

2020

RANK Improvement **WORKBOOK**



**Answer key and Hint of
Objective & Conventional Questions**

Civil Engineering
Fluid Mechanics



MADE EASY
Publications

1

Fluid Properties and Manometry

LEVEL 1 Objective Questions

1. (c)
2. (a)
3. (2.92)
4. (c)
5. (1181.27)
6. (c)
7. (d)
8. (d)
9. (b)
10. (c)
11. (b)
12. (a)
13. (7.807)
14. (126.55)
15. (649)
16. (c)
17. (a)

LEVEL 2 Objective Questions

18. (c)
19. (c)

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20. (*)

21. (*)

22. (b)

23. (a)

24. (d)

25. (b)

26. (d)

27. (b)

28. (b)

LEVEL 3 Conventional Questions

Solution : 1

Terminal velocity = 2.66 cm/sec

Solution : 2

Increase in velocity = 185.71 m/sec

Solution : 3

$$u = \frac{\rho g}{\mu} \left(\frac{y^2}{2} - hy \right) + v_0$$

Solution : 4

- (a) 688.3 kPa
- (b) 206.4 kPa

Solution : 5

Surface tension, $\sigma = 0.051 \text{ N/m}$

Solution : 6

Terminal velocity = 0.5625 m/sec

2

Hydrostatic Force

LEVEL 1 Objective Questions

1. (d)
2. (d)
3. (3)
4. (a)
5. (25.28)
6. (a)
7. (0.5416)
8. (c)
9. (b)
10. (c)
11. (a)

LEVEL 2 Objective Questions

12. (d)
13. (a)
14. (d)
15. (337.16)

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16. (147.44)

17. (28.79)

18. (c)

LEVEL 3 Conventional Questions

Solution : 1

Height of oil = 4.34 m

Solution : 2

$F = 3.62 \text{ kN}$, $h_{cp} = 1.0536$

Solution : 3

- (i) $Z_1 = 60 \text{ cm}$
- (ii) $P_2 - P_1 = 19.02 \text{ KPa}$

Solution : 4

Resultant Fluid force = 37.54 kN

Solution : 6

$F = 31.29 \text{ kN}$, $h_p = 2.577 \text{ m}$ from water surface

Solution : 7

$F_t = 0.790 \text{ kN}$

Solution : 8

Bottom cube above tank base = 4.453 cm

Liquid surface above tank base = 10.837 cm

Solution : 9

$$y_p = \frac{3}{4}h$$

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3

Buoyancy & Floatation

LEVEL 1 Objective Questions

1. (d)
2. (b)
3. (d)
4. (23.5)
5. (c)
6. (a)
7. (d)

LEVEL 2 Objective Questions

8. (12.04)
9. (a)
10. (d)
11. (d)
12. (a)

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13. (b)

14. (a)

15. (d)

16. (c)

17. (d)

LEVEL 3 Conventional Questions

Solution : 2

$$h = \frac{W}{\gamma \left(\frac{\pi D^2}{4} \right)} \left(\frac{1}{S} - 1 \right)$$

Solution : 3

Stable

Solution : 4

Unstable equilibrium
GM = -0.20 m

Solution : 5

Stable equilibrium
GM = 3.939 m

■■■■

LEVEL 1 Objective Questions

1. (a)

2. (a)

3. (c)

4. (d)

5. (b)

6. (d)

7. (10.82)

8. (0)

9. (2.304)

10. (0.126)

11. (d)

12. (c)

13. (b)

14. (b)

15. (c)

16. (d)

17. (b)

18. (b)

19. (b)

20. (b)

21. (a)

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22. (b)

23. (2.08)

24. (c)

25. (d)

LEVEL 3 Conventional Questions**Solution : 1**Local acceleration = 0.1507 m/sec^2 Convective acceleration = -3.3352 m/sec^2 Total acceleration = -0.1845 m/sec^2 **Solution : 2**

(i) Acceleration = - 35.85 units

(ii) Frictional resistance, $F_s = 1.358 \text{ kN}$ **Solution : 3**

$$\vec{a} = 5\hat{i} - 8\hat{j} + 6\hat{k}$$

Solution : 4

(i) 21.42 cm

(ii) 1.132 m

Solution : 5 ϕ exists**Solution : 6**(i) $Q = 0.00628 \text{ m}^3/\text{sec}$ (ii) $V_{\text{avg}} = 0.01 \text{ m/sec}$ **Solution : 7** $y = 8 \text{ units}, \quad V = 24.33 \text{ units}$

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LEVEL 1 Objective Questions

1. (3.14)
2. (1.5)
3. (61.4)
4. (b)
5. (b)
6. (1254.94)
7. (d)
8. (90.18)
9. (34.72)
10. (c)
11. (± 2.25)
12. (b)
13. (2.0387)
14. (d)
15. (a)
16. (b)

LEVEL 2 Objective Questions

17. (1.898)

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18. (0.637)

19. (b)

20. (c)

21. (91.1 s)

22. (0.36)

23. (d)

24. (*)

LEVEL 3 Conventional Questions

Solution : 1

- (a) $Q = 1.035 \text{ m}^3/\text{sec}$
- (b) $Q = 0.966 \text{ m}^3/\text{sec}$

Solution : 2

- (a) $Q = 40 \text{ L/sec}$
- (b) $y = 14 \text{ cm}$

Solution : 3

Force on the bolt = 256.6745 N

Solution : 4

Discharge, $Q = 30.2 \text{ Lt/min}$

Solution : 5

Dia. of throat = 97 mm

Solution : 6

Speed of arm = 507 rpm

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6

Viscous Flow of Incompressible Fluid

LEVEL 1 Objective Questions

1. (c)
2. (2.73)
3. (b)
4. (c)
5. (b)
6. (b)

LEVEL 2 Objective Questions

7. (60.75)
8. (b)
9. (c)
10. (-12326.72)
11. (b)
12. (d)
13. (c)
14. (c)
15. (d)
16. (0.106)

17. (12.73)

18. (d)

LEVEL 3 Conventional Questions

Solution : 1

- (i) Wall shear stress = 41.69 Pa
- (ii) Shear stress τ at $r = 10$ cm = 27.79 Pa
- (iii) $f = 0.00363$

Solution : 2

- (i) $\tau_0 = 1000$ N/m²
- (ii) $q = 0.004$ m³/sec/m

Solution : 3

$$V_{\text{avg}} = \frac{5}{8} U_{\infty} \quad \alpha = 1.677$$

Solution : 4

$$\alpha = 1.06$$

Solution : 5

- (a) $U_{\text{max}} = 0.675$ m/sec
- (b) $V_{\text{avg}} = 0.3375$ m/sec
- (c) $Q = 3.817$ L/sec

Solution : 6

- (a) $T_0 = 4.48$ N/m²
- (b) $DP_1 = 179.2$ N/m²

Solution : 7

$$\tau = \frac{128\mu AL}{\pi D^4 \gamma} \ln \frac{H_1}{H_2}$$

Solution : 8

$$\mu = 0.3419 \text{ Pa.s}$$

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LEVEL 1 Objective Questions

1. (c)
2. (b)
3. (a)
4. (7.9)
5. (33.59)
6. (1.82)
7. (d)
8. (c)
9. (b)
10. (c)

LEVEL 2 Objective Questions

11. (b)
12. (a)
13. (d)
14. (c)
15. (b)
16. (c)
17. (a)
18. (b)

LEVEL 3 Conventional Questions**Solution : 1**

$$h_f = 0.97 \text{ m}$$

Solution : 2

$$Q = 20.63 \text{ Lt/sec}$$

Solution : 3

$$h = 2.667 \text{ m}$$

Solution : 4

$$Q_{\min} = 17.64 \text{ Lt/sec}$$

Solution : 5

- A. P_{gauge} of air = 73.32 kPa
 B. (i) $\delta = 15.5 \text{ mm}$
 (ii) $t_0 = 56.7 \text{ N/m}^2$
 (iii) $F_D = 27.18 \text{ N}$

Solution : 6

$$\frac{h_1}{h_2} = 0.022$$

Solution : 7

$$Q_{AD} = 5.97 \text{ unit}$$

$$Q_{AB} = 19.65 \text{ unit}$$

$$Q_{CB} = 25.35 \text{ unit}$$

$$Q_{CD} = 9.03 \text{ unit}$$

$$Q_{CA} = 5.5 \text{ unit}$$

Solution : 8

- (i) $L_{\text{eq}} = 4318$
 (ii) $D_{\text{eq}} = 0.39 \text{ m}$

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8

Boundary Layer Theory, Drag & Lift

LEVEL 1 Objective Questions

1. (a)
2. (b)
3. (b)
4. (0.26)
5. (0.5)
6. (c)
7. (36.77)
8. (a)
9. (61.24)
10. (3.77)

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LEVEL 2 Objective Questions

11. (d)
12. (b)
13. (c)
14. (c)
15. (b)
16. (c)
17. (d)
18. (b)
19. (a)
20. (a)
21. (b)
22. (a)
23. (a)

LEVEL 3 Conventional Questions**Solution : 1**

$$F_T = 65.88 \text{ kN, Power} = 17.351 \text{ kW}$$

Solution : 2

$$\text{Stagnation pressure} = 101.54 \text{ kN/m}^2$$

$$\text{At } \theta = 90^\circ, P = 99.38 \text{ kN/m}^2$$

Solution : 3

$$\text{Stagnation pressure} = 459.7 \text{ kN/m}^2$$

Solution : 4

Satisfied

Solution : 5

$$F_D = 17.78 \text{ N/m}$$

Solution : 6

$$x = 0.235 \text{ m from leading edge,}$$

$$\tau_0 = 0.177 \text{ N/m}^2$$

Solution : 7

(sec) t	1	10	100	1000
(m/sec) V	89	45	7.6	0.8
m, S	94	654	2114	3944

Solution : 8

$$\text{Skin friction drag} = 44.3 \text{ N}$$

$$\text{Wage drag} = 25.7 \text{ N}$$

Solution : 9

$$\delta = 1.3 \text{ m, } T = 63.8 \text{ N/m}^2, F_D = 17.23 \text{ N}$$

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LEVEL 1 Objective Questions

1. (d)

2. (b)

3. (b)

4. (d)

5. (c)

6. (a)

7. (c)

8. (c)

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LEVEL 2 Objective Questions

9. (b)

10. (a)

11. (a)

12. (4.762)

13. (4.8)

14. (0.2285)

15. (d)

16. (d)

LEVEL 3 Conventional Questions**Solution : 1**

$$V = 2.6 \text{ m/sec, } \delta' = \text{LSL} = 9.7169 \times 10^{-3} \text{ mm}$$

Solution : 2

$$y = 0.00406 r_0$$

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LEVEL 1 Objective Questions

1. (c)
2. (c)
3. (0.0329)
4. (a)
5. (1.5)
6. (c)
7. (c)
8. (c)
9. (c)
10. (b)
11. (d)

LEVEL 2 Objective Questions

12. (b)
13. (d)
14. (c)
15. (b)
16. (a)

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17. (c)

18. (a)

19. (c)

20. (b)

LEVEL 3 Conventional Questions**Solution : 1**

$$P_p = 150 \text{ kPa}, \quad Q_m = 0.289 \text{ L/sec}$$

Solution : 2

$$t_m = 1.697 \text{ hrs}$$

Solution : 4

$$V_m = 86.76 \text{ m/sec}, \quad L_r = 8.35, \quad \frac{F_p}{F_m} = 14.4375$$

Solution : 5

$$P_{\text{model}} = 8.103 \text{ Pa}, \quad F_p = 1053 \text{ N}$$

Solution : 6

$$\frac{Q}{gH^{5/2}} = fn \left[\frac{P}{H}, \frac{L}{H}, \frac{\mu}{H^{3/2}g^{1/2}\rho}, \frac{\sigma}{\rho g H^2} \right]$$

Solution : 8

$$\eta_p = 0.028$$

Solution : 9

$$V_m = 400 \text{ km/h}, \quad F_p = 5000 \text{ N}, \quad F_p = 2.5 \text{ Hz}$$

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LEVEL 1 Objective Questions

1. (a)
2. (6570)
3. (a)
4. (67.39)
5. (1214.58)
6. (d)
7. (b)
8. (d)
9. (d)
10. (b)
11. (d)
12. (c)
13. (1088.35)
14. (c)
15. (25829.3)

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LEVEL 2 Objective Questions

16. (10601.25)
17. (2.0028)
18. (b)
19. (a)
20. (c)
21. (d)
22. (c)
23. (d)
24. (b)
25. (56.43)
26. (42.76)
27. (10187.2)
28. (10601.25)

LEVEL 3 Conventional Questions**Solution : 1**

- (i) $P = 6069 \text{ kW}$
- (ii) $h = 91.9\%$
- (iii) $N_s = 18.72$

Solution : 2

$$N = 303.5 \text{ rpm}, \quad \phi = 28.19^\circ$$

Solution : 3

- (i) $N_m = 892.9 \text{ rpm}$
- (ii) $Q_m = 1.252 \text{ m}^3/\text{sec}$
- (iii) $P = 269.7 \text{ kW}$

Solution : 4

- (i) $\text{Power} = 5273 \text{ kW}$
- (ii) $\eta_H = 89.7\%$

Solution : 5

$$N_{nt} = 19.1 \text{ m}, \quad \text{Power} = 10978.1 \text{ kW}, \quad N_s = 485$$

Solution : 6

$$P = 24.5 \text{ kN}$$

Solution : 7

$$N = 303.5 \text{ rpm}, \quad \phi = 28.19^\circ$$

Solution : 8

- (i) $\text{Dia. of impeller} = 0.45 \text{ m}$
- (ii) $\text{Width of impeller} = 2.83 \text{ m}$

Solution : 9

- (i) $\eta_m = 39.35\%$
- (ii) $Q = 15.79^\circ$
- (iii) $N_{\min} = 569.58 \text{ rpm}$

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LEVEL 1 Objective Questions

1. (a)
2. (b)
3. (b)
4. (d)
5. (9.26)
6. (1.275)
7. (a)
8. (1.40)
9. (c)
10. (c)
11. (a)
12. (c)
13. (6.08)

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LEVEL 2 Objective Questions

14. (151.13)
15. (d)
16. (b)
17. (c)
18. (c)
19. (1.04)
20. (0.50)
21. (c)
22. (2.47)
23. (d)
24. (2.74)
25. (0.255)
26. (a)
27. (c)

LEVEL 3 Conventional Questions**Solution : 1**

Yes, x = Distance between venacontracta section where jump is located = 118 m

Solution : 2

$$y_c = 0.97 \text{ m}, E_c = 1.458 \text{ m}$$

Solution : 3

- (a) $\Delta z = 0.312 \text{ m}$
(b) Fall in water level = 0.293 m

Solution : 4

- (i) $q = 1.284 \text{ m}^3/\text{sec}/\text{m}$
(ii) $E_L = 1.042 \text{ m}$

Solution : 5

- (i) $y_1 = 0.0863 \text{ m}, y_2 = 1.178 \text{ m}$
(ii) $q = 0.7941 \text{ m}^3/\text{sec}/\text{m}$
(iii) $F_2 = 0.1983$

Solution : 6

$$\Delta z = 0.054 \text{ m}$$

Solution : 7

$$S_w = -0.000605$$

Solution : 8

$$y_1 = 1.296 \text{ m}, F_1 = 0.561, y_2 = 0.625 \text{ m}, F_2 = 1.675$$

Solution : 10

- (i) $q = 1.284 \text{ m}^3/\text{sec}/\text{m}$
(ii) $E_L = 1.042 \text{ m}$

