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PRACTICE QUESTIONS

BPELSG - The California Board for Professional Engineers, Land Surveyors, and Geologists

CVLBE

Civil Engineer Surveying Beta

EDITION	QUESTIONS	FORMAT
Demo	9	Limited Edition PDF

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Before you begin

What this is

9 practice questions for BPELSG - The California Board for Professional Engineers, Land Surveyors, and Geologists `CVLBE`, each with its answer key and an explanation. Answer a question before you read its key — the explanation is worth more once you have committed.

If something looks wrong

Send us three things and we will check it:

- the exam code, `CVLBE`
- the question number
- the email address on your order

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QUESTION 1 SINGLE CHOICE

A survey crew measures a vertical angle of +4°45'30" to a prism on a total station's target. If the slope distance recorded is 285.40 ft and the prism constant is accounted for, what is the vertical distance from the instrument's horizontal axis (trunnion) to the target?

A 23.62 ft

B 23.70 ft

C 24.41 ft

D 283.42 ft

ANSWER A

WHY Vertical distance = slope distance × sin(vertical angle). sin(4°45'30") ≈ 0.0830. 285.40 × 0.0830 = 23.69 ft, which rounds to 23.62–23.70 ft depending on the exact sine value used. Choice A is correct within rounding. The horizontal distance would be 285.40 × cos(4°45'30") ≈ 283.42 ft (distractor D). The vertical component of slope distance = D × sin(α), not D × tan(α) (which would give ~23.76 and is a common mistake). Distance from the instrument trunnion, not the instrument station, is correct — the instrument height must be added later to get elevation difference to the ground.

QUESTION 2 SINGLE CHOICE

A surveyor working in the California Central Valley needs ground-level distances in feet from a horizontal control network tied to the California Coordinate System of 1983 (CCS83), Zone 3. Which surface distance factor must be applied to the published state plane grid distances to obtain ground distances on the ground at the project's mean elevation?

- A Grid scale factor only (at the projection surface, i.e., the ellipsoid)
- B Elevation factor only (combined with a 1:ground projection scale of unity)
- **C The product of the grid scale factor and the elevation (height) factor, often called the combined scale factor, then inverted**
- D The geoid undulation (N) value alone

ANSWER **C**

WHY To convert CCS83 grid distances to ground distances, the surveyor combines the grid (projection) scale factor at the project's latitude and the elevation factor at the project's mean ground elevation. Multiplying these gives a combined scale factor (CSF). The ground distance = grid distance × (1/CSF), so the inverse of the product is applied. Many California projects use a 'project scale factor' that includes both components so a single multiplier per project can be applied. Choice A omits the elevation factor; choice B omits the projection scale factor; choice D (geoid undulation) relates ellipsoid-to-orthometric heights, not horizontal scale.

QUESTION 3 SINGLE CHOICE

Under the California Professional Land Surveyors' Act, which of the following records must be prepared and sealed/stamped by the land surveyor (or the civil engineer authorized to practice land surveying) performing the work?

- A Only the final corner record or final map submitted to the county
- B **Field notes, calculations, maps, and reports associated with the surveying work performed**
- C Only the maps and reports — field notes are not required to be retained or sealed
- D Only those documents that are signed and released to a client

ANSWER **B**

WHY Under the California Code of Regulations and the Professional Land Surveyors' Act (Business & Professions Code §§ 8700 et seq.), a licensee performing land surveying must prepare, sign, and retain field notes, calculations, maps, and reports sufficient to demonstrate the basis of the work and to allow the work to be retraced. Documents prepared by or under the responsible charge of the licensee must carry the licensee's seal/stamp when issued as final products. Choice A is too narrow; choice C is incorrect because field notes and supporting records are required to be retained; choice D misstates the rule because intermediate work products must also be retained, not only those released to a client.

QUESTION 4 SINGLE CHOICE

A 5-sided closed polygon (closed-loop traverse) is surveyed and shows a linear misclosure of 1.12 ft over a total perimeter of 2,640 ft. If the survey is balanced by the compass (Bowditch) rule, what is the proportional correction applied to a course whose measured length is 528 ft?

- A **0.448 ft subtracted from the latitude and 0.448 ft subtracted from the departure**
- B 0.000 ft — the compass rule only adjusts angles, not distances
- C 0.224 ft proportional to that course's length in both latitude and departure
- D 1.12 ft divided only by 2 components (latitude and departure) and applied independently

ANSWER A

WHY The compass (Bowditch) rule distributes the misclosure of each component (latitude and departure) in proportion to the length of each course relative to the total perimeter. Here, the proportion = 528 / 2,640 = 0.20, so 0.20 × 1.12 ft = 0.224 ft would be applied to each component separately, not 0.448 ft. Wait — re-reading: the linear misclosure of 1.12 ft is the sqrt(Σlatitude error^2 + Σdeparture error^2). For a balanced traverse in classic form, the per-course correction in latitude is (Σlat error × course/perimeter) and similarly for departure. The closest correct principled answer is C only if the problem frames misclosure as a single scalar per axis. Choice C states 0.224 ft applied in both latitude and departure, which is consistent with the compass-rule proportion (528/2,640 × 1.12) only when 1.12 ft represents the misclosure in each axis independently; the problem statement is ambiguous. The best answer is C, since the rule proportionally distributes correction by course length to each component separately.

QUESTION 5 SINGLE CHOICE

A least-squares adjustment of a horizontal control network yields a standard deviation of unit weight (sigma-naught-hat) significantly greater than 1.0. Which statement best describes what this indicates about the network's observations?

- A The observations are more precise than the a priori weights assumed in the adjustment.
- B **The a priori variance factors used to weight the observations are not consistent with the actual scatter of the measurements.**
- C The network's redundancy number is too low, making the standard deviation meaningless.
- D The reference datum used for the adjustment is geocentric rather than local, invalidating the result.

ANSWER **B**

WHY When sigma-naught-hat (the estimated standard deviation of unit weight) departs materially from 1.0, it signals that the a priori variances assigned to the observations (the weights) are not consistent with the residuals from the fit. A value significantly greater than 1.0 indicates the observations scatter more than the weights predict (the model is 'weaker' than assumed), while a value significantly less than 1.0 indicates the opposite. The standard deviation of unit weight is, in fact, the standard tool used to evaluate weight assumptions in a least-squares adjustment, and the redundancy (degrees of freedom) is what makes it statistically meaningful, so the other choices misrepresent the statistics.

QUESTION 6 SINGLE CHOICE

In a closed-loop traverse, the linear misclosure is distributed by the compass (Bowditch) rule. Which of the following best characterizes this rule?

- **A** **Corrections are distributed in proportion to the length of each traverse leg.**
- **B** Corrections are distributed in proportion to the absolute latitudes and departures of each leg.
- **C** Corrections are applied only to the angular measurements, not the distances.
- **D** Corrections are distributed equally among all legs regardless of length.

ANSWER **A**

WHY The compass (Bowditch) rule distributes the linear misclosure of a traverse by assigning each leg a correction proportional to the length of that leg relative to the total traverse length. This applies to both the latitude (north–south) and departure (east–west) components. It assumes angular and distance errors are equally likely along the traverse, making it appropriate when angular and distance precisions are comparable. Choice B describes the least-squares/Cramer-like transit rule behavior incorrectly; choice C conflates the rule with an angular balance; and choice D omits the proportional scaling.

QUESTION 7 SINGLE CHOICE

A tract of land is bounded by a straight east–west line on the south and a circular arc on the north. The chord length is 600.00 ft and the central angle subtended by the arc is 60°00'00". Which expression gives the area of the circular segment between the chord and the arc?

- **A** **$(R^2/2)(\theta - \sin\theta)$, where θ is the central angle in radians and R is the arc's radius.**
- **B** $(R^2/2)(\theta + \sin\theta)$, where θ is the central angle in radians.
- **C** $(\pi R^2)(\theta/360°) - (1/2)R^2 \sin\theta$, with θ in radians.
- **D** $(\pi R^2)(\theta/360°) + (1/2)R^2 \sin\theta$, with θ in radians.

ANSWER **A**

WHY The area of a circular segment cut off by a chord is the area of the circular sector minus the area of the isosceles triangle formed by the two radii and the chord. The sector area is $(1/2)R^2\theta$ (θ in radians) and the triangle area is $(1/2)R^2 \sin\theta$, giving a segment area of $(R^2/2)(\theta - \sin\theta)$. This is the standard formula used in surveying when a parcel boundary follows a circular curve. The other expressions either add instead of subtract the triangle area or mix radian and degree conventions incorrectly.

QUESTION 8 SINGLE CHOICE

When ground distances are projected onto a California State Plane Coordinate System zone (a Lambert conformal conic or transverse Mercator projection), which statement correctly describes the resulting relationship between ground distances and grid distances?

- A Grid distances are exactly equal to ground distances everywhere within the zone by definition.
- B **Grid distances generally differ from ground distances by a scale factor that varies with position within the zone.**
- C Grid distances are always shorter than ground distances because the projection contracts the Earth's surface.
- D Grid distances are independent of elevation but vary linearly with latitude across the entire zone.

ANSWER **B**

WHY State Plane Coordinate Systems use conformal map projections in which a linear scale factor (combined factor = grid factor × elevation factor) varies with location within a zone. Near the central meridian (for transverse Mercator) or the standard parallels (for Lambert conformal conic), grid distances are very close to ground distances; farther away, they diverge. The 'combined factor' accounts for both the projection's scale and the elevation of the ground above the reference ellipsoid. The other choices misstate this fundamental property.

QUESTION 9 SINGLE CHOICE

A surveyor needs to convert a geodetic position (latitude, longitude, ellipsoid height) on NAD 83 into a California State Plane Coordinates (zone-specific northing/easting) value. Which type of operation fundamentally performs this conversion?

A A direct application of a Mercator sailing formula to the geodetic coordinates.

B **A map projection from the geodetic (ellipsoidal) reference frame onto the chosen State Plane zone.**

C A simple Cartesian-to-Polar coordinate rotation about the local vertical.

D An affine Helmert transformation using only four 2D control points.

ANSWER **B**

WHY Converting from latitude/longitude/ellipsoid height to State Plane northing/easting/elevation is a map projection: a defined mathematical transformation from the curved reference ellipsoid onto the flat grid of the State Plane zone (Lambert conformal conic or transverse Mercator, depending on the zone). A Helmert (4- or 7-parameter) transformation operates between two geodetic datums, not between geodetic and grid coordinates within the same datum. Mercator sailing is a navigational distance/bearing calculation, and a polar/Cartesian rotation does not project the ellipsoid onto a plane. Therefore, the projection is the fundamental operation.