L-2/T-2/ChE **Date : 21/03/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub : **CHE 205** (Fluid Mechanics)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonably if any additional data is required. Symbols indicate their usual meanings.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Classify the fluids on the basis of shear stress and shear rate relationship. Elaborate the importance of the study of rheology in fluid mechanics. **(7+6=13)**

   (b) Water flows downward in a pipe at 45°, as shown in Fig. 1(b). The mercury manometer reads a 6-in height. The pressure drop $P_2 - P_1$ is partly due to friction and partly due to gravity. Determine the total pressure drop and also the part due to friction only. Which part does the manometer read? Why? **(22)**

2. (a) Derive the equation of steady motion along a stream line (energy equation) for a real fluid. **(15)**

   (b) Figure 2(b) shows a pump delivering 840 L/min of crude oil (SG = 0.85) from an underground storage drum to the first stage of a processing system. **(20)**

   (i) If the total energy loss in the system is 4.2 N.m/N of oil flowing, calculate the power delivered by the pump.

   (ii) If the energy loss in the suction pipe is 1.4 N.m/N of oil flowing, calculate the pressure at the pump inlet.

3. (a) Why is the concept of hydraulic radius more important than normal radius? Two pipes, one circular and one square, have the same cross-sectional area. Which has the larger hydraulic radius? **(10)**

   (b) With laminar flow in a circular pipe, find the velocities at 0.1π, 0.3π, 0.5π, 0.7π, and 0.9π. Plot the velocity profile with hand drawing. **(12)**

   (c) How much power is lost per meter of pipe length when oil with a viscosity of 0.20. N.s/m^2 flows in a 20-cm-diameter pipe at 0.50 L/s? The oil has density of 840 kg/m^3. **(13)**

4. (a) Water at 80°F is being supplied to an irrigation ditch from an elevated storage reservoir as shown in Fig. 4(a). Calculate the volume flow rate of water into the ditch. **(30)**

   (b) Explain series and parallel branching of pipes. **(5)**

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SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) A certain submerged body is to move horizontally through oil (ρ = 52 lb/ft^3, μ = 0.0006 lb-s/ft^2) at a velocity of 45 fps. To study the characteristics of this motion, an enlarged model of body is tested in 60°F water. The model ratio λ is 8 : 1. Determine the velocity at which this enlarged model should be pulled through the water to achieve dynamic similarity. If the drag force on the model is 0.8 lb_f, predict the drag force on the prototype. **(20)**

   (b) Describe characteristic curves for a typical mixed flow centrifugal pump. **(15)**

6. (a) A Z-in circular tube orifice at the end of the 3-in diameter pipe shown in Fig. for Q. 6(a) discharges into the atmosphere, a measured flow of 0.6 cfs of water when the pressure in the pipe is 10 psi. The jet velocity is determined by a pitot tube to be 39.2 fps. Find the values of the coefficients C_v, C_c and C_d. Find also the head loss from inlet to vena contracta. **(20)**

   (b) With a clear schematic diagram, explain the operation of Saybolt Viscometer. Derive necessary equations. **(15)**

7. Two immiscible incompressible liquids are flowing in the z direction in a horizontal thin slit of length L and with width W under the influence of a horizontal pressure gradient $\left(\frac{P_0 - P_L}{L}\right)$.

   The fluid flow rates are adjusted so that the slit is half filled with fluid I (the more dense phase) and half filled with fluid II (the less dense phase). The fluids are flowing sufficiently slowly that no instabilities occur-that is, the interface remains exactly planar. Determine:

   (i) Velocity distribution **(15)**

   (ii) Average velocities **(10)**

   (iii) Momentum flux **(10)**

8. (a) Describe different types of centrifugal pumps with diagrams. **(15)**

   (b) Explain different types of multi phase flow regimes. **(10)**

   (c) Derive a cavitation parameter for pumps. **(10)**

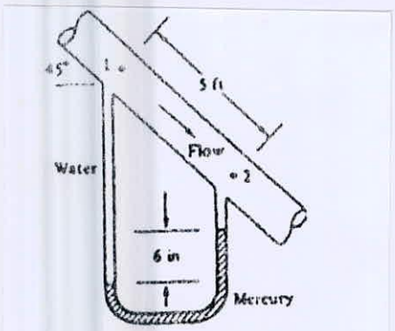

Fig. 1 (b)

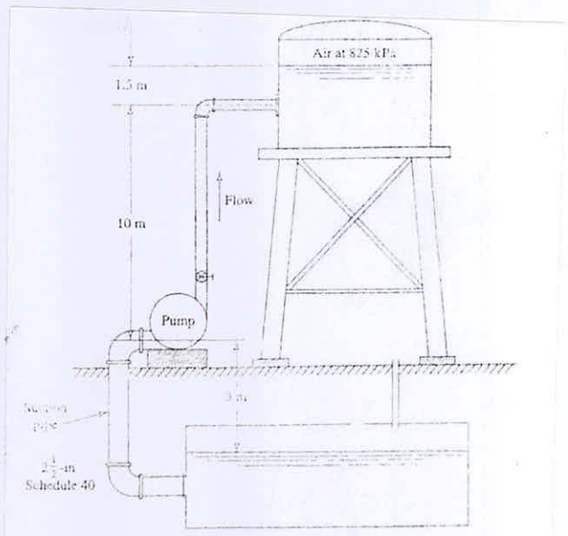

Fig. 2 (b)

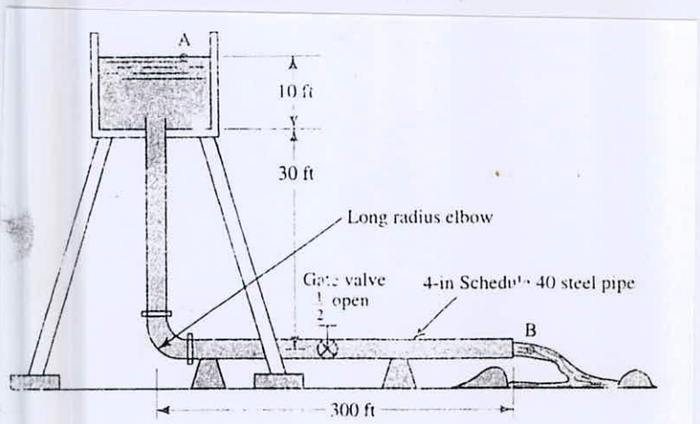

Fig. 4 (a)

Table for 8.4 (b)

Nominal Pipe Size (in)	Friction Factor, f_T	Nominal Pipe Size (in)	Friction Factor, f_T
1/2	0.027	3½, 4	0.017
3/4	0.025	5	0.016
1	0.023	6	0.015
1¼	0.022	8–10	0.014
1½	0.021	12–16	0.013
2	0.019	18–24	0.012
2½, 3	0.018		

Table for Q. 4(a)

Type	Equivalent Length in Pipe Diameters, L/D
Globe valve—fully open	340
Angle valve—fully open	150
Gate valve—fully open	8
—3/4 open	35
—1/2 open	160
—1/4 open	900
Check valve—swing type	100
Check valve—ball type	150
Butterfly valve—fully open	45
Foot valve—poppet disc type	420
Foot valve—hinged disc type	75
90° standard elbow	30
90° long radius elbow	20
90° street elbow	50
45° standard elbow	16
45° street elbow	26
Close return bend	50
Standard tee—with flow through run	20
—with flow through branch	60

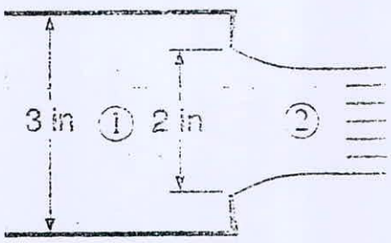

Fig. for Q. 6(a)

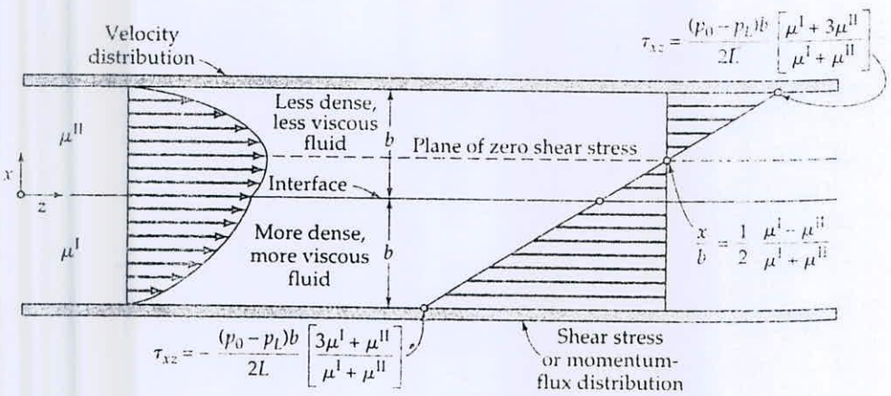

Fig. for Q. 7.

L-2/T-2/ChE **Date : 07/04/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub : **ME 243** (Mechanics of Solids)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Symbols have their usual meanings.

1. (a) The simply supported beam shown in Fig. 1.(a) supports the triangular distributed loading. Determine its maximum deflection. *EI* is constant. **(20)**

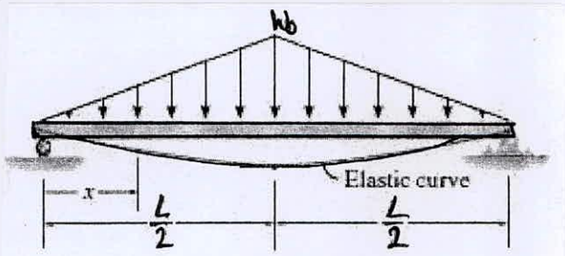

Fig. ~~for ques~~. 1a

(b) A cast-iron beam 10 m long m long and supported as shown in Fig. 1(b). carries a uniformly distributed load of intensity w_0 (including its own weight). The allowable stresses are $\sigma_{bt} \leq 20$ MPa and $\sigma_{bc} \leq 80$ MPa. Determine the maximum safe value of w_0 if $x = 1.0$ m. **(15)**

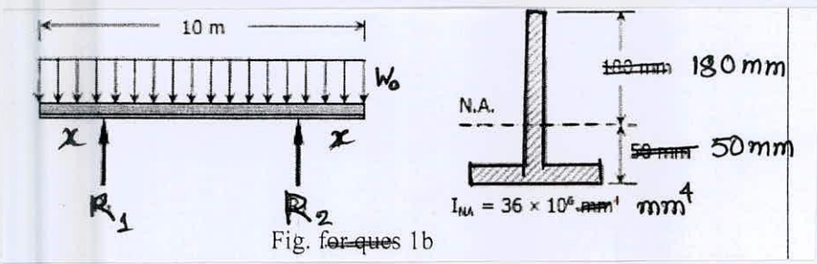

Fig. ~~for ques~~ 1b

2. (a) For the loaded simple beam shown in Fig. 2(a) use method of sections to derive the shear force and bending moment as functions of x over the entire beam and draw the shear force and bending moment diagrams. **(25)**

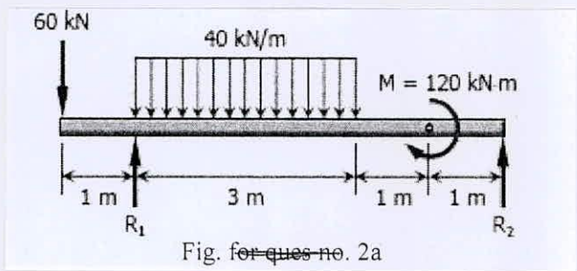

Fig. ~~for ques no~~. 2a

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Cont... Q. No. 2

(b) A cantilever beam of length l is subjected to a point load P at the free end as shown in Fig. 2(b). Using Castigliano's theorem, determine the deflection at the midpoint of the beam. Neglect the effect of vertical shear. **(10)**

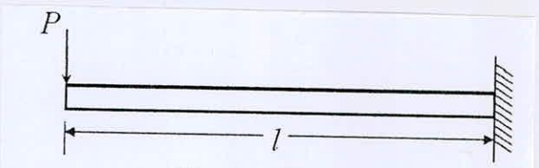

Fig. for ques no. 2b

3. (a) A composite beam is made of wood and reinforced with a steel strap located on its bottom side. It has the cross-sectional area shown in Fig. 3(a). Transform the section into one made entirely of steel and determine the normal stress at points B and C if the beam is subjected to a bending moment of M = 2 kN.m. Take E_w = 12 GPa and E_{st} = 200 GPa. **(20)**

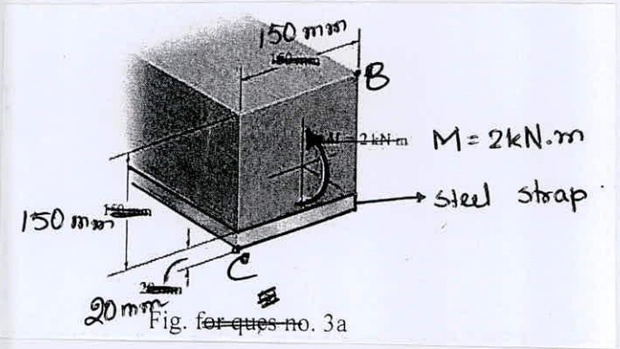

Fig. for ques no. 3a

(b) A pipe carrying steam at 3.5 MPa has an outside diameter of 450 mm and a wall thickness of 10 mm. A gasket is inserted between the flame at one end of the pipe and a flat plate used to cap the end. How many 40-mm-diameter bolts must be used to hold the cap on if the allowable stress in the bolts is 80 MPa, of which 55 MPa is the initial stress? What circumferential stress is developed in the pipe? **(15)**

4. (a) Select the lightest W shape for a fixed ends column of length 6 m that carries an axial load of 145 kN. Use AISC column specifications. Yield strength = 360 MPa and modulus of elasticity = 200 GPa (Use attached table for properties of wide flange sections (W shape). **(20)**

(b) The aluminum column is fixed at its bottom and is braced at its top by cables so as to prevent movement at the top along the x axis as shown in Fig. 4(b). If it is assumed to be fixed at its base, determine the largest allowable load P that can be applied. Use a factor of safety for buckling of 2.0. Take E_{al} = 70 GPa, A = $7.5(10^{-3})$ m^2, I_x = $23.2(10^{-6})$ m^4. Discuss the justification of using the Euler's equation for solving this problem. **(15)**

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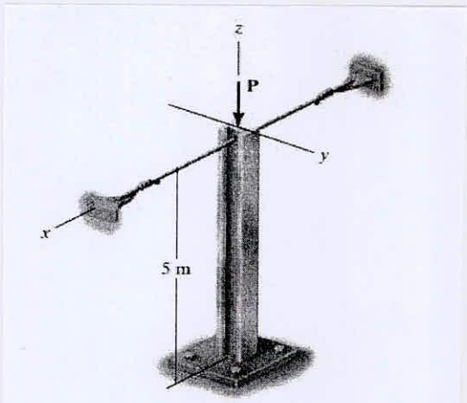

Fig. for ques no. 4b

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Assume that a 20-mm-diameter rivet joins two plates each of which are 110 mm wide. The allowable stresses are 120 MPa for bearing in the plate material and 60 MPa for shearing of rivet. Determine (a) the largest average tensile stress in the plate. And (b) the minimum thickness of each plate. Assume each plate has same thickness. **(15)**

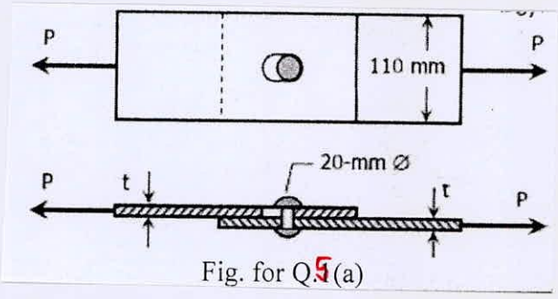

Fig. for Q.5(a)

(b) The rigid bars AB and CD shown in Fig. for Q. 5(b) below are supported by pins at A and C and the two rods BD and EF. Determine the maximum force P that can be applied as shown if its vertical movement is limited to 5 mm. Neglect the weight of all members. **(20)**

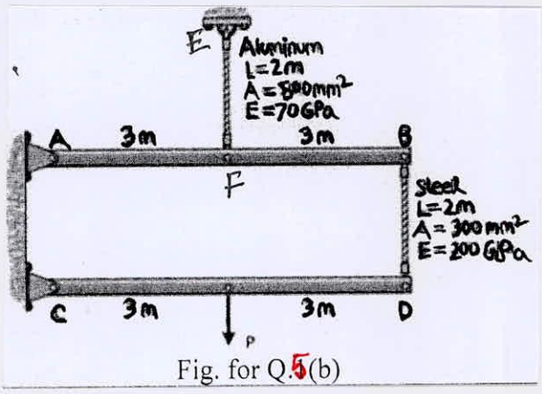

Fig. for Q.5(b)

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6. (a) The assembly in Fig. for Q. 6(a) below consists of a light rigid bar AB, pinned at O, that is attached to the steel and aluminum rods. In the position shown, bar AB is horizontal and there is a gap, Δ = 5 mm, between the lower end of the steel rod and its pin support at C. Compute the stress in the aluminum rod when the lower end of the steel rod is attached to its support. **(17)**

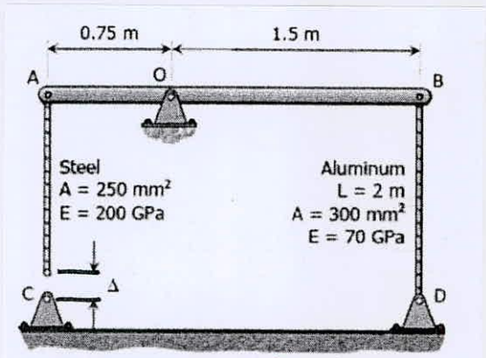

Fig. For Q. 6(a)

(b) For assembly shown in the Fig. for Q. 6(b), determine the stress in each of the two vertical rods if the temperature of each rod rises 40°C after the load P = 50 kN is applied. Neglect the deformation and mass of the horizontal bar AB. Use E_a = 70 GPa, α_a = 23.0 μm/m.°C, A_a = 900 mm^2, E_s = 200 GPa, α_s = 11.7 μm/m.°C, and A_s = 600 mm^2. **(18)**

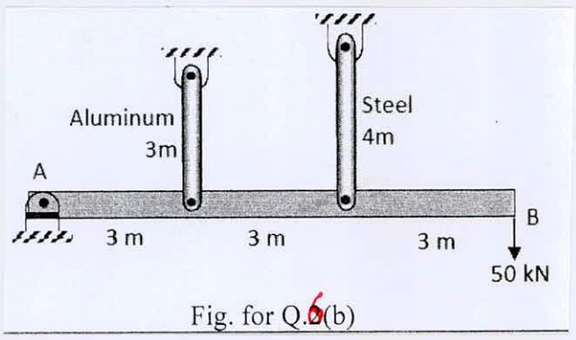

Fig. for Q. 6(b)

7. (a) A compound shaft consisting of an aluminum segment and a steel is acted upon by two torque as shown in the Fig. for Q. 7(a) below. Determine the maximum permissible value of T subjected to the following conditions: $\tau_s \leq 100$ MPa, $\tau_a \leq 70$ MPa, and the angle of rotation of the free end limited to 12°. Use G_s = 83 GPa and G_a = 83 GPa. **(18)**

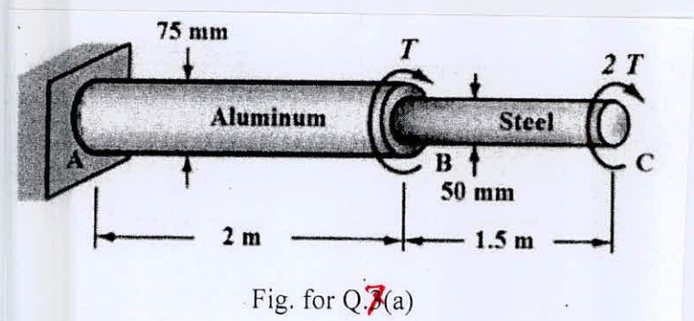

Fig. for Q. 7(a)

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Contd...Q. No. 7

(b) A rigid bar, hinged at one end, is supported by two identical springs as shown in Fig. for Q. 37(b) below. Each spring consists of 20 turns of 10-mm wire having a mean diameter of 150 mm. Compute the maximum shearing stress in the springs. Neglect the mass of the rigid bar. **(17)**

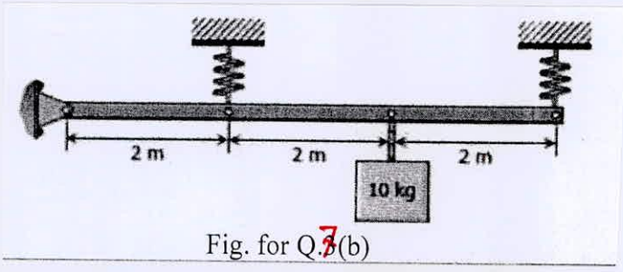

Fig. for Q.37(b)

8. (a) The stress element shown in Fig. for Q. 8(a) has $\sigma_x = 4800$ MPa, $\sigma_y = 0$, and $\tau_{xy} = -2000$ MPa. Using Mohr's circle, determine the principal stresses, maximum shearing stress and the planes on which stresses act. **(20)**

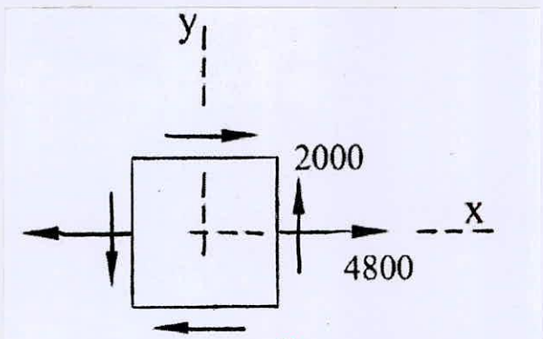

Fig. for Q.8(a)

(b) Find the diameter of a rod subjected to a bending moment of 3 kN.m and a twisting moment of 1.8 kN .m according to the following theories of failure, taking yield strength as 420 MPa and factor of safety as 3. **(15)**

(i) Normal stress theory

(ii) Shear stress theory

Table for question 4a)

TABLE B-2 PROPERTIES OF WIDE-FLANGE SECTIONS (W SHAPES): SI UNITS (*Continued*)

Designation	Theoretical mass (kg/m)	Area (mm^2)	Depth (mm)	Flange Width (mm)	Flange Thickness (mm)	Web thickness (mm)	Axis X–X I (10^6 mm^4)	Axis X–X $S = \frac{I}{c}$ (10^3 mm^3)	Axis X–X $r = \sqrt{I/A}$ (mm)	Axis Y–Y I (10^6 mm^4)	Axis Y–Y $S = \frac{I}{c}$ (10^3 mm^3)	Axis Y–Y $r = \sqrt{I/A}$ (mm)
W360 ×262	262.7	33 500	387	398	33.3	21.1	894	4 620	163	350	1 760	102
×237	236.3	30 100	380	395	30.2	18.9	788	4 150	162	310	1 570	101
×216	216.3	27 600	375	394	27.7	17.3	712	3 790	161	283	1 430	101
×196	196.5	25 000	372	374	26.2	16.4	636	3 420	159	229	1 220	95.7
×179	179.2	22 800	368	373	23.9	15.0	575	3 120	159	207	1 110	95.3
×162	162.0	20 600	364	371	21.8	13.3	516	2 830	158	186	1 000	95.0
×147	147.5	18 800	360	370	19.8	12.3	463	2 570	157	167	904	94.2
×134	134.0	17 100	356	369	18.0	11.2	415	2 330	156	151	817	94.0
×122	121.7	15 500	363	257	21.7	13.0	365	2 010	153	61.5	478	63.0
×110	110.2	14 000	360	256	19.9	11.4	331	1 840	154	55.7	435	63.1
×101	101.2	12 900	357	255	18.3	10.5	302	1 690	153	50.6	397	62.6
×91	90.8	11 600	353	254	16.4	9.5	267	1 510	152	44.8	353	62.1
×79	79.3	10 100	354	205	16.8	9.4	227	1 280	150	24.2	236	48.9
×72	71.5	9 110	350	204	15.1	8.6	201	1 150	149	21.4	210	48.5
×64	63.9	8 140	347	203	13.5	7.7	178	1 030	148	18.8	186	48.1
×57	56.7	7 220	358	172	13.1	7.9	161	897	149	11.1	129	39.2
×51	50.6	6 450	355	171	11.6	7.2	141	796	148	9.68	113	38.7
×45	45.0	5 730	352	171	9.8	6.9	122	691	146	8.18	95.7	37.8
×39	39.1	4 980	353	128	10.7	6.5	102	580	143	3.75	58.6	27.4
×33	32.8	4 170	349	127	8.5	5.8	82.7	474	141	2.91	45.8	26.4
W310 ×500	500.4	63 700	427	340	75.1	45.1	1 690	7 910	163	494	2 910	88.1
×454	454.0	57 800	415	336	68.7	41.3	1 480	7 130	160	436	2 600	86.9
×415	415.1	52 900	403	334	62.7	38.9	1 300	6 450	157	391	2 340	86.0
×375	374.3	47 700	391	330	57.1	35.4	1 130	5 760	154	343	2 080	84.8
×342	343.3	43 700	382	328	52.6	32.6	1 010	5 260	152	310	1 890	84.2
×313	313.3	39 900	374	325	48.3	30.0	896	4 790	150	277	1 700	83.3
×283	283.0	36 000	365	322	44.1	26.9	787	4 310	148	246	1 530	82.7
×253	252.9	32 200	356	319	39.6	24.4	682	3 830	146	215	1 350	81.7
×226	226.8	28 900	348	317	35.6	22.1	596	3 420	144	189	1 190	80.9
×202	202.6	25 800	341	315	31.8	20.1	520	3 050	142	166	1 050	80.2
×179	178.8	22 800	333	313	28.1	18.0	445	2 680	140	144	919	79.5
×158	157.4	20 100	327	310	25.1	15.5	386	2 360	139	125	805	78.9
×143	143.1	18 200	323	309	22.9	14.0	348	2 150	138	113	729	78.8
×129	129.6	16 500	318	308	20.6	13.1	308	1 940	137	100	652	77.8
×118	117.5	15 000	314	307	18.7	11.9	275	1 750	135	90.2	588	77.5
×107	106.9	13 600	311	306	17.0	10.9	248	1 590	135	81.2	531	77.3
×97	96.8	12 300	308	305	15.4	9.9	222	1 440	134	72.9	478	77.0
×86	86.4	11 000	310	254	16.3	9.1	199	1 280	135	44.5	351	63.6
×79	78.9	10 100	306	254	14.6	8.8	177	1 160	132	39.9	314	62.9
×74	74.5	9 490	310	205	16.3	9.4	165	1 060	132	23.4	229	49.7
×67	66.8	8 510	306	204	14.6	8.5	145	949	131	20.7	203	49.3
×60	59.6	7 590	303	203	13.1	7.5	129	849	130	18.3	180	49.1
×52	52.3	6 670	317	167	13.2	7.6	118	747	133	10.3	123	39.3
×45	44.6	5 690	313	166	11.2	6.6	99.2	634	132	8.55	103	38.8
W310 ×39	38.7	4 940	310	165	9.7	5.8	85.1	549	131	7.27	88.1	38.4
×33	32.8	4 180	313	102	10.8	6.6	65.0	415	125	1.92	37.6	21.4
×28	28.4	3 610	309	102	8.9	6.0	54.3	351	123	1.58	31.0	20.9
×24	23.8	3 040	305	101	6.7	5.6	42.7	280	119	1.16	22.9	19.5
×21	21.1	2 690	303	101	5.7	5.1	37.0	244	117	0.983	19.5	19.1

(continues)

Table for Question : 4a

TABLE B-2 PROPERTIES OF WIDE-FLANGE SECTIONS (W SHAPES): SI UNITS (*Continued*)

Designation	Theoretical mass (kg/m)	Area (mm^2)	Depth (mm)	Flange Width (mm)	Flange Thickness (mm)	Web thickness (mm)	Axis X–X I (10^6 mm^4)	Axis X–X $S = \frac{I}{c}$ (10^3 mm^3)	Axis X–X $r = \sqrt{I/A}$ (mm)	Axis Y–Y I (10^6 mm^4)	Axis Y–Y $S = \frac{I}{c}$ (10^3 mm^3)	Axis Y–Y $r = \sqrt{I/A}$ (mm)
W360 ×262	262.7	33 500	387	398	33.3	21.1	894	4 620	163	350	1 760	102
×237	236.3	30 100	380	395	30.2	18.9	788	4 150	162	310	1 570	101
×216	216.3	27 600	375	394	27.7	17.3	712	3 790	161	283	1 430	101
×196	196.5	25 000	372	374	26.2	16.4	636	3 420	159	229	1 220	95.7
×179	179.2	22 800	368	373	23.9	15.0	575	3 120	159	207	1 110	95.3
×162	162.0	20 600	364	371	21.8	13.3	516	2 830	158	186	1 000	95.0
×147	147.5	18 800	360	370	19.8	12.3	463	2 570	157	167	904	94.2
×134	134.0	17 100	356	369	18.0	11.2	415	2 330	156	151	817	94.0
×122	121.7	15 500	363	257	21.7	13.0	365	2 010	153	61.5	478	63.0
×110	110.2	14 000	360	256	19.9	11.4	331	1 840	154	55.7	435	63.1
×101	101.2	12 900	357	255	18.3	10.5	302	1 690	153	50.6	397	62.6
×91	90.8	11 600	353	254	16.4	9.5	267	1 510	152	44.8	353	62.1
×79	79.3	10 100	354	205	16.8	9.4	227	1 280	150	24.2	236	48.9
×72	71.5	9 110	350	204	15.1	8.6	201	1 150	149	21.4	210	48.5
×64	63.9	8 140	347	203	13.5	7.7	178	1 030	148	18.8	186	48.1
×57	56.7	7 220	358	172	13.1	7.9	161	897	149	11.1	129	39.2
×51	50.6	6 450	355	171	11.6	7.2	141	796	148	9.68	113	38.7
×45	45.0	5 730	352	171	9.8	6.9	122	691	146	8.18	95.7	37.8
×39	39.1	4 980	353	128	10.7	6.5	102	580	143	3.75	58.6	27.4
×33	32.8	4 170	349	127	8.5	5.8	82.7	474	141	2.91	45.8	26.4
W310 ×500	500.4	63 700	427	340	75.1	45.1	1 690	7 910	163	494	2 910	88.1
×454	454.0	57 800	415	336	68.7	41.3	1 480	7 130	160	436	2 600	86.9
×415	415.1	52 900	403	334	62.7	38.9	1 300	6 450	157	391	2 340	86.0
×375	374.3	47 700	391	330	57.1	35.4	1 130	5 760	154	343	2 080	84.8
×342	343.3	43 700	382	328	52.6	32.6	1 010	5 260	152	310	1 890	84.2
×313	313.3	39 900	374	325	48.3	30.0	896	4 790	150	277	1 700	83.3
×283	283.0	36 000	365	322	44.1	26.9	787	4 310	148	246	1 530	82.7
×253	252.9	32 200	356	319	39.6	24.4	682	3 830	146	215	1 350	81.7
×226	226.8	28 900	348	317	35.6	22.1	596	3 420	144	189	1 190	80.9
×202	202.6	25 800	341	315	31.8	20.1	520	3 050	142	166	1 050	80.2
×179	178.8	22 800	333	313	28.1	18.0	445	2 680	140	144	919	79.5
×158	157.4	20 100	327	310	25.1	15.5	386	2 360	139	125	805	78.9
×143	143.1	18 200	323	309	22.9	14.0	348	2 150	138	113	729	78.8
×129	129.6	16 500	318	308	20.6	13.1	308	1 940	137	100	652	77.8
×118	117.5	15 000	314	307	18.7	11.9	275	1 750	135	90.2	588	77.5
×107	106.9	13 600	311	306	17.0	10.9	248	1 590	135	81.2	531	77.3
×97	96.8	12 300	308	305	15.4	9.9	222	1 440	134	72.9	478	77.0
×86	86.4	11 000	310	254	16.3	9.1	199	1 280	135	44.5	351	63.6
×79	78.9	10 100	306	254	14.6	8.8	177	1 160	132	39.9	314	62.9
×74	74.5	9 490	310	205	16.3	9.4	165	1 060	132	23.4	229	49.7
×67	66.8	8 510	306	204	14.6	8.5	145	949	131	20.7	203	49.3
×60	59.6	7 590	303	203	13.1	7.5	129	849	130	18.3	180	49.1
×52	52.3	6 670	317	167	13.2	7.6	118	747	133	10.3	123	39.3
×45	44.6	5 690	313	166	11.2	6.6	99.2	634	132	8.55	103	38.8
W310 ×39	38.7	4 940	310	165	9.7	5.8	85.1	549	131	7.27	88.1	38.4
×33	32.8	4 180	313	102	10.8	6.6	65.0	415	125	1.92	37.6	21.4
×28	28.4	3 610	309	102	8.9	6.0	54.3	351	123	1.58	31.0	20.9
×24	23.8	3 040	305	101	6.7	5.6	42.7	280	119	1.16	22.9	19.5
×21	21.1	2 690	303	101	5.7	5.1	37.0	244	117	0.983	19.5	19.1

(continues)

=8=

Table for Question 4 (a)

TABLE B-2 PROPERTIES OF WIDE-FLANGE SECTIONS (W SHAPES): SI UNITS (*Continued*)

Designation	Theoretical mass (kg/m)	Area (mm^2)	Depth (mm)	Flange Width (mm)	Flange Thickness (mm)	Web Thickness (mm)	Axis X–X I (10^6 mm^4)	Axis X–X $S = \frac{I}{c}$ (10^3 mm^3)	Axis X–X $r = \sqrt{I/A}$ (mm)	Axis Y–Y I (10^6 mm^4)	Axis Y–Y $S = \frac{I}{c}$ (10^3 mm^3)	Axis Y–Y $r = \sqrt{I/A}$ (mm)
W250 ×167	167.4	21 300	289	265	31.8	19.2	300	2 080	119	98.8	746	68.1
×149	148.9	19 000	282	263	28.4	17.3	259	1 840	117	86.2	656	67.4
×131	131.1	16 700	275	261	25.1	15.4	221	1 610	115	74.5	571	66.8
×115	114.8	14 600	269	259	22.1	13.5	189	1 410	114	64.1	495	66.3
×101	101.2	12 900	264	257	19.6	11.9	164	1 240	113	55.5	432	65.6
×89	89.6	11 400	260	256	17.3	10.7	143	1 100	112	48.4	378	65.2
×80	80.1	10 200	256	255	15.6	9.4	126	982	111	43.1	338	65.0
×73	72.9	9 280	253	254	14.2	8.6	113	891	110	38.8	306	64.7
×67	67.1	8 550	257	204	15.7	8.9	104	806	110	22.2	218	51.0
×58	58.2	7 420	252	203	13.5	8.0	87.3	693	108	18.8	186	50.3
×49	49.0	6 250	247	202	11.0	7.4	70.6	572	106	15.1	150	49.2
×45	44.9	5 720	266	148	13.0	7.6	71.1	534	111	7.03	95.1	35.1
×39	38.7	4 920	262	147	11.2	6.6	60.1	459	111	5.94	80.8	34.7
×33	32.7	4 170	258	146	9.1	6.1	48.9	379	108	4.73	64.7	33.7
×28	28.5	3 630	260	102	10.0	6.4	40.0	307	105	1.78	34.8	22.1
×25	25.3	3 230	257	102	8.4	6.1	34.2	266	103	1.49	29.2	21.5
×22	22.4	2 850	254	102	6.9	5.8	28.9	227	101	1.23	24.0	20.8
×18	17.9	2 270	251	101	5.3	4.8	22.4	179	99.3	0.913	18.1	20.1
W200 ×100	99.5	12 700	229	210	23.7	14.5	113	989	94.3	36.6	349	53.7
×86	86.7	11 100	222	209	20.6	13.0	94.7	853	92.4	31.4	300	53.2
×71	71.5	9 110	216	206	17.4	10.2	76.6	709	91.7	25.4	246	52.8
×59	59.4	7 560	210	205	14.2	9.1	61.1	582	89.9	20.4	199	51.9
×52	52.3	6 660	206	204	12.6	7.9	52.7	512	89.0	17.8	175	51.7
×46	46.0	5 860	203	203	11.0	7.2	45.5	448	88.1	15.3	151	51.1
×42	41.7	5 310	205	166	11.8	7.2	40.9	399	87.7	9.00	108	41.2
×36	35.9	4 580	201	165	10.2	6.2	34.4	342	86.7	7.64	92.6	40.8
×31	31.4	4 000	210	134	10.2	6.4	31.4	299	88.6	4.10	61.1	32.0
×27	26.6	3 390	207	133	8.4	5.8	25.8	249	87.2	3.30	49.6	31.2
×22	22.4	2 860	206	102	8.0	6.2	20.0	194	83.6	1.42	27.8	22.3
×19	19.4	2 480	203	102	6.5	5.8	16.6	163	81.8	1.15	22.6	21.5
×15	15.0	1 900	200	100	5.2	4.3	12.7	127	81.8	0.869	17.4	21.4
W150 ×37	37.1	4 730	162	154	11.6	8.1	22.2	274	68.5	7.07	91.8	38.7
×30	29.8	3 790	157	153	9.3	6.6	17.2	219	67.4	5.56	72.6	38.3
×22	22.3	2 850	152	152	6.6	5.8	12.1	159	65.2	3.87	50.9	36.8
×24	24.0	3 060	160	102	10.3	6.6	13.4	168	66.2	1.83	35.8	24.5
×18	18.0	2 290	153	102	7.1	5.8	9.16	120	63.2	1.26	24.7	23.5
×14	13.6	1 730	150	100	5.5	4.3	6.87	91.5	63.0	0.918	18.4	23.0
W130 ×28	28.1	3 580	131	128	10.9	6.9	10.9	167	55.2	3.81	59.6	32.6
×24	23.6	3 010	127	127	9.1	6.1	8.80	139	54.1	3.11	49.0	32.1
W100 ×19	19.4	2 470	106	103	8.8	7.1	4.76	89.9	43.9	1.61	31.2	25.5

[a] Produced exclusively by Algoma Steel (Canada).

L-2/T-2/CHE **Date: 16/4/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **CHEM 221** (Organic Chemistry)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Symbols used have their usual meaning.

1. (a) Give the general method for the synthesis of the three five-membered heterocycles starting from a 1, 4-diketone. **(9)**

(b) Show with mechanism the electrophilic substitution reactions of the five membered heterocycles. **(10)**

(c) Explain the difference between sp^2 hybridization of nitrogen in pyrrole and pyridine. **(10)**

(d) What happens when thiophene is subjected to mild and catalytic reduction? **(6)**

2. (a) Write the Fischer-Indole synthesis of indole with reasonable mechanism. **(6)**

(b) Unlike pyrrole, indole undergoes electrophilic substitution at C-3 rather than C-2 position. Give reasons. **(9)**

(c) Write with reactions how would you bring out the following conversions. **(5×3=15)**

(i) Octahydroindole from indole

(ii) Isatin from indigo

(iii) *N*-Methylpyridinium bromide from pyridine

(iv) 2-Aminopyridine from pyridine

(v) Pyridine -2,3-dicarboxylic acid from pyridine

(d) Illustrate the mechanism of vat dying with indigo. **(5)**

3. (a) What structural features are necessary for a compound to be aromatic? **(8)**

(b) Friedel-Crafts acylation reaction of benzene is synthetically more valuable than Friedel-Crafts alkylation reaction. Justify with examples. **(10)**

(c) What happens when toluene is treated with the followings? **(4×3=12)**

(i) Bromine in presence of Lewis acid in the dark

(ii) Chlorine in presence of sunlight

(iii) Alkaline potassium permanganate

(iv) Hydrogen in presence of nickel catalyst

(d) With reference to aromatic disubstitution explain the term ortho-para directors. **(5)**

Contd P/2

CHEM 221/CHE

4. (a) Draw the structures of the following alkaloids and write down their physiological activities. (i) Quinine (ii) Nicotine (iii) Ephedrine **(4×3=12)**

(b) Give the mechanism of biosynthesis of alkaloids in plant materials. **(8)**

(c) What information do you get about the structure of coniine when it is distilled with zinc dust and then the product is treated with potassium permanaganate? **(10)**

(d) Name some alkaloidal reagents and mention their functions. **(5)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Draw the structure of 2,2-dimethylpentane. How will you prepare the compound by Corey-House synthesis? Discuss the mechanism. **(13)**

(b) Which reaction in each of the following pairs will take place more rapidly? Explain the reasons. **(12)**

(i) $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$

$CH_3Br + H_2O \rightarrow CH_3OH + HBr$

(ii) $CH_3I + OH^- \rightarrow CH_3OH + I^-$

$CH_3Cl + OH^- \rightarrow CH_3OH + Cl^-$

(c) Give the major product(s) of the reaction of 1-methylcyclohexene with the following reagents, ignoring stereoisomers. **(10)**

(i) NBS/Δ/peroxide

(ii) HBr/ peroxide

6. (a) Define "degree of unsaturation". Determine the degree of unsaturation, and then draw possible structures, for compounds with the following molecular formulas: **(10)**

(i) C_3H_6 (ii) C_3H_4

(b) For the following reaction, give the major 1,2- and 1,4-addition products and indicate which is the kinetic product and which is the thermodynamic product: **(10)**

1,3-pentadiene + HCl

(c) Draw the structure of 2,4-dimethylcyclohexene. What would be the major product obtained from the reaction of Br_2 with the compound if the reactions were carried out in **(15)**

(i) dichloromethane

(ii) water

(iii) ethyl alcohol?

Discuss the mechanism.

Contd P/3

CHEM 221/CHE

7. (a) Draw the structures for each of the following molecules: **(8)**

(i) (*S*)-1-bromo-1-chlorobutane

(ii) (*2R,3R*)-2,3-dichloropentane

(iii) Allyl chloride

(iv) trans-1,2-dimethylcyclohexene

(b) Give the product(s) that would be obtained from the reaction of 2-butyne with the following reagents. If the products can exist as stereoisomers, show which stereoisomers are obtained. **(12)**

(i) H_2/Lindlar catalyst

(ii) sodium in liquid ammonia

(iii) Br_2 (1 mol) in CH_2Cl_2

(c) How will you synthesize the following compounds? **(15)**

(i) 2-pentyne from propyne

(ii) Ketone from 2-pentyne

Give the mechanisms.

8. (a) Identify compound (A), $C_4H_{10}O$, from the following data: **(10)**

(i) (A) + Br_2 / CCl_4 $\rightarrow$ No reaction

(ii) (A) + Na $\rightarrow$ Bubbles

(iii) (A) + HCl/$ZnCl_2$ $\rightarrow$ Immediate cloudiness

(b) What would be the elimination products of 3,3-dimethyl-2-butanol? Give the mechanism. **(15)**

(c) How will you synthesize 3,3- dimethy1-2-butanol from 3,3- dimethyl-1-butene? **(10)**

L-2/T-2/CHE **Date: 27/03/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **MATH 223** (Numerical Analysis and Statistics)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Use Newton-Raphson method to obtain a real root, correct to five decimal places, of the equation $2x\cos 2x-(x-2)^2=0$ for $2\le x\le 3$ and $3\le x\le 4$. **(17)**

(b) Show that $f(x)=x^3+4x^2-10=0$ has a root in [1, 2], and use the Bisection method to determine an approximation to the root that is accurate to at least within 10^{-4}. **(18)**

2. (a) Derive Lagrange's interpolation formula and apply Lagrange's formula to find a cubic polynomial which approximates the following data and find $f(4)$: **(17)**

x:	–2	–1	2	3
$f(x)$:	–12	–8	3	5

(b) Derive Newton's forward difference interpolation formula and find the equations of the curve $y=f(x)$ joining the points (1, 24), (3, 120), (5, 336), (7, 720) by using Newton's forward difference interpolation formula. **(18)**

3. (a) Use the following data to approximate the first and second derivative of $f(x)=xe^x$ at $x=2.0$. Use the midpoint formula to approximate the second derivative. **(18)**

x:	1.8	1.9	2.0	2.1	2.2
y:	10.889365	12.703199	14.778112	17.148957	19.855030

(b) Derive general quadrature formula for equidistant ordinates and hence find Simpson's 1/3 rule as well as Simpson's 3/8 rule. **(17)**

4. (a) Evaluate $\int_3^5 \frac{1}{\sqrt{x^2-4}}dx$ with n = 8 using the Composite Trapezoidal rule. **(17)**

(b) Evaluate $\int_{-2}^{2} \frac{t}{5+2t}dt$ with h = 0.5 by Simpson's 1/3 rule. Also compare the result with exact value of integral. **(18)**

Contd P/2

MATH 223/CHE

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Using three successive approximations of Picard's method, obtain approximate solution of $\frac{dy}{dx} = x^2 + y^2$ satisfying the initial condition $y(0) = 0$. **(17)**

(b) Apply the fourth order Runge-Kutta method to find $u(0, 2)$ of the initial value problem $\frac{du}{dt} = -2tu^2, u(0) = 1$ using h = 0.2. **(18)**

6. (a) An analysis of companies resulted in the following distribution:

Profit (Lakhs):	79-90	90-110	110-130	130-150	150-170
No of Companies:	8	11	18	9	4

Calculate moments about the mean. Also, find Karl Pearson's coefficient of skewness, and kurtosis and comment on the result. **(17)**

(b) The following is a portion of a classic data set called the "pilot plot data" in Fitting Equations to Data by Daniel and Wood, published in 2021. The response Y is the acid content of material produced by titration, whereas the regressor X is the organic acid content produced by extraction and weighing. **(18)**

X:	123	55	100	75	159	109	48	138	164	28
Y:	76	62	66	58	88	70	37	82	88	43

(i) Plot the data; does it appear that a simple linear regression will be a suitable model?

(ii) Fit a simple linear regression; estimate a slope and intercept.

(iii) Graph the regression line on the plot in (i).

7. (a) According to Consumer Digest (July/August 2016), the probable location of personal computers (PC) in the home is as follows: Adult bedroom: 0.03, Child bedroom: 0.15, Other bedroom: 0.14, Office or den: 0.40, Other rooms: 0.28. **(17)**

(i) What is the probability that a PC is in a bedroom?

(ii) What is the probability that it is not in a bedroom?

(iii) Suppose a household is selected at random from households with a PC; in what room would you expect to find a PC?

(b) It is known by researchers that 1 in 100 people carries a gene that leads to the inheritance of a certain chronic disease. **(18)**

(i) In a random sample of 1000 individuals, what is the probability that fewer than 7 individuals carry the gene (use a Poisson approximation)?

(ii) Again, using the approximation, what is the approximate mean number of people out of 1000 carrying the gene?

Contd P/3

MATH 223/CHE

8. (a) A product developer is interested in reducing the drying time of a primer paint. Two formulations of the paint are tested; formulation-1 is the standard chemistry, and formulation-2 has a new drying ingredient that should reduce the drying time. From experience, it is known that the standard deviation of drying time is 8 minutes, and this inherent variability should be unaffected by the addition of the new ingredient. Ten specimens are painted with formulation-1, and another 10 specimens are painted with formulation-2. The two samples average drying times are $\bar{x}_1 = 121$ minutes and $\bar{x}_2 = 112$ minutes, respectively. What conclusions can the product developer draw about the effectiveness of the new ingredient, using α = 0.05? (critical value of $z = -1.645$ or 1.645). **(13)**

(b) An electrical firm manufactures light bulbs that have a life, before burn-out, that is normally distributed with a mean equal to 800 hours a standard deviation of 30 hours. Find the probability that a bulb burns between 776 and 824 hours. **(10)**

(c) It is conjectured that an impurity exists in 30% of all drinking wells in a certain rural community. In order to gain some insight into the true extent of the problem, it is determined that some testing is necessary. It is too expensive to test all of the wells in the area, so 10 are randomly selected for testing. **(12)**

(i) Use binomial distribution to find the probability that exactly 3 wells have the impurity, assuming that the conjecture is correct.

(ii) What is the probability that more than 3 wells are impure?

Table 1: Area under the Standard Normal curve from 0 to z.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900

For question no 8(b)

MATH 223 page-05

Table 2: Binomial Probability Sums $\sum_{x=0}^{r} b(x; n, p)$

		p									
n	r	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90
8	0	0.4305	0.1678	0.1001	0.0576	0.0168	0.0039	0.0007	0.0001	0.0000	
	1	0.8131	0.5033	0.3671	0.2553	0.1064	0.0352	0.0085	0.0013	0.0001	
	2	0.9619	0.7969	0.6785	0.5518	0.3154	0.1445	0.0498	0.0113	0.0012	0.0000
	3	0.9950	0.9437	0.8862	0.8059	0.5941	0.3633	0.1737	0.0580	0.0104	0.0004
	4	0.9996	0.9896	0.9727	0.9420	0.8263	0.6367	0.4059	0.1941	0.0563	0.0050
	5	1.0000	0.9988	0.9958	0.9887	0.9502	0.8555	0.6846	0.4482	0.2031	0.0381
	6		0.9999	0.9996	0.9987	0.9915	0.9648	0.8936	0.7447	0.4967	0.1869
	7		1.0000	1.0000	0.9999	0.9993	0.9961	0.9832	0.9424	0.8322	0.5695
	8				1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	0	0.3874	0.1342	0.0751	0.0404	0.0101	0.0020	0.0003	0.0000		
	1	0.7748	0.4362	0.3003	0.1960	0.0705	0.0195	0.0038	0.0004	0.0000	
	2	0.9470	0.7382	0.6007	0.4628	0.2318	0.0898	0.0250	0.0043	0.0003	0.0000
	3	0.9917	0.9144	0.8343	0.7297	0.4826	0.2539	0.0994	0.0253	0.0031	0.0001
	4	0.9991	0.9804	0.9511	0.9012	0.7334	0.5000	0.2666	0.0988	0.0196	0.0009
	5	0.9999	0.9969	0.9900	0.9747	0.9006	0.7461	0.5174	0.2703	0.0856	0.0083
	6	1.0000	0.9997	0.9987	0.9957	0.9750	0.9102	0.7682	0.5372	0.2618	0.0530
	7		1.0000	0.9999	0.9996	0.9962	0.9805	0.9295	0.8040	0.5638	0.2252
	8			1.0000	1.0000	0.9997	0.9980	0.9899	0.9596	0.8658	0.6126
	9					1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	0	0.3487	0.1074	0.0563	0.0282	0.0060	0.0010	0.0001	0.0000		
	1	0.7361	0.3758	0.2440	0.1493	0.0464	0.0107	0.0017	0.0001	0.0000	
	2	0.9298	0.6778	0.5256	0.3828	0.1673	0.0547	0.0123	0.0016	0.0001	
	3	0.9872	0.8791	0.7759	0.6496	0.3823	0.1719	0.0548	0.0106	0.0009	0.0000
	4	0.9984	0.9672	0.9219	0.8497	0.6331	0.3770	0.1662	0.0473	0.0064	0.0001
	5	0.9999	0.9936	0.9803	0.9527	0.8338	0.6230	0.3669	0.1503	0.0328	0.0016
	6	1.0000	0.9991	0.9965	0.9894	0.9452	0.8281	0.6177	0.3504	0.1209	0.0128
	7		0.9999	0.9996	0.9984	0.9877	0.9453	0.8327	0.6172	0.3222	0.0702
	8		1.0000	1.0000	0.9999	0.9983	0.9893	0.9536	0.8507	0.6242	0.2639
	9				1.0000	0.9999	0.9990	0.9940	0.9718	0.8926	0.6513
	10					1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

For question no 8(c)

L-2/T-2/CHE **Date: 31/03/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **HUM 103** (Economics)

Full Marks: 210 Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

Symbols indicate their usual meaning

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** from the rest.

1. (a) What do you understand by MRTS? Explain any three characteristics of an isoquant. **(10)**

(b) Complete the following table and plot the total product (TP), average product (AP) and marginal product (MP) of labour. **(15)**

Number of workers	Total product (TP)	Average Product (AP)	Marginal Product (MP)
1	3		
2	8		
3	12		
4	15		
5	17		
6	17		
7	16		
8	13		

(c) What is the relation between the AP and MP curves? Use these curves to define three stages of production for labour. **(10)**

2. (a) How would you measure price elasticity of demand at any point of a straight-line demand curve? Explain graphically. **(10)**

(b) Define cross elasticity of demand and income elasticity demand. **(10)**

(c) From the following table calculate elasticity of demand if you move from point A to C and explain what you understand from the result. **(15)**

POINT	Y	Q
A	1500	50
B	1600	60
C	1700	70

Contd P/2

HUM 103

3. (a) Explain the properties of an indifference curve. **(15)**

(b) Explain consumer's equilibrium with the help of budget line and indifference curve. **(10)**

(c) From the following budget line and the utility function, calculate the amount of two commodities that maximizes satisfaction. What is the maximum amount of satisfaction? **(10)**

$$5000 = 45\,X + 55Y$$

$$U = 500\,X^{0.6}Y^{0.7}$$

4. (a) From the following demand function, make a hypothetical demand schedule and plot the curve. **(10)**

$$Q = 80 - 20P + P^2.$$

(b) What are the main causes of shifting of the supply curve? Explain them. **(15)**

(c) What are the exceptions to the law of demand? Explain. **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) State the prerequisites for an effective demand. How would you construct market demand and market supply curves using a hypothetical demand and supply schedule? Distinguish between 'change in demand and 'change in quantity demanded'. **(20)**

(b) Define market equilibrium. How are the price and output of a commodity determined in the open market economy through market equilibrium? The demand and supply functions of a commodity (say) X are given respectively by **(15)**

$Q_{DX} = 1520 - 70P_X$

$Q_{SX} = 750 + 20P_X$

Find the equilibrium price and quantity of the commodity X. If the Government imposes 15% VAT on unit price, what will be the new equilibrium price and quantity? Calculate the share of tax that would be incurred by the consumers.

6. (a) Define income effect and substitution effect of a price change . Show these effects with graphical presentations. **(20)**

(b) How would you derive the formula for measuring cross-price elasticity of demand? Let, the demand function of Igloo Ice-cream is given by **(15)**

$Q_{dx} = 1575 - 27P_x + 0.004\,M + 3.5\,P_y$

Contd P/3

HUM 103

Contd... Q. No. 6(b)

Where price of Igloo ice-cream, P_x = tk. 50, price of Polar ice-cream, Y, P_y = tk. 60 and Income of the consumer, m = 75000. Find the income elasticity and cross-price elasticity of Igloo ice-cream. State the implications of the results you have obtained.

7. (a) When does a firm emerge as a monopolist? Explain the short run equilibrium of a firm under monopoly. **(25)**

(b) What is the relation between marginal revenue (MR), price (P) and price elasticity of demand (e) of a firm under monopoly? **(10)**

8. Write short notes on any THREE of the following **(35)**

(i) Fundamental economic problems and their solutions

(ii) Optimal consumption point under ordinal approach to utility analysis

(iii) Applications of elasticity of demand

(iv) 'Law of diminishing marginal utility' and Marginal Rate of Substitution (MRS)'
