ACE Engineering Academy

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ESE- 2019 (Prelims) - Offline Test Series Test- 17

CIVIL ENGINEERING

SUBJECT: HYDRAULIC MACHINES AND HYDRO POWER, HYDROLOGY, WATER RESOURCES ENGG, SURVEYING, GEOLOGY AND FLUID MECHANICS & OPEN CHANNEL FLOW

01. Ans: (a)

Sol:

- Continuum hypothesis assumes fluid is a continuous substance. This is valid only when intermolecular spacing is very small as compared to the size of object with which it is interacting.
- Both absolute/dynamic viscosity (μ) and kinematic viscosity are used for fluid in motion.
- When fluid is static, shear stresses are zero and concept of viscosity is not required.

02. Ans: (d)

Sol: Efficiency of the draft tube is defined as the change in Energy across the draft to the K.E of water supplied to the draft tube.

$$\eta = \frac{(\Delta E) - \dot{m}gh_f}{(E_1)} = \frac{\frac{1}{2}\dot{m}\left(V_1^2 - V_2^2\right) - \dot{m}gh_f}{\frac{1}{2}\dot{m}V_1^2}$$

$$\therefore\ \eta_{\text{Drafttube}} = \frac{V_1^2 - V_2^2 - 2gh_f}{V_1^2}$$

(or)

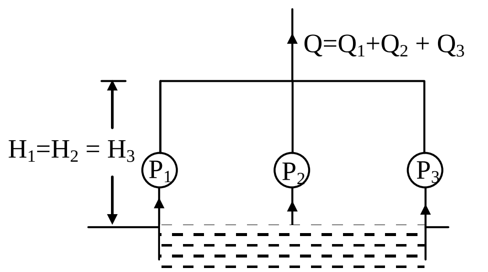
$$\eta_{\text{Draft tube}} = \frac{\frac{V_1^2}{2g} - \frac{V_2^2}{2g} - h_f}{\frac{V_1^2}{2g}}$$

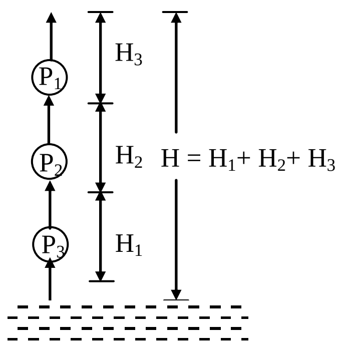
03. Ans: (d)

Sol:

Statement (1) is false: Positive displacement pumps like reciprocating pumps are more efficient than centrifugal pump (rotodynamic pumps).

Statement (2) is false: For high flow requirement, pumps are operated in parallel. For high head requirement, pumps are operated in series.





Statement (3) is false: Net positive suction head needed at the pump suction to prevent the pump from cavities is known as Net Positive Suction Head Required. (NPSHR).

Statement (4) is correct: Relation between power developed and speed of the runner is as follows

$P = \rho.g.\ Q.H$

$P \propto Q.H$

$P \propto A.V.H$

$P \propto D^2.\ \sqrt{H}\ .\ H$

Power coefficient: $P \propto D^2\ (H)^{3/2}$

Speed coefficient: $U \propto V$

$$\frac{\pi DN}{60} \propto \sqrt{2gH}$$

$$N.D \propto \sqrt{H}$$

Replace $H \propto N^2D^2$

$$\therefore\ P \propto D^2.\left(N^2D^2\right)^{\frac{3}{2}}$$

$$P \propto D^5\ N^3$$

For given pump: $P \propto N^3$

$$\frac{P_2}{P_1} = \left(\frac{N_2}{N_1}\right)^3$$

$$P_2 = P_1\left(\frac{0.8N_1}{N_1}\right)^3$$

$$P_2 = 10\ \text{MW}\ (0.8)^3$$

$$= 10 \times \left(\frac{8}{10}\right)^3 = 5.12\,\text{MW}$$

04. Ans: (d)

Sol: For a wide rectangular channel from Manning's formula

$$Q = A \times \frac{1}{n}(R)^{2/3}(S)^{1/2}$$

$$A = b\ \times d$$

$$R = \frac{bd}{b + 2d}$$

$$\therefore b >> d \Rightarrow R = \frac{bd}{b}$$

$$R = d$$

$$\therefore Q = bd.\frac{1}{n}(d)^{2/3}(S)^{1/2}$$

$$= \frac{1}{n}b(S)^{1/2}(d)^{5/3}$$

$Q = (\text{const})\ (d)^{5/3}$

Given $Q = C_r\ (G - a)^{\beta}$

when n, b, s are constant

$G - a = d$

$$\therefore \beta = \frac{5}{3} = 1.67$$

05. Ans: (b)

Sol:

Time	**1hr UH**	**Lag 1 hour S-curve addition**	**S-curve**
0	0	-	0
1	3	0	3
2	12	3	15
3	8	15	23
4	6	23	29
5	3	29	32
6	0	32	32

06. Ans: (d)

Sol: Work done = Increase in surface energy

$= \sigma A_2 - \sigma A_1$

$= \sigma \times (4\pi R_2^2 - 4\pi R_1^2)$

$= 4\pi\sigma\ (0.1^2 - 0.05^2)\ = 0.03\pi\sigma$ J

07. Ans: (c)

Sol: $\text{Duty} = 8.64 \times \frac{B}{\Delta}$

Where, B = Base period in days

= 30 days

Δ = Delta in meters

D = duty in Ha/cumecs

$$\text{Duty} = 8.64 \times \frac{30}{\frac{(56-8)}{100}}$$

$$= 864 \times \frac{30}{48}$$

= 540 Ha/cumecs

Losses = 100 – 25 = 75%

Duty = 540 × 0.75 = 405 Ha/cumecs

08. Ans: (c)

Sol: Vertical acceleration reduces the unit weight of the dam material and that of water by 10%.

09. Ans: (b)

Sol:

1. Crop period is the time period that elaspses from the instant of its sowing to the instant of its harvesting is called crop period.
2. The time between the first watering of a crop at the time of its sowing to its last watering before harvesting is called base period

3. Watering done prior to sowing is called paleo irrigation
4. Duty of water at distributary channel is outlet factor

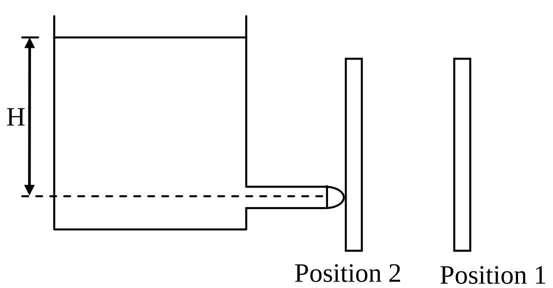
10. Ans: (b)

Sol: Statement 2: classification of saline and alkaline soils depends on electrical conductivity and p^H of soil.

Statement 3: $\left(SAR = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}\right)$

11. Ans: (d)

Sol:



In position 1 force on the plate is due to impact force of jet

$\therefore\ F_1 = \rho a V^2 = \rho a(\sqrt{2gh})^2 = 2\rho a g H$ …. (1)

In position 2 force on the plate is due to hydrostatic pressure,

$\therefore F_2 = pa = \rho g H a$

$\therefore \frac{F_1}{F_2} = 2$

12. Ans: (d)

Sol:

1. Net Irrigation Requirement

$= C_u - R_e = 10 - 3 = 7$ cm

2. Field Irrigation Requirement

$$= \frac{NIR}{\eta_a} = \frac{7}{1-0.2} = 8.75\,cm$$

3. Gross Irrigation Requirement

$$= \frac{FIR}{\eta_c} = \frac{8.75}{1-0.125} = \frac{8.75}{0.875} = 10\,cm$$

13. Ans: (a)

Sol: Daily evaporation loss from reservoir

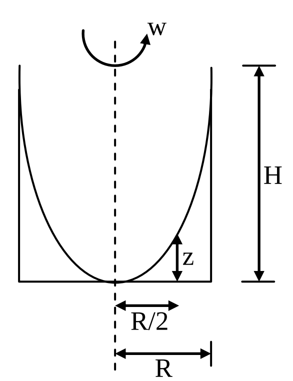
$= A \times E$

$$= \frac{20\times10^6\times30\times10^{-2}}{30}$$

$= 200000\ m^3$

14. Ans: (b)

Sol:



Volume of paraboloid of revolution is half of volume of cylinder which encloses the paraboloid. Hence when half of the water spills out the vertex of paraboloid just touches the base of tank.

The elevation 'z' above the base at any radial distance 'r' is given by

$$z = \frac{\omega^2 r^2}{2g} = \frac{\omega^2 (R/2)^2}{2g} = \frac{1}{4}.\frac{\omega^2 R^2}{2g}$$

$$= \frac{H}{4} \qquad (\because H = \frac{\omega^2 R^2}{2g})$$

$\therefore$ Pressure on base at radial distance r = R/2 is given by

$$P = \rho g z = \rho g \frac{H}{4}$$

15. Ans: (b)

16. Ans: (b)

Sol: Soil moisture deficit = Sd (Fc – mc)

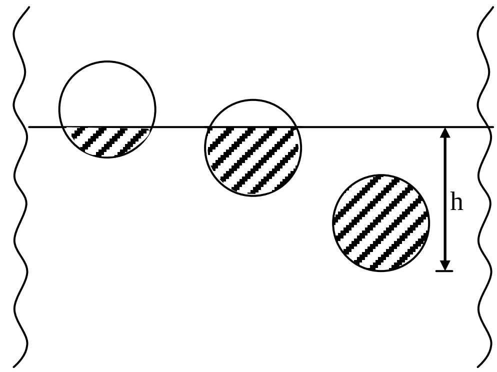
$= 0.192$ m

$$\%\text{ water wasted} = \frac{0.250 - 0.192}{0.250} \times 100$$

$= 23.2\%$

17. Ans: (b)

Sol:



As depth 'h' increases the displaced volume increases non-linearly and then becomes constant when sphere is completely submerged.

$F_B = \rho g \forall$

Where, $\forall$ = displaced volume.

18. Ans: (b)

Sol: $$\eta_D = \left[1 - \frac{y_d}{y_m}\right]$$

y_d = Average of the absolute values of deviations from the mean.

y_m = Mean depth of water stored during irrigation

$$\eta_D = \left[1 - \frac{10}{60}\right] \times 100$$

$= 83.33\%$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19. Ans: (c)

Sol: $\frac{1}{2}\times 50\times Q_p = 100\times 10^4\times\frac{5}{100}$

$Q_p = 2000\ m^3/hour$

20. Ans: (a)

Sol: $H_C = \frac{f}{\gamma_w(S+1)}$

$= \frac{3.87\times 10^3}{9.81(2.5+1)}$

$= 112.7$ m Say 113 m

21. Ans: (c)

Sol: $\phi\text{-index} = \frac{P_e - R}{t_e}$

$P_e = 12 + 18 + 16 + 14 = 60$

$8 = \frac{60-R}{4}$

R = 28 mm

22. Ans: (d)

Sol: Lacey's regime formulae are applicable to alluvial channels with sedimentation concentration less than 500 ppm.

Lacey's mean velocity, $V = 10.8\ R^{2/3}.\ S^{1/3}$

23. Ans: (c)

Sol:

- Existence of stream function implies flow is incompressible. Hence, if stream function is available then flow must satisfy continuity equation for incompressible flow i.e. $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0$.
- For irrotational flow stream function satisfies Laplace equation and vice versa

  i.e. $\frac{1}{2}\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)=0$

  or $\frac{\partial v}{\partial x}=\frac{\partial u}{\partial y}$

24. Ans: (b)

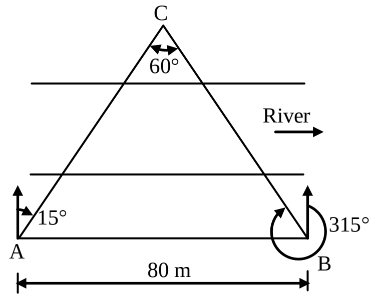
Sol: P = 28 kPa $\Rightarrow$ h = 2.8 m

$$t_{min} = (FOS)\frac{h}{S_c-1} = 1.5\times\frac{2.8}{2.4-1} = 3m$$

25. Ans: (b)

26. Ans: (a)

Sol:



By sine rule

$$\frac{80}{\sin 60°} = \frac{AC}{\sin 45°}$$

$$AC = 65.32 \text{ m}$$

Width of the river

$$= AC \sin 75°$$

$$= 65.32 \times 0.966$$

$$= 63.09 \text{ m}$$

27. Ans: (c)

Sol:

- Velocity normal to streamline is zero Hence, there is no flow across the streamline.
- Velocity normal to streamline is zero but acceleration can be non zero $a_n = \frac{V^2}{R}$, where R = Radius of curvature.
- As spacing between streamline increases velocity decreases but discharge between two streamlines is always constant.
- $\frac{\partial\psi}{\partial x}dx + \frac{\partial\psi}{\partial y}dy = 0$

  i.e. vdx – udy = 0

  i.e. $\frac{dx}{u} = \frac{dy}{v}$ represents equation of streamline.

In other words stream function is constant along streamline.

$$\therefore\ d\psi = \frac{\partial\psi}{\partial x}dx + \frac{\partial\psi}{\partial y}dy = 0$$

28. Ans: (d)

29. Ans: (a)

30. Ans: (c)

Sol: Contour interval required for location surveys is large.

31. Ans: (c)

Sol: $Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}}.\sqrt{2gh}$

where $h = x\left(\frac{\rho_m}{\rho} - 1\right)$

$$= 10 \times \left(\frac{13.6\times 10^3}{1000} - 1\right)$$

$$= 126 \text{ cm}$$

$$C_d = \sqrt{1 - \frac{h_f}{h}}$$

$$0.95^2 = 1 - \frac{h_f}{126}$$

$$\therefore\ h_f = (1 - 0.95^2) \times 126$$

$= 12.3$ cm of water

32. Ans: (a)

33. Ans: (c)

Sol:

Station	A	B	C	D
W	0.1	0.2	0.3	W_D =0.4
P (cm)	5	10	P_c = ?	15

P_a = 145 mm = 14.5 cm

$P_a = P_1 w_1 + P_2 w_2 + \ldots\ldots + P_m w_m$

$14.5 = (5\times0.1)+(10\times0.2)+(P_c\times0.3)+(15\times0.4)$

$0.3P_c = 14.5 - 0.5 - 2 - 6$

$$P_c = \frac{6}{0.3}$$

P_c = 20 cm

34. Ans: (d)

Sol: Area = M (F – I ± 10 N + C)

C = 0 ($\because$ The anchor point is outside)

+ve sign because zero mark is passed in clockwise direction

Area = M (F – I + 10 N)

$= 100\,(1.378 - 8.378 + 10 \times 2)$

$= 1300\ \text{cm}^2$

35. Ans: (b)

36. Ans: (d)

37. Ans: (d)

Sol:

$$L = \frac{r\cos^2\frac{\theta}{2}}{D}(206265)$$

$$= \frac{(75\times10^{-3})(\cos30)^2(206265)}{9450}$$

$= 1.6370 \times (\cos 30)^2$

$= 1.397$

38. Ans: (d)

Sol: By Bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z^2 + h_f$$

$$h_f = \frac{P_1 - P_2}{\rho g} + (Z_1 - Z_2)$$

$$= \frac{150\times10^3}{15\times10^3} + 3$$

$= 13$ m

39. Ans: (d)

Sol: F = Total infiltration water in 2 hours

= 80 cm

f_o = 300 mm/hr f_c = 100 mm/hr

$$F_s = \frac{f_o - f_c}{k} + f_c t$$

$$800 = \frac{300-100}{k} + 100\times 2$$

$$600 = \frac{200}{k}$$

$$k = \frac{200}{600} = \frac{1}{3}$$

40. Ans: (b)

Sol:

$$L = \left((1-0.6)\frac{250\times10^{-3}}{\left(\frac{1}{20{,}000}\right)} \right)\times 10^{-3} = 2\,\text{km}$$

$$W = \left((1-0.3)\frac{250\times10^{-3}}{\left(\frac{1}{20{,}000}\right)} \right) 10^{-3} = 3.5\text{ km}$$

a = L.W = 2 × 3.5 = 7 km^2

41. Ans: (a)

Sol: $$h_{L,exp} = \frac{(V_1 - V_2)^2}{2g}$$

$$h_{L,cont} = \frac{(V_c - V_2)^2}{2g} = \frac{V_2^2}{2g}\left(1 - \frac{1}{C_c}\right)^2$$

where $C_c = \frac{A_c}{A_2}$ = Contraction coefficient

$$h_{L,ent} = 0.5\frac{V^2}{2g} \text{ (for sharp entrance)}$$

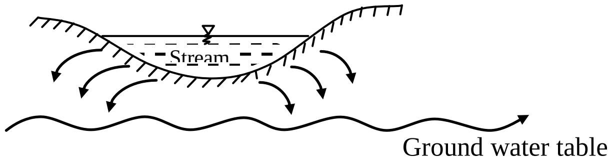
$$h_{L,exit} = \frac{V^2}{2g}$$

42. Ans: (c)

43. Ans: (d)

Sol:

1. When the water table intersects a land surface, ground water comes out to the surface in the form of springs or seepage.
2. The water table retained in impervious stratum is called as perched water table and the yield is very small as it is of limited extent and surrounded by material.
3. Perennial rivers are effluent streams and they get water from the surface of water table .these streams will rise or fall as the water table rises or fall.
4. Influent streams are disappearing streams because they loose water as it flow downward or infiltrate into the ground, so depression is formed.



44. Ans: (b)

Sol:

True R.L. of B

Instrument at A

Incorrect level difference between

A and B = 1.630 – 1.03 = 0.600 m

Instrument at B

Incorrect level difference between

A and B = 1.540 – 0.95 = 0.59 m

True difference of level between A and B

= Mean of the two incorrect differences

$$= \frac{0.6 + 0.59}{2}$$

= 0.595 m (Fall from A to B)

(or)

$$h = \frac{(h_a - h_b) + (h'_a - h'_b)}{2}$$

$$= \frac{(1.630 - 1.03) + (1.540 - 0.95)}{2}$$

= 0.595 m

45. Ans: (d)

Sol: The pressure rise due to sudden closure of valve is given by

P = ρVC

where ρ = density of fluid

V = velocity of fluid

C = sonic velocity in the medium

Note: Water hammer pressure is independent of length of pipe.

46. Ans: (b)

Sol: S = 1.781 – 1.285

S = 0.496 m

$$D = \frac{f}{i}s + (f + d)$$

$$50 = \frac{0.25}{i} \times 0.496 + (0.25 + 0.15)$$

i = 2.5 mm

47. Ans: (c)

Sol: $$\frac{dH}{dx} = \frac{dZ}{dx} + \frac{dE}{dx}$$

$$\frac{dE}{dx} = \frac{dH}{dx} - \frac{dZ}{dx}$$

$$= S_o - S_f$$

$$= \frac{dy}{dx}\left(1 - F_r^2\right)$$

48. Ans: (d)

Sol:

- $h_L = \dfrac{fLQ^2}{12.1D^5}$ where f = $f\left(\dfrac{\text{Re}\,K}{D}\right)$
- Hence 'K' depends on pipe (K, L, D) as well as fluid (μ, ρ).

- Summation of pressure drop around loop has to be zero hence $\Sigma h_L = \frac{\Sigma \Delta P}{\rho g} = 0$.
- Incoming and outgoing discharges must be same at any junction.

49. Ans: (d)

50. Ans: (a)

Sol:

1. In Pelton wheel, regulation of water at nozzle by spear valve is easy by servomechanism. In case of Francis turbine, wicket gates attached to guide wheel ring is not effective due to leakage and complex linkage mechanism. Hence Statement-1 is correct.
2. Statement-2 is wrong: Kaplan turbines are more efficient at low heads and part loads than Francis turbine. They can not be used for high heads when they are subjected to cavitation action. They are also costly to manufacture.
3. Statement-3 is correct: By providing draft tube at tail end of Francis turbine, Gross head is increased, without incurring loss of head.
4. Statement-4 is wrong: Pelton wheels always run at speeds considerably less than that of Francis wheels as the resistance offered to rotation is more.
5. Statement-5 is correct: This statement means lesser sizes of the power house to accommodate the same number of Francis turbines.

51. Ans: (a)

Sol:

$$\eta = \frac{\text{Work done / second by runner}}{\text{K.E / sec of water Jet}}$$

$$\eta = \frac{\dot{m}(\Delta V)_{whirl}.U}{\frac{1}{2}\dot{m}V_1^2}$$

$$\eta = \frac{2(\Delta V)_{whirl}.U}{V_1^2}$$

Velocity Diagrams: $V_{w_1} = V_1$

$$V_{w_2} = (V_1 - U)\cos\theta^\circ - U$$

$$\eta = \frac{2[V_1 + (V_1 - U)\cos\theta^\circ - U].U}{V_1^2}$$

$$\eta = \frac{2(V_1 - U)(1 + \cos\theta)U}{V_1^2}$$

52. Ans: (a)

Sol: $y_n = 0.8$ m

$$y_c = \left(\frac{q^2}{g}\right)^{1/3}$$

$= 1$ m

$y_n = 0.8$ m

$y_n < y_c$, $S_0 > S_c$

$\therefore$ Slope is steep

53. Ans: (d)

Sol: Specific speed of water turbine is given by

$$N_s = \frac{N\sqrt{P}}{(H)^{5/4}}$$

Where, N is the speed of the turbine runner equal to synchronous speed of the electric generator $\left(\frac{120f}{n}\right)$. Hence N is replaced by $\left(\frac{120f}{n}\right)$

54. Ans: (c)

Sol: For dynamic similarity of gravity force

$(F_r)_m = (F_r)_P$

i.e. $\left(\frac{V}{\sqrt{gL}}\right)_m = \left(\frac{V}{\sqrt{gL}}\right)_P$

$$\frac{V_m}{V_P} = \sqrt{\frac{L_m}{L_P}} \ldots\ldots\ldots\ldots\ldots (1)$$

For dynamic similarity of viscous forces

$(Re)_m = (Re)_P$

$$\left(\frac{VL}{\nu}\right)_m = \left(\frac{VL}{\nu}\right)_P$$

i.e. $\frac{V_m}{V_P} = \frac{\nu_m}{\nu_P} \times \frac{L_P}{L_m} \ldots\ldots\ldots (2)$

From (1) & (2)

$$\sqrt{\frac{L_m}{L_P}} = \frac{\nu_P}{\nu_P} \times \frac{L_P}{L_m}$$

$$\therefore \frac{\nu_m}{\nu_P} = \left(\frac{L_m}{L_P}\right)^{3/2}$$

55. Ans: (d)

Sol: $y_c^3 = \frac{2y_1^2 y_2^2}{(y_1 + y_2)}$

$$= \frac{2(0.5)^2(2)^2}{(0.5)+(2)} = \frac{2 \times \frac{1}{4} \times 4}{2.5}$$

$$y_c^3 = \frac{2}{2.5} = \frac{4}{5}$$

$$y_c = \left(\frac{4}{5}\right)^{1/3}$$

56. Ans: (b)

Sol: n = 3(T, K, g)

m = 2 (L, T)

π terms = n – m = 1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57. Ans: (a)

58. Ans: (a)

Sol: $N_S = \frac{N\sqrt{P}}{(H)^{5/4}} = \frac{N}{H^{1/2}}.\frac{\sqrt{P}}{H^{3/4}}$

$= \frac{N}{\sqrt{H}}.\frac{\sqrt{P}}{\sqrt{H^{3/2}}}$

$= \frac{N}{\sqrt{H}}.\sqrt{\frac{P}{H^{3/2}}}$

$= N_U.\sqrt{P_U}$

$= 100 \times \sqrt{16}$

$= 100 \times 4 = 400$

$N_s > 60$, Hence it is not an impulse turbine.

59. Ans: (b)

Sol: u = A sin (By) + C

at y = 0, u = 0 ⇒ C = 0

at y = δ, u = U_∞ = A sin Bδ ……… (1)

at y = δ, $\frac{du}{dy} = 0$

$\frac{du}{dy} = A.B.\cos By$

0 = A.B cos Bδ

$\Rightarrow B\delta = \frac{\pi}{2}$

or $\delta = \frac{\pi}{2\delta}$

substituting in equation (1)

$U_\infty = A\sin\left(\frac{\pi}{2\delta}\times\delta\right)$

$\Rightarrow A = U_\infty$

60. Ans: (b)

Sol: $\Delta E = \frac{(y_2 - y_1)^3}{4y_1y_2} = \frac{(6-1)^3}{4\times1\times6}$

$= \frac{5^3}{24} = \frac{125}{24} \simeq 5$ m

61. Ans: (c)

Sol: Deceleration $\frac{F_D}{m} = \frac{\frac{C_D}{2}\rho_{air}AV^2}{\rho_{ball}\forall g}$

$= \frac{C_D}{2}.\rho_r \times \frac{\pi R^2}{\frac{4}{3}\pi R^3} \times \frac{V^2}{g}$

$= \frac{3}{8}.C_D.\rho_r\frac{V^2}{Rg}$

62. Ans: (a)

63. Ans: (a)

Sol:

- Mixing length is used to calculate Reynolds stress.
- Magnus effect is present when spinning object is placed in flow.

- Boundary layer flow is governed by Navier-Stokes equation.
- If velocity potential exits then angular velocity is zero.

64. Ans: (d)

65. Ans: (a)

66. Ans: (d)

Sol:

- Irrigation canals are generally not constructed at maximum gradient since it results in high velocity and lowers FSL of the canal.
- Lower FSL cannot irrigate much area.
- Maximum grade will allow free flow of water so, more water for irrigation is available to cultivate more dry land (Arid land).

67. Ans: (d)

Sol: A surge is unsteady RVF

68. Ans: (a)

Sol: Statement (I) and statement (II) are correct and statement (II) is correct explanation to statement – (I)

In modern Francis turbine water enters into the turbine radially are leaves axially through its centre. Due to this reason, it called as mixed flow reaction turbine.

69. Ans: (c)

Sol:

- Volatile liquids have more vapour pressure than non volatile liquids because they have more tendency to evaporate. Statement II is wrong.
- Cavitation starts when minimum pressure falls below vapour pressure. ($P_{min} < P_v$). Hence, there is more chance of cavitation in volatile liquids.

70. Ans: (c)

Sol: Statement-I is true, Statement-II is false.

In winter month when low temperature prevail, infiltration capacity is also low.

71. Ans: (a)

72. Ans: (d)

Sol: Navier stokes equation for incompressible flow is given by

$$\frac{D\vec{v}}{Dt} = -\frac{1}{\rho}\nabla P + \vec{g} + \mu\nabla^2\vec{v}$$

It considers pressure, body and viscous shear stresses as external forces. It is applicable for real as well as ideal fluid flow. For ideal flow $\mu\nabla^2\vec{v}$ is zero and Navier stokes equation reduces to Euler's equation.

73. Ans: (c)

Sol:

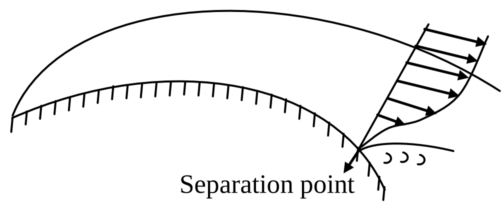
Probable error of weighted arithmetic mean

$$= \pm 0.6745\sqrt{\frac{\sum WV^2}{\sum W(n-1)}}$$

Weight are inversely proportional to the variance of the standard error.

74. Ans: (a)

Sol:



As tangent to velocity profile is normal to surface

$$\left.\frac{du}{dy}\right|_{y=0} = 0$$

$$\tau_w = \mu \left.\frac{du}{dy}\right|_{y=0} = 0$$

75. Ans: (a)

Sol: Both are true and statement-II is correct explanation of statement-I.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