
PE Civil Exam E-Book
80-Water Resources and Environmental
Solved Problems-CBT
2022 Exam Design Standards
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Presented by PE Civil Exam

PE Civil Exam 80- **Water Resources and Environmental** Questions & Answers (pdf Format) For Depth Exam

PE Civil Depth Exam:

This practice exam contains 80-questions and answers from all Water Resources and Environmental.

I. Analysis and Design –8 Solved Problems

A. Mass balance

B. Hydraulic loading

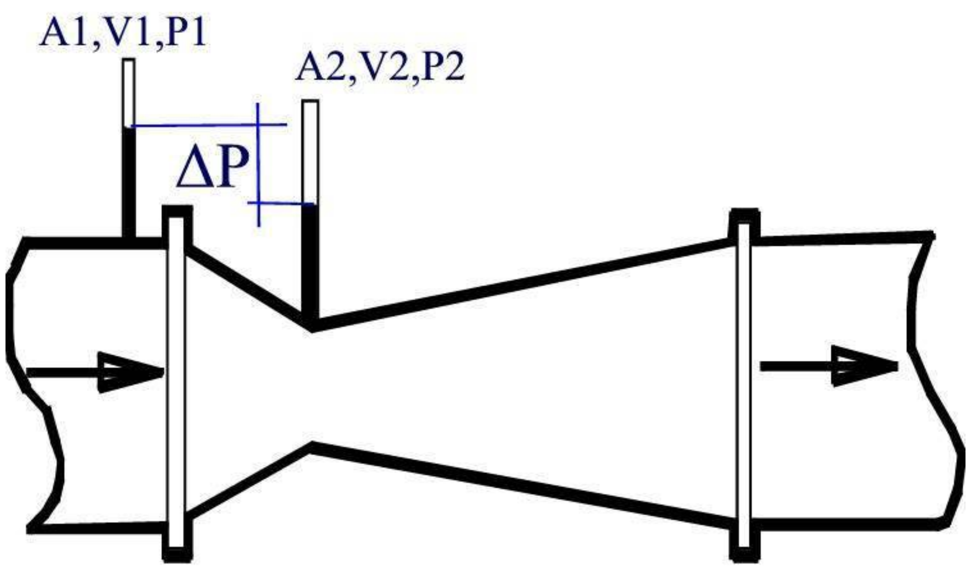
C. Solids loading (e.g., sediment loading, sludge)

D. Hydraulic flow measurement

(Ref:NCEES)

8. PROBLEM (Hydraulic flow measurement)

A venturi flow meter of the following figure, upstream diameter is 0.2 meter, and downstream diameter is 0.12 meter. The pressure difference, ΔP=P1–P2=200 kPa (2x 105 N/m2) between upstream and downstream. It has used for kerosene; specific gravity of kerosene is 0.83. Calculate the mass of the flow.



A. 80.00 kg/sec

B. 70.00 kg/sec

C. 45.00 kg/sec

D. 60.00 kg/sec

8. SOLUTION:

Where,

Upstream diameter is 0.2 meter and downstream diameter is 0.12 meter.

Density of kerosene, $\rho = 0.83\ (1000\ kg/m^3) = 830\ kg/m^3$

Upstream and downstream area:

$A_1 = \pi/4 \times (0.2)^2 = 0.0314 m^2$

$A_2 = \pi/4 (0.12)^2 = 0.0113 m^2$

Flow, $Q = A_2[\ 2\Delta p\ /\ \rho(1 - (A_2/A_1)^2)\ ]^{1/2}$

For a pressure difference, $\Delta P = 200\ kPa = 2x10^5\ N/m^2$

1 Newton/meter^2 = 0.101 kilogram-force/meter^2

$Q = (0.0113\ )\ [2\ (2\ x10^5 x\ 0.101)\ /\ (830)(1 - (\ (0.0113\ )\ /\ (0.0314\ )$

$)^2)]^{1/2}$

$Q = (0.0113)\ [2\ (200000 \times 0.101)\ /\ (830)(1 - 0.13)]^{1/2}$

Flow, $Q = 0.084 m^3/sec$

Mass of flow, $m = Q\ \rho$

$= (0.084\ m^3/s)\ (830\ kg/m^3)$

$= 70.0\ kg/sec$

The Correct Answer is: (B)

II. Hydraulics-Closed Conduit -11 Solved Problems

A. Energy and continuity equation (e.g., Bernoulli, momentum equation)

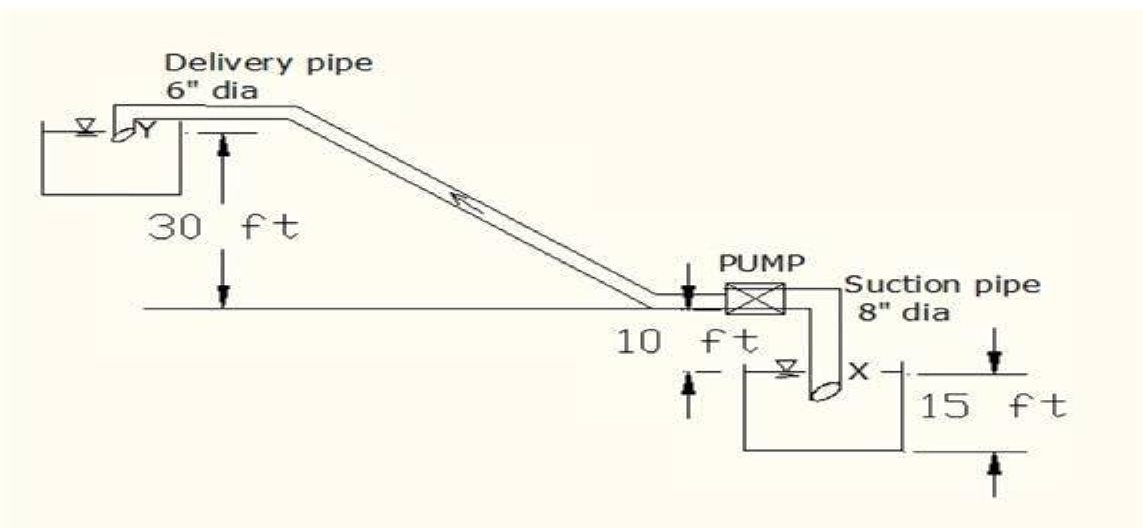
B. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)

C. Pump application and analysis, including wet wells, lift stations, and cavitation

D. Pipe network analysis (e.g., series, parallel, and loop networks) (Ref:NCEES)

11. PROBLEM (Bernoulli)

What is the total head at point Y fromthebase of the bottom reservoir datum? The pump discharge is 5.0ft^3/sec, where γ_w=62.4 lbs/ ft^3 and the Specific Gravity of Mercury=13.6.



A. 65.0 ft

B. 55.0 ft

C. 40.0 ft

D. 75.0 ft

11. SOLUTION:

Where, $Q= 5.0ft^3/sec$

Pressure head=P/ .g, Velocity Head=$V^2/2g$, Elevation Head=z

Total Head point, Y=z+ $Vy^2/2g$+ Py/ .g

Velocity for delivery Pipe, Vy=Q/A=Q/[π/4(d^2)]

= 5/[(3.14/4)$(6/12)^2$]=25.47 ft/see

Total Head at Point Y= z+ $Vy^2/2g$+ Py/ .g

=(15+10+30)+$(25.47)^2$/(2x32.2)+0=65.07 ft

The Correct Answer is: (A)

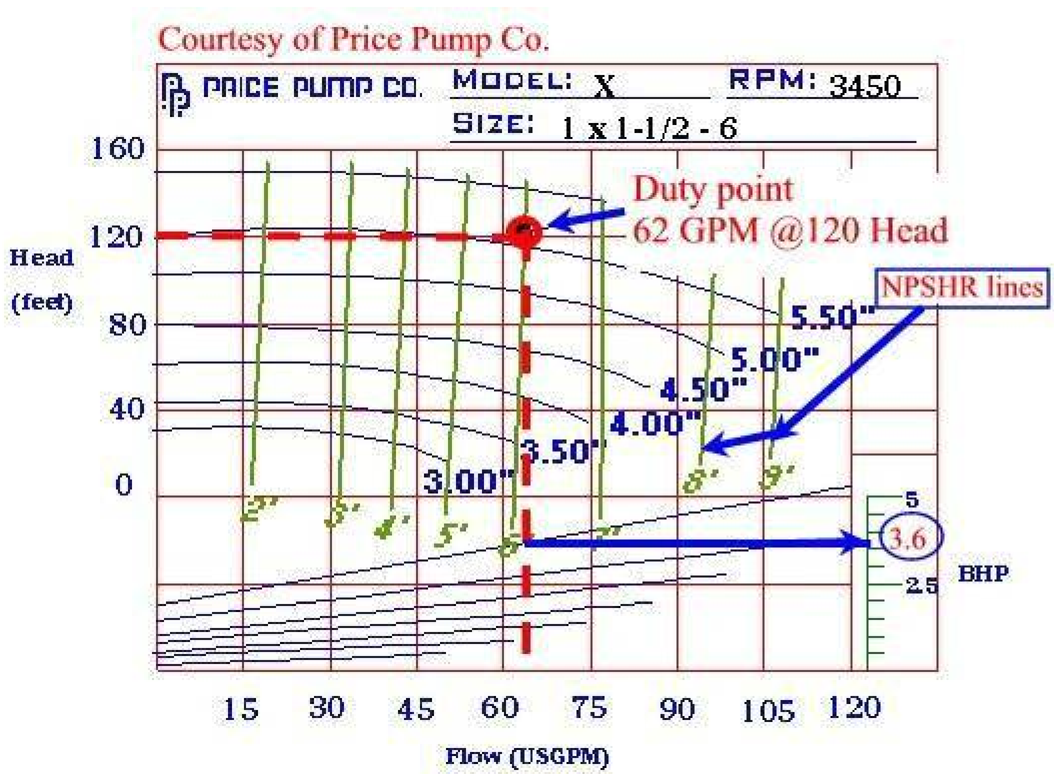
19. **PROBLEM** (Pump)

A Pump operating discharge is 62 GPM of water with a head of 120 ft. What are the Brake Horsepower (BHP) of the pump and Net Positive Suction Head (NPSH) available at the suction port to avoid pump cavitation, using the following pump curve?

	Net Positive Suction Head (NPSH)	Brake Horsepower (BHP)
A.	6.0	3.6
B.	5.5	4.3
C.	5.0	4.5
D.	6.0	5.0

19. **SOLUTION:**

Where, Q=62
GPM Head,
H=120 ft



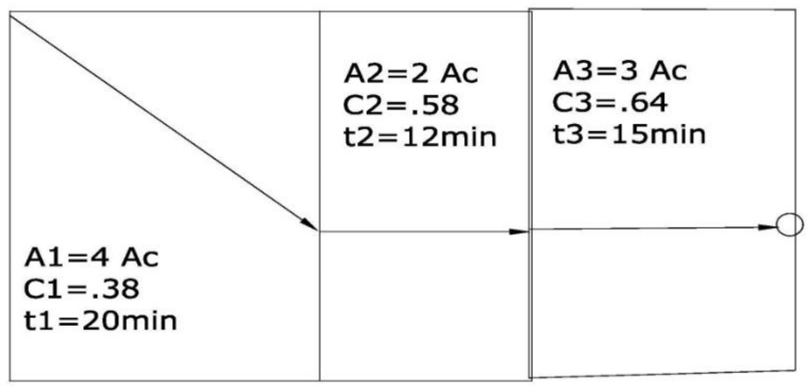
From the graph, corresponding of duty point 62 GPM @ 120 ft heads would require 6 feet of NPSH required at the suction port to avoid cavitations and pump have 3.6 (BHP) Brake Horsepower.

Note: 2 feet of extra NPSH required at the suction flange to avoid any problems at the duty point.

The Correct Answer is: (A)

31. **PROBLEM** (Runoff analysis)

Determined Average Runoff Coefficient, “C” as shown in the Figure, which is the runoff, contributes to a collector.



A. 0.51
B. 0.45
C. 1.60
D. 0.48

31. **SOLUTION:**

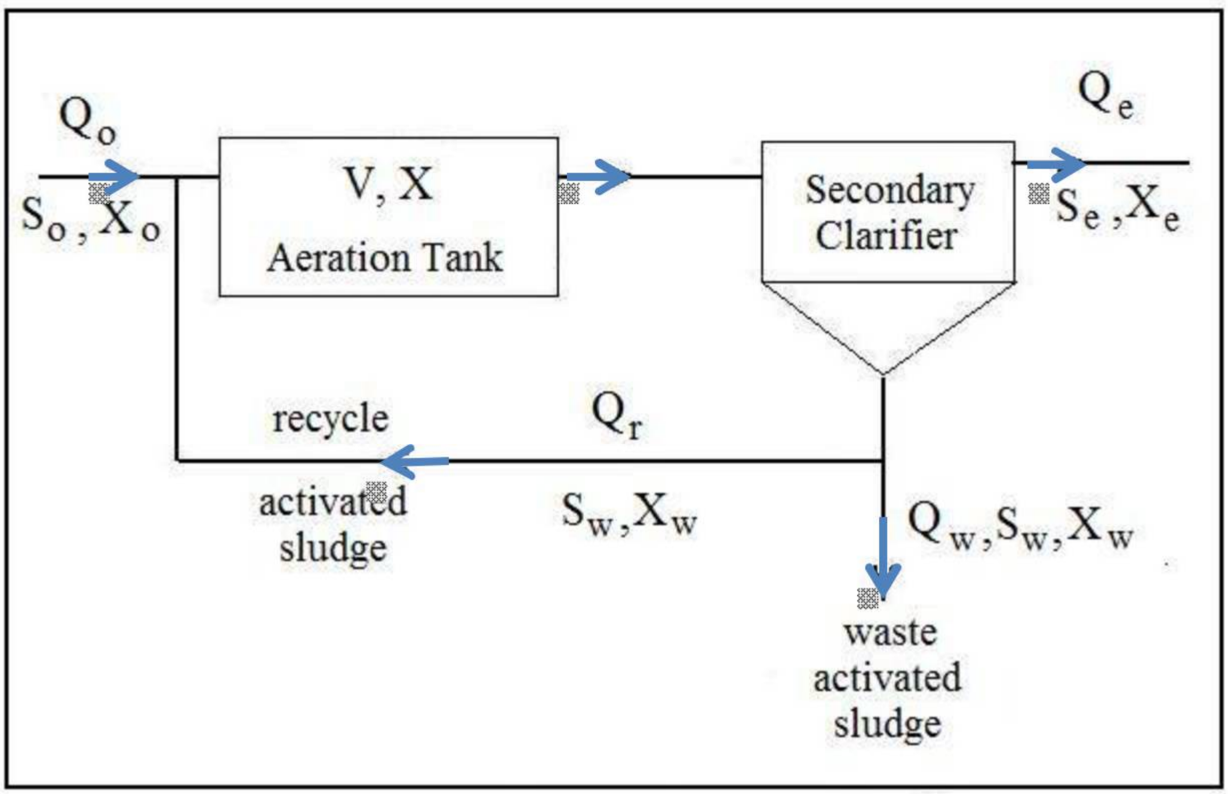
A_1 = 4 ac ,C_1 = 0.38 , t_1 = 20 min , A_2 = 2ac , C_2 = 0.58 ,
t_2 = 12 min, A3=3ac, C3=.64, t3=15 min
C=(C1A1+C2A2+C3A3)/(A1+A2+A3)
=(4 x .38 + 2 x .58+3 x.64)/(4+2+3)=0.51

The Correct Answer is: (A)

56. **PROBLEM** (Wastewater treatment processes)

A primary influent flow rate, Q_o =12 MGD of the Figure an activated sludge treatment plant. The plant biochemical oxygen demand (BOD) concentration is S_o=170 mg/L, suspended solids concentration, X_o=200 mg/L and volumetric loading, VL=34 lbs BOD/day/1000 ft^3. Determine the sludge retention time (**SRT**).

A. 12.0 hrs.
B. 8.75 hrs.
C. 6.50 hrs.
D. 7.50 hrs.



Activated sludge flow Diagram

57. SOLUTION:

Where,

Primary influent flow rate, **Q_o** =12 MGD,

BOD concentration, **S_o**=170 mg/L

Suspended solids concentration, **X_o**=200mg/L

Design volume lodging, VL=34lbs BOD/day/1000

ft^3 Volume of aeration Tank,

V = {[(8.34 x So x Qo)]/[VL x (1000)]} x 1,000,000

V ={[(8.34 x 170 x 12)]/[34 x (1000)]} x 1,000,000=500400

ft^3 Volume of aeration Tank in MG,

V_{MG}=(V x 7.48)/1,000,000=(500400 x 7.48)/1,000,000=3.74 MG

Sludge retention time (**SRT)** = 24 x V_{MG}/Qo

Sludge retention time (**SRT)** = 24 x 3.74/12=7.48 hrs.

The Correct Answer is: (D)

IX. Engineering Economics Analysis- 2 Solved Problems

Economic analysis (e.g., present worth, Life Cycle Cost, comparison of alternatives)

79. PROBLEM (Economics Analysis)

You are incharge of a sewer treatment upgrade construction project. The project has budgeted $2.0 million (BAC) with duration of 20 months.

After 10 months, the project has reported the following figure: Planned Cost, PV= $1.0 M
Actual Cost, AC= $800K
Earn Value, EV= $850K

The project would not make any difficulties and complete without any hiccups. What is the Estimate at Completion (EAC) of the project?

A. $2.33 M, Over Budget

B. $1.88 M, Under Budget

C. $2.00 M, At Budget

D. $1.55 M, Under Budget

79. SOLUTION:

Where,
Budgeted Cost, BAC=$2.0
M Planned Cost, PV= $1.0
M Actual Cost, AC= $900K
Earn Value, EV= $950K

Cost performance Index, CPI = EV / AC

CPI = EV / AC =950/900=1.06, project is under spent.

Estimate at Completion, EAC=BAC/CPI=2.0/1.06=$1.88 M, Under Budget

The Correct Answer is: (B)

80. PROBLEM (Economics Analysis)

A running construction project is an investment of $200,000. The project has forecasted to create revenues of $50,000 in the first year after the end of the project and of $80,000 in each of the two following years.
What is true for the net present value (NPV) of the project over the three years cycle at a discount/interest rate of 12%?

A. The project NPV is positive that create the attractive.
B. The project NPV is positive, that create the unattractive.
C. The project NPV is negative, that create the attractive.
D. The project NPV is negative, that create the unattractive.

80. SOLUTION:

Calculating Present Values, $PV=FV/(1+r)^{n}$
Where, Future Value=FV, Interest rate=r, and n=number of year
NPV=SUM(PV)

Construction project

			Cash out	Cash inflow, Present value	Cash inflow, future values	PV	NPV
Interest	period	0	$200,000.00	$0.00	-$200,000.00	-$200,000.00	-$34,639.21
12%	Year	1		$50,000.00	$50,000.00	$44,642.86	
	Year	2		$80,000.00	$80,000.00	$63,775.51	
	Year	3		$80,000.00	$80,000.00	$56,942.42	

Revenue (3yrs)=	$210,000.00
Net revenue (3yrs)=	-$34,639.21

The Correct Answer is: (D)