MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)

(ISO/IEC -270001 – 2005 certified)

SUMMER -2019 EXAMINATION

Subject code: 22301 **Model Answer**

Important Instructions to examiners:

1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

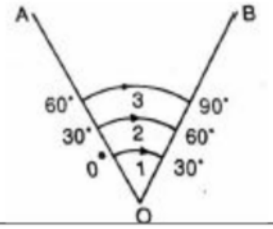
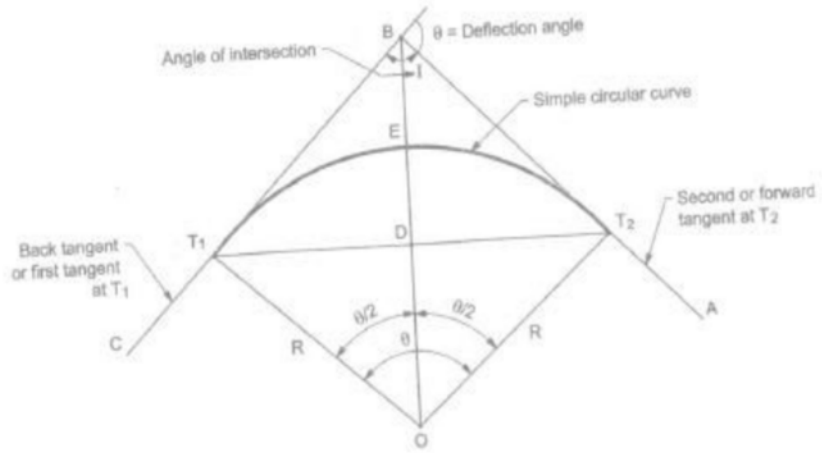
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

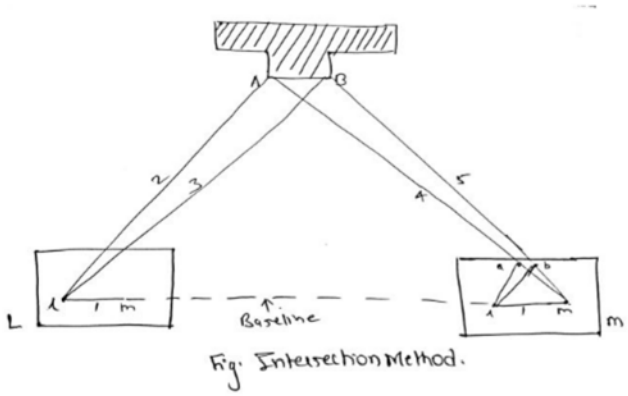
Q. No.	Question and Model Answers	Marks
1.	**Attempt any FIVE of the following:**	10M
a)	**State the purpose of alidade and 'U' fork in plane table surveying.**	
	Ans: In plane table surveying, purpose of– 1) **Alidade –** 1) to sight the object and 2) to draw or plot sight rays. 2) **'U' fork –** for centering the plane table.	**1M (each)**
b)	**Define swinging and transiting in theodolite surveying.**	
	Ans: In theodolite surveying, 1) **Swinging –**The turning of telescope about the vertical axis in horizontal plane is termed as swinging. 2) **Transiting –**The method of turning the telescope about its horizontal axis in a vertical plane through 180^0 is termed as transiting.	**1M (each)**
c)	**What is face left and face right observations.**	
	Ans: Face left observations – The observations taken with the vertical circle of instrument on the left side of the observer, are called face left observations. 1) **Face right observation – T**he observations taken with the vertical circle of instrument on the right side of the observer, are called face right observations.	**1M (each)**

d)	**State the principle of tacheometry.**	
	Ans: **Principle of Tacheometry –**The principle of tacheometry is based on the property of isosceles triangles, where the ratio of the distance from the apex and the length of the base is always constant. $\frac{D1}{S1} = \frac{D2}{S2} = \frac{D3}{S3} = \frac{f}{i}$ = constant Where f= focal length and i= stadia intercept ***(*Note- Student may draw figure to explain principle, give credit as 1M for figure and 1M for equation.)***	**1M*** **1M**
e)	**Define horizontal curve and vertical curve.**	
	Ans: 1) **Horizontal curve –**When the curve is provided in horizontal plane, it is called as horizontal curve. 2) **Vertical curve –** When the curve is provided in vertical plane, it is called as vertical curve.	**1M (each)**
f)	**State uses of Total station.**	
	Ans: **Uses of Total Station –** 1) To measure horizontal, vertical and sloping distance. 2) To measure horizontal and vertical angles. 3) To measure the level difference between different points. 4) To carry out contouring. 5) To prepare the map and drawings using software. 6) To prepare layout of building 7) To measure area and volume.	**2M (for any four uses)**
g)	**State uses of GPS.**	
	Ans: **Uses of GPS –** 1) To determine position or locations. 2) To navigate from one location to another. 3) To create digitized map. 4) To determine distance between two points. 5) Used in remote sensing. 6) Used in military and space. 7) To track or monitor object or personal movement. 8) To locate geographical features.	**2M (for any four uses)**
2.	**Attempt any <u>THREE</u> of the following:**	**12M**
a)	**Define orientation and explain back sight method of orientation with sketch.**	
	Ans: **Orientation-** The process of keeping the table at each successive stations parallel to the position which it occupied at the first station is known as orientation. **<u>OR</u>** The process by which the positions occupied by the board at various survey stations are kept parallel is known as orientation. **Back sight method of Orientation-** 1) The table is set up on first station A and next station B is bisected with the	**1M**

	help of alidade and lineab is drawn with appropriate scale. 2) On moving the table to the next station B, the table is oriented with the help of alidade. 3) The alidade is kept parallel to line ab and the table is rotated until the line of sight bisects the first station A. 4) The board is clamped properly without disturbing the centering.  Station A Station B	**2M** **1M**
b)	**State functions of optical plummet and shifting head in theodolite.**	
	Ans: Functions of- **1) Optical plummet** a) An optical plummet to be used in combination with a surveying instrument or theodolite. b) It is used for centering the theodolite over the station point. c) The optical plummet replaces the conventional plumb bob, in which a pointed weight is provided at the end of a string. d) It has the advantage thereover that it can be more precisely set than the conventional plumb bob. It is unaffected by the wind. **2) Shifting head** a) Shifting head contains two parallel plates which are moved one over the other within small area. Shifting head lies below the lower plate. b) It is useful for exact centering of the whole instrument over the station. c) It is done after initial setting of instrument. d) It is done by unclamping the screw and the upper plate of the shifting head is slid over the lower one until the plumb bob is exactly over the station mark. ***(*Note-2M for any two points of each.)***	**2M*** **2M***
c)	**Explain method of repetition of horizontal angle measurement.**	
	Ans: **Method of repetition of horizontal angle measurement-** 1) Set-up the theodolite over station O and level it properly. 2) Set the vernier A and vernier B at 0°0'0" and 180°0'0" respectively on the horizontal graduated scale. This is done by loosening the upper clamp and moving the upper plate until the zero of the vernier plate A coincides with the zero of the main scale. Tighten both the clamps. 3) Loosen the lower clamp and bisect point A, the readings in vernier A and vernier B should be 0°0'0" and 180°0'0" respectively. Minor adjustment in reading is done by lower tangent screw. 4) Loosen the upper clamp and bisect point B. Point B is accurately bisected using upper tangent screw. Tighten both the clamps and note the readings in both verniers. 5) Tighten the upper clamp and rotate the telescope either in clockwise or anticlockwise until it bisects point A. The readings in the vernier should remain the same. Loosen the upper clamp and bisect point B. Point B is accurately bisected using upper tangent screw. Tighten both the clamps and note the readings in both verniers. This time vernier A will be twice of the earlier angle.	**3M (for method)**

	6) In the same way take the angle for the third time. 7) Read the final angle. The average angle by face left will be the accumulated angle divided by 3. 8) Change the face of the theodolite and repeat the same procedure. 9) The mean of both angles gives the horizontal angle AOB.  	**1M (for Fig.)**
d)	**Explain with sketch notations of simple circular curve.**	
	Ans:  **Elements of simple curve** Where: Notations are as follows - 1) AB and BC are two tangents 2) BT_1 and BT_2 are lengths of tangents 3) BE are Apex distance. **4)** DE are Versed sine 5) T_1ET_2 is length of curve. 6) R is Radius of curve. 7) T_1DT_2 are length of long chord	**2M (for sketch)** **2M (for any four notations)**
3.	**Attempt any THREE of the following:**	**12M**
a)	**Explain measurement of bearing of line using theodolite.**	
	Ans: **Measurement of Bearing of line using theodolite:** Consider a Line AB whose bearing is to be measured by using theodolite. 1. Fix the instrument to the tripod stand and set the instrument exactly over station A. 2. Centre the theodolite, level it by using three foot screws and make the bubble exactly centre of tube with face left condition. 3. Unclamp the both plate clamping screw and set vernier A to 0° and vernier B to 180° and clamp the both the plate screw. 4. Unclamp lower plate screw and swing the telescope in horizontal plane keeping face left condition. 5. Place the trough compass exactly at the attachment provided to fix trough compass at the top of the standards. 6. Swinging the telescope fix the lower plate clamp when trough compass shows exactly north.	**4M for proper sequence**

	7. Unclamp the upper plate screw and bisect the ranging rod at B exactly and clamp the upper plate screw and take the readings on vernier A and Vernier B and note in the field book. 8. Repeat the same procedure with face right condition and mean of the both the readings give the correct bearing of the line AB.	
b)	**State any four essential characteristics of tacheometer.**	
	Ans: 1. The value of constant $\frac{f}{i}$= 100, where f is focal length and i= length of image. 2. The telescope when fitted with anallatic less, the value of (f+c) should be zero. 3. One should get clear and bright image even of long distance object. 4. The telescope should be powerful, the magnification should be 20 to 30 times Diameter. 5 The aperture of objective should be 35 to 45 mm in diameter in order to have Sufficiently bright image.	**1M each (any four)**
c)	**State the procedure of building set out using total station.**	
	Ans: 1. On the site plan and the floor plan supplied by the an architect/engineer, number the column serially from left to right and top to bottom starting from top left corner . 2. Work out the coordinates of the column centres with respect to any one plot corner or such other well defined point, assuming the parallel to any one building face as meridian. 3. In case of load bearing building one should work out co- ordinates at point of intersection of all centre lines. 4. Create on your personnel computer an excel document with four independent columns for column number and rest three for N,E, and H co-ordinates. 5. Upload this file to your total station instrument by making use of communication/transfer software provided with the total station. 6. Such software is invariably required to establish interface between external computer and total station instrument. 7. Carry this total station to proposed site. Set the total station at site at a point with respect with which the co-ordinates of columns centre are worked out. 8. Get done all the temporary adjustments of total station. Initiates the total station by providing it with the coordinates of the station occupied and by orienting the telescope along the meridian taken at the time of reduction of co-ordinates of column centres. 9. Now, activate the setting of program on the board of total station. Open the uploaded file and bring in the play the coordinates of any column to be set out. 10. Hold the prism pole at tentative position of that column at ground, bisect it and get measured its coordinates. 11. In next second, machine will display the discrepancies in the coordinates of the point occupied and point to be set out. 12. Get it understood, direct the reflector man accordingly to occupy the new position, bisect it again and get measured its coordinates to know the discrepancy in the coordinates of point occupied and point to be set out. 13. Repeat the process till you get no discrepancy in the coordinates of point occupied and point to be set out. This way get marked the centers of rest of the columns. 14. Check the accuracy of the process of setting out by comparing the diagonal	**4M for correct sequence**

	distance between the extreme column centers to their calculated values . 15 The points marked so may be transferred to the sight rails on sides, so that it can be easily referred by the workmen from time to time when the construction of foundation is in progress	
d)	**Define Active and Passive Sources.**	
	Ans: **Active Sources (System):** When the system in which irradiance from artificially generated energy sources such as RADAR, is used then it is called as Active system. **Passive Sources (System):** The system in which sun and earths materials are used as natural sources so as to radiate electro magnet energy of variable wavelength is called as passive system	**2M each**
4.	**Attempt any THREE of the following.**	**12M**
a)	**Explain with sketch intersection method of plane table surveying.**	
	 Fig. Intersection Method.	**2M**
	Ans: In intersection method the point is fixed on plan by intersection of rays drawn from the two instruments station. **Procedure:** 1. Select two stations L and M in a commanding position. 2. The line joining the station L and M is known as base line. 3. Measure the base line LM. 4. Set up the table at station L and mark the point *l* on sheet over L. 5. Orient board by placing alidade along *lm* and turn the board until the ranging rod at B is bisected and clamp the board. 6. With alidade touching point l draw rays 1,2,3, of indefinite length as shown in figure. 7. The table is then shifted to station M, orient it by back sighting method. **8.** Through *m* draw rays towards the points previously sighted that is 4,5 are drawn. Intersection of rays drawn from l and m gives position of objects on paper.	**2M**

b) **A traverse survey was conducted and following data is received, find missing length and bearing of line DA.** **4M**

Line	Length	Bearing
AB	155.80	78°30′
BC	175.00	155°35′
CD	238.50	248°42′
DA	?	?

Step 1) Calculation of Reduced Bearing :

Reduced bearing of AB = 78°30′= N78°30E

Reduced bearing of BC = 155°35′= 180°-155°35′=S24°25′E

Reduced bearing of CD = 248°42′=248°42′-180°00′=S68°42′W

Step 2) Calculation of Lattitude :

Lattitude of Line AB= $l\cos\theta$ = 155.80cos78°30′=31.06 (as line going towards north is considered as +ve) **1M**

Lattitude of Line BC= $l\cos\theta$ =175cos24°25′ = -159.34 (as line going towards south is considered as -ve)

Lattitude of Line CD= $l\cos\theta$ =238.50cos68°42′ = - 86.63 (as line going towards south is considered as -ve)

Step 3) Calculation of Departure :

Departure of Line AB = $l\sin\theta$ = 155.80sin78°30′= 152.67(as line going towards east is considered as +ve)

Departure of Line BC = $l\sin\theta$ = 175sin24°25′ = 72.33 (as line going towards east is considered as +ve) **1M**

Departure of Line CD = $l\sin\theta$ = 238.50sin68°42′ = -222.20 (as line going towards west is considered as -ve)

Step 4) Calculation of Lattitude and Departure of Line DA **1M**

Algebraic Sum of all latitude = 0

∴ 31.06-159.34-86.63+L=0

-214.91+L=0

∴Lattitude of line DA = 214.91

Algebraic Sum of all departures = 0

∴ 152.67+72.33-222.20+D=0

2.8+D=0

∴Departure of line DA = -2.8

Step 5) Calculation of length and bearing of line DA **1M**

Length of DA = $\sqrt{L^2 + D^2} = \sqrt{214.91^2 + 2.8^2}$ = **214.92m**

$\tan\theta = \frac{D}{L} = \frac{2.8}{214.91} = 0.01$

$\theta = \tan^{-1}(0.01) = 0°44′47''$

∴Reduced Bearing of SP = N0°44°47′W

∴ Whole circle Bearing of SP = 360°- 0°44′47" = **359°15′13"**

Step 6) Table :

Line	Length	Bearing	Reduced Bearing	Lattitude	Departure
AB	155.80	78°30′	N78°30E	31.06	152.67
BC	175.00	155°35′	S24°25′E	-159.34	72.33
CD	238.50	248°42′	S68°42′W	86.63	-222.20
DA	**214.92**	**359°15′27"**	**N0°44°47′W**	**214.91**	**-2.8**

c) **State fundamental axis and lines of theodolite and give relations between them**

Ans: Axes and lines **2M (any four)**

1. Line of collimation or line of sight
2. Axis of Telescope
3. Axis of bubble tube
4. Vertical Axis
5. Horizontal Axis

Relation between different axis of theodolite. **2M (any two)**

1. Line of collimation and axis of telescope should coincide with each other.
2. Axis of bubble tube and line of collimation should be parallel to each other.
3. Horizontal axis should be perpendicular to vertical axis.

4 Axis of plate level must be perpendicular to vertical axis.
5 If the instrument has fixed vertical circle verniers, it must read zero in leveled Position.

d) State the features of electronic theodolite.

Ans: Following are features of Electronic Theodolite.

1. Dual side display and keyboard with push button/ keys.
2. Built in illumination for night operations.
3. Rechargeable Ni-Cd battery with auto power cutoff.
4. Compatability with E.D.M.S.
5. Communication port with RS-232 C compatibility.
6 Three keys commonly used are:

a. ON-OFF key for starting measurement or ending of the measurement.
b. RCL for recalling data from memory as well as changing sign(+ or -)

1M (any four)

5. Attempt any THREE of the following. **12M**

a **Calculate consecutive co-ordinates of following traverse.**

Line	Length(m)	WCB
AB	162	120° 30'
BC	142	17° 30'
CD	201	220° 30'
DA	120	333° 20'

Line	Length(m)	Reduced Bearing	latitude L*cosθ	Departure L*sinθ
AB	162	S 59^0 30′ E	-82.22	+139.58
BC	142	N $17^0$30′ E	+135.42	+42.70
CD	201	S $40^0$30′ W	-152.84	-130.54
DA	120	N $26^0$40′ W	+107.23	-53.85

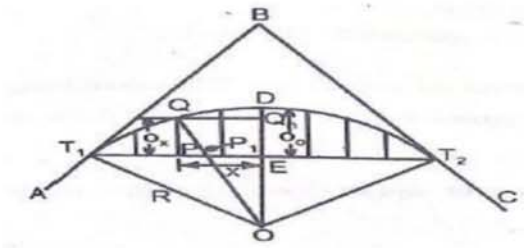
**

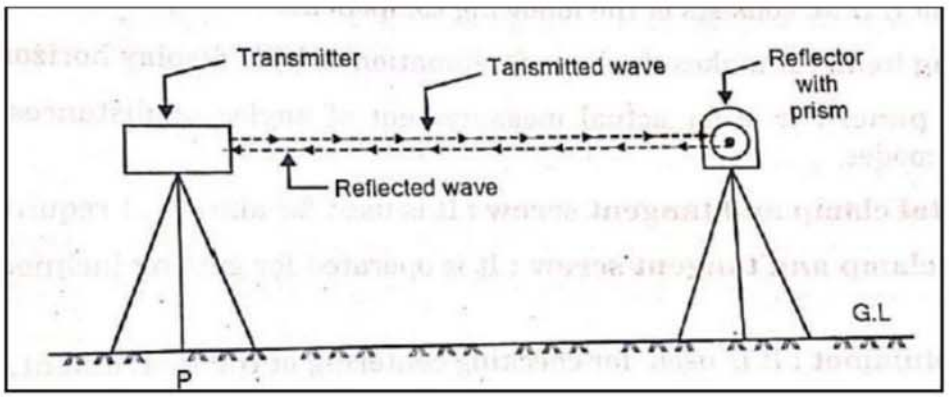
Calculations: Consecutive co-ordinates of Survey lines.
Line AB- Latitude = l*cosθ = 162 x cos 59^0 30′ = -82.22
Line BC- Latitude = l*cosθ = 142x cos $17^0$30′ = +135.42
Line CD- Latitude = l*cosθ = 201 x cos $40^0$30′ = -152.84
Line DA- Latitude = l*cosθ = 120 x cos $26^0$40′ = +107.23

Line AB- Departure = l*sinθ = 162 x sin 59^0 30′ = +139.58
Line BC- Departure = l*sinθ = 142 x sin $17^0$30′ = +42.70
Line CD- Departure = l*sinθ = 201 x sin $40^0$30′ = -130.54
Line DA Departure = l*sinθ = 120 x sin $24^0$40′ = -53.85

**(½Mark for each correct Latitude and ½ Mark for each correct Departure)

b	**Following observation were made using tacheometer, find constant of given tacheometer.** **Distance** | 50 m | 100 m **Staff readings** | 1.20,1.40,1.60 | 1.25,1.45,1.65	
	The constants of tacheometer. **Case 1 :** $D_1 = f/i \times S_1 + (f + c)$ $50 = f/i \times (1.60 - 1.20) + (f + c)$ $50 = 0.40 \times f/i + (f + c)$ ----------(1) $D_2 = f/i \times S_2 + (f + c)$ $100 = f/i \times (1.65 - 1.25) + (f + c)$ $100 = 0.40 \times f/i + (f + c)$ ----------(2) Equation 2 minus equation 1 gives result as : $50 = 0$ **Note: If student attempted to solve the question as above give appropriate marks accordingly."**	**1M** **1M** **1M** **1M**
c	**List any four feature of total station.**	
	Following are the features of total station. a) **High accuracy and long measuring range.** 1) High accuracy : ± (2 mm + 2 ppm) 2) Long measuring range with mini prism is 0.9 km. Long measuring range with single prism is 2 km. Long measuring range with 3 prism is 2.7 km. b) **Versatile application programs.** 1) On board data collection, stakeout/ survey road calculation and many more functions. 2) Integrated alphanumeric key realizes the quicker operation. 3) Large internal memory up to 24000 points. c) **Enhanced absolute encoder.** Adopted absolute encoder, which need not require zero set and it can also realize stable measurement with less reading error. d) **Superior water-resistant and dust proof.** e) **No worry about sudden bad weather**	**1M each (any four)**
d	**State various applications of GIS.**	
	Applications of GIS:- 1) Map making 2) Site selection 3) Mineral Exploration 4) Land use planning and management 5) Environmental Impact studies 6) Natural Hazard mapping or assessment	**1M each (any four)**

	7) Water Resources availability. 8) Road network analysis and planning	
6.	**Attempt any <u>THREE</u> of the following**	**12M**
a	State errors eliminated by the method of repetition.	
	The errors eliminated by repetition method are : 1) Errors due to eccentricity of verniers and centers are eliminated by taking the both vernier readings and averaging them. 2) Errors due to in adjustments of line of collimation and trunnion axis are eliminated by taking both face left and face right readings. 3) Errors due to inaccurate graduations are eliminated by taking the readings at different parts of circle. 4) Errors due to inaccurate bisection of object may compensate each other. 5) Errors due to improper levelling can be minimized.	**1M each (any four**
b	**Explain offset from long chord method curve setting.**	
	 **Given data:** direction of two straights, chainage of point of intersection, radius of curve **Procedure:** 1) Set theodolite over B and measure deflection angle ϕ 2) Calculate tangent length by formula Rx tan (ϕ/2). 3) Locate first tangent T_1 point by measuring backward along BA distance equal to tangent length and second tangent point T_2 by measuring forward along BC distance equal to tangent length. 4) Divide long chord into even number of equal parts. 5) Calculate ordinate O0 by formula $O0 = R - (R^2-(L/2)^2)^{0.5}$ and other ordinates by formula $O_x = (R^2- x^2)^{0.5} - (R - O0)$. 6) Locate mid point of Long chord (point E). 7) Chain is laid in ET_1 direction , perpendicular is erected at E, say by optical square, point on curve is fixed by measuring distance O_0 along the erected perpendicular. 8) Other offsets are similarly set. **9)** Curve being similar about mid point of long chord, calculations for right half are similar to left half.	**1M fig.** **3M procedure.**

c	**State the principle of EDM with sketch.**	
	 • Let the distance between P and Q be 'D' which is to be measured. • A wave transmitted from the transmitter at station 'P' with certain phase angle. There is a reflector at the other end 'Q'. Reflector consist of prism. The wave strikes on reflector at Q and then gets reflected from Q. • It is received back at the transmitter end at 'P' with different phase angle. For finding the distance, the phase difference between transmitted wave is measured and converted into distance.	**2M** **2M**
d	**State the different sources of error in GIS**	
	Source of Error in GIS Following are the various source of error in GIS 1. Error due to source data: a) Geometrical and semantic errors in the compilation of the source maps. b) Inaccuracy in source data. c) Inaccuracies due to the range character of natural boundaries. d) Error due to source data being out of date. e) Limitation of survey equipment. 2. Error occurring due to data input: a) Error in attribute data entry. b) Error due to operation mistakes. 3. Error in data storage: a) Error due to limited precision with which co-ordinates and other numerical data are stored. b) Error arising from resterization. 4. Error in data analysis and manipulation: a) Error due to incorrect formula used. b) Error due to map overlay. 5. Error in output application: a) Error due to the limitation of output device. **b)** Incorrect application of GIS products.	**1M each (any four**