GATE 2026 GE Question Paper with Solutions

Time Allowed :3 Hour	Maximum Marks :100	Total Questions :65

General Instructions

Please read the following instructions carefully:

1. This question paper is divided into three sections:
   - **General Aptitude (GA):** 10 questions (5 questions $\times$ 1 mark + 5 questions $\times$ 2 marks) for a total of 15 marks.
   - **Environmental Science and Engineering + Engineering Mathematics:**
     - **Part A (Mandatory):** 36 questions (1 questions $\times$ 1 mark + 19 questions $\times$ 2 marks) for a total of 55 marks.
     - **Part B (Section 1):** Candidates can choose either Part B1 (Surveying and Mapping) or Part B2 (Section 2). Each part contains 16 questions (8 questions $\times$ 1 mark + 11 questions $\times$ 2 marks) for a total of 30 marks.
2. The total number of questions is **65**, carrying a maximum of **100 marks**.
3. The duration of the exam is **3 hours**.
4. Marking scheme:
   - For 1-mark MCQs, $\frac{1}{3}$ mark will be deducted for every incorrect response.
   - For 2-mark MCQs, $\frac{2}{3}$ mark will be deducted for every incorrect response.
   - No negative marking for numerical answer type (NAT) questions.
   - No marks will be awarded for unanswered questions.
5. Ensure you attempt questions only from the optional section (Part B1 or Part B2) you have selected.
6. Follow the instructions provided during the exam for submitting your answers.

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1. The angle between true north and magnetic north is called:

(A) Local attraction
(B) Magnetic declination
(C) Dip of needle
(D) Bearing

Correct Answer: (B) Magnetic declination

Solution:

Step 1: Understanding the Concept:
In surveying, there are different meridians used as reference lines.
The "True North" represents the direction towards the geographic North Pole, which remains constant.
The "Magnetic North" is the direction indicated by a freely suspended magnetic needle, which varies due to the Earth's shifting magnetic field.

Step 2: Detailed Explanation:
The horizontal angle between the true meridian (true north) and the magnetic meridian (magnetic north) at a particular location is defined as Magnetic Declination.
1. If the magnetic north is to the east of true north, the declination is termed as "Positive" or "Eastern Declination".
2. If the magnetic north is to the west of true north, the declination is termed as "Negative" or "Western Declination".
- Local attraction refers to the disturbance of the magnetic needle by nearby magnetic objects.
- Dip of the needle is the vertical angle the needle makes with the horizontal plane.
- Bearing is a general term for the horizontal angle between any reference meridian and a line.

Step 3: Final Answer:
The angle between true north and magnetic north is specifically called magnetic declination.

> Quick Tip
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> True Bearing = Magnetic Bearing $\pm$ Declination.
> Use (+) for Eastern Declination and (-) for Western Declination when calculating True Bearing.
> Remember: "East is Least, West is Best" is a common mnemonic, but for True Bearing, East is Added and West is Subtracted.

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2. In aerial photogrammetry, the scale of a vertical photograph is given by:

(A) Flying height / focal length
(B) Focal length / flying height
(C) Flying height $\times$ focal length
(D) Flying height $-$ focal length

Correct Answer: (B) Focal length / flying height

Solution:

Step 1: Understanding the Concept:
Scale in photogrammetry is the ratio of a distance on the photograph (map distance) to the corresponding distance on the ground (ground distance).

Step 2: Key Formula or Approach:
For a truly vertical photograph taken over flat terrain, the scale (S) is defined as:

$$S = \frac{\text{Distance on Photo (d)}}{\text{Distance on Ground (D)}} = \frac{f}{H - h}$$

Where:
f = Focal length of the camera lens.
H = Flying height of the aircraft above the Mean Sea Level (MSL).
h = Elevation of the ground above the MSL.

Step 3: Detailed Explanation:
If we consider the flying height relative to the ground (let $H_{avg} = H - h$), the formula simplifies to:

$$S = \frac{f}{H_{avg}}$$

This shows that the scale is directly proportional to the focal length and inversely proportional to the flying height.
A shorter focal length or a higher flying altitude results in a smaller scale (covers more area but with less detail).

Step 4: Final Answer:
The scale of a vertical photograph is the ratio of focal length to flying height.

Quick Tip

Scale is never perfectly uniform across an aerial photograph if the terrain is not perfectly flat.
The scale at a specific point depends on its elevation; higher points on the ground appear at a larger scale than lower points.

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3. Which type of remote sensing system uses its own source of energy?

(A) Passive remote sensing
(B) Optical remote sensing
(C) Active remote sensing
(D) Thermal remote sensing

Correct Answer: (C) Active remote sensing

Solution:

Step 1: Understanding the Concept:
Remote sensing systems are categorized based on the source of electromagnetic radiation used to illuminate the target.

Step 2: Detailed Explanation:
1. **Passive Remote Sensing:** These sensors detect energy that is naturally available. Most often, this is reflected sunlight or thermal energy emitted from the Earth's surface. Examples include standard satellite cameras and thermal infrared sensors.
2. **Active Remote Sensing:** These systems provide their own energy source for illumination. The sensor emits radiation (usually in the form of pulses) directed toward the target and then detects the radiation reflected or backscattered from that target.
Common examples of active systems include:
- **RADAR** (Radio Detection and Ranging)
- **LiDAR** (Light Detection and Ranging)
- **SONAR** (Sound Navigation and Ranging)

Step 3: Final Answer:
Active remote sensing systems are the ones that use their own source of energy.

> Quick Tip
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> Active systems like RADAR have a major advantage: they can operate during the day or night and can "see" through clouds and rain, unlike passive optical sensors which require sunlight and clear skies.

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4. Which data model represents geographic features using points, lines, and polygons?

(A) Raster model
(B) Vector model
(C) DEM model
(D) TIN model

Correct Answer: (B) Vector model

Solution:

Step 1: Understanding the Concept:
In Geographic Information Systems (GIS), real-world features are represented digitally using two primary data models: Raster and Vector.

Step 2: Detailed Explanation:
1. **Vector Data Model:** This model uses discrete geometric primitives to represent objects with distinct boundaries.

- **Points:** Represented by a single X, Y coordinate (e.g., a well, a light pole).
- **Lines (Polylines):** Represented by a sequence of connected points (e.g., a road, a river).
- **Polygons:** Represented by a closed sequence of connected points forming an area (e.g., a lake, a land parcel).

2. **Raster Data Model:** This model represents the world as a grid of cells or pixels, where each cell contains a value representing information (e.g., satellite imagery, elevation maps).

Step 3: Final Answer:
The Vector model is the one that uses points, lines, and polygons to represent geographic features.

> **Quick Tip**
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> Use Vector data for discrete features with high precision requirements (like cadastral boundaries).
> Use Raster data for continuous phenomena (like temperature, precipitation, or digital elevation models).

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5. The minimum number of satellites required to determine a 3D position using GPS is:

(A) 2
(B) 3
(C) 4
(D) 5

Correct Answer: (C) 4

Solution:

Step 1: Understanding the Concept:
Global Positioning System (GPS) positioning is based on the principle of trilateration, which involves measuring the distance (range) from the receiver to multiple satellites.

Step 2: Detailed Explanation:
To determine a position in three-dimensional space, we have four unknowns:
1. Latitude (X)
2. Longitude (Y)
3. Altitude or Elevation (Z)
4. Receiver Clock Bias (t)

While mathematically, three spheres (from 3 satellites) intersect at two points (one of which can usually be discarded as being in space), a fourth satellite is absolutely necessary to synchronize the receiver's clock with the atomic clocks on the satellites. Without this time synchronization, distance measurements would be highly inaccurate.

Step 3: Final Answer:
Therefore, a minimum of 4 satellites is required to solve for the four variables (X, Y, Z, t) and provide a 3D position fix.

> **Quick Tip**
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> If you only need a 2D position (Latitude and Longitude at a known altitude), a minimum of 3 satellites is required.
> For high-precision survey work, often 5 or more satellites are preferred to improve the Dilution of Precision (DOP).

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6. The method of least squares is used to:

(A) Eliminate systematic errors
(B) Reduce random errors
(C) Increase gross errors
(D) Correct instrumental errors

Correct Answer: (B) Reduce random errors

Solution:

Step 1: Understanding the Concept:
Errors in surveying observations are classified into three types:
1. **Gross Errors (Blunders):** Human mistakes (e.g., misreading a tape). They must be detected and removed.
2. **Systematic Errors:** Errors that follow a fixed pattern or mathematical law (e.g., tape expansion due to heat). They are corrected using formulas.
3. **Random Errors (Accidental):** Unpredictable variations that remain after gross and systematic errors are accounted for. They follow the laws of probability.

Step 2: Key Formula or Approach:
The Principle of Least Squares states that the "most probable value" of a quantity is the one for which the sum of the squares of the residuals (errors) is a minimum.

$$\sum v_i^2 \rightarrow \text{minimum}$$

Step 3: Detailed Explanation:
Since random errors cannot be eliminated, we use statistical methods to distribute them such that the overall discrepancy in the network is minimized. The method of least squares provides

a mathematically rigorous way to find the best estimate from redundant observations, thereby reducing the influence of random errors.

Step 4: Final Answer:
The method of least squares is primarily used to adjust observations and reduce random errors.

Quick Tip

Always remember:
- Systematic errors are "corrected".
- Random errors are "adjusted" (using Least Squares).
- Gross errors are "eliminated".

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7. Which map projection preserves angles and shapes locally?

(A) Equal-area projection
(B) Equidistant projection
(C) Conformal projection
(D) Azimuthal projection

Correct Answer: (C) Conformal projection

Solution:

Step 1: Understanding the Concept:
Map projections are mathematical transformations that project the 3D surface of the Earth onto a 2D plane. This process always introduces distortion in at least one property (Area, Shape, Distance, or Direction).

Step 2: Detailed Explanation:
Projections are classified based on the property they preserve:
1. **Equal-area (Equivalent) Projections:** Preserve the relative size (area) of regions but distort shapes.
2. **Conformal (Orthomorphic) Projections:** Preserve angles and therefore maintain the correct shapes of small (local) features. The scale is the same in all directions at any point.
3. **Equidistant Projections:** Maintain correct distances along certain specific lines (e.g., along meridians).
4. **Azimuthal Projections:** Preserve directions (azimuths) from a central point to all other points on the map.

Step 3: Final Answer:
A Conformal projection is designed to preserve local angles and shapes.

Quick Tip

The **Mercator Projection** is the most famous example of a conformal projection. It is indispensable for marine navigation because a straight line drawn on it represents a constant compass bearing (rhumb line).
