CHAPTER 1: LEVELLING

1. Write short notes on the following: **(1 Mark)**
    1. A level surface & level line
    2. A horizontal plane
    3. A vertical plane
    4. Line of collimation
    5. Axis of the level tube
    6. Axis of telescope
    7. Back sight reading
    8. Fore sight reading
    9. Intermediate sight
    10. Height of instrument
    11. Change point
    12. Bench mark
    13. Plumb line
    14. Equalization of BS and FS
    15. Mean sea level
    16. Datum surface
    17. Reduced level
    18. Precise leveling
    19. Check leveling
    20. Compound leveling
    21. Reciprocal Levelling
    22. Differential Levelling

2. Answer the following: **(2 Marks)**
    i. What is the datum adopted for GTS bench mark?
    ii. What are the different types of BM. Explain?
    iii. How does the RL of the starting point determined?
    iv. What is the difference between a level surface and a horizontal surface?
    v. How is the level centered?
    vi. What are the arithmetical checks for the HI method and the Rise and Fall method?
    vii. Why is datum assumed for plotting a levelling operation?
    viii. What is the difference between temporary and permanent adjustment?
    ix. State the advantages of reciprocal levelling.
    x. Find the height of a Tee-beam above the floor level. The R.L of the floor is 100.885m and the staff reading on the floor is 2.055m. The reading on a staff held upside down against the underside of the beam is 3.565m. (ans: 5.62m)
    xi. A level is set up at C on a line AB at 60m from A and 700m from B. The B.S on A is 2.650m and the F.S. on B is 2.780 m. Find the difference in levels between A & B. (Ans: 0.097m fall)

3. Solve/Explain the following: **(5/10 Marks)**
    1. Describe the procedure for the setting up of a level at a particular station. (**5**)
    2. Describe in short 'Rise and fall' method of Levelling. (**5**)
    3. Differentiate between Curvature correction and Refraction correction. (**5**)
    4. What are the permanent adjustments of a Dumpy Level? (**5**)
    5. Compare the two systems of reduction of levels, namely, collimation system and rise and fall method (**5**)
    6. Describe the various types of levelling. (**10**)
    7. Enumerate the difficulties in levelling. How will you cross each of them.(**10**)
    8. Mention how will you carry out the process of levelling under the following circumstances: (**5 x 4**)
    (a) Levelling across a high wall.

(b) Levelling across wide lake or pond.
(c) Levelling across a river.
(d) Levelling on summits or hollows.

9. Explain clearly the effect of curvature and refraction in levelling operations. Derive the formula for curvature correction and then deduce the formula for combined correction for curvature and refraction. When are these corrections applied in levelling? (**10**)
10. Show that the reciprocal levelling eliminates the effect of atmospheric refraction and earth's curvature as well as the effect of in-adjustment of line of collimation. (**10**)
11. Explain differential levelling, when is it called fly levelling? How is the day's work checked at the end? (**5**)
12. What are the essential parts of a dumpy level? (**5**)
13. Discuss the various types of bench marks. (**5**)
14. Explain the principle of balancing backsights and foresights. (**5**)
15. Calculate the correction for curvature, correction for refraction and combined correction for a distance of 10 km. (Ans: 7.85 m, 1.12 m, 6.73 m) (**5**)
16. R.L. of a factory-floor is 30.000 m. Staff reading on floor is 1.540 m and the staff reading when the staff is held inverted with bottom touching the beam of the roof truss is 3.888 m. Find the R.L. of the beam. (**5**)
17. The following series of readings of back sights and fore sights was taken in a fly levelling. The first reading was taken on a point of R.L. 100.000 m. Find the R.L. of all the points. Apply Checks.
    1.235, 1.396, 2.345, 1.986, 2.148, 3.755, 0.325, 2.568, 1.465, 2.435, 1.356, 0.768, 1.985 and 2.655
    (Ans: R.L. of last point = 98.296 m) (**10**)
18. The following is the page of a level book from which several values are missing. Reconstruct the page and fill the missing entries. Apply all necessary checks.

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks
1	1.385					100.000	B.M.
2		1.430			?	?	
3		1.825			0.395	?	
4	?		1.275	?		100.110	C.P.
5	0.630		0.585	0.310		?	C.P.
6		0.920			?	100.130	
7		?			0.210	?	
8			1.740		0.610	?	

    (Ans: B.S. = 0.895; I.S. = 1.130; Rise = 0.550; Fall = 0.045, 0.290; R.L. = 99.955, 99.560, 100.420, 99.920, 99.310) (**10**)
19. The observer at a height of 50 m above M.S.L. just sees a luminous object on the top of a hill. The distance between the observer's station and the hill is 100 km. What is the height of the hill? (Ans: 386.12 m) (**5**)
20. The observer standing on the deck of a ship just sees a light house. The top of the light house is 81 m above the sea level and the height of the observer's eye is 4 m above the sea level. Find the distance of the observer from the light house. (Ans: 42.40 km) (**5**)
21. The following table refers to reciprocal levels:

Instrument Near	Staff Readings on		Remarks
	P (m)	Q (m)	
P	1.850	2.850	PQ = 1055 m
Q	1.000	2.200	R.L. of P = 126.100

Determine the R.L. of Q and combined correction for curvature and refraction. (Ans: 125.000 m; 0.0749 m) (**5**)

22. In a levelling between two points A and B on opposite sides of a river. The level was set up near A and readings on A and B was 2.645 m and 3.230 m respectively. The level was then moved and set up near B. The respective staff readings on A and B were 1.085 m and 1.665 m. Find the true difference of level in A and B. (Ans: 0.5825 m) (**5**)
23. Two pegs A and B are driven in the ground at a distance of about 100 m. A dumpy level is set up near A and leveled. The observations are taken on a staff held at A and B and the readings on A and B are 1.054 and 1.084 respectively. The level is then shifted to a place near B and levelled. The staff readings at A and B are found to be 1.024 and 0.994 respectively. State if the instrument is in adjustment. If R.L. of A is 166.636 m, calculate the R.L. of B. (Ans: Out of adjustment; 166.636) (**5**)
24. The following details refer to reciprocal levels taken with a dumpy level:

Instrument at	Staff Readings on		Remarks
	A	B	
A	1.405	2.775	Distance between A and B = 1150 m
B	0.650	1.795	R.L. of B = 200.000 m

Determine (a) true level difference between A and B, (b) R.L. of A and (c) the error in collimation adjustment of the level. (Ans: (a) 1.257 m, fall from A to B, (b) 201.2575 m and (c) line of collimation in inclining upward, error: +0.001 m in 50 m) (**10**)

25. Reciprocal levels were taken with a dumpy level and the following observations were recorded:

Instrument at	Staff readings at station	
	A	B
A	1.225	1.375
B	0.850	0.500

R.L. of station A is known to be 626.155. Calculate the R.L. of station B. Also calculate the error in the line of collimation and state whether it is inclined upwards or downwards. (Ans: 626.055; 0.250, downwards) (**10**)

26. While performing levelling, a low boundary wall was found on the route. The HI on one side of the wall was calculated as 121.705m, and the FS taken putting the staff on the wall was 0.330. After shifting the instrument on the other side of the wall the B.S reading taken was 0.600. What is the HI after shifting the instrument? (Ans: 121.975m) (**5**)
27. R.L of a floor in an industrial complex is 64.500m. Staff reading on the floor is 1.715 and staff reading when it is held inverted with bottom touching the ceiling of the room is 2.970. Find the height of the ceiling above the floor. (Ans: 4.685m) (**5**)
