# PROCESS SIMULATION LAB

# Day 1 Group 2

Student's Name	Roll no
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Submission Date 09/08/2023

# **Question 1**

Create one materials stream that contains only water with following conditions:

Fluid Package: Peng-Robinson

Flowrate: 100 kgmol/h

Pressure: 1 atm

Vapor/Phase Fraction: 1.00

What is the temperature of this stream?

## **Answer:**



Water										
Temperature	99.96	С								
Pressure	101.3	kPa								
Molar Flow	100.0	kgmole/h								

Temperature of the stream is 99.96°C.

## **Material Stream: Water**

CON	DIT	IONS
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2		Company	Jama Nat Availabla	Case Name:	Assignment 1.hsc			
3	<b>@aspen</b> tech	Bedford, M	Name Not Available A	Unit Set:	SI			
5		USA		Date/Time:	Wed Aug 2 21:42:53 2023			
6		1 1 04	<b>NA</b> 4			Fluid Package:	Basis-1	
7	Mate	rial Stre	am: Water			December December	Danie Dahimani	
8						Property Package:	Peng-Robinson	
9				CONDITIONS				
10				CONDITIONS				
11			Overall	Vapour Phase	Aqueous Phase			
12	Vapour / Phase Fraction		1.0000 *	1.0000	0.0000			
13	Temperature:	(C)	99.96	99.96	99.96			
14	Pressure:	(kPa)	101.3 *	101.3	101.3			
15	Molar Flow	(kgmole/h)	100.0 *	100.0	0.0000			
16	Mass Flow	(kg/h)	1802	1802	0.0000			
17	Std Ideal Liq Vol Flow	(m3/h)	1.805	1.805	0.0000			
18	Molar Enthalpy	(kJ/kgmole)	-2.393e+005	-2.393e+005	-2.804e+005			
19	Molar Entropy	(kJ/kgmole-C)	181.1	181.1	71.23			
20	Heat Flow	(kJ/h)	-2.393e+007	-2.393e+007	0.0000			
21	Liq Vol Flow @Std Cond	(m3/h)	1.775 *	1.775	0.0000			
22	·			•				

22 23			PROPERTIES		
24		Overall	Vapour Phase	Aqueous Phase	
25	Molecular Weight	18.02	18.02	18.02	
26	Molar Density (kgmole/m3)	3.295e-002	3.295e-002	52.62	
27	Mass Density (kg/m3)	0.5935	0.5935	947.9	
28	Act. Volume Flow (m3/h)	3035	3035	0.0000	
29	Mass Enthalpy (kJ/kg)	-1.329e+004	-1.329e+004	-1.556e+004	
30	Mass Entropy (kJ/kg-C)	10.06	10.06	3.954	
31	Heat Capacity (kJ/kgmole-C)	34.36	34.36	79.22	
32	Mass Heat Capacity (kJ/kg-C)	1.907	1.907	4.398	
33	LHV Molar Basis (Std) (kJ/kgmole)	0.0000	0.0000	0.0000	
34	HHV Molar Basis (Std) (kJ/kgmole)	4.101e+004	4.101e+004	4.101e+004	
35	HHV Mass Basis (Std) (kJ/kg)	2276	2276	2276	
36	CO2 Loading				
37	CO2 Apparent Mole Conc. (kgmole/m3)				
38	CO2 Apparent Wt. Conc. (kgmol/kg)				
39	LHV Mass Basis (Std) (kJ/kg)	0.0000	0.0000	0.0000	
40	Phase Fraction [Vol. Basis]	1.000	1.000		
41	Phase Fraction [Mass Basis]	1.000	1.000	0.0000	
42	Phase Fraction [Act. Vol. Basis]	1.000	1.000	0.0000	
13	Mass Exergy (kJ/kg)	492.6			
14	Partial Pressure of CO2 (kPa)	0.0000			
15	Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	
46	Act. Gas Flow (ACT_m3/h)	3035	3035		
47	Avg. Liq. Density (kgmole/m3)	55.40	55.40	55.40	
48	Specific Heat (kJ/kgmole-C)	34.36	34.36	79.22	
49	Std. Gas Flow (STD_m3/h)	2364	2364	0.0000	
50	Std. Ideal Liq. Mass Density (kg/m3)	998.0	998.0	998.0	
51	Act. Liq. Flow (m3/s)	0.0000		0.0000	
52	Z Factor		0.9914	6.208e-004	
53	Watson K				
54	User Property				
55	Partial Pressure of H2S (kPa)	0.0000			
56	Cp/(Cp - R)	1.319	1.319	1.117	
57	Cp/Cv	1.331	1.331	1.176	
58	Ideal Gas Cp/Cv	1.323	1.323	1.323	
59	ldeal Gas Cp (kJ/kgmole-C)	34.09	34.09	34.09	
60	Mass Ideal Gas Cp (kJ/kg-C)	1.892	1.892	1.892	
31	Heat of Vap. (kJ/kgmole)	4.101e+004			
32	Kinematic Viscosity (cSt)	20.40	20.40	0.2944	
33	Liq. Mass Density (Std. Cond) (kg/m3)	1015	1015	1015	
64	Liq. Vol. Flow (Std. Cond) (m3/h)	1.775	1.775	0.0000	
35	Liquid Fraction	0.0000	0.0000	1.000	
66	Molar Volume (m3/kgmole)	30.35	30.35	1.900e-002	
67	Mass Heat of Vap. (kJ/kg)	2276			
86	Phase Fraction [Molar Basis]	1.0000	1.0000	0.0000	
9	Aspen Technology Inc.	A	spen HYSYS Versio	n 11	Page 1 of 2

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Company Name Not Available

Case Name: Assignment 1.hsc

3	@aspentech	Bedford, MA		Available	ι	Jnit Set:	SI						
5		USA			[	Date/Time:	Wed	d Aug 2 21:42	2:53 2023	1			
6									Fluid	d Packag	ne. E	Basis-1	
7	Mater	ial Strea	am: \	Water (	(coı	ntinued)				perty Pa	-	eng-Robir	noon .
8									FIO	Jelly Fat	ckaye. F	eng-Nobii	15011
10					Р	ROPERTIES							
11			Ov	verall	Va	apour Phase	F	Aqueous Phas	ie .				
12 13	Surface Tension	(dyne/cm)		0.440000		0.440000			3.61				
14	Thermal Conductivity  Bubble Point Pressure	(W/m-K) (kPa)		2.446e-002 101.3		2.446e-002		0.6					
15	Viscosity	(cP)		1.211e-002		1.211e-002		0.2	791				
16		kJ/kgmole-C)		26.04		26.04		70	).91				
17 18	Mass Cv (Semi-Ideal)	(kJ/kg-C)		1.446		1.446			936				
19	Cv (l Mass Cv	kJ/kgmole-C) (kJ/kg-C)		25.81 1.432		25.81 1.432			7.38 740				
20		kJ/kgmole-C)		1.432		1.402		<u> </u>					
21	Mass Cv (Ent. Method)	(kJ/kg-C)											
22	Cp/Cv (Ent. Method)												
23 24	Reid VP at 37.8 C True VP at 37.8 C	(kPa)											
25	Liq. Vol. Flow - Sum(Std. C	(kPa) Cond) (m3/h)		1.775		1.775		0.0	000				
26	Viscosity Index	Jona) (mom)		-23.99				0.0					
27					C	OMPOSITION	J						
28						J.W.1 COTTION	•						
29 30					O	verall Phase					Vapour	Fraction	1.0000 *
31	COMPONENTS	MOLAR FLC	W N	/OLE FRACTI	ION	MASS FLOW	,	MASS FRA	CTION	LIQUI	D VOLUME	LIQUI	D VOLUME
32						(kg/h)				FLO	W (m3/h)	FR	ACTION
33	H2O		000 *	1801.51			1.0000 *		1.8051	*	1.0000 *		
34 35	Total	100.0	0000	1.0	000	1801.51	00		1.0000		1.8051		1.0000
36					Va	apour Phase					Phase F	raction	1.000
37	COMPONENTS	MOLAR FLC		OLE FRACTI	ION	MASS FLOW	'	MASS FRA	CTION		D VOLUME		D VOLUME
38 39	1100	(kgmole/h		4.0	000	(kg/h)		4 0000	FLO	W (m3/h)	FR	ACTION	
40	H2O Total	100.0		1.0					1.0000 1.0000		1.8051 1.8051		1.0000 1.0000
41						Aqueous Phase					Phase F	Fraction	0.0000
42					Aq								
43 44	COMPONENTS	MOLAR FLC (kgmole/h		IOLE FRACTI	ION	MASS FLOW (kg/h)	'				D VOLUME W (m3/h)		D VOLUME ACTION
45	H2O		0000	1.0	000	0.00	00		1.0000	1 20	0.0000	110	1.0000
46	Total		0000		000	0.00			1.0000		0.0000		1.0000
47						K VALUE							
48 49	COMPON	FNTS			MIXED			LIGH	т			HEAVY	
50	COIVIFON	L1410	H2O		IVIIALU	1.000		LIGH				TILAVI	1.000
51					רואוו	OPERATIO	NS						
52	5550	TO.					110			1.0	01041 0041	NECTION	
53 54	FEED	10			Р	RODUCT FROM				LO	GICAL CONI	NECTION	
55													
56						UTILITIES							
57				( N	o utilitie	es reference this	strear	n )					
58 59					PRC	CESS UTILI	ΤY						
60													
61					-	DYNAMICS							7
62 63	Pressure Specification (	(Active): 101	.3 kPa *										
64		(Active): 101 (Active) Molar		100	.0 kgm	ole/h * Mass:			1802 kg	/h St	td Ideal Liq V	olume:	1.805 m3/h
65										1	,		
66													
67 68													
00	A T					LIVOVO Varais	44						0.10

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# **Question 2**

Calculate the discharge pressure and required duty of the pump of mixtures half pentene and half hexane.

Given, property method: Peng Robinson

Total mass flow: 30000 kg/h

Feed temperature: 30°C

Feed pressure - 1 bar.

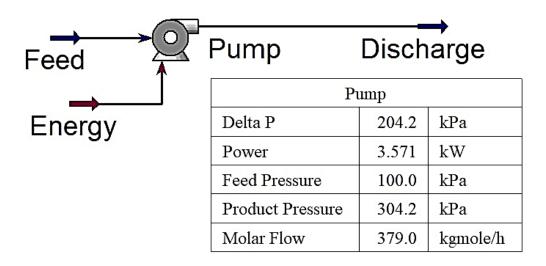
Pressure changer-Pump

Pump efficiency: 75%

Pump curve data

GPM	25	50	100	150	200	250	300	325	350	375	400	425	450
Head(ft)	115.3	114.9	113.8	111	108.2	103	97	94	90.3	86.3	82.4	78.5	74.4

### **Answer:**



Discharge Pressure: 304.2 *kPa* 

Required Duty: 3.571 kW

1				0	M=====	Ai	h						
2	aspentech	Company N Bedford, M	Name Not Available	Unit S		Assignment_Day1_Qn2 SI	.1150						
4	e aspentech	USA	A	Unit S	et	51							
5				Date/	ime:	Sun Aug 6 21:07:26 20:	23						
6			- 45										
7 8	Tronkbooki Gudo (mam)												
9				Materia	I Streams	5		Fluid Pkg:	All				
10 11	Name		Feed	Discharge									
12	Vapour Fraction		0.000		0.0000								
13	Temperature	(C)	30.0	-	30.11								
14	Pressure	(kPa)	100.	0 *	304.2								
15	Molar Flow (	kgmole/h)	379.	0	379.0								
16	Mass Flow	(kg/h)	3.000e+00	4 * 3.0	000e+004								
17	Liquid Volume Flow	(m3/h)	46.3		46.35								
18	Heat Flow	(kJ/h)	-7.012e+00	7 -7.0	10e+007								
19 20	Compositions Fluid Pkg: All												
21	Name		Feed	Discharge									
22	Comp Mole Frac (n-Pentane)		0.500	0 *	0.5000								
23	Comp Mole Frac (n-Hexane)		0.500	0 *	0.5000								
24	Energy Streams Fluid Pkg: All												
25 26	Name Energy Signature												
27	Heat Flow	(kJ/h)	1.285e+00	4									
28													
29	T Init ()ne												
30	Operation Name	Оре	ration Type	Feed	ls	Products		Ignored	Calc Level				
31	Pump	Pump		Feed		Discharge		No	500.0 *				
32				Energy					333.3				
33 34		D	mnı Dumi	_									
35		Pui	mp: Pum <sub>l</sub>	9									
36				20111									
37				CONN	ECTIONS								
38 39				Inlet	Stream								
40	Stream	Name				From Unit Op	eration						
41	Feed					·							
42				Outlo	t Stream								
43				Julie	Cueam								
44	Stream	Name				To Unit Ope	ration						
45 46	Discharge												
47				Energ	y Stream								
48	Stream	Name				From Unit Op	eration						
49	Energy												
50				PARA	METERS								
51	= :												
52	Adiabatic Efficiency (%):	75.00	Delta P:	204.2 kPa	Pressure	Ratio: 3	3.042 I	Duty:	3.571 kW				
53 54	Multiphase Pump								Not Active				
55				CU	RVES								
56	Delta P:			204.2 kPa	Duty:				3.571 kW				
57	Coefficient A:		0.0000 * Coeffic			0.0000 * Coe	ficient C:		0.0000 *				
58	Parameter Preferen	ces	Units for Head:	m	Flow Bas	sis ActVol	Flow	Units for Flow:	m3/h				
59 60				User \	/ariables								
61					<b>-</b> 1110								
62				R.A	TING								

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Case Name: Assignment\_Day1\_Qn2.hsc

2	Company	lame Not Available		Case Name: Assignment_Day1_Qn2.hsc						
3	<b>@aspentech</b> Bedford, M.		Unit Set:		SI					
4 5	USA		Date/Tim	ne:	Sun Aug 6 21:07	':26 2023				
6										
7	Pui	mp: Pum	p (continu	ued)						
8		•								
9	Head Offset:		0.0000 m	Efficienc				0.0	0000	
11			Characteris	tic Curv	es					
12	PumpCurve-1 for Pump			Speed:						
13	Flow (m3/h)		Head				Efficiency (%	<u>)</u>		
14	5.678	*	35.		*		75.00		*	
15 16	11.36 22.71	*	35. 34.		*		75.00 75.00		*	
17	34.07	*	33.		*		75.00		*	
18	45.43	*	32.		*		75.00		*	
19	56.78	*	31.	39	*		75.00		*	
20	68.14	*	29.		*		75.00		*	
21	73.82	*	28.		*		75.00		*	
22 23	79.49	*	27.		*		75.00		*	
24	85.17 90.85	*	26. 25.		*		75.00 75.00		*	
25	96.53	*	23.		*		75.00		*	
26	102.2	*	22.		*		75.00		*	
27		'	NP:	C11						
28			NP:	эп						
29	NPSH Required	NPSH	l Available	-	9.807 m	Enable NPSH Cur	ves:	No		
30			NPSH (	Curves						
31 32										
33			Nozzle Pa	ramater	s					
34	Base Elevation Relative to Ground Level							0.00	00 m *	
35			Feed		Di	scharge				
36	Diameter	(m)				5.000e-002				
37 38	Elevation (Base)		(m) 0.0000 (m) 0.0000			0.0000				
39	Elevation (Ground)	(m)		0.0000						
40			Inei	rtia						
41	Rotational inertia (kg-m2) 0.5000 F	Radius of gyration (	m) 0.1000	Mass (kg	) 5	60.00 Friction los	s factor (kg-m	n2/s) 5.000e	-002	
42 43			Start	t Up						
44	Design Flow Typical Operating Capacity							10.00 ו	m3/h	
45			CONDI	TIONS						
46				TIONS						
47 48	Name		Feed		Discharge	Er	nergy			
48	Vapour Temperature	(C)	0.0000 30.0000 *		0.0000 30.1119					
50	Pressure	(kPa)	100.0000 *		304.2385					
51		gmole/h)	378.9580		378.9580					
52	Mass Flow	(kg/h)	30000.0000 *		30000.0000			_		
53	Std Ideal Liq Vol Flow	(m3/h)	46.3508		46.3508					
54	Molar Enthalpy (kJ.	-1.850e+005								
55 56	Molar Entropy (kJ/kg Heat Flow	gmole-C) (kJ/h)	82.57 -7.0115e+07		82.60 -7.0102e+07	1.2854	 e+04			
57	Heat How	(NJ/11)	'		-1.0102E+01	1.2054	GTU <del>4</del>			
58			PROPE	RTIES						
59	Name	Feed	Dischar							
60	Molecular Weight	79		79.16						
61	Moss Density (kgmole/m3)	8.0		8.030						
62 63	Mass Density (kg/m3)  Aspen Technology Inc	63:	5.6   Δsnen HVSV	635.7 C Version	. 11			Page 2	of 1	

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Company Name Not Available Bedford, MA USA Case Name: Assignment\_Day1\_Qn2.hsc

Unit Set: SI

Date/Time: Sun Aug 6 21:07:26 2023

# **Pump: Pump (continued)**

8	Pump. Pump (continued)											
9			PROPERTIES									
10 11	Name a	F4	Dischanne									
12	Name Act. Volume Flow (m3/h)	Feed 47.20	Discharge 47.19									
13	` '	-2337	-2337									
-	Mass Enthalpy (kJ/kg)  Mass Entropy (kJ/kg-C)	1.043	1.043									
14 15		177.6	177.6									
16	Heat Capacity (kJ/kgmole-C)  Mass Heat Capacity (kJ/kg-C)	2.243	2.243									
17	LHV Molar Basis (Std) (kJ/kgmole)	3.581e+006	3.581e+006									
18	HHV Molar Basis (Std) (kJ/kgmole)	3.848e+006	3.848e+006									
19		4.860e+004	4.860e+004									
20	, , ,	4.0000+004										
21	CO2 Apparent Mala Cons. (kgmala/m2)											
$\vdash$	CO2 Apparent Mole Conc. (kgmole/m3)		<del></del>									
22	CO2 Apparent Wt. Conc. (kgmol/kg)	4.500004	4.500004									
23	LHV Mass Basis (Std) (kJ/kg)	4.523e+004	4.523e+004									
24	Phase Fraction [Vol. Basis]	0.0000	0.0000									
25	Phase Fraction [Mass Basis]	0.0000	0.0000									
26	Phase Fraction [Act. Vol. Basis]	0.0000	0.0000									
27	Mass Exergy (kJ/kg)	9.059e-002	0.4072									
28	Partial Pressure of CO2 (kPa)	0.0000	0.0000									
29	Cost Based on Flow (Cost/s)	0.0000	0.0000									
30	Act. Gas Flow (ACT_m3/h)											
31	Avg. Liq. Density (kgmole/m3)	8.176	8.176									
32	Specific Heat (kJ/kgmole-C)	177.6	177.6									
33	Std. Gas Flow (STD_m3/h)	8960	8960									
34	Std. Ideal Liq. Mass Density (kg/m3)	647.2	647.2									
35	Act. Liq. Flow (m3/s)	1.311e-002	1.311e-002									
36	Z Factor	4.942e-003	1.503e-002									
37	Watson K	12.91	12.91									
38	User Property (LDC)											
39	Partial Pressure of H2S (kPa)	0.0000	0.0000									
40	Cp/(Cp - R)	1.049	1.049									
41	Cp/Cv	1.332	1.331									
42	Ideal Gas Cp/Cv	1.066	1.066									
43	Ideal Gas Cp (kJ/kgmole-C)	133.4	133.5									
44	Mass Ideal Gas Cp (kJ/kg-C)	1.685	1.686									
45	Heat of Vap. (kJ/kgmole)	2.882e+004	2.640e+004									
46	Kinematic Viscosity (cSt)	0.3890	0.3886									
47	Liq. Mass Density (Std. Cond) (kg/m3)	650.0	650.0									
48	Liq. Vol. Flow (Std. Cond) (m3/h)	46.15	46.15									
49	Liquid Fraction	1.000	1.000									
50	Molar Volume (m3/kgmole)	0.1246	0.1245									
51	Mass Heat of Vap. (kJ/kg)	364.0	333.4									
52	Phase Fraction [Molar Basis]	0.0000	0.0000									
53	Surface Tension (dyne/cm)	16.09	16.08									
54	Thermal Conductivity (W/m-K)	0.1084	0.1084									
55	Bubble Point Pressure (kPa)	53.04	53.26									
56	Viscosity (cP)	0.2472	0.2470									
57	Cv (Semi-Ideal) (kJ/kgmole-C)	169.3	169.2									
58	Mass Cv (Semi-Ideal) (kJ/kg-C)	2.138	2.138									
59	Cv (kJ/kgmole-C)	133.4	133.4									
60	Mass Cv (kJ/kg-C)	1.685	1.685									
61	Cv (Ent. Method) (kJ/kgmole-C)	137.1	137.1									
62	Mass Cv (Ent. Method) (kJ/kg-C)	1.731	1.732									

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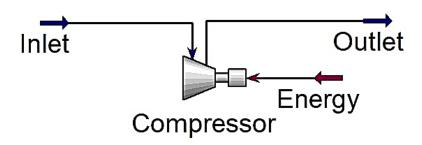
1 2		0	. N N 4	\:!-b-!-	Case N	ame:	Assignment_Day	1_Qn2.hsc			
3	<b>@aspen</b> tech	Company Bedford,	Name Not A MA	Available	Unit Set	:	SI				
5		USA				ne:	Sun Aug 6 21:07	7:26 2023			
6		D-		<b></b>	/ 4!	1\					
7		PU	ımp: ı	Pump	(contin	uea)					
9					PROPE	RTIES					
10 11	Name		F	eed	Discha						
12	Cp/Cv (Ent. Method)			1.296	2.001.0	1.295					
13	Reid VP at 37.8 C	(kPa)		69.82		69.82					
14	True VP at 37.8 C	(kPa)		70.07		70.07					
15	Liq. Vol. Flow - Sum(Std. Con	nd) (m3/h)		46.15		46.15					
16	Viscosity Index			-14.52		-14.55					
17 18					PERFOR	RMANC	E				
19					Res	ulte					
20	Total Hood										
21 22	Total Head  Total Fluid Head					Velocity	/ Head			-1.	.097e-003 m
23	Pressure Head				32.77 m	Delta P	excluding Static H	lead Results			
24 25					DYNA	MICS					
26					Dynamic Sp	ecifica	tions				
27 28	Head	(m)			Not Active	Power		(kJ/h)	1.285e+00		Not Active
29	Fluid Head	(kJ/kg)			Not Active						NOI ACTIVE
30	Speed	(rpm)	_	-	Not Active	Capaci		(m3/h)	46.35		
31	Efficiency	(%)	75.	00	Active	Use Ch	aracteristic Curves	5			Not Active
32	Pressure Increase	(kPa)	204	4.2	Active	Pump is	s Acting as a Turbi	ne			Not Active
33 34					Malfuncti	on Deta	ils				
35	Total Pump Failure		Not Active	Pump Ove			Not Active		ormance Deteriora	ition	Not Active
36 37	Delay Time			Delay Time				Delay Time			
38	Ramp Time			Ramp Tim Additional				Ramp Time Decrease i			
39				Additional	пеаі			Decrease i			
40					Haldrin	Dataila		200.0000			
41					Holdup	Details	•		1		
42 43	Phase			Accumulation	n		Moles		,	Volume	
44	Vapour			(kgmole/h) 0.0000			(kgmole) 0.0000			(m3) 0.0000	
45	Liquid			0.0000			0.0000			0.0000	
46	Aqueous			0.0000			0.0000			0.0000	
47	Total			0.0000			0.0000			0.0000	
48					NO.	TEQ					
49											
50											
51											
52 53											
54											
54 55											
56											
57											
58											
59											
60 61											
62											
63	Aspen Technology Inc				Asnan HVSV	'C Maraia	n 11			Г	Page 4 of 4

Aspen Technology Inc.

# **Question 3**

Air is compressed by a reversible compressor from an inlet state of  $100 \, kpa$  and  $300 \, K$  to an exit pressure of  $900 \, kpa$ . Using the Peng-Robinson equation of state, determine the compressor work per unit mass (kJ/kg). Assume 100% adiabatic efficiency of the compressor.

## **Answer:**



Compressor									
Feed Pressure	100.0	kPa							
Product Pressure	900.0	kPa							
Molar Flow	3.454e-002	kgmole/h							
Energy	351.4	kJ/h							

Feed Basis, F = 1 kg/hr

Compressor Duty,  $W = 351.4 \, kJ/hr$ 

Compressor work per unit mass is:

$$\frac{W}{F} = \frac{351.4}{1} \frac{kJ/hr}{kg/hr} = 351.4 \, kJ/kg$$

1				Case N	Name: Assignment_Day1_Qn3.hsc				
3	aspentech	Name Not Available IA	Unit Set	:: S	SI				
4 5			Date/Tii	Date/Time: Sun Aug 6 21:25:34 2023					
6									
7	Workbook: Case (Main)								
9 10		Material	Material Streams			Fluid Pkg:	All		
11	Name		Inlet	Outlet					
12	Vapour Fraction		1.00		1.0000				
13	Temperature	(C)		.85 *	369.5				
14 15	Pressure Molar Flow (	(kPa)	3.454e-0	0.0 *	900.0 * 54e-002				
16	Mass Flow	kgmole/h) (kg/h)		00 *	1.000				
17	Liquid Volume Flow	(m3/h)	1.137e-0		37e-003				
18	Heat Flow	(kJ/h)	1.5		353.0				
19 20				Compo	sitions			Fluid Pkg:	All
21	Name		Inlet	Outlet					
22	Comp Mole Frac (Air)		1.00	00 *	1.0000				
23 24				Energy	Streams			Fluid Pkg:	All
25	Name		Energy						
26	Heat Flow	(kJ/h)	35 <sup>-</sup>	1.4					
27					0==			-	
28 29	Operation Name	One	ration Type	Feeds	Ops	Prodi	ıcts	Ignored	Calc Level
30	·	·	<u>, , , , , , , , , , , , , , , , , , , </u>	Inlet	<u>'</u>	Outlet	4010		
31	Compressor	Compress	sor	Energy				No	500.0 *
32									
33 34									
35 36	1 DESIGN								
37 38				Conne	ections				
39 40				Inlet S	Stream				
41	STREAM	NAME				FROM UN	IT OPERATION		
42	Inlet								
43 44				Outlet	Stream				
45	STREAM	/ NAMF				TO LINIT	OPERATION		
46	Outlet								
47				Enorm	Stroam				
48				Energy	Stream				
49	STREAM	M NAME				FROM UN	IT OPERATION		
50 51	Energy								
52				Paran	neters				
53							9.7619e-02 kW		
54	Adiabatic Eff.:			75.00				81.04	
55				2.688e+004 m	n Polytropic Head: 2.90			2.904e+004 m	
56				263.6 kJ/kg	Polytropic	Fluid Head:	B		284.8 kJ/kg
57 58						1.002			
59				User Va	ariables				
60				RAT	ING				
61 62				Cui	ves				
52	Aspen Technology Inc Aspen HYSYS Version 11 Page 1 of 4								

**RATING** Curves Aspen HYSYS Version 11

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aspentech
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Company Name Not Available

Case Name: Assignment\_Day1\_Qn3.hsc Unit Set:

#### 3 Bedford, MA 4 USA Date/Time: Sun Aug 6 21:25:34 2023 5 6 **Compressor: Compressor (continued)** 7 8 9 Curves 10 Efficiency: Compressor Speed: ---Adiabatic Curves Enabled: No 11 0.0000 m Head Offset: Efficiency Offset: 0.00 % 12 Speed: 13 Flow Head Efficiency (%) 14 **Flow Limits** 15 16 Surge Curve: 17 Speed Flow Speed Flow Speed Flow 18 Stone Wall Curve: Inactive 19 Speed Flow Speed Flow Speed Flow 20 Surge Flow Rate Field Flow Rate 0.8611 ACT\_m3/h Stone Wall Flow Compressor Volume 0.0000 m3 21 **Nozzle Paramaters** 22 Base Elevation Relative to Ground Level 0.0000 m 24 Inlet Outlet Diameter (m) 5.000e-002 5.000e-002 Elevation (Base) (m) 0.0000 0.0000 Elevation (Ground) (m) 0.0000 0.0000 28 Inertia 29 30 Rotational inertia (kg-m2) 6.000 Radius of gyration (m) 0.2000 Mass (kg) 150.0 Friction loss factor (rad/min) (kg-m2/s) 6.000e-003 32 WORKSHEET 34 Conditions 36 Outlet Inlet Name Energy Vapour 1.0000 1.0000 38 26.8500 369.4582 Temperature (C) 39 Pressure (kPa) 100.0000 3 900.0000 40 Molar Flow (kgmole/h) 0.0345 0.0345 Mass Flow (kg/h) 1.0000 1.0000 Std Ideal Liq Vol Flow (m3/h) 0.0011 0.0011 43 Molar Enthalpy (kJ/kgmole) 45.13 1.022e+004 Molar Entropy (kJ/kgmole-C) 118.5 45 Heat Flow 1.5588e+00 3.5143e+02 (kJ/h) 3.5299e+02 46 **Properties** 47 48 Outlet 49 Molecular Weight 28.95 28.95 0.1680 50 4.011e-002 Molar Density (kgmole/m3) 51 4.863 Mass Density (kg/m3) 1.161 Act. Volume Flow 0.8611 0.2056 (m3/h) Mass Enthalpy 1.559 353.0 (kJ/kg) 4.092 Mass Entropy (kJ/kg-C) 4.238 **Heat Capacity** (kJ/kgmole-C) 28.74 30.79 (kJ/kg-C) Mass Heat Capacity 0.9927 1.064 57 LHV Molar Basis (Std) (kJ/kgmole) 0.0000 0.0000 58 HHV Molar Basis (Std) (kJ/kgmole) 0.0000 0.0000 59 HHV Mass Basis (Std) (kJ/kg) 0.0000 0.0000 60 CO<sub>2</sub> Loading CO2 Apparent Mole Conc. (kgmole/m3) CO2 Apparent Wt. Conc. (kgmol/kg) Aspen Technology Inc. Aspen HYSYS Version 11 Page 2 of 4



## **Compressor: Compressor (continued)**

1			Case Name: Assignment Day1 Qn3.hsc				
2	Company Na	ame Not Available	Case Name.	Assignment_Day I_Qno.nsc			
3	easpentech  Bedford, MA  USA		Unit Set:	SI			
5	00A		Date/Time:	Sun Aug 6 21:25:34 2023			
6							
7	Compress	or: Compres	ssor (contir	sor (continued)			
8	•						
9 10			Properties				
11	Name	Inlet	Outlet				
12	LHV Mass Basis (Std) (kJ/kg)	0.0000	0.0000				
13	Phase Fraction [Vol. Basis]	1.000	1.000				
14	Phase Fraction [Mass Basis]	1.000	1.000				
15	Phase Fraction [Act. Vol. Basis]	1.000	1.000				
16	Mass Exergy (kJ/kg)	-1.121	306.7				
17	Partial Pressure of CO2 (kPa)	0.0000	0.0000				
18	Cost Based on Flow (Cost/s)	0.0000	0.0000				
19	Act. Gas Flow (ACT_m3/h)	0.8611	0.2056				
20	Avg. Liq. Density (kgmole/m3)	30.38	30.38				
21	Specific Heat (kJ/kgmole-C)	28.74	30.79				
22	Std. Gas Flow (STD_m3/h)	0.8167	0.8167				
23	Std. Ideal Liq. Mass Density (kg/m3)	879.6	879.6				
24	Act. Liq. Flow (m3/s)						
25	Z Factor	0.9995	1.003				
26	Watson K	5.914	5.914				
27	User Property						
28	Partial Pressure of H2S (kPa)	0.0000	0.0000				
29	Cp/(Cp - R)	1.407	1.370				
30	Cp/Cv	1.410	1.373				
31	Ideal Gas Cp/Cv	1.408	1.371				
32	ldeal Gas Cp (kJ/kgmole-C)	28.69	30.71				
33	Mass Ideal Gas Cp (kJ/kg-C)	0.9909	1.061				
34	Heat of Vap. (kJ/kgmole)	5826	4677				
35	Kinematic Viscosity (cSt)	16.51	6.894				
36	Liq. Mass Density (Std. Cond) (kg/m3)	1.225	1.225				
37	Liq. Vol. Flow (Std. Cond) (m3/h)	0.8162	0.8162				
38	Liquid Fraction	0.0000	0.0000				
39	Molar Volume (m3/kgmole)	24.93	5.953				
40	Mass Heat of Vap. (kJ/kg)	201.3	161.6				
41	Phase Fraction [Molar Basis]	1.0000	1.0000				
42	Surface Tension (dyne/cm)						
43	Thermal Conductivity (W/m-K)	2.463e-002	4.515e-002				
44	Bubble Point Pressure (kPa)						
45	Viscosity (cP)	1.917e-002	3.353e-002				
46	Cv (Semi-Ideal) (kJ/kgmole-C)	20.43	22.48				
47	Mass Cv (Semi-Ideal) (kJ/kg-C)	0.7055	0.7764				
48	Cv (kJ/kgmole-C)	20.38	22.42				
49	Mass Cv (kJ/kg-C)	0.7040	0.7746				
50	Cv (Ent. Method) (kJ/kgmole-C)						
51	Mass Cv (Ent. Method) (kJ/kg-C)						
52	Cp/Cv (Ent. Method)						
53	Reid VP at 37.8 C (kPa)						
54	True VP at 37.8 C (kPa)	0.0400	0.0400				
55	Liq. Vol. Flow - Sum(Std. Cond) (m3/h)	0.8162	0.8162				
56	Viscosity Index	-5.179	-7.622				
57 58			PERFORMANCE	:			
59			Desults				

Results

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Power Consumed

Polytropic Head Factor

2.688e+004

(m)

(m)

Aspen Technology Inc.

Adiabatic Head

Polytropic Head

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9.762e-002

(kW)



Case Name: Assignment\_Day1\_Qn3.hsc

Compressor:	Compressor (	(continued)
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2		ONN	company Name Not Available		Assignment_Day1_Qn3.nsc			
3	@aspentech	Bedford, MA	Not Avallable	Unit Set:	SI			
5		USA		Date/Time:	Sun Aug 6 21:25:34 2023			
6								
7	Compressor: Compressor (continued)							
8		<u> </u>	•		<u>,                                      </u>			
9	Results							
10				Results				
11	Adiabatic Fluid Head	(kJ/kg)	263.6	Polytr	opic Exponent	1.53	34	
12	Polytropic Fluid Head	(kJ/kg)	284.8	Isentro	opic Exponent	1.39	99	
13	Adiabatic Efficiency		75	Speed	d (rpm)			
14	Polytropic Efficiency		81					
15 16	Power/Torque							

#### Power/Torque

10						
17	Total Rotor Power	(kW)	9.762e-002	Total Rotor Torque	(N-m)	
18	Transient Rotor Power	(kW)	0.0000	Transient Rotor Torque	(N-m)	
19	Friction Power Loss	(kW)	0.0000	Friction Torque Loss	(N-m)	
20	Fluid Power	(kW)	9.762e-002	Fluid Torque	(N-m)	

#### **DYNAMICS**

#### **Dynamic Specifications**

21	DYNAMICS							
22								
23	Dunamia Occalifications							
24	Dynamic Specifications							
25	Duty	(kJ/h)	351.4	Active	Head	(m)	2.904e+004	Not Active
26	Adiabatic Efficiency		75	Not Active	Fluid Head	(kJ/kg)	284.8	Not Active
27	Polytropic Efficiency		81	Active	Capacity	(ACT_m3/h)	0.8611	Not Active
28	Pressure Increase	(kPa)	800.0	Not Active	Speed	(rpm)		Not Active
29	Use Characteristic Curves No							
30								
31	Holdup Details							

#### **Holdup Details**

32	Phase	Accumulation	Moles	Volume
33		(kgmole/h)	(kgmole)	(m3)
34	Vapour	0.0000	0.0000	0.0000
35	Liquid	0.0000	0.0000	0.0000
36	Aqueous	0.0000	0.0000	0.0000
37	Total	0.0000	0.0000	0.0000

#### **NOTES**

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