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CLASS TEST

CIVIL ENGINEERING

Date of Test : 09/10/2021

ANSWER KEY ➤ Surveying

1.	(b)	7.	(d)	13.	(b)	19.	(b)	25.	(a)
2.	(d)	8.	(d)	14.	(a)	20.	(b)	26.	(c)
3.	(d)	9.	(b)	15.	(d)	21.	(b)	27.	(a)
4.	(b)	10.	(c)	16.	(d)	22.	(b)	28.	(c)
5.	(a)	11.	(c)	17.	(c)	23.	(d)	29.	(c)
6.	(d)	12.	(a)	18.	(a)	24.	(d)	30.	(b)

DETAILED EXPLANATIONS

2. (d)

1. If a quantity is multiplied by a factor, the weight of the product is equal to the weight of that quantity divided by the square of the factor. For example, if an angle is α and weight = 2, then

   weight of 3α = $\frac{2}{3^2} = \frac{2}{9}$.

2. If a quantity is divided by a factor, the weight of the result equal to the weight of that quantity multiplied by the square of the factor. For example, if an angle is α and weight = 2, then weight of $\alpha/3 = 2 \times 3^2 = 18$.
3. If an equation is multiplied by its own weight, the weight, of the resulting equation is equal to the reciprocal of the weight of the equation. For example, angle is (A+B) and weight of angle (A+B) is 4/9, then weight of 4/9 (A+B) =9/4.

3. (d)

As the ends of bubble lie on opposite side of zero.

$$n = \frac{(L_1 - r_1) + (r_2 - L_2)}{2} = \frac{(20-10)+(20-10)}{2} = 10$$

$$R = \frac{nLd}{s} = \frac{10 \times 100 \times 0.002}{(1.452 - 1.370)} = 24.39 \text{ m}$$

$$\phi = \frac{206265}{Ln} = \frac{206265 \times (1.452 - 1.370)}{100 \times 10} = 16.91''$$

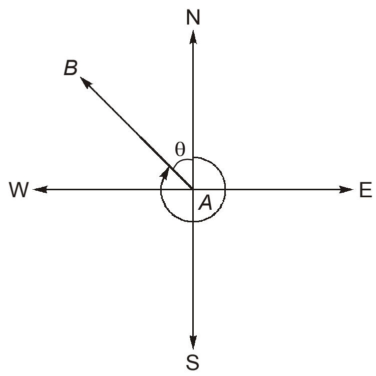
5. (a)

$$\text{Correct length} = \frac{\text{RF of wrong scale}}{\text{RF of correct scale}} \times \text{ measure length}$$

$$= \frac{1/50}{1/100} \times 50 = 100 \text{ m}$$

$$\text{Correct area} = \frac{(1/50)^2}{(1/100)^2} \times 60 = 240 \text{ m}^2$$

7. (d)



$$l \cos \theta = 78 \text{ and } l \sin \theta = -45.1$$

$\therefore$ $$\tan \theta = -0.578$$

$$\theta = -30°$$

$\therefore$ $$\text{WCB of } AB = 360° - 30°$$

$$= 330°$$

9. (b)

$$\text{TB} = \text{MB} \pm \text{declination}$$

$$\text{MB} = 178°$$

$$\text{TB of sun at noon} = 180°$$

$$180 = 178 \pm \text{declination}$$

$$\text{declination} = 2° \quad (\text{positive}) \quad \Rightarrow \quad 2°\text{E}$$

11. (c)

For a well-conditioned triangle.

Interior angle should be within 30° to 120° otherwise they are called ill-conditioned.

12. (a)

BS	*IS*	*FS*	*Rise*	*Fall*	*RL*
0.680					80.750
	1.455			0.775	79.975
	1.855			0.400	79.575
	2.330			0.475	**79 100**
	2.885			0.555	78.545
1.055		3.380		0.495	78.050

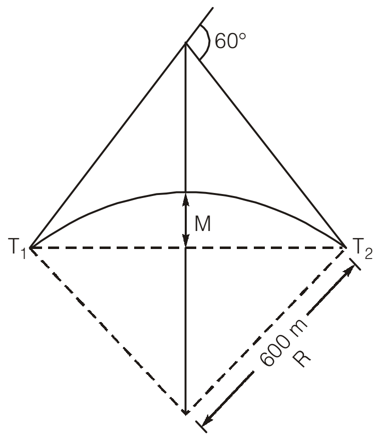
RL of the point that was read as 0.680

= 79.100 + total fall up to 2.330 reading

= 79.100 + (0.475 + 0.400 + 0.775)

= 80.750 m

13. (b)



Length of long chord,

$$T_1T_2 = 2\,R \sin(\Delta/2)$$
$$= 2 \times 600 \times \sin(60/2)$$
$$= 600 \text{ m} \qquad (\because \Delta = 60°)$$

Length of mid-ordinate,

$$M = R[1 - \cos(\Delta/2)]$$
$$= 600[1 - \cos(60/2)]$$
$$= 600 \times 0.134 = 80.4 \text{ m}$$

15. (d)

Let CD be the width of the river.

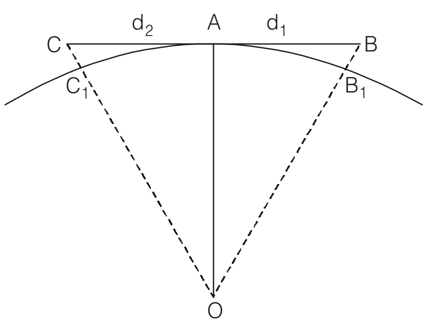
$$\frac{AD}{CD} = \tan 38°$$

$$\frac{DB}{CD} = \tan 22°$$

$$AD = CD \tan 38°$$
$$DB = CD \tan 22°$$
$$AD + DB = 75$$
$$= CD(\tan 38° + \tan 22°)$$

$$CD = \frac{75}{\tan 38° + \tan 22°} = 63.27 \text{ m}$$

16. (d)



B is the position of top of tower

C is the eye level of the sailor

BC is tangential of sea level at A

Then $B_1B = h_1 = 30$ m and $C_1C = h_2 = 5$ m

$$d_1 = 3855.3\sqrt{h_1} = 3855.3\sqrt{30} = 21116.3 \text{ m}$$

$$d_2 = 3855.3\sqrt{h_1} = 3855.3\sqrt{5} = 8620.7 \text{ m}$$

Distance between the observer and the lighthouse

$= d_1 + d_2$

$= 8620.7 + 21116.3 = 29737$ m

$= 29.737$ km

17. (c)

Height of vane above the instrument axis

$= D \tan\alpha = 2000 \tan 9°30'$

$= 334.69$ m

Correction for curvature and refraction $= \dfrac{6}{7}\dfrac{D^2}{2R} = 0.06728D^2$ m (*D* is in km)

$= 0.06728\ (2)^2 = 0.2691$ m $= 0.27$ m (+ve)

Height of vane above instrument axis

$= 334.69 + 0.27 = 334.96$ m

R.L of vane $= 334.96 + 2650.38 = 2985.34$ m

R.L of Q $= 2985.34 - 4 = 2981.34$ m

18. (a)

The first section and the second section have odd number of ordinates, and therefore, Simpson's rule is directly applicable.

The third section has 4 ordinates (even number); the rule is applicable for the first three ordinates only

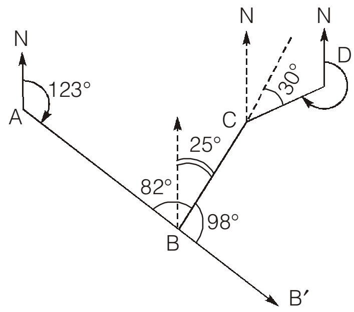
$$\Delta_1 = \frac{15}{3}[(7.60+10.6)+4(8.5+12.8)+2(10.7)] = 624 \text{ m}^2$$

$$\Delta_2 = \frac{10}{3}[(10.6+8.3)+4(9.5)] = 189.7 \text{ m}^2$$

$$\Delta_3 = \frac{20}{3}[(8.3+6.4)+4(7.9)]+\frac{20}{2}(6.4+4.4) = 308.6+108 = 416.6 \text{ m}^2$$

$$\Delta = 624 + 189.7 + 416.6 = 1230.3 \text{ m}^2$$

19. (b)



$$\angle CBB' = 180° - 82° = 98°$$

Bearing of line BC with True North = 123° – 98° = 25°

Bearing of line CD with True North = 25° + 30° = 55°

Bearing of line DC with True North = 180° + 55° = 235°

20. (b)

The horizontal distance (D) between the vertical axis and staff may be given as

$$D = u + d$$

But

$$u = \left(\frac{f}{i}\right)s + f$$

$$D = \left(\frac{f}{i}\right)s + f + d = \left(\frac{280}{4}\right)\times(2.4-0.8)+\frac{280}{1000}+\frac{140}{1000}$$

$$= 112 + 0.28 + 0.14 = 112.42 \text{ m}$$

21. (b)

For the first 2000 m, average error is

$$e = \frac{0+10}{2} = 5 \text{ cm} = 0.05 \text{ m}$$

∴ Incorrect length of chain,

$$L' = 20 + 0.05 = 20.05 \text{ m}$$

Measured length, $l' = 2000$ m

∴ True length, $l_1 = \left(\frac{L'}{L}\right)\times l'$

$$= \left(\frac{20.05}{20}\right)\times 2000 = 2005 \text{ m}$$

For the next 2000 m, average error is

$$e = \frac{10+18}{2} = 14 \text{ cm} = 0.14 \text{ m}$$

∴ $L' = 20 + 0.14 = 20.14$ m

$l' = 2000$ m

$\therefore$ True length, $l_2 = \left(\frac{L'}{L}\right)\times l' = \left(\frac{20.14}{20}\right)\times 2000 = 2014$ m

Hence, true distance, $l = l_1 + l_2$

$= 2005 + 2014$

$= 4019$ m

22. (b)

$$g_1 = +1.5\%$$

$$g_2 = -0.5\%$$

Change in gradient, $N = g_1 - g_2$

$= 1.5 - (-0.5)$

$= 2.0\%$

Since rate of change of grade is 0.2% per 20 m chain.

$\therefore$ Length of curve for 2.0% gradient,

$$L = \frac{20}{0.2}\times 2\,\text{m}$$

$$L = 200 \text{ m}$$

23. (d)

First RL = 51.45 m, Last RL = 63.50 m

$$\Sigma BS = 87.755 \text{ m}$$

$$\Sigma FS = 73.725 \text{ m}$$

$\because$ $\Sigma BS - \Sigma FS$ = Last RL – First RL

The difference between LHS and RHS is the closing error of the work.

$$\Sigma BS - \Sigma FS = 87.755 - 73.725 = 14.03 \text{ m}$$

Last RL – First RL = 63.50 – 51.45 = 12.05 m

$\therefore$ Closing error = 14.03 – 12.05 = 1.98 m

24. (d)

Sensitivity of bubble tube is given by,

$$\alpha' = \frac{S}{nD}\times\left(\frac{360^\circ}{2\pi}\times 60\times 60\right)$$

= 24 seconds (given)

S = ? (staff intercept)

n = 2 division, and

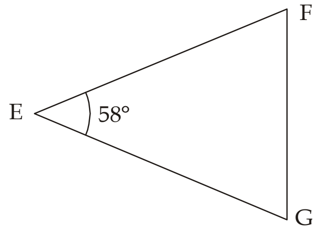
D = Distance of the staff from level = 110 m

$$\therefore \quad 24 = \frac{S}{2\times 110}\left(\frac{360}{2\pi}\times 60\times 60\right) = \frac{S}{2\times 110}\times 206265$$

$$\Rightarrow \quad S = \frac{24\times 2\times 110}{206265} = 25.599\times 10^{-3}\,\text{m}$$

$$\simeq 25.59 \text{ mm}$$

25. (a)



$$EF = ks + C = 105\,(0.35) + 0.2 = 36.95 \text{ m}$$
$$EG = ks + C = 105\,(0.23) + 0.2 = 24.35 \text{ m}$$

Applying the cosine rule,

$$\cos 58° = \frac{EF^2 + EG^2 - FG^2}{2(EF)(EG)}$$

$$\cos 58° = \frac{(36.95)^2 + (24.35)^2 - FG^2}{2 \times 36.95 \times 24.35}$$

$$FG = 31.696 \text{ m}$$

26. (c)

Sum of angles, $S = \angle A + \angle B + \angle C$

Let e_A, e_B and e_C be the probable errors of angles A, B and C respectively

Then,
$$e_S = \sqrt{e_A^2 + e_B^2 + e_C^2}$$
$$= \sqrt{0.2^2 + 0.1^2 + 0.2^2}$$
$$= \pm 0.3'$$

27. (a)

Let the length of line CD be L and bearing of line AB be θ.

Line	Length (in m)	Reduced Bearing	Quadrant
AB	200.0	θ	?
BC	98.0	2°	SE
CD	L	90°	SW
DA	86.4	1°	NE

Since $ABCD$ is a closed traverse and therefore, ΣL and ΣD both are zero.

$$\Sigma L = 0 = 200 \cos\theta - 98 \cos 2° - l \cos 90° + 86.4 \cos 1°$$
$$\theta = 86° \, 41'$$

and
$$\Sigma D = 0 = 200 \sin 86° \, 41' + 98 \sin 2° - L \sin 90° + 86.4 \sin 1°$$
$$L = 204.60 \text{ m}$$

28. (c)

Given: $H = 3000$ m, $h_1 = 1150$ m, $h_2 = 80$ m and $r_2 = 7.25$ cm

The displacement,
$$d = \frac{r_2 h_2}{H - h_1} = \frac{7.25 \times 80}{(3000 - 1150)} = 0.31 \text{ cm}$$

29. (c)

Correction for temperature = $20 \times 6.2 \times 10^{-6}$ (80 – 55) = 0.0031 m (additive)

$$\text{Correction for pull} = \frac{(P - P_0)L}{AE}$$

Now, weight of tape = A(20 × 100) (7.86 × 10^{-3}) kg = 0.8 kg

⇒ A = 0.051 cm^2

Hence, $$C_p = \frac{(16-10)\times 20}{0.051\times 2.109\times 10^6} = 0.00112 \text{ (additive)}$$

$$\text{Correction for sag} = \frac{l_1 (wl_1)^2}{24P^2} = \frac{20(0.8)^2}{24(16)^2} = 0.00208 \text{ m (subtractive)}$$

∴ Total correction = +0.0031 + 0.00112 – 0.00208

= +0.00214 m

30. (b)

The scale expressed as R.F. is given by

$$S = \frac{f}{H-h}$$

$$\Rightarrow \quad \frac{1}{8000} = \frac{(20/100)}{(H-1500)}$$

$$H - 1500 = \frac{20\times 8000}{100}$$

$$\Rightarrow \quad H = 1600 + 1500 = 3100 \text{ m}$$

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