control is.
- C: cost of instruments is unrelated to the principle.
- D: triangulation is one way to fix control, not something the principle avoids.

Final Answer: prevent the accumulation and spread of errors $\Rightarrow \boxed{\text{B}}$

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 $40°20'$.

Step 1 – list the seconds and weights: $x_1 = 10''\,(w_1 = 1)$, $x_2 = 16''\,(w_2 = 2)$, $x_3 = 12''\,(w_3 = 3)$.

Step 2 – form each product $w_i x_i$: $w_1 x_1 = 1 \times 10 = 10$

$w_2 x_2 = 2 \times 16 = 32$

$w_3x_3 = 3 \times 12 = 36$

Step 3 – add the products: $10 + 32 + 36 = 78$

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

Step 5 – divide: $\bar{x} = \dfrac{78}{6} = 13''$

Step 6 – add back the common part: $40°20'13''$

Final Answer: $40°20'13'' \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – classifying tape errors: An error that has the same sign and (proportionally) the same size every time is systematic; it accumulates with the number of measurements.

Step 1 – describe the fault: The tape is short by a fixed amount, so every length read off it is too long by that same proportion.

Step 2 – note the sign never changes: Because the effect is always in the same direction it does not average out; it adds up.

Step 3 – name the class: An error of constant sign that accumulates is a systematic (cumulative) error.

Why the other options are wrong:

- A and C: random/compensating errors change sign and tend to cancel; this one does not.
- B: a blunder is an isolated gross mistake, not a repeatable fixed offset.

Final Answer: systematic (cumulative) error $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – temperature correction to a tape: $C_t = \alpha\,(T_m - T_0)\,L$, positive when the field temperature exceeds the standard temperature.

Step 1 – find the temperature change: $T_m - T_0 = 40 - 20 = 20\ °\text{C}$

Step 2 – multiply α by the temperature change: $\alpha\,(T_m - T_0) = 11.7 \times 10^{-6} \times 20$

$\alpha\,(T_m - T_0) = 234 \times 10^{-6}$

Step 3 – multiply by the tape length: $C_t = 234 \times 10^{-6} \times 30$

$C_t = 7020 \times 10^{-6}$ m

Step 4 – convert to millimetres: $C_t = 7.02 \times 10^{-3}$ m $= 7.02$ mm

Step 5 – fix the sign: The tape is warmer than standard, so it has lengthened and the correction is added: $C_t \approx +7.0$ mm.

Final Answer: $C_t \approx +7.0 \text{ mm} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept – slope (reduction to horizontal) correction: For a small height difference the correction is $C_s = -\dfrac{h^2}{2L}$, always subtractive.

Step 1 – square the height difference: $h^2 = 6^2 = 36$

Step 2 – form the denominator: $2L = 2 \times 100 = 200$

Step 3 – divide: $\dfrac{h^2}{2L} = \dfrac{36}{200}$

$\dfrac{h^2}{2L} = 0.18$

Step 4 – apply the negative sign: $C_s = -0.18$ m

Final Answer: $C_s = -0.18 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – reduced level by the rise-and-fall / HI method: RL of forepoint $=$ RL of BM $+$ BS $-$ FS.

Step 1 – add the backsight to the benchmark RL (gives the collimation line): $100.000 + 1.545 = 101.545$ m

Step 2 – subtract the foresight: $101.545 - 2.320 = 99.225$ m

Step 3 – interpret: The foresight (2.320) is larger than the backsight (1.545), so the ground has fallen; $99.225 < 100.000$, which is consistent.

Final Answer: $\text{RL} = 99.225 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept – height of instrument (collimation) method: RL of point $=$ HI $-$ staff reading.

Step 1 – write the height of instrument: $\text{HI} = 152.400$ m

Step 2 – subtract the staff reading: $\text{RL} = 152.400 - 1.200$

Step 3 – evaluate: $\text{RL} = 151.200$ m

Final Answer: $\text{RL} = 151.200 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) 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: $128.0 - 120.0 = 8.0$ m

Step 2 – rise from A up to the contour: $122.0 - 120.0 = 2.0$ m

Step 3 – form the proportion of the total distance: $\dfrac{2.0}{8.0} = 0.25$

Step 4 – multiply by the horizontal distance AB: $d = 0.25 \times 40$

$d = 10$ m

Final Answer: $d = 10 \text{ m from A} \Rightarrow \boxed{\text{A}}$

Answer: (A) 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: $8 \text{ mm} \times 10{,}000 = 80{,}000$ mm

Step 2 – convert to metres: $80{,}000 \text{ mm} = 80$ m

Step 3 – form the slope ratio: slope $= \dfrac{5\text{ m}}{80\text{ m}}$

Step 4 – reduce to 1 in n: $\dfrac{5}{80} = \dfrac{1}{16}$

Final Answer: slope $= 1$ in $16 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

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

Step 1 – note the fore bearing: $\text{FB} = 60°30'$

Step 2 – since it is less than $180°$, add $180°$: $\text{BB} = 60°30' + 180°$

Step 3 – evaluate: $\text{BB} = 240°30'$

Final Answer: $\text{BB} = 240°30' \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – whole-circle to reduced bearing: A WCB between $180°$ and $270°$ lies in the third (south-west) quadrant, with RB $=$ WCB $- 180°$ measured from south towards west.

Step 1 – identify the quadrant: $210°$ is between $180°$ and $270°$, i.e. the SW quadrant.

Step 2 – subtract $180°$: $210° - 180° = 30°$

Step 3 – attach the quadrant letters: Measured from south towards west, the bearing is S30°W.

Final Answer: S30°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), Departure $= L\sin\theta$ (E–W component), θ measured from north.

Step 1 – compute the latitude: Lat $= 100\cos 30°$

Lat $= 100 \times 0.8660$

Lat $= 86.6$ m (northerly)

Step 2 – compute the departure: Dep $= 100\sin 30°$

Dep $= 100 \times 0.5$

Dep $= 50.0$ m (easterly)

Final Answer: 86.6 m N, 50.0 m E $\Rightarrow \boxed{\text{C}}$

Answer: (C) 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: $(\sum L)^2 = (0.3)^2 = 0.09$

Step 2 – square the departure misclosure: $(\sum D)^2 = (-0.4)^2 = 0.16$

Step 3 – add: $0.09 + 0.16 = 0.25$

Step 4 – take the square root: $e = \sqrt{0.25}$

$e = 0.5$ m

Final Answer: $e = 0.5$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – sum of interior angles of a closed polygon: For a closed traverse of n sides the interior angles sum to $(2n - 4) \times 90°$.

Step 1 – substitute $n = 6$: $(2 \times 6 - 4) \times 90°$

Step 2 – simplify inside the bracket: $(12 - 4) = 8$

Step 3 – multiply: $8 \times 90° = 720°$

Final Answer: $720^\circ \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept – Bowditch (compass) rule: The rule assumes errors are proportional to length, so each side's latitude/departure correction is shared in proportion to the length of that side relative to the perimeter.

Step 1 – recall the correction formula: Correction to a side $=$ total misclosure $\times$ $\frac{\text{length of that side}}{\text{perimeter}}$

Step 2 – read off the proportionality: The correction varies directly with the length of the side.

Why the other options are wrong:

- A and C: departure/latitude of the side is what gets corrected, not what sets the share.
- B: the transit rule (not Bowditch) weights by latitude/departure; neither uses length squared.

Final Answer: proportional to the length of the side $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

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

Step 1 – halve the deflection angle: $\dfrac{\Delta}{2} = \dfrac{60^\circ}{2} = 30^\circ$

Step 2 – take the tangent of the half-angle: $\tan 30^\circ = 0.5774$

Step 3 – multiply by the radius: $T = 300 \times 0.5774$

Step 4 – evaluate: $T = 173.2$ m

Final Answer: $T = 173.2$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

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

Step 1 – form the ratio $\Delta/180^\circ$: $\dfrac{90^\circ}{180^\circ} = 0.5$

Step 2 – multiply by πR: $L = \pi \times 200 \times 0.5$

Step 3 – simplify: $L = 100\pi$

Step 4 – evaluate with $\pi = 3.1416$: $L = 314.16 \text{ m} \approx 314.2 \text{ m}$

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

Answer: (D) Go Back to Q20

Q21.

Solution

Concept – horizontal-sight tacheometry (stadia formula): $D = k\,s + C$, where k is the multiplying constant, s the staff intercept and C the additive constant.

Step 1 – list the data: $k = 100$, $s = 0.750$ m, $C = 0$.

Step 2 – multiply the constant by the intercept: $k\,s = 100 \times 0.750$

$k\,s = 75.0$

Step 3 – add the additive constant: $D = 75.0 + 0$

$D = 75.0$ m

Final Answer: $D = 75.0 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept – mid-ordinate of a circular curve: $M = R\big(1 - \cos(\Delta/2)\big)$.

Step 1 – halve the deflection angle: $\dfrac{\Delta}{2} = \dfrac{30^\circ}{2} = 15^\circ$

Step 2 – take the cosine: $\cos 15^\circ = 0.9659$

Step 3 – subtract from one: $1 - 0.9659 = 0.0341$

Step 4 – multiply by the radius: $M = 400 \times 0.0341$

Step 5 – evaluate: $M = 13.6$ m

Final Answer: $M \approx 13.6$ m $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q22

Q23.

Solution

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

Step 1 – compute the stadia distance along the sight: $k\,s = 100 \times 1.000 = 100$

Step 2 – take the cosine of the vertical angle: $\cos 10° = 0.9848$

Step 3 – square it: $\cos^2 10° = (0.9848)^2 = 0.9698$

Step 4 – multiply: $D = 100 \times 0.9698$

$D = 96.98 \text{ m} \approx 97.0 \text{ m}$

Final Answer: $D \approx 97.0$ m $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept – altitude of the celestial pole: For any observer, the altitude of the celestial pole above the horizon is numerically equal to the observer's latitude.

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

Step 2 – substitute the latitude: altitude = $28°$

Why the other options are wrong:

- A, $62°$: is the co-latitude ($90° - 28°$), the altitude of the celestial equator, not the pole.
- C, $90°$: would apply only at the geographic pole.
- D, $0°$: would apply only on the equator.

Final Answer: altitude $= 28° \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept – scale of a vertical photograph: Scale $= \dfrac{f}{H}$, with f the focal length and H the flying height above the ground, in the same unit.

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

Step 2 – form the ratio: Scale $= \dfrac{0.150}{1500}$

Step 3 – simplify: Scale $= \dfrac{1}{10{,}000}$

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

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – flying height from photo scale: From Scale $= f/H$ we get $H = f \times (\text{scale denominator})$.

Step 1 – convert the focal length: $f = 200\text{ mm} = 0.200\text{ m}$

Step 2 – multiply by the scale denominator: $H = 0.200 \times 8000$

Step 3 – evaluate: $H = 1600\text{ m}$

Final Answer: $H = 1600\text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept – relief displacement on a vertical photograph: $d = \dfrac{r\,h}{H}$, where r is the radial distance of the image from the principal point.

Step 1 – multiply the radial distance by the object height: $r\,h = 80 \times 100$

$r\,h = 8000$

Step 2 – divide by the flying height: $d = \dfrac{8000}{2000}$

Step 3 – evaluate (units of r, i.e. mm): $d = 4\text{ mm}$

Final Answer: $d = 4\text{ mm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept – ground length to photo length: photo length $=$ ground length$\times$scale.

Step 1 – write the scale as a fraction: Scale $= \dfrac{1}{10{,}000}$

Step 2 – multiply the ground length by the scale: photo length $= 500 \times \dfrac{1}{10{,}000}$

Step 3 – evaluate in metres: photo length $= 0.05$ m

Step 4 – convert to millimetres: 0.05 m $= 50$ mm

Final Answer: 50 mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept – forward overlap for stereoscopy: To view a strip in three dimensions, consecutive photographs must share enough ground so that every point appears on two frames.

Step 1 – recall the standard value: The conventional forward (end) overlap is about 60%.

Step 2 – reason why: A 60% end lap guarantees full stereoscopic coverage even with small tilt and crab; the side lap between adjacent strips is about 30%.

Why the other options are wrong:

- B, 30%: is the typical *side* lap between flight lines, not the forward overlap.
- C, 20%: is too small to give a continuous stereo model.
- D, 90%: is wasteful and used only for special high-overlap missions.

Final Answer: about $60\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – ground area from a photograph: Convert each photo dimension to a ground dimension using the scale, then multiply.

Step 1 – ground length of the first side: $40 \text{ mm} \times 5000 = 200{,}000 \text{ mm} = 200 \text{ m}$

Step 2 – ground length of the second side: $30 \text{ mm} \times 5000 = 150{,}000 \text{ mm} = 150 \text{ m}$

Step 3 – multiply for the area: $A = 200 \times 150$

$A = 30{,}000 \text{ m}^2$

Step 4 – convert to hectares (1 ha = 10,000 m²): $A = \dfrac{30{,}000}{10{,}000} = 3 \text{ ha}$

Final Answer: $A = 3 \text{ ha} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – wavelength from frequency: $\lambda = \dfrac{c}{f}$.

Step 1 – substitute the values: $\lambda = \dfrac{3 \times 10^8}{6 \times 10^{14}}$

Step 2 – divide the mantissas: $\dfrac{3}{6} = 0.5$

Step 3 – subtract the exponents: $10^{8-14} = 10^{-6}$

Step 4 – combine: $\lambda = 0.5 \times 10^{-6} \text{ m}$

Step 5 – convert to micrometres: $\lambda = 0.5\ \mu\text{m}$

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

Answer: (C) Go Back to Q31

Q32.

Solution

Concept – optical regions of the electromagnetic spectrum: The human eye and optical sensors respond to the 0.4–$0.7\ \mu$m band.

Step 1 – match the band to its name: 0.4–$0.7\ \mu$m is the visible region (violet through red).

Why the other options are wrong:

- A, thermal infrared: lies around 8–14 μm.
- B, microwave: lies at millimetre-to-centimetre wavelengths.
- C, near infrared: begins just beyond 0.7 μm (about 0.7–1.3 μm).

Final Answer: visible region $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept – ground sampling distance: $\text{GSD} = \dfrac{\text{swath width}}{\text{number of pixels across the swath}}$.

Step 1 – convert the swath to metres: $8 \text{ km} = 8000 \text{ m}$

Step 2 – divide by the pixel count: $\text{GSD} = \dfrac{8000}{8000}$

Step 3 – evaluate: $\text{GSD} = 1 \text{ m}$

Final Answer: $\text{GSD} = 1 \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept – spectral signature of vegetation: Chlorophyll absorbs strongly in the red, while leaf cell structure reflects strongly in the near infrared, producing a steep step between the two.

Step 1 – locate the feature: The reflectance jumps sharply near 0.7 μm, at the red / near-infrared boundary.

Step 2 – name it: This steep rise is called the "red edge".

Why the other options are wrong:

- A, blue shift: not a vegetation reflectance feature.
- B, thermal emission peak: belongs to the far infrared, unrelated to this step.
- C, water absorption band: causes dips in the mid-infrared, not the red/NIR rise.

Final Answer: red edge $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – the four resolutions of a sensor: Spectral resolution describes how finely the sensor separates wavelengths.

Step 1 – match the definition: Distinguishing two adjacent, narrow wavelength intervals is a wavelength-discrimination ability.

Step 2 – name it: That ability is the spectral resolution.

Why the other options are wrong:

- B, spatial: the smallest ground feature resolved.
- C, temporal: how often the same area is revisited.
- D, radiometric: the number of brightness levels recorded.

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

Answer: (A) Go Back to Q35

Q36.

Solution

Concept – radiometric resolution: With b bits per pixel the number of grey levels is 2^b.

Step 1 – substitute $b = 8$: levels $= 2^8$

Step 2 – expand the power: $2^8 = 256$

Final Answer: 256 grey levels $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – raster data model: A raster tessellates space into a regular array of cells, each cell storing one attribute value (elevation, reflectance, class, etc.).

Step 1 – describe the structure: Space is a rectangular matrix of equal-size cells.

Step 2 – state what each cell holds: Each cell carries a single numeric value for the location it covers.

Why the other options are wrong:

- A, node–edge network: describes a topological network model.
- C, points/lines/polygons by coordinates: is the vector model.
- D, triangulated irregular network: is a TIN, used mainly for surfaces.

Final Answer: a matrix of grid cells, each with a value $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept – raster storage size: size $=$ rows $\times$ columns $\times$ bytes per cell.

Step 1 – multiply rows by columns: $1000 \times 1000 = 1{,}000{,}000$ cells

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

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

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

Answer: (A) Go Back to Q38

Q39.

Solution

Concept – buffer operation in GIS: A buffer creates a new polygon that contains every location within a specified distance of an input feature.

Step 1 – identify the input and distance: Input is the road line; buffer distance is 50 m on each side.

Step 2 – state the output: The result is a polygon enclosing all ground lying within 50 m of the road.

Why the other options are wrong:

- B: a buffer is a vector polygon, not an elevation raster.
- C: a buffer expands the feature; it does not collapse it to a point.
- D: a contour is an equal-value line, unrelated to a distance buffer.

Final Answer: a polygon of all points within 50 m of the road $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – intersection (AND) overlay: An intersection keeps only the geometry (and combined attributes) where both input layers coincide.

Step 1 – apply the logical AND: A location is retained only if it lies in A *and* in B.

Step 2 – describe the output: That is exactly the region common to both polygons, i.e. $A \cap B$.

Why the other options are wrong:

- A: keeping either layer is a union (OR), not an intersection.
- B: keeping A outside B is an erase/difference.
- D: keeping the outside of both is the complement.

Final Answer: the area common to both A and B $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept – classifying GIS queries: A query that selects features by their distance to other features is spatial and proximity-based.

Step 1 – read the condition: "Within 2 km of a highway" is a distance (nearness) test.

Step 2 – classify it: Selecting by nearness is a proximity-based spatial query (typically done with a buffer or a distance function).

Why the other options are wrong:

- A: an attribute-only query uses table fields, not location.
- C: shortest-path uses a connected network, not a simple distance band.
- D: reclassification changes raster cell values, not a selection by proximity.

Final Answer: proximity-based spatial query $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – GNSS position fix: Each satellite pseudorange gives one equation; the unknowns are the three position coordinates plus the receiver clock bias.

Step 1 – count the unknowns: X, Y, Z and clock error $\Rightarrow 4$ unknowns.

Step 2 – match equations to unknowns: Solving for 4 unknowns needs at least 4 independent pseudorange equations.

Step 3 – conclude: Hence at least 4 satellites must be tracked simultaneously.

Why the other options are wrong:

- A, 3: enough only if the clock error were already known.
- C, 5: more than the minimum (adds redundancy, not required).
- D, 2: far too few even for a horizontal fix.

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

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – pseudorange from travel time: $\rho = c \times t$, distance equals speed of light times signal travel time.

Step 1 – substitute the values: $\rho = (3 \times 10^8) \times (0.07)$

Step 2 – multiply the mantissas: $3 \times 0.07 = 0.21$

Step 3 – write with the power of ten: $\rho = 0.21 \times 10^8$ m

Step 4 – normalise: $\rho = 2.1 \times 10^7$ m

Step 5 – convert to kilometres: $\rho = 2.1 \times 10^4$ km $= 21{,}000$ km

Final Answer: $\rho \approx 21{,}000$ km $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q43

Q44.

Solution

Concept – UTM zone width: The UTM system splits the Earth into 60 longitudinal zones covering $360°$.

Step 1 – divide the full longitude range by the number of zones: $\dfrac{360°}{60} = 6°$

Step 2 – state the width: Each UTM zone spans $6°$ of longitude.

Why the other options are wrong:

- B, $3°$: is the zone width of the Gauss–Kruger / national grids, not UTM.
- C and D: give the wrong number of zones (45 and 36 respectively).

Final Answer: $6°$ of longitude $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q44

Q45.

Solution

Concept – the WGS-84 reference surface: Geodetic coordinates in WGS-84 are defined on a mathematically smooth, Earth-centred, Earth-fixed ellipsoid of revolution.

Step 1 – identify the surface: Latitude, longitude and ellipsoidal height are referred to the WGS-84 reference ellipsoid.

Why the other options are wrong:

- A, geoid: is the equipotential (mean-sea-level) surface used for orthometric heights, not the datum's coordinate surface.
- C, flat plane: is only a local approximation for small areas.
- D, topographic surface: is the irregular physical ground, not a reference surface.

Final Answer: an Earth-centred reference ellipsoid $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept – conformal (orthomorphic) projection: A conformal projection preserves angles at every point, so the shapes of small features and local directions are kept true (which is why rhumb lines plot as straight lines in Mercator).

Step 1 – state the defining property: Meridians and parallels intersect at right angles and the scale is the same in all directions at a point.

Step 2 – give the consequence: Local angles and the shapes of small areas are preserved, aiding navigation.

Why the other options are wrong:

- A and C: preserving area is the property of an equal-area projection, and Mercator badly exaggerates high-latitude areas.
- B: no flat map can preserve true distance in every direction everywhere.

Final Answer: preserves local angles and shapes (conformality) $\Rightarrow \boxed{D}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q46

Answer Key

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