## UPPSC AE

2020 PAPER-2

## Civil Engineering

Mega Mock Challenge (May 23- May 24 2020)

## Questions \& Solutions

1. Which of the following is the correct chronological sequence of struggles led by Gandhiji in India?
A. Champaran, Ahmedabad, Kheda
B. Kheda, Champaran, Ahmedabad
C. Ahmedabad, Kheda, Champaran
D. Champaran, Kheda, Ahmedabad

Ans. A
Sol. Gandhiji arrived in India in 1915 and travelled across the country for two years before actively entering into politics.

- The correct chronological sequence of Gandhiji's struggles in India is-

1) Champaran in 1917 in Bihar on request of Rajkumar Shukla.
2) Ahmedabad Mill Strike in 1918 in Gujrat for plague bonus of factory workers.
3) Kheda Satyagrah in 1918 in Gujrat for compensating drought hit farmers in Kheda.
2. The Battle of Chausa was fought between Humayun and $\qquad$ .
A. Nadir Shah
B. Krishnadeva Raya
C. Sher Shah Suri
D. Hemu

Ans. C
Sol. - The Battle of Chausa took place between Mughal Emperor Humayun and Sher Shah Suri on June 26,1539 at Chausa, south west of Buxar in modern-day Bihar.

- In this battle Humayun got defeated .

3. Vajji Mahajanpada is located in $\qquad$ .
A. Madhya Pradesh
B. Bihar
C. Maharashtra
D. West Bengal

Ans. B
Sol. - Vajji or Vrajhi was one of the 16 Mahajanapadas of ancient India.

- It originated by joining several small states.
- Its capital was Vaishali.
- It was located on the north of River Ganga in Bihar.

4. Which Kushana dynasty's ruler was known as Second Ashoka?
A. Vasishka
B. Huvishka
C. Vasudeva I
D. Kanishka

Ans. D
Sol. - Kanishka was the most famous ruler of Kushana dynasty.

- He was also known as second Ashoka.
- He has two capitals-Purushpur and Mathura.
- He started an era in 78 AD, which is now known as Saka era and is used by Government of India.


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5. The first charter act of India was passed in which year?
A. 1777
B. 1783
C. 1793
D. 1803

Ans. C
Sol. * The first charter act of India was passed in 1793.

* It continued the company's trade monopoly in India for another 20 years.
* This Act separated the revenue administration and the judiciary functions of the company.
* Major charter acts are- Charter Act of 1793, Charter Act of 1813, Charter Act of 1833, Charter Act of 1853 and Charter Act of 1858.

6. The concept of union territories was introduced by which constitutional amendment?
A. Sixth
B. Seventh
C. Eighth
D. Eleventh

Ans. B
Sol. - The concept of union territories was introduced by the seventh constitutional amendment. This amendment was done on 1 Nov 1956.

- The Andaman and Nicobar Islands was the first union territory of India.
- Union Territories are special administrative sectors in the republic of India which operate directly under the central government.

7. Which article deals with prohibition of the slaughter of cows, calves and draught cattle?
A. Article 32
B. Article 48
C. Article 53
D. Article 148

Ans. B
Sol. - Article 48 deals with prohibition of the slaughter of cows, calves and draught cattle.

- Article 32 of the Indian Constitution gives the right to individuals to move to the Supreme Court to seek justice.
- Article 53 deals with Executive power of the Union.
- Article 148 is related to the Comptroller and Auditor General of India.

8. The President may resign from his office by writing under his hand addressed to the:
A. Vice President
B. Prime Minister of India
C. Speaker of the Lok Sabha
D. Chief Election Commissioner

Ans. A
Sol. - Under article 56, the President shall hold office for a term of five years from the date on which he enters upon his office.

- He may resign from his office by writing under his hand addressed to the Vice-President.

9. Khadi and Village Industries Commission was founded in which year?
A. 1957
B. 1956
C. 1958
D. 1955

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Ans. B
Sol. • The Khadi and Village Industries Commission (KVIC) is a statutory body.

- It was formed by the Government of India, under the Act of Parliament, 'Khadi and Village Industries Commission Act of 1956'.
- It is an apex organisation under the Ministry of Micro, Small and Medium Enterprises.
- It is headquartered in Mumbai, Maharashtra.

10. Which state is the largest producer of Gypsum in India?
A. West Bengal
B. Rajasthan
C. Bihar
D. Jharkhand

Ans. B
Sol. •Rajasthan is considered as the largest producer of gypsum in India.

- Rajasthan produces 99 percent of India's total production of gypsum.
- The remaining gypsum is produced by Tamil Nadu, Jammu and Kashmir, Gujarat and Uttar Pradesh in order of production.

11. Barren Island, the active volcano, is located in $\qquad$ _.
A. Andaman Islands
B. Nicobar Islands
C. Lakshadweep Islands
D. None of the above

Ans. A

## Sol. Barren Island is located in Andaman Islands archipelago.

- Barren Island is the only active volcano in South Asia. It belongs to North and Middle Andaman administrative district of Andaman and Nicobar Islands.
- Narcondam Volcano is also situated in Andaman and Nicobar Islands but it is a dormant volcano.
- The volcano here was dormant for a long time, but in the year 1991, it experienced an explosion which was quite major and it again erupted in 2017.

12. Which of the following in NOT a part of the Meghalaya Plateau?
A. Palamu Hills
B. Khasi Hills
C. Jaintia Hills
D. Garo Hills

Ans. A
Sol. - Palamu hills are located in Jharkhand and are not a part of Meghalaya Plateau.

- Meghalayan Plateau is a extension of Indian peninsular plateau.
- The western, central and the eastern parts of the plateau are known as the Garo Hills, the Khasi-Jaintia Hills and the Mikir Hills.
- Meghalayan Plateau is rich in coal and uranium deposits.
- Cherrapunji and Mawsynram, located in the Khasi hills, are the wettest places in India and are a part of the plateau.


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13. As per the Census of 2011 which district of India is the most populous?
A. Theni, Tamil Nadu
B. Thane, Maharashtra
C. Churu, Rajasthan
D. Ghaziabad, Uttar Pradesh

Ans. B
Sol. •As per the Census of 2011, Thane district of Maharashtra is the most populated district of India.

- Thane with population of $\mathbf{1 . 1}$ Crore is the most populated district of India.
- North Twenty Fourth Pargana in West Bengal is the second most populous district of India with a population of 1.08 Crore.

14. In which state has the Jawara Dance, a dance form to celebrate wealth, originated?
A. Gujarat
B. Madhya Pradesh
C. Kerala
D. Rajasthan

Ans. B
Sol. - Jawara Dance is a dance form to celebrate wealth in Bundelkhand region of Madhya pradesh.

- It is also known as the Harvest Dance.
- The women carry a basket full of Jawara crop on their heads while performing the dance.

15. Wembley Stadium is located in $\qquad$ .
A. London
B. Washington DC
C. Mexico
D. Beijing

Ans. A
Sol. - Wembley Stadium is located in Wembley, London.

- It was opened in 2007.
- It is a football stadium. The stadium hosts major football matches including home matches of the England national football team, and the FA Cup Final.
- It is the most iconic stadium in world football.
- The stadium has a seating capacity of over 90000 people.

16. The National Charkha Museum is located at which place?
A. Calcutta
B. Ahmedabad
C. Gandhinagar
. New Delhi

Ans. D

## Sol. • The National Charkha Museum is located in Connaught Place, New Delhi.

- It has been jointly constructed by the New Delhi Municipal Council and the Khadi Development and Village Industries Commission.
- The Museum was inaugurated on May 21, 2017 by the then BJP National President Amit Shah.


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17. Which organization of UNO aims at building space through International Cooperation of Education, Science and Culture?
A. FAO
B. WIPO
C. UNESCO
D. UNHCR

Ans. C
Sol. •The United Nations Education, Scientific and Cultural Organization is a specialised agency which aims at building space through International Cooperation inf Education, Science and Culture.

- UNESCO has 193 members and 11 associate members.
- UNESCO has five major objectives:
A) Education
B) Natural Sciences
C) Social Sciences
D) Culture
E) Communication
- UNESCO's aim is "to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information".

18. The book "Mother India" was written by $\qquad$
A. B.R Ambedkar
B. Mahatma Gandhi
C. Amrita Pritam
D. Katherine Mayo

Ans. D
Sol. • The book 'Mother India' was published in 1927.

- It was a polemical book by the American author Katherine Mayo.
- In her book, She attacked society, religion and culture of India.
- The book pointed to the treatment of India's women, the untouchables, animals, dirt, and the character of its nationalistic politicians.
- Katherine Mayo was an American researcher and historian.

19. The process of absorption of digested food in the bloodstream is known as $\qquad$ .
A. Digestion
B. Ingestion
C. Assimilation
D. Egestion

Ans. C
Sol. - Egestion is the process of discharging waste material from body.

- Digestion is the process of breaking larger food particles into smaller one.
- Ingestion is the process of taking in food.
- Assimilation is process of absorption of digested food in the bloodstream.


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20. The first Kirchhoff's current law states that "current flowing into a node must be $\qquad$ current flowing out of it.
A. Less than
B. More than
C. Equal to
D. Either more or equal to

Ans. C
Sol. - Kirchhoff's first current law states that current flowing into a node must be equal to current flowing out of it.

- It is statement of conservation of charge and energy in a circuit. As, charge cannot be created or destroyed at a junction, So whatever current enters a given junction in a circuit must leave that junction.

21. Recently which country launched its first military satellite 'Noor'?
A. Pakistan
B. Iran
C. Iraq
D. Afghanistan

Ans. B
Sol. * Recently Iran launched its first military satellite 'Noor'.

* The satellite is launched by Ghased Launcher.
* The Satellite was launched by Iran's Islamic Revolutionary Guard Corps (IRGC).
* IRGC is operates its own military infrastructure in parallel to armed forces and answerable only to Leader Ayatollah Ali Khamenei.
* The US administration has warned that the technology used to launch satellites could help Iran develop Inter Continental Ballistic Missiles

22. Which is the most commonly used nail polish remover?
A. Acetone
B. Sodium borate
C. Boric Acid
D. Methyl alcohol

Ans. A
Sol. - The most commonly used nail polish remover is Acetone.

- Acetone can also remove artificial nails made of acrylic gel.
- Acetone is a colorless, volatile, flammable liquid and the simplest ketone.

23. Ayushman Bharat Diwas is celebrated on $\qquad$ _.
A. 22 March
B. 25 April
C. 30 April
D. 25 September

Ans. C
Sol. •Ayushman Bharat Diwas is celebrated on $\mathbf{3 0}^{\text {th }}$ April.

- Ayushman Bharat is a centrally sponsored scheme launched in 2018 under Ayushman Bharat Mission. Under this mission, National Health Protection Scheme and Wellness Centres were introduced.


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- National Health Protection Scheme aimed at covering around 10 crore poor and vulnerable families providing coverage up to 5 lakh rupees per family per year for secondary and tertiary care hospitalization.

24. In Microsoft Word shortcut key Ctrl+W is used for?
A. To underline selected text
B. To close the currently open document
C. To save the open document
D. None of these

Ans. B
Sol. • In Microsoft Word shortcut key Ctrl+W is used for to close the currently open document.

- By using this shortcut key we can Closes the active window, but does not Exit Word.
- Ctrl+U is used to underline the selected text.
- Ctrl+S is used to save the open document.

25. The three-day fourth International Diabetes Summit was held from March 6 to 8, 2020 in $\qquad$ .
A. Bengaluru
B. Mumbai
C. New Delhi
D. Pune

Ans. D
Sol. * The three-day Fourth International Diabetes Summit was held from March 6 to 8, 2020, in Pune, Maharashtra.

* It was organised by the Chellaram Diabetes Institute.
* The Chellaram Diabetes Institute (CDI) is well known for its commitment towards the fight against Diabetes organized International Diabetes Summits for three consecutive years.

26. A plate of thickness 0.001 m , distant from a fixed plate, moves at $6 \mathrm{~cm} / \mathrm{s}$ and requires a shear force of $12 \mathrm{~N} / \mathrm{mm}^{2}$ to maintain this speed. The fluid viscosity is
A. 0.2 Poise
B. 0.1 Poise
C. 0.4 Poise
D. None of these

Ans. D
Sol. given,
shear stress, $\mathrm{T}=12 \mathrm{~N} / \mathrm{m}^{2}$,
velocity of the plate $=6 \mathrm{~cm} / \mathrm{s}=0.06 \mathrm{~m} / \mathrm{s}$
gap between plates $=0.0001 \mathrm{~m}$

$$
\begin{aligned}
\tau & =\mu \frac{\mathrm{du}}{\mathrm{dy}} \\
12 & =\mu \frac{0.06}{0.001} \\
\mu & =0.2 \mathrm{~N}-\mathrm{s} / \mathrm{m}^{2} \\
\mu & =2 \text { poise }
\end{aligned}
$$

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27. Which one of the following device is used to measure the rate of flow of fluid?
A. Rotameter
B. Current meter
C. Hot wire anemometer
D. Pitote tube

## Ans. A

Sol. Rotameter is used to measure the discharge i.e, rate of flow of fluid and others are used to measure the velocity.
28. If the pressure of water is raised from 1 atm to 3500 atm then, volume changes from 1000 $\mathrm{m}^{3}$ to $120 \mathrm{~m}^{3}$ then, bulk modulus of elasticity is approximately ?
A. 0.56 GPa
B. 0.397 GPa
C. 0.865 GPa
D. none of these

Ans. B
Sol. Given,
Pressure of water is raised from 1 atm to 3500 atm,
Volume changes from $1000 \mathrm{~m}^{3}$ to $120 \mathrm{~m}^{3}$
The bulk modulus of elasticity $(K)$ of fluid is given as
$K=-\frac{\text { Change in pressure }}{\frac{\text { Change in volume }}{\text { Originalvolume }}}=-\frac{\mathrm{dp}}{\mathrm{dv} / \mathrm{v}}$
$K=\frac{-(3500-1) \times 10^{5}}{\frac{(120-1000)}{1000}}$
$K=0.397 G P a$
29. A fluid flowing through a circular pipe of radius $R$ with a maximum velocity $U_{\text {max }}$, considering the flow to be laminar, what will be the velocity of the fluid at radius $\frac{R}{\sqrt{2}}$
A. $\frac{U_{\max }}{2}$
B. $U_{\max }$
C. $2 U_{\max }$
D. $\frac{U_{\max }}{4}$

Ans. A
Sol. For laminar pipe flow
$U=U_{\max }\left[1-\frac{r^{2}}{R^{2}}\right]$
$r=\frac{R}{\sqrt{2}}$
$U=\frac{U_{\max }}{2}$

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30. Match List I with List II and select the correct answer using the codes given below the lists.

## List-I (Measuring Instrument)

A) Pitot-tube
B) Micro- manometer
C) Pipe bend meter
D) Wall pressure tap

## List-II (Variable to be measured)

1) Flow static pressure
2) Rate of flow (indirect)
3) Differential pressure
4) Flow stagnation pressure
A. A-1; B-3; C-2; D-4
B. A-4; B-3; C-2; D-1
C. A-1; B-2; C-3; D-4
D. A-4; B-2; C-3; D-1

Ans. B
Sol. Option B is correct.

| Measurement <br> Instrument | Variables to be <br> measured |
| :--- | :--- |
| Pitot tube | $\Rightarrow$Flow stagnation <br> pressure |
| Micro-Manometer | $\Rightarrow$Differential <br> pressure |
| Pipe bend meter | $\Rightarrow$Rate of flow <br> (indirect) |
| Wall pressure tap | $\Rightarrow$Flow static <br> pressure |

31. A jet of water of velocity $40 \mathrm{~m} / \mathrm{s}$ impinges normally on a flat plate moving towards it at 10 $\mathrm{m} / \mathrm{s}$. The cross-sectional area of the jet is $0.01 \mathrm{~m}^{2}$, the force developed on the plate is
$\qquad$ .
A. 1 kN
B. 9 kN
C. 25 kN
D. 16 kN

Ans. C
Sol. The Force on plate $(F)=p A v^{2}$

$$
F=1000 \times 0.01 \times(10+40)^{2}=25 \mathrm{kN}
$$

32. Stream function is given as $\Psi=2 x y^{2}$, find the magnitude of velocity vector at $(1,-1)$ is
A. $\sqrt{ } 10$
B. $\sqrt{ } 20$
C. 5
D. 4

Ans. B

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Sol. Given,
Stream function $=\psi=2 x y^{2}$
$v=\delta \psi / \delta x=2 y^{2}$, ie at $(1,-1), v=2$
$u=-\delta \Psi / \delta y=-4 x y$, ie at $(1,-1), u=4$
$\mathrm{V}=\sqrt{\mathrm{u}^{2}+\mathrm{v}^{2}}$
$=\sqrt{4^{2}+2^{2}}=\sqrt{20}$
33. Two plates (one stationary and other moving at a velocity of $2 \mathrm{~m} / \mathrm{s}$ ) are separated by glycerine $\left(\mu_{=} 0.95 \mathrm{Ns} / \mathrm{m}^{2}\right)$ kept 50 mm apart. The shear stress and force acting on the plates respectively if the area of the plates is $40 \mathrm{~cm}^{2}$ each
A. 38 Pa and 0.76 N
B. 38 Pa and 0.152 N
C. 76 Pa and 0.152 N
D. 76 Pa and 0.76 N

Ans. B
Sol. According to Newton's law of viscosity, shear stress is given by $\tau=\mu \frac{d u}{d y}$
Here, $\mu=0.95 \mathrm{Ns} / \mathrm{m}^{2}, \mathrm{du}=2 \mathrm{~m} / \mathrm{s}$ and dy $=50 \mathrm{~mm}=50 / 1000=0.05$
On substituting these values, we get shear stress $=38 \mathrm{~Pa}$
Force $=$ shear stress $\times$ Area $=38 \times 40 \times 10^{-4}=0.152 \mathrm{~N}$
34. Water is flowing through the inclined pipe at an angle of $30^{\circ}$ from horizontal. The length of the pipe is 6 m and uniform diameter of pipe is 500 mm , the pressure at the ground is 2 bar, then the pressure at top is
[neglect minor losses, take $\mathrm{g}=10 \mathrm{~m} / \mathrm{s}^{2}$ ]
A. 17 bar
B. 2 bar
C. 1.7 bar
D. 2 kPa

Ans. C
Sol. $p=1000 \mathrm{~kg} / \mathrm{m}^{\mathbf{3}} \mathrm{g}=10 \mathrm{~m} / \mathrm{s}^{2} \mathrm{P}_{1}=2 \mathrm{bar}$


Apply Bernoulli's equation
(1)-(2)
$\frac{P_{1}}{P g}+\frac{W_{1}^{2}}{2 g}+z_{1}=\frac{P_{2}}{P g}+\frac{V_{2}^{2}}{2 g}+z_{2}$
$A_{1} V_{1}=A_{2} V_{2}$
$A_{1}=A_{2} \quad\left[D_{1}=D_{2}\right]$

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$$
\begin{aligned}
& \therefore V_{1}=V_{2} \\
& \therefore \frac{2 \times 10^{5}}{1000 \times 10}+0=\frac{P_{2}}{1000 \times 10}+3 \\
& \therefore P_{2}=17 \times 10^{4} \mathrm{~Pa}=1.7 \mathrm{bar}
\end{aligned}
$$

35. Match List I with List II and Select the correct answer using the codes given below the lists.

| List-I (Loss) |  | List-II (Parameter responsible) |  |
| :--- | :--- | :--- | :--- |
| A | Leakage loss | 1 | Zero at design point |
| B | Friction loss | 2 | Proportional to head |
| C | Entrance loss | 3 | Proportional to half of relative velocity square |

A. $A-1 ; B-2 ; C-3$
B. $A-2 ; B-3 ; C-1$
C. $\mathrm{A}-1 ; \mathrm{B}-3 ; \mathrm{C}-2$
D. $A-2 ; B-1 ; C-3$

Ans. A
Sol. Correct answer is

## Loss Parameter Responsible

Leakage loss----------- Zero at design point
Friction loss------------- Proportional to head
Entrance loss---------- Proportional to half of relative velocity square
36. The pressure in meters of oil of specific gravity 0.9 equivalent to 90 m of water is
A. 90 m
B. 100 m
C. 80 m
D. 95 m

Ans. B
Sol. For equivalent pressure,
$\mathrm{S}_{1} \mathrm{~h}_{1}=\mathrm{S}_{2} \mathrm{~h}_{2}$
$0.9 \times \mathrm{h}=90 \times 1$
$\mathrm{h}=100 \mathrm{~m}$
37. If the surface tension of water air interface is $0.073 \mathrm{~N} / \mathrm{m}$; The gauge pressure inside a rain drop of 1 mm diameter will be.
A. $0.146 \mathrm{~N} / \mathrm{m}^{2}$
B. $73 \mathrm{~N} / \mathrm{m}^{2}$
C. $146 \mathrm{~N} / \mathrm{m}^{2}$
D. $292 \mathrm{~N} / \mathrm{m}^{2}$

Ans. D
Sol.
$P=\frac{4 \sigma}{d}$
$P=\frac{4 \times 0.073}{1 \times 10^{-3}}$
$P=0.292 \times 10^{3}=292 \mathrm{~N} / \mathrm{m}^{2}$

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38. In case of a two dimensional flow the components of velocity are given by $u=a x ; u=a y$, the streamlines will consist of a series of
A. circular arcs
B. parabolic arcs
C. straignt line passing through origin
D. straignt line not passing through origin

Ans. C
Sol. Given,
$u=a x, \quad v=a y$
stream line equation
$\frac{d y}{d x}=\frac{v}{u}=\frac{a y}{a x}=\frac{y}{x}$

$$
\begin{aligned}
& \frac{d y}{y}=\frac{d x}{x} \Rightarrow \ln y=\ln x+\ln c \\
& \ln y=\ln c x \\
& y=c x
\end{aligned}
$$

thus stream lines will be straight passing through origin
39. Two pipes $P$ and $Q$ are used to deliver oil from a station to other station. Pipe $P$ is having a square cross section and pipe Q is having a triangular cross-section with equal sides. The sides of square and triangle are $L$ units each. The ratio of equivalent diameter of pipe $P$ to pipe $Q$ will be
A. $1 / \sqrt{3}$
B. $\sqrt{3}$
C. 1
D. $2 / \sqrt{3}$

Ans. B
Sol. For pipe $P, A=L^{2}$ and Perimeter $P=4 L$
Then, equivalent diameter of pipe $P$ is given by
$D_{P}=\frac{4 A}{P}=\frac{4 \times L^{2}}{4 L}=L$
For pipe $\mathrm{Q}, A=\frac{\sqrt{3}}{4} L^{2}$ and Perimeter $\mathrm{P}=3 \mathrm{~L}$
Then, equivalent diameter of pipe Q is given by
$D_{Q}=\frac{4 A}{P}=\frac{4 \times \frac{\sqrt{3}}{4} L^{2}}{3 L}=\frac{L}{\sqrt{3}}$
The ratio of equivalent diameters $=\frac{D_{P}}{D_{Q}}=\sqrt{3}$

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40. Let the velocity of a fluid flow $v=-x^{3} \hat{\imath}+y^{3} j$. Which of the following is true at point $(1,1)$ for the fluid flow?
A. Irrotational, compressible
B. Rotational, Incompressible
C. Irrotational, Incompressible
D. Rotational, compressible

Ans. C
Sol. $u=-x^{3}$
$v=y^{3}$
Vorticity $=d v / d x-d u / d y=0$, hence, flow is irrotational
and at $(1,1) d u / d x+d v / d y=0$, hence continuity equation is satisfied therefore, flow is incompressible too.
41. The Navier Stokes equation has the following parameters:

1) Viscous 2) Gravitational 3) pressure 4) inertia forces
A. $1,2,3$
B. $1,2,3,4$
C. $2,3,4$
D. $1,2,4$

Ans. A
Sol. The basic equation which govern the motion of incompressible viscous fluid in the laminar motion is called as
Navier Stokes equation. which has the following parameters: gravitational, pressure and Viscous forces.
42. Specific gravity of stone weighing 500 N in air and 200 N in water when fully submerged is
A. 0.1666
B. 1.666
C. 0.666
D. 6.666

Ans. B
Sol. Given,
Weight of stone in air $=500 \mathrm{~N}$,
Weight if stone in water $=200 \mathrm{~N}$
Weight of water displaced=Weight of stone in air - Weight of stone in water $=300 \mathrm{~N}$

Volume of water displaced $=$ Volume of stone $=\frac{300}{9.8 \times 1000}=0.03061 \mathrm{~m}^{3}$
Density of stone $=$ mass $/$ volume $=\frac{500}{9.8 \times 0.03061}=1666.66 \mathrm{~kg} / \mathrm{m}^{3}$
specific gravity $=$ Density of stone/Density of water $=1.666$
43. When the jet strikes to the flat stationary plate, as the velocity of jet doubles, the force exerted by the jet normal to the plate is
A. 4 times
B. double
C. same
D. one-fourth time

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Ans. A
Sol. Force exerted by the jet normal to the plate $=\rho a V^{2}$

$$
\begin{aligned}
& \therefore F \propto V^{2} \text { and } V_{2}=2 V_{1} \\
& \therefore \frac{F_{2}}{F_{1}}=\left(\frac{V_{2}}{V_{1}}\right)^{2} \Rightarrow F_{2}=4 F_{1}
\end{aligned}
$$

44. A centrifugal pump gives maximum efficiency when its blades are:
A. Bent forward
B. Bent backward
C. Straight
D. wave shaped

Ans. B
Sol. Backward blades are used for maximum efficiency. It gives better performance over wide range of application where forward blades are used for higher pressure ratio.
45. Which of the following is not a reaction turbine
A. Pelton turbine
B. Francis turbine
C. Kaplan turbine
D. Propeller turbine

Ans. A
Sol. Pelton turbine is not reaction turbine.
46. The specific speed of a hydraulic turbine which develops 10000 kW when running at a speed of 150 rpm under the head of 81 m is
A. 65
B. 71.73
C. 61.73
D. 70

Ans. C
Sol. Given
$\mathrm{N}=150 \mathrm{rpm}$
$\mathrm{P}=10000 \mathrm{~kW}$
$\mathrm{H}=81 \mathrm{~m}$
The specific speed of a hydraulic turbine, $N_{s}=\frac{\mathrm{N} \sqrt{\mathrm{P}}}{\mathrm{H}^{5 / 4}}=\frac{150 \sqrt{10000}}{81^{5 / 4}}=61.73$ (SI unit).
So, the correct option is (c).
47. In an irrigation project, 6000 ha of gross commanded area includes $20 \%$ of the area reserved for forests and roads. $10 \%$ for the pastures and fallow lands. If the intensity of irrigation is $60 \%$, the area to be irrigated is $60 \%$,the area to be irrigated (in ha) is
A. 2880
B. 3960
C. 3120
D. 2456

Ans. A
Sol. Gross command area (GCA) $=6000$ ha
Culturable commanded area (CCA)
=GCA-Area reserved for forests \&roads

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$=6000-\frac{20}{100} * 6000=4800$ ha.
Pastures \& fallows lands are included in culturable commanded area. So it will be a part of CCA.

Area to be irrigated=Intensity of irrigation *CCA $=\frac{60}{100} * 4800=2880$ ha
48. The silt factor used by Lacey in his regime theory was equal to 1.0 for upper Bari-doab alluvium. What was the median size of the alluvium?
A. 0.28 mm
B. 0.32 mm
C. 0.40 mm
D. 0.50 mm

Ans. B
Sol. Silt factor, $f=1.76 \sqrt{d}$

$$
\begin{aligned}
& \Rightarrow 1.0=1.76 \sqrt{d} \\
& \Rightarrow 1.0=1.76 \sqrt{d} \\
& \Rightarrow d=0.32 \mathrm{~mm}
\end{aligned}
$$

49. Which of the following statements is or are correct with respect to lined canals
I. Lined canals are designed based on Kennedy's theory
II. Lined canals are designed based on Lacey's theory.
III. The design is based on the Manning's equation.
IV. The design is based on Chezy's equation.
A. I and IV
B. II and III
C. III only
D. IV only

Ans. C
Sol. The design is based on the Manning's equation.
50. Accordind to Koshla's theory of independent variables for seapage below hydraulic structure, the exit gradient gradient in the absence of downstream sheet pile is
A. Zero
B. 1
C. 2
D. $\infty$

Ans. D
Sol. Exit gradient $\mathrm{G}_{\mathrm{e}}=\frac{H}{d} * \frac{1}{\pi \sqrt{\lambda}}$
In absence downstream sheet pile $\mathrm{d}=0$
$\therefore G_{e}=\infty$

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51. For the soil in a wheat field, the field capacity is $25 \%$ and permanent wilting point is $12.5 \%$, depth of root zone is 90 cm and specific dry unit weight of the soil is 1.6 . If the watering is to be applied when the average soil moisture is $18 \%$, the required depth of water (in cm ) needed at the canal outlet is $\qquad$ if field efficiency is $80 \%$ and conveyance losses in field water course is $15 \%$
A. 14.8
B. 15.6
C. 13.2
D. 12.88

Ans. A
Sol. Net depth of water needed=C.d(F.C. - S.M. $)=1.6 * 0.9(0.25-0.18)=0.101 \mathrm{~m}=10.1 \mathrm{~cm}$ Field efficiency $=80 \%$

Depth of water at field $=10.1 / 0.8=12.6 \mathrm{~cm}$
Conveyance losses=15\%
Depth of water at canal outlet $=12.6 / 0.85=14.8 \mathrm{~cm}$
52. Pick up the correct statement regarding Lacey's theory.
A. The characteristics of a regime channel are precisely defined.
B. The various equations developed by Lacey are applicable to channels which has attained initial regime.
C. Silt charge and silt grade have been defined properly by Lacey.
D. A true regime channel has a semi-elliptical section but the same is not supported by any of lacey's equation.
Ans. D
Sol. The characteristics of a regime channel are not precisely defined in Lacey's theory. The various equations developed by Lacey are applicable to channels which has attained final regime.
Silt charge and silt grade have not been defined properly by Lacey.
53. Rigid module are those outlets in which ;
A. Discharge gets affected by the change in water level of the distributory but not with the field channel.
B. Dicharge gets affected by the change in water level of field channel.
C. Discharge is independent of water levels in the distributing channel and the field channel.
D. Discharge is depend upon both distributory channel and field channel.

Ans. C
Sol. Rigid module also called Gibb's module are those through which the discharge remains constant and fixed within limits, irrespective of the fluctuations in the water level in both the channels.

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54. For a culturable command area of 1000 hectares with intensity of irrigation of $70 \%$,the duty on field for a certain crop is 1500 hectare/cumec. What is the discharge(cumec) required at head of water course with $25 \%$ losses of water?
A. 0.75
B. 0.81
C. 0.62
D. 0.55

Ans. C
Sol. The area to be irrigated $=1000 * 0.7=700$ hectares
Discharge needed $=700 / 1500=0.466$ cumec
For $25 \%$ loss of water at the head of water course, the discharge required;
$\mathrm{Q}=0.466 / 0.75=0.62 \mathrm{cumec}$
55. $12 \mathrm{~m}^{\wedge} 3 / \mathrm{s}$ of water is applied to a field having area of 30 hectares for 4 hours. About 0.3 m of water stored in the root zone. Water application efficiency(\%)in this case would be;
A. 52
B. 62
C. 72
D. 42

Ans. A
Sol. The volume of water in root zone $\mathrm{V}_{\mathrm{f}}=0.3 * 30 * 10^{\wedge} 4=90000 \mathrm{~m} \wedge 3$
The volume of water supplied $\mathrm{V}_{\mathrm{s}}=12 * 4 * 3600=172800 \mathrm{~m} \wedge 3$
Water application efficiency $=\mathrm{V}_{\mathrm{f}} / \mathrm{V}_{\mathrm{s}} * 100=90000 / 172800=52 \%$
56. Which of the following is incorrect?
A. Sprinkler irrigation system is suitable when the land gradient is steep and the soil is easily erodible.
B. Irrigation helps in avoiding mixed cropping.
C. In a mildly water scarce area, the drip irrigation could be preferred for growing fruits and vegetables.
D. In border method of irrigation, the flow along the border is a case of spatially varied, steady, open channel flow with decreasing discharges.

Ans. D
Sol. In border method of irrigation, the flow along the border is a case of spatially varied, unsteady, open channel flow with decreasing discharges.
57. Consider the following with respect to reduction in evaporation losses:

1) Reduction in surface area
2) Installation of mechanical covers
3) Lining with chemical films

Which of the above is/ are correct?
A. 1 only
B. 2 and 3
C. 4 only
D. 1, 2 and 3

Ans. D

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Sol. In order to minimise the evaporation loss from an water body, preventive measures like reducing the surface area of exposure, shielding the water body with roof like arrangements and providing a layer of chemical emulsions like cetyl alcohol and steryl alcohol can be adopted.
58. A catchment having an area of $150 \mathrm{~km}^{2}$ has the $\varnothing$ index $0.3 \mathrm{~cm} / \mathrm{hr}$. The base flow at the outlet is $10 \mathrm{~m}^{3} / \mathrm{s}$. One hour unit hydrograph of the catchment area is triangular in shape with a time base of 20 hours. The peak ordinate occurs at 8 hours. If a rainfall of 4.5 cm occurs in 1 hour, then the peak ordinate of the flood hydrograph will be:
A. 165
B. 185
C. 187.5
D. 199.5

Ans. B
Sol. Total rainfall excess depth $=4.5 \mathrm{~cm}-0.3 \mathrm{~cm}=4.2 \mathrm{~cm}$
Total runoff volume $=$ Area of hydrograph $=1 / 2 \times$ time base $\times$ peak ordinate
$0.042 \times 150 \times 10^{6}=0.5 \times(20 \times 3600) \times$ peak ordinate
Peak ordinate of DRH $=175$
Peak ordinate of $\mathrm{FH}=175+10=185$
59. A reservoir has a catchment area is about 150 hectares. The rainfall is 2.5 times of run-off and the catmint gets 10 cm rainfall, a stream flow at the catchment outlet lasts for 10 hours, what is average stream flow in the period?
A. $1.33 \mathrm{~m}^{3} / \mathrm{s}$
B. $1.667 \mathrm{~m}^{3} / \mathrm{s}$
C. $60000 \mathrm{~m}^{3} / \mathrm{h}$
D. $3.5 \mathrm{~m}^{3} / \mathrm{s}$

Ans. B
Sol. Run off $=150 * 10^{4} * 0.4 * 0.1=60,000 \mathrm{~m}^{3}$
Average stream flow $=\frac{60,000}{10 \times 60 \times 60}=1.667 \mathrm{~m}^{3} / \mathrm{s}$
60. The equation used in the distributed routing is/are
I. Continuity equation
II. Energy equation
III. Water budget equation
IV. Momentum equation
A. I only
B. I and II
C. I and III
D. I and IV

Ans. D
Sol. Hydraulic routing is called distributed routing which uses both continuity and momentum equation.

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61. Match List I and List II and select the correct answer using the codes given below the lists.

## List- I

P. Aquifer
Q. Aquitard
R. Aquifuge
S. Aquiclude

List -II

1) Clay
2) Unconsolidated deposits of sand and gravel
3) Sandy clay
4) Massive compact rock
A. P-2 Q-1 R-4 S-3
B. P-4 Q-1 R-2 S-3
C. P-3 Q-4 R-1 S-2
D. $\mathrm{P}-2 \mathrm{Q}-3 \mathrm{R}-4 \mathrm{~S}-1$

Ans. D
Sol. An aquifer is a saturated formation of earth materials that stores as well as yields water in sufficient quantity.
Aquitard is a formation which allows only seepage hence yielding is insignificant. Aquifuge is neither porous nor permeable.

Aquiclude is essentially impermeable to water flow.
62. An aquifer has coefficient of permeability $0.002 \mathrm{~m} / \mathrm{s}$. There is a drawdown of 2.5 m due to the continuous discharge $0.5 \mathrm{~m}^{3} / \mathrm{s}$. Find the area of the aquifer.
A. $100 \mathrm{~m}^{2}$
B. $200 \mathrm{~m}^{2}$
C. $450 \mathrm{~m}^{2}$
D. $50 \mathrm{~m}^{2}$

Ans. A
Sol. $Q=C \cdot A \cdot S=\frac{k}{R} \cdot A \cdot S$
Assume $\mathrm{R}=1$.
$Q=k . A . S=0.002 \times A \times 2.5$
$0.5=0.005 \times A$
$A=100 \mathrm{~m}^{2}$
63. If the storage S , inflow rate rate I and outflow rate Q for a river reach is given as $\mathrm{S}=$ $K\left(x I^{n}+(1-x) Q^{n}\right)$
A. $n=0$ represents storage routing through a reservoir
B. $n=1$ represents the muskingam method
C. $n=0$ represents relation between storage and inflow rate
D. $n=1$ represnts linear channel

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Ans. B
Sol. $S=K\left(x I^{n}+(1-x) Q^{n}\right)$
When $\mathrm{n}=0, \mathrm{~S}=\mathrm{k}$ which makes S to be a constant and doesnot depend on I or Q
When $\mathrm{n}=1, \mathrm{~S}=\mathrm{K}((1-\mathrm{x}) \mathrm{Q}+\mathrm{xI})$ which is Muskingham method of flood routing
64. Which of the following is incorrect regarding linear reservoir?
A. The weightage factor, $x=0$
B. Storage $S$ depends only on $Q$ (outflow rate)
C. Storage $S$ depends on both Inflow and Outflow rate
D. All the options are incorrect

Ans. C
Sol. Equation of muskingham routing is $K((1-x) Q+x I)$
for it to be a linear reservoir, $x=0$
For linear reservoir, $S=k Q$ and therefore it only depends on Outflow.
65. The spacing of contraction joints when
(a) the pavement is Plain Cement Concrete (PCC)
(b) the width of road $=3.75 \mathrm{~m}$
(c) the allowable tensile strength of concrete $=0.8 \mathrm{MPa}$
(d) the thickness of rigid pavement $=17 \mathrm{~cm}$ is
A. $5.2 \mathrm{~m} \mathrm{c} / \mathrm{c}$
B. $6.3 \mathrm{~m} \mathrm{c} / \mathrm{c}$
C. $7.2 \mathrm{~m} \mathrm{c} / \mathrm{c}$
D. $4.4 \mathrm{~m} \mathrm{c} / \mathrm{c}$

Ans. D
Sol. For plain cement concrete road: $l c=\frac{2 \sigma_{c}}{\gamma_{\epsilon} f}=\frac{2 * 0.8}{24 * 0.15}=4.4 \mathrm{~m} \mathrm{c} / \mathrm{c}$ Where Ic $=$ slab length or spacing between contraction joints, m
$\sigma_{c}=$ allowable stress in tension in cement concrete in MPa
$\psi=$ unit weight of cement concrete in $\mathrm{kg} / \mathrm{cm}^{2}$
$\mathrm{f}=$ coefficient of friction $=0.15$
66. Determine the capacity of a two lane highway in vehicles per hour if the free speed of the vehicles is 60 kmph and average spacing between vehicles is 6 m .
A. 2500
B. 5000
C. 2000
D. 7500

Ans. B
Sol. Traffic Capacity in one lane $=\frac{1}{4} \times \mathrm{v}_{\mathrm{f}} \times \mathrm{K}_{\mathrm{j}}$ $K_{j}=\frac{1000}{6}=166.667 \mathrm{veh} / \mathrm{km}$
Total Traffic Capacity $=2 \times \frac{1}{4} \times 60 \times 166.667=5000$

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67. The main drawback of CBR method is that it
A. does not consider the engineering parameters of the soil.
$B$. is considered to be a difficult method
C. gives total thickness which remains the same irrespective of the quality.
D. All of the above

## Ans. C

Sol. The main drawback of CBR method is that it gives total thickness which remains the same irrespective of the quality. Option $A, B$ and $D$ are incorrect.
68. If the self-weight of the pavement slab is considered, the temperature stresses at the top of the slab during night time will be
A. zero
B. tensile
C. compressive
D. depends on reinforcement

Ans. B
Sol. At top temperature is less at night so, trying to shrink but it can't and undergoes tension.
69. What is the maximum value of centrifugal force (in tonnes) to avoid overturning of a vehicle of weight 8 tonnes, height of vehicle is 2.4 m and distance between tyres in opposite direction is 2.2 m ?
A. 2.66
B. 3.66
C. 4.66
D. 5.66

Ans. B
Sol. To avoid overturning ( $\mathrm{P} / \mathrm{W}$ ) $<(\mathrm{b} / 2 \mathrm{~h})$
Thus maximum value of $\mathrm{P}=\mathrm{b} * \mathrm{~W} / 2 * \mathrm{~h}=2.2 * 8 / 2 * 2.4=3.66$ tonnes
70. Which of the following is a correct relation according to Westergaard's theory (the symbols carry their usual meanings)
A. $l=\left(\frac{E h^{2}}{12 K(1-\mu)}\right)^{\frac{1}{3}}$
B. $l=\left(\frac{E h^{3}}{12 K\left(1-\mu^{2}\right)}\right)^{\frac{1}{4}}$
C. $l=\left(\frac{E h^{3}}{12 K\left(1-\mu^{3}\right)}\right)^{\frac{1}{3}}$
D. $l=\left(\frac{E h^{3}}{12 K(1-\mu)}\right)^{\frac{1}{3}}$

Ans. B
Sol. According to Westergaard's theory, $l=\left(\frac{E h^{3}}{12 K\left(1-\mu^{2}\right)}\right)^{\frac{1}{4}}$ where,
$E=$ modulus of elasticity of concrete
I=radius of relative stiffness
$\mu=$ Poisson's ratio of concrete
$h=$ thickness of slab
$\mathrm{K}=$ Modulus of subgrade reaction

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71. A transition curve has length 50 cm \& curvature $0.1 \mathrm{~cm}^{-1}$. Shift for transition curve is-
A. 10.4 cm
B. 250 cm
C. 5 cm
D. none of these

Ans. A
Sol. For transition curve,
Shift, $S=L^{2} / 24 R$
Given, $L=50 \mathrm{~cm} \& 1 / R=0.1 \mathrm{~cm}^{-1}$
So, $S=50^{2} \times 0.1 / 24$
$=10.41 \mathrm{~cm}$
72. Two roads of 7.5 m wide and two way traffic meets and form a T-Junction. Total no. of conflict points will be
A. 5
B. 6
C. 7
D. 8

Ans. B
Sol.


Total number of conflict points is 6
73. When the speed of traffic flow becomes zero, then the
A. traffic density and traffic volume both attains maximum value.
B. traffic density attains maximum value whereas traffic volume becomes zero.
C. traffic density and traffic volume both becomes zero.
D. traffic density becomes zero whereas traffic volume attains maximum value.

## Ans. B

Sol. When the speed of traffic flow becomes zero, then the traffic density attains maximum value whereas traffic volume becomes zero.

Traffic density: The average number of vehicles that occupy one mile or one kilometer of road space, expressed in vehicles per mile or per kilometer.

Traffic volume: Traffic volume is the numbers of vehicles that pass a point on a highway on a particular lane on particular direction in unit time, generally in per unit hour, there is a term which represents the capacity of a road to accommodate the traffic volume.

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74. If the load, warping and frictional stresses in a cement concrete slab are $130 \mathrm{~N} / \mathrm{mm}^{2}$, $220 \mathrm{~N} / \mathrm{mm}^{2}$ and $15 \mathrm{~N} / \mathrm{mm}^{2}$ respectively, the critical combination of stresses during summer mid-day is
A. $365 \mathrm{~N} / \mathrm{mm}^{2}$
B. $350 \mathrm{~N} / \mathrm{mm}^{2}$
C. $335 \mathrm{~N} / \mathrm{mm}^{2}$
D. $400 \mathrm{~N} / \mathrm{mm}^{2}$

Ans. C
Sol. Load Stress, $\sigma=130 \mathrm{~N} / \mathrm{mm}^{2}$
Warping Stress, $\sigma_{w}=220 \mathrm{~N} / \mathrm{mm}^{2}$
Frictional Stress, $\sigma_{f}^{f}=-15 \mathrm{~N} / \mathrm{mm}^{2}$ (Because compressive)
During summer (mid-day), Resultant stress, $\sigma_{R}=\sigma+\sigma_{v}-\sigma_{f}=130+220-15=335 \mathrm{~N} / \mathrm{mm}^{2}$
75. The following test results were obtained by a CBR test on a sub grade soil

| Penetration in mm | 0 | 2.5 | 5.0 |
| :--- | :--- | :--- | :--- |
| Load (in kg) | 0 | 52 | 76 |

Area of plunger $=20.3 \mathrm{~cm}^{2}$
Standard Aggregate pressures for 2.5 mm and 5 mm penetration are $70 \mathrm{~kg} / \mathrm{cm}^{2}$ and 105 $\mathrm{kg} / \mathrm{cm}^{2}$ respectively. CBR value of the soil is
A. $3 \%$
B. $3.66 \%$
C. $4 \%$
D. $3.56 \%$

Ans. B
Sol. CBR for $2.5 \mathrm{~mm}=\frac{52}{20.3 \times 70} \times 100 \%=3.66 \%$
CBR for $5 \mathrm{~mm}=\frac{76}{20.3 \times 105} \times 100 \%=3.56 \%$
Considering higher value $\mathrm{CBR}=3.66 \%$
76. Which of the following properties are possessed by bitumen?
$1)$. It is thermoplastic
2). It is chemically inert and oxidizes slowly
$3)$. It is soluble in carbon disulphide
4). Its specific gravity is around 2.65
A. 1, 2 and 3
B. 2, 3 and 4
C. 1, 3 and 4
D. All of these

Ans. A
Sol. Its specific gravity is around 1.00 .

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77. A typical Marshall test graph is shown in the figure below. The quantity on the $y$-axis is

A. Flow value
B. Unit weight
C. Stability value
D. Air void

Ans. D
Sol. Air Void Vs \% binder content weight of total mix
78. The free mean speed of any route is 90 kmph and jam density is $120 \mathrm{veh} / \mathrm{km}$. What is the speed(kmph) of traffic if present density is $55 \mathrm{veh} / \mathrm{km}$ according to Green Shield formula?
A. 48.75
B. 55
C. 42.75
D. 40

Ans. A
Sol. The equation for this relationship as per Greenshields's Macroscopic Stream Modelis shown below.
$v=v_{f}-\left[\frac{v_{f}}{k_{j}}\right] . k$
So, v = 90-90×55/120
$=48.75 \mathrm{kmph}$
79. From floating car method following observation are determined -: Average journey time of test vehicle against and with the direction of flow 15 minute and 21 minutes respectively.
Average number of vehicle in direction of against flow $=76$
Average number of vehicle overtaking the test vehicle $=39$
Average number of vehicle overtaken the test vehicle $=25$
What is the traffic flow (vehicle /hr)?
A. 250
B. 150
C. 350
D. 225

Ans. B
Sol. $q=\left(n_{a}+n_{y}\right) /\left(t_{w}+t_{a}\right)$
$n_{a}=76$
$n_{y}=39-25=14$
$\mathrm{t}_{\mathrm{w}}=21 \mathrm{~min}=0.35$ hour

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$\mathrm{t}_{\mathrm{a}}=15 \mathrm{~min}=0.25$ hour
$\mathrm{q}=(76+14) /(0.35+0.25)=150$
80. Match the following. Match List-A (type of cutback bitumen) with List B (solvent used) and select the correct codes.

| List A |  | List B |  |
| :--- | :--- | ---: | :--- |
| P | Slow curing | 1 | Acetic Acid |
| Q | Medium curing | 2 | Kerosene |
| R | Rapid curing | 3 | Naptha and Gasolene |
|  |  | 4 | High boiling point gas oil/light oil |

A. P-4 Q-2 R-3
B. P-1 Q-2 R-4
C. P-3 Q-2 R-4
D. P-3 Q-1 R-4

Ans. A
Sol. The solvents are variously called distillate, diluents or cutter stock. If the solvent used in making the cutback asphalt is highly volatile, it will quickly escape by evaporation. Solvents of lower volatility evaporate more slowly. On the basis of the relative speed of evaporation, cutback asphalts are divided into three types: rapid curing (RC), medium curing (MC) and slow curing (SC).

1. Medium curing (MC) asphalt cement uses medium diluents of intermediate volatility generally in the kerosene boiling point range
2. Rapid curing (RC) asphalt cement is a combination of light diluents of high volatility, generally in the gasoline or naphtha boiling point range
3. Slow curing - High boiling point gas oil/light oil
4. There is a single toll booth in operation at a motorway where motorist are charged before being allowed to cross a bridge. the booth can handle 750 veh/hour and the service times may be considered exponential. The peak flow is 600 veh/hour. The vehicle arrivals being random. What is the percentage of time a toll booth operator is free and also what is the probability that there is no vehicle in the system?
A. 10 and 0.2
B. 10 and 0.4
C. 20 and 0.4
D. 20 and 0.2

Ans. D
Sol. Mean rate of arrival per unit time, $\lambda=\frac{600}{3600}=\frac{1}{6} v e h / s e c o n d$
Mean rate of service,
$\mu=\frac{750}{3600}=\frac{5}{24}$ veh/second
$\rho=\frac{\lambda}{\mu}=\frac{\left(\frac{1}{6}\right)}{\left(\frac{5}{24}\right)}=\frac{1}{6} \times \frac{24}{5}=\frac{4}{5}$

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Percentage of time toll booth operator is free
$=\frac{750-600}{750} \times 100=20 \%$
Probability that there is no vehicle in the system
$P_{0}=(1+\rho)=\left(1-\frac{4}{5}\right)=\frac{1}{5}=0.2$
82. Which one of the following represents the hardest grade of bitumen?
A. $30 / 40$
B. $60 / 70$
C. $80 / 120$
D. $100 / 120$

Ans. A
Sol. Hardest bitumen has the least penetration value
83. Valley curves are not formed when
A. a descending gradient meets another descending gradient.
B. a descending gradient meets a flat gradient.
C. an ascending gradient meets another more ascending gradient.
D. an ascending gradient meets a descending gradient.

Ans. D
Sol. In case (a), (b) and (c) valley curve are formed but in case (d) summit curve is formed.

84. In case of governing equations for calculating wheel load stress using Westergaard's approach, the following statements are made.

Statement-I: Load Stresses are inversely proportional to wheel load.
Statement-II: Modulus of subgrade reaction is useful for load stress calculation. Which of the following options are correct?
A. Both the statements are TRUE
B. I is TRUE and II is FALSE
C. Both the statements are FALSE
D. I is FALSE and II is TRUE

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Ans. D
Sol. Modulus of subgrade reaction is useful for load stress calculation but Load Stresses is not inversely proportional to wheel load.
85. Marshall Test was performed for seven specimens for which the results are given below.

| \% Bitumen <br> Content | Stability (Kg) | Flow (Units) | \% Vol. <br> of Voids | VFB | Gm |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 3 | 480 | 8 | 13.8 | 29 | 2.18 |
| 3.5 | 505.6 | 8.5 | 10.4 | 35 | 2.21 |
| 4 | 640.8 | 10 | 9.1 | 42.3 | 2.23 |
| 4.5 | 734 | 11 | 7.5 | 63.1 | 2.25 |
| 5 | 586.3 | 12 | 6.2 | 76 | 2.24 |
| 5.5 | 447.9 | 15 | 4 | 81 | 2.18 |
| 6 | 376 | 17 | 2.3 | 94 | 2.16 |

The optimum bitumen content of the mix is
A. $3.8 \%$
B. $4.3 \%$
C. $4.8 \%$
D. $5.4 \%$

Ans. C
Sol. Optimum bitumen content of the mix
The optimum bitumen content is the average of bitumen content corresponding to:

1) Maximum stability
2) Maximum $\mathrm{Gm}_{\mathrm{m}}$
3) 4\% percent air void

From above table:
Maximum stability occurs at 4.5\% bitumen content
Maximum Gm occurs at 4.5\% bitumen content
$4 \%$ percent air void occurs at $5.5 \%$ bitumen content
Optimim bitumen Content $=\frac{4.5+4.5+5.5}{3}=4.833 \%$
86. On a broad gauge rail line for a 3 degree curve the equilibrium cant is provided for a speed of 80 kmph is-
A. 12.9 cm
B. 13 cm
C. 14.7 cm
D. none of these

Ans. C
Sol. Equilibrium cant is given by the equation,
$e=1.315 \times v^{2} / R($ in $c m)$
Where, $\mathrm{R}=1720 \mathrm{~m}$
So, $e=1.315 \times 80^{2} \times 3 / 1720$
$=14.68 \mathrm{~cm}$.

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87. The steepest gradient to be provided on a $4^{\circ}$ curve on a B.G. line having a ruling gradient of $0.5 \%$ will be
A. 0.34
B. 0.16
C. 0.25
D. 0.18

Ans. A
Sol. Grade compensation for a B.G. curve=0.04\% per degree curve
Total grade compensation $=0.04 * 4=0.16 \%$
Gradient provided=0.5-0.16=0.34\%
88. The sleeper density for a broad gauge track if 19 sleepers are used under a rail length. Given that length of a rail for B.G. track is 12.8 metres.
A. $\mathrm{n}+7$
B. $\mathrm{n}+5$
C. $\mathrm{n}+4$
D. $n+6$

Ans. D
Sol. Let, sleeper density $=n+x$
Where n is length of rail in metres
$x$ is a factor depending upon several factors, axle load, section of rail etc.
Now, $19=12.8+x$
$x=6.2$ may be 6
So, sleeper density $=\mathrm{n}+6$
89. Heel divergence is
A. always less than flangeway clearance
B. equal to flangeway clearance
C. always greater than flangeway clearance
D. sometimes greater than flangeway clearance

Ans. C
Sol. Heel divergence is equal to flange way clearance plus tolerance for the wear plus the width of head of rail.
90. If the BOD curve with time is drawn as concave upwards, then on decreasing the temperature the curve will shift
A. upwards
B. downwards
C. does not shift
D. can't be determined

Ans. A
Sol. On decreasing the temperature, the BOD rate constant decreases, so BOD consumed will be less and hence the curve will shift upwards.

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91. An oxidation pond is designed for a population of 20,000 and sewage flow rate of 200 lpcd. BOD of sewage is $2000 \mathrm{mg} / \mathrm{l}$ and effluent BOD required is not greater than $20 \mathrm{mg} / \mathrm{l}$. Termperature is $24^{\circ}$ Cand $\mathrm{k}_{20}$ is $0.3 \mathrm{~d}^{-1}$. The minimum detention period of the pond to achieve desired minimum efficiency is $\qquad$ days.
A. 6
B. 7
C. 5
D. 4

Ans. A
Sol. $\mathrm{K}_{24}=\mathrm{K}_{20}(1.047)^{24-20}=0.3(1.047)^{4}=0.36$
Detention period, $\theta=\frac{1}{\left(k_{D}\right)_{24}} \times \log \left[\frac{B O D_{i}}{B O D_{0}}\right]$
$\theta=(1 / 0.36) *(\log (2000 / 20))$
$=5.55$ days
$\therefore$ Detention period should be at least 6 days.
92. Find the dissolved oxygen in the sewage sample which is discharged into a river of flow 2 $\mathrm{m}^{3} / \mathrm{s}$ having dissolved oxygen $120 \mathrm{mg} / \mathrm{l}$, the resultant dissolved oxygen becomes $90 \mathrm{mg} / \mathrm{l}$. If the initial oxygen in the sewage was $6 \mathrm{mg} / \mathrm{l}$. Then the sewage flow is
A. $755 \mathrm{I} / \mathrm{sec}$
B. $580 \mathrm{I} / \mathrm{sec}$
C. $714 \mathrm{I} / \mathrm{sec}$
D. $680 \mathrm{I} / \mathrm{sec}$

Ans. C
Sol.
$D O_{\text {final }}=\frac{Q_{s} D O_{s}+Q_{R} D O_{R}}{Q_{R}+Q_{s}}$
$90=\frac{Q_{s} \times 6+2 \times 120}{2+Q_{s}}$
$6 Q_{s}+240=180+90 Q_{S}$
$Q_{s}=\frac{60}{84}=0.714 \mathrm{~m}^{3} / \mathrm{s}$
93. Find the efficiency of a trickling filter unit having organic loading rate $120 \mathrm{gm} / \mathrm{m}^{3} /$ day.
A. $89 \%$
B. $87 \%$
C. $85 \%$
D. $83 \%$

Ans. B
Sol. $\eta=\frac{100}{1+0.44 \sqrt{\mu}}=\frac{100}{1+0.44 \sqrt{0.12}}=86.77 \%$

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94. Determine the theoretical oxygen demand in $\mathrm{mg} / \mathrm{l}$ of fructose solution which is present in quantity $600 \mathrm{mg} / \mathrm{l}$ of water.
A. 192
B. 180
C. 640
D. 384

Ans. C
Sol. Mol Wt. of Fructose $\left(\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}\right)=180 \mathrm{gms}$
Reaction
$\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}+6 \mathrm{O}_{2} \tilde{\mathrm{~A}} 6 \mathrm{CO}_{2}+6 \mathrm{H}_{2} \mathrm{O}$
1 mole of fructose requires 6 moles of $\mathrm{O}_{2}=192 \mathrm{gms}$.
Oxygen demand,
$\frac{600}{180} \times 192=640 \mathrm{mg} / \mathrm{l}$
95. Considering the process of coagulation, when the coagulants such as alum are used then
A. it causes reduction in pH of water
B. it causes increase in pH of water
C. it increases the hardness of water
D. both (a) and (c)

Ans. D
Sol. Reduction of pH takes place when alum is added to the water because of formation of carbonic acid. Also increases permanent hardness.
96. The rate of food removal in attached growth system depends on many factors. These include

1. Wastewater flow rate
2. Organic loading rate
3. Rate of diffusivity of both oxygen and food into the biofilm.
4. Temperature
A. 1, 2 and 4
B. 1, 3 and 4
C. 2, 3 and 4
D. All of these

Ans. D
Sol. Rate of food removal in attached growth system depends on all the given factors
97. The volume of settled sludge in a graduated cylinder is $150 \mathrm{ml} / \mathrm{I}$. MLSS concentration was $1800 \mathrm{mg} / \mathrm{I}$ and the sewage flow rate is $3.6 \mathrm{~m}^{3} / \mathrm{hr}$. The recirculation rate is
A. $0.64 \mathrm{~m}^{3} / \mathrm{hr}$
B. $0.7 \mathrm{~m}^{3} / \mathrm{hr}$
C. $0.8 \mathrm{~m}^{3} / \mathrm{hr}$
D. $0.84 \mathrm{~m}^{3} / \mathrm{hr}$

Ans. A
Sol. $S V I=\frac{150}{1.8}=83.33 \mathrm{ml} / \mathrm{g}$
Recirculation Rate $=Q\left[\frac{x}{\frac{10^{6}}{S V I}-x}\right]=3.6\left[\frac{1800}{\frac{10^{6}}{83.33}-1800}\right]=0.635 \mathrm{~m}^{3} / \mathrm{hr}$

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98. Consider the following statements regarding activated sludge process

1) The completely mix process is more stable to shock loading.
2) Settling in the secondary sedimentation tank of the effluent of the ASP takes place under type-III settling
3) Secondary sedimentation tank settling of the effluent of the ASP takes place under type IV settling.

Which of the above statements are correct?
A. 1 only
B. 1 and 2 only
C. 1 and 3 only
D. None of these

Ans. B
Sol. The complete mix process has increases stability to shock loading. The effluent from ASP has medium concentration of solids so it settles as type III settlement which is also called hindered settling.
99. Determine the critical deficit (in ppm) of dissolved oxygen when the stream flowing at a rate of 210 cumec with saturated dissolved oxygen limit of 10.6 ppm is diluted with a sewage flowing at the rate of 1.35 cumec. Assume the Dissolved oxygen limit of waste water as 4ppm.
A. 0.05
B. 0.30
C. 6.60
D. 4.00

Ans. A
Sol.
D. 0 of mix $=\frac{(210 \times 10.6)+(1.35 \times 4)}{(210+1.35)}$
D.O. of mix $=10.55 \mathrm{ppm}$

Critical deficit of D.O. = Saturated D.O. of stream - D.O. of mix $=0.05$ ppm
100. Consider the following statements regarding the water distribution network system and choose the correct statement(s)
i. Radial system is designed for towns with haphazard and irregular expansion.
ii. Tree system, also known as grid - iron system is used eliminate the dead ends completely.
iii. To ensure high pressure and efficient design of pipe system, radial network is ideal.
iv. Equal pressure and multiple flow path can be achieved by designing circular network system.
A. i and ii
B. ii and iii
C. iii and iv
D. iv only

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Ans. C
Sol. Dead - end system or Tree system is adopted for older towns that has developed in a haphazard manner and which expand irregularly.

Grid- iron is suitable for well-planned towns and cities. It requires more number of cut-off valves.

Ring or circular system is suitable for cities with well-planned roads and helps in ensuring equal pressure
Radial system ensures high pressure of water supply, thus making the design of pipe sizes simple.
101. Match the following values of permissible BOD for disposal of sewage:

List - I
A) Lake water
B) River water
C) Land
D) Sea
A. A-5, B-4, C-1, D-2
C. A-4, B-5, C-2, D-1

List - II

1) $100 \mathrm{mg} / \mathrm{l}$
2) $50 \mathrm{mg} / \mathrm{l}$
3) $500 \mathrm{mg} / \mathrm{l}$
4) $30 \mathrm{mg} / \mathrm{l}$
5) $20 \mathrm{mg} / \mathrm{l}$
B. $A-5, B-4, C-2, D-3$
D. $A-4, B-5, C-3, D-1$

Ans. D
Sol. Pemissible BOD for disposal in
Surface water - $20 \mathrm{mg} / \mathrm{l}$
Lake water - $30 \mathrm{mg} / \mathrm{l}$
Marine water - 100 mg/l
Land - 500 mg/l
102. Elevation and temperature data for places are tabulated below;

| Elevation(m) | Temprature $\left({ }^{\circ} \mathrm{C}\right)$ |
| :--- | :--- |
| 4 | 21.25 |
| 444 | 15.70 |

Based on data, lapse rate can be referred as
A. Super-adiabatic
B. Sub-adiabatic
C. Neutral
D. Inversion

Ans. A
Sol.
$E L R=\frac{21.25-15.70}{444-4} * 1000=12.6^{\circ} \mathrm{C} / \mathrm{km}$
$A L R=9.8^{\circ} \mathrm{C} / \mathrm{Km}$
$E L R>A L R$
When the environment lapse rate exceeds the Adiabatic lapse rate, The ELR is said to be super adiabatic.

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103. Which of the following statements are true?

1) The organic matter present in the sewage may either be biodegradable or nonbiodegradable.
2) Nitrogenous organic matter is oxidised by nitrosomonous bacteria into nitrite.
3) The process of conversion of nitrogeous organic matter into nitrite and then nitrates is called denitrification.
4) Nitrogenous organic matter is oxidised after the oxidation of carbonaceous organic matter.
A. 1 and 3 only
B. 1, 2 and 4 only
C. 1, 2, 3 and 4
D. 1, 2 and 3 only

Ans. B
Sol. The process of conversion of nitrogenous organic matter into nitrites and nitrates by bacteria is called nitrification and further conversion into Nitrogen gas is called denitrification. Statement 3 is incorrect. Other statements are correct.
104. Which of the following statement is correct in relation to activated sludge process in general
A. Hydraulic retention time is greater than sludge age
B. Hydraulic retention time is lesser than sludge age
C. Hydraulic retention time and sludge age is same
D. Nothing can be said

## Ans. B

Sol. As hydraulic retention time is the average time for which sewage remains in the reactor but the sludge age is the average time for which mass of suspended solids remain under aeration. And in activated sludge process part of sludge is recycled many times which increases the sludge age.
105. Match the given water quality parameters in group I to the cause for rejection values in group II.
Group I

## Group II

P) Alkalinity

1) $1 \mathrm{mg} / \mathrm{L}$
Q) Chloride Content
2) $0.5 \mathrm{mg} / \mathrm{L}$
R) Iron
3) $600 \mathrm{mg} / \mathrm{L}$
S) Manganese
4) $1000 \mathrm{mg} / \mathrm{L}$
A. P-4, Q-3, R-2, S-1
B. P $-3, Q-4, R-1, S-2$
C. P-4, Q-1, R-2, S-3
D. P-3, Q-2, R-1, S-4

Ans. B
Sol. Alkalinity has cause for rejection value $600 \mathrm{mg} / \mathrm{L}$.
Chloride content has cause for rejection value $1000 \mathrm{mg} / \mathrm{L}$.
Iron has cause for rejection value of $1 \mathrm{mg} / \mathrm{L}$.
Manganese has cause for rejection value of $0.5 \mathrm{mg} / \mathrm{L}$.

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106. Iron and Manganese are generally present in water supplies as-:
A. Suspension
B. Solution
C. Colloidal particles
D. Either suspension or solution

Ans. D
Sol. Iron and Manganese are generally present in water supplies in the form of hydrated oxide as suspension and bicarbonate as solution. To remove iron and manganese impurities generally aeration method is implied. This method precipitates the iron and manganese impurities and thus can be easily removed.
107. A water sample has concentration of $\mathrm{OH}^{-}$ion measured on $0.17 \mathrm{mg} / \mathrm{L}$ at $25^{\circ} \mathrm{C}$. What is the pH of the water sample?
A. 10
B. 9
C. 8
D. 7

Ans. B
Sol. Concentration, $\left[\mathrm{OH}^{-}\right]=0.17 \mathrm{mg} / \mathrm{L}$
Molecular weight $=17 \mathrm{gm} / \mathrm{mole}$
Concentration in moles/ $\mathrm{L},\left[\mathrm{OH}^{-}\right.$]
$=\frac{0.17 \times 10^{-3}}{17}=1 \times 10^{-5}$ moles $/ L$
$\mathrm{pOH}=-\log _{10}\left[\mathrm{OH}^{-}\right]=-\log _{10}\left[1 \times 10^{-5}\right]$
$\mathrm{pOH}=5$
$\mathrm{pH}+\mathrm{pOH}=14$
$\mathrm{pH}=14-\mathrm{pOH}=9$
$\mathrm{pH}=9$
108. Which of the following statements are incorrect?

1) $B O D$ is measured after diluting the waste water with an aerated sample.
2) $B O D$ is measured as the amount of oxygen utilized by microorganisms anaerobically.
3) The ultimate $B O D$ value of the water changes with temperature.
4) Saturation concentration of oxygen in water at $20^{\circ} \mathrm{C}$ is $9 \mathrm{mg} / \mathrm{l}$.
A. 1 and 3
B. 2 and 4
C. 3 and 4
D. 2 and 3

Ans. D
Sol. BOD is measured aerobically. Ultimate BOD doesn't change with temperature, only the rate changes with change in temperature. Hence statements 2 and 3 are wrong. Other statements are correct.

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109. Calculate the number of slow sand filter required to treat the water for a population of 4000 with an average rate of water supply of 150 lpcd. Given rate of filtration is $200 \mathrm{l} / \mathrm{hr} / \mathrm{m}^{2}$.
A. 5
B. 3
C. 2
D. 6

Ans. B
Sol. Maximum daily demand of water $=1.8 * 4000 * 150$
$=1.08$ MId
Rate of filtration $=200 * 24=4800 \mathrm{l} /$ day $/ \mathrm{m}^{2}$
Total surface area of filter required $=1080000 / 4800$
$=225 \mathrm{~m}^{2}$
When surface area is in between 20-249 $\mathrm{m}^{2}$, Total 3 numbers of filter is required out of which one filter is kept on standby.
110. If the downhill end of a 20 m tape is held 80 cm low, then its horizontal length (in m) will be
A. 19.894
B. 19.984
C. 20.016
D. 20.061

Ans. B
Sol.


If ' $h$ ' is the difference in level, then

$$
D^{2}=l^{2}-h^{2}
$$

Here $l=20 \mathrm{~m}, h=80 \mathrm{~cm}=0.8 \mathrm{~m}$
$\Rightarrow \quad D^{2}=(20)^{2}-(0.8)^{2}$
$\Rightarrow \quad D=\sqrt{399.36}$
$\therefore \quad D=19.984 \mathrm{~m}$
111. What is $\angle A B C$ if $F B$ of line $A B$ is $40^{\circ}$ and $B B$ of line $B C$ is $280^{\circ}$ ?
A. $90^{\circ}$
B. $120^{\circ}$
C. $240^{\circ}$
D. $320^{\circ}$

Ans. B

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Sol. $\quad B B$ of $B C=F B$ of $B C+180^{\circ}$
$\Rightarrow \quad F B$ of $B C=280^{\circ}-180^{\circ}$
$\Rightarrow \quad F B$ of $B C=100^{\circ}$

$B B$ of $A B=F B$ of $A B+180^{\circ}$
$=40^{\circ}+180^{\circ}=220^{\circ}$
Included angle, $\propto=B B$ of $A B-F B$ of $B C$
$220^{\circ}-100^{\circ}=120^{\circ}$
112. The most accurate method of orientation by the three point method of plane tabling is the
A. tracing paper method
B. graphical method
C. trial and error method
D. Both (A) and (B)

Ans. C
Sol. The most accurate method of orientation by the three point method of plane tabling is the trial and error method
113. For a vertically held staff, if staff intercept is 3 m \& multiply and additive constant is 10 and 1. Then horizontal distance between staff station and observer will be-
A. 13 m
B. 31 m
C. 14 m
D. 19 m

Ans. B
Sol. Here, multiplying constant, $k=f / i=10$
\& additive constant, $c=f+d=1$
\& staff intercept, $\mathrm{S}=3 \mathrm{~m}$
Now horizontal distance,
$D=k s+c$
$=10 \times 3+1$
$=31 \mathrm{~m}$.
114. The purpose of an Anallactic lens in a tachometer is to
A. increase magnification.
B. reduce effective length of the telescope.
C. eliminate multiplying constant.
D. make staff intercept proportional to its distance from the tachometer.

Ans. D

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Sol. It is a special convex lens, fitted in between the object glass and eyepiece, at a fixed distance from the object glass, inside the telescope of a tacheometer. The function of the anallactic lens is to reduce the stadia constant to zero. Thus, when tacheometer is fitted with anallactic lens, the distance measured between instrument station and staff position (for line of sight perpendicular to the staff intercept) becomes directly proportional to the staff intercept. Anallactic lens is provided in external focusing type telescopes only.
115. Match list I with list II and select the correct answer using the codes given below:

| LIST I | LIST II |
| :--- | :--- |
| A. Correction for sag | 1. Tacheometer |
| B. Least count $30^{\prime}$ | 2. Aerial photograph |
| C. overlap | 3. base line |
| D. additive constant | 4. prismatic compass |

A. A-4, B-3, C-2, D-1
B. $A-3, B-4, C-2, D-1$
C. A-1, B-2, C-3, D-4
D. $A-3, B-4, C-1, D-2$

Ans. B
Sol. In a triangulation, baseline is measured very precisely.

- The sag correction is used for baseline measurement.
- Temperature correction is applied by measuring the temperature correction at least at three places.
- Finally, slope correction is also needed on steep slopes.
- The overlap of the photo are maintained to ensure complete coverage of the area.
- The overlap in the direction of light is known as longitudinal or forward overlap (about 60\%).
The overlap between adjacent flights is known as side overlap (about 30\%). It is used to :
i) Orient point so as to form a continuous flight slip.
ii) View the photograph by stereoscope.

116. Consider the following statements about the theodolites:
1) Transit Theodolite is a theodolite in which the telescope can be transited
2) EDMI is a theodolite fitted with micrometre for measurements.
3) A double reading theodolite is one in which diametrically opposite segments of the graduated circle are brought into view and the readings are averaged.
Which of the following statements are correct?
A. 1,2 AND 3
B. 1 AND 3
C. 1 AND 2
D. 2 AND 3

Ans. B
Sol. Self-understood from the statements.

## Correct Statements are

Transit Theodolite is a theodolite in which the telescope can be transited
A double reading theodolite is one in which diametrically opposite segments of the graduated circle are brought into view and the readings are averaged

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117. In an instrument, the bubble tube with the divisions of 1 mm and radius of 0.9 m has sensity of?
A. $1 / 2$
B. $1 / 70$
C. $1 / 90$
D. $1 / 900$

Ans. D
Sol. Sensitivity of bubbletube

$$
\begin{aligned}
& S=\frac{n l}{r} \\
& =\frac{1 X 0.001}{0.9} \\
& =\frac{1}{900}
\end{aligned}
$$

118. The R.L. of the floor is 100.78 m and the staff reading on the floor is 2.32 m . The reading on a staff held upside down against the underside of the beam, if the $R, L$, of the underside of the Tee-beam is 106.4 m, is $\qquad$ m.
A. 3.3
B. 3.56
C. 4.11
D. 4.46

Ans. A
Sol. R.L. of the under side of Tee-beam $=$ R.L. of the floor + staff reading + Staff reading held upside down
$\Rightarrow 106.4=100.782+2.32+$ Staff reading held upside down
$\therefore$ Staff reading held upside down $=3.3 \mathrm{~m}$
119. A steel tape was exactly 30 m long at $20^{\circ} \mathrm{C}$ when supported throughout its length and at a mean temperature of $32^{\circ} \mathrm{C}$ found to be 780 mm long. What will be the temperature correction, Take $\theta=11 \times 10^{-6}$ per ${ }^{0} \mathrm{C}$
A. . 00396 (-ve)
B. . 0396 (+ve)
C. . 00396 (+ve)
D. 0396 (-ve)

Ans. C
Sol. Given $L=30 \mathrm{~m}, \mathrm{Tm}_{\mathrm{m}}=32^{\circ} \mathrm{C}$ \& $\mathrm{T}_{0}=20^{\circ} \mathrm{C}$
So, temperature correction,
$C_{t}=\theta\left(T_{m}-T_{0}\right) . L$
$=11 \times 10^{-6}(32-20) \times 30$
$=.00396 \mathrm{~m}(+\mathrm{ve})$
120. Surveys which are carried out to depict mountains, water bodies, weeds and other details are known as
A. Cadastral survey
B. City surveys
C. Topographical survey
D. Hydrographic survey

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Ans. C
Sol.

- Topographic Surveys are used to identify and map the contours of the ground and existing features on the surface of the earth or slightly above or below the earth's surface (i.e. trees, buildings, streets, walkways, manholes, utility poles, retaining walls, etc.).
- Hydrographic survey is the science of measurement and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration/offshore oil drilling and related activities.
- Cadastral surveying is the sub-field of surveying that specialises in the establishment and re-establishment of real property boundaries. It is an important component of the legal creation of properties.

121. Choose the correct statement(s) with respect to the line of collimation.
i. The level line is always a straight line parallel to earth surface.
ii. Line of sight is the line joining the optical center of object glass.
iii. Line joining the axis of optical center of eyepiece with that of the object is telescope axis.
iv. Axis of the bubble tube follows the principle of a dumpy level.
A. i only
B. ii and iii only
C. ii ,iii and iv only
D. i, ii, iii and iv

Ans. C
Sol. The level line is always a curved line parallel to the earth surface.
The line of sight or the line of collimation is the line joining the point of intersection of the cross hair of the diaphragm and the optical center of the eyepiece.

The axis of telescope is the line joining the optical center of eyepiece and the optical center of the object glass of a telescope.
The axis of the bubble tube is the tangential line of the bubble which is always horizontal and it follows the same principle adopted in dumpy level.
122. In the double application of principle of reversion, the apparent error is
A. equal to true error
B. half the true error
C. two times the true error
D. four times the true error

Ans. D
Sol. In the double application of principle of reversion, the apparent error is four times the true error.
123. In levelling, if the sum of back sight and fore sight is 1.365 and 0.875 m and reduced level of B.M. is 100 m . then reduced level of end point will be-
A. 100.49 m
B. 99.51 m
C. 101.365 m
D. 100.875 m

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Ans. A
Sol. According to arithmetic check;
SB.S - $\sum$ F.S $=$ Last R.L - First R.L
So, last R.L $=$ first R.L $-\Sigma F . S+\Sigma B . S$
$=100-0.875+1.365$
$=100.49 \mathrm{~m}$
124. The population of a city in first three continuous years is given as 6000, 8000 and 10000 respectively. What is the population of the city in the fourth continuous year, according to the geometric increase method?
A. 11500
B. 12000
C. 12870
D. 14000

Ans. C
Sol. Percentage increase in population for $1^{\text {st }}$ to $2^{\text {nd }}$ year $=(8000-6000 / 6000) * 100=33.33 \%$
Percentage increase in population for $2^{\text {nd }}$ to $3^{\text {rd }}$ year $=(10000-8000 / 8000)=25 \%$
Geometric mean of percentage increase $=\sqrt{ }(33.33 \times 25)=28.86 \%$
Therefore population of the city in the $4^{\text {th }}$ year $=P_{1}(1+r)^{n-1}=6000(1.2886)^{4-1}=12840$ Nearest answer is option C.
125. One litre of sewage when allowed to settle for 30 minutes gives a sludge volume of 27 $\mathrm{cm}^{3}$. If the dry weight of this sludge is 3 grams, then its sludge volume index will be
A. 9
B. 24
C. 30
D. 81

Ans. A
Sol. The settled sludge volume $\mathrm{V}_{\mathrm{ob}}=27 \mathrm{~cm}^{3} / \mathrm{lit}=27 \mathrm{ml} / \mathrm{lit}$
The concentration of suspended solids in mixed liquor, $X_{o b}=3 \mathrm{~g} / \mathrm{lit}$
SVI $=\frac{V_{o b}}{X_{o b}}=\frac{27}{3}=9 \mathrm{ml} / \mathrm{gm}$

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