L-I/T-I/IPE **Date: 22/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-I/T-I B. Sc. Engineering Examinations 2020-2021

Sub: **IPE 105** (Principles of Cost and Management Accounting)

Full Marks: 210 Time: 3 Hours

Assume reasonable values for missing data, if any.

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**.

1. Luxguard Home Paint Company produces exterior latex pain, which it sells in one-gallon containers. The company has two processing departments-Base Fab and Finishing. White paint, which is used as a base for all the company's paints, is mixed from raw ingredients in the Base Fab Department. Pigments are then added to the basic white paint, the pigmented paint is squired under pressure into one-gallon containers, and the containers are labeled and packed for shipping in the Finishing Department. Information related to the company's operations for April:

   (a) Issued raw materials for use in production: Base Fab Department; $851,000: and Finishing Department, $629,000.

   (b) Incurred direct labor costs: Basic Fab Department, $330,000; and Finishing Department, $270,000

   (c) Applied manufacturing overhead cost: Base Fab Department, $665,000; and Finishing Department, $405,000.

   (d) Transferred basic white paint from the Base Fab Department to the Finishing Department, $1,850,000.

   (e) Transferred paint that had been prepared for shipping from the Finishing Department to Finished Goods, $3,200,000.

   Determine the cost of ending work in process inventories and of units transferred out of the Base Fab Department in April. **(35)**

   The following additional information is available regarding production in the Base Fab Department during April:

Production data:	
Units (gallons) in process, April 1: materials 100% complete; labor and overhead 60% complete	30,000
Units (gallons) started into production during April	420,000
Units (gallons) completed and transferred to the Finishing Department	370,000
Units (gallons) in process, April 30: materials 50% complete; labor and overhead 25% complete	80,000
Cost data:	
Work in process inventory, April 1:	
Materials	$ 92,000
Labor	21,000
Overhead	37,000
Total cost of work in process inventory	$ 150,000
Cost added during April:	
Materials	$ 851,000
Labor	330,000
Overhead	665,000
Total cost added during April	$1,846,000

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2. Three grams of musk oil are required for each bottle of Mink Caress, a very popular perfume made by a small company in western Siberia. The cost of the musk oil is 150 roubles per kilogram. Note that the currency of Siberia is the rouble. Budgeted production of Mink Caress is given below by quarters for Year 2 and for the first quarter of Year 3. **(35)**

	Year 2 Quarter				Year 3 Quarter
	First	Second	Third	Fourth	First
Budgeted production, in bottles	60,000	90,000	150,000	100,000	70,000

Musk oil has become so popular as a perfume ingredient that it has become necessary to carry large inventories as a precaution against stock-outs. For this reason, the inventory of musk oil at the end of a quarter must be equal to 20% of the following quarter's production needs. Some 36,000 grams of musk oil will be on hand to start the first quarter of Year 2.

Required: Prepare a direct materials budget for musk oil, by quarter and in total, for Year 2. At the bottom of your budget, show the amount of purchases in roubles for each quarter and for the year in total.

3. (a) Tami Tyler opened Tami's Creations, Inc., a small manufacturing company, at the beginning of the year. Getting the company through its first quarter of operations placed a considerable strain on Ms. Tyler's personal finances. The following income statement for the first quarter was prepared by a friend who has just completed a course in managerial accounting at State University.

TAMI'S CREATIONS, INC.
Income Statement
For the Quarter Ended March 31

Sales (28,000 units)		$1,120,000
Less variable expenses:		
Variable cost of goods sold*	$462,000	
Variable selling and administrative	168,000	630,000
Contribution margin		490,000
Less fixed expenses:		
Fixed manufacturing overhead	300,000	
Fixed selling and administrative	200,000	500,000
Net operating loss		$ (10,000)

*Consists of direct materials, direct labor, and variable manufacturing overhead.

Ms. Tyler is discouraged over the loss shown for the quarter, particularly since she had planned to use the statement as support for a bank loan. Another friend, a CPA, insists that the company should be using absorption costing rather than variable costing, and argues that if absorption costing had been used the company would probably have reported at least some profit for the quarter. At this point, Ms. Tyler is manufacturing only one product, a swimsuit. **(25)**

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Production and cost data relating to the swimsuit for the first quarter follow:

Units produced	30,000
Units sold	28,000
Variable costs per unit:	
Direct materials	$3.50
Direct labor	$12.00
Variable manufacturing overhead	$1.00
Variable selling and administrative	$6.00

Required:

Prepare the company's income statement for the quarter using absorption costing.

(b) Management of Mittel Rhein AG of Köln, Germany, would like to reduce the amount of time between when a customer places an order and when the order is shipped. For the first quarter of operations during the current year the following data were reported:

	Days
Inspection time	0.3
Wait time (from order to start of production)	14.0
Process time	2.7
Move time	1.0
Queue time	5.0

Compute the manufacturing cycle efficiency (MCE) for the quarter. What percentage of the throughput time was spent in non-value-added activities? **(10)**

4. (a) The auto repair shop of Quality Motor Company uses standards to control the labor time and labor cost in the shop. The standard labor cost for a motor tune-up is given below:

Job	Standard Hours	Standard Rate	Standard Cost
Motor tune-up	2.5	$9	$22.50

The record showing the time spent in the shop last week on motor tune-ups has been misplaced. However, the shop supervisor recalls that 50 tune-ups were completed during the week, and the controller recalls the following variance data relating to tune-ups: **(25)**

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Labor rate variance	$87 F
Total labor variance	$93 U

Required:

(i) Determine the number of actual labor-hours spent on tune-ups during the week.

(ii) Determine the actual hourly rate of pay for tune-ups last week.

(b) Provide example for unit-level, batch-level, product-level, customer-level, and organization-sustaining activities in the context of activity-based costing. **(10)**

SECTION – B

Present Value Tables (two) are attached.

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

5. (a) Luzadis Company makes furniture using the latest automated technology. The company uses a job-order costing system and applies manufacturing overhead cost to products on the basis of machine-hours. The predetermined overhead rate was based on a cost formula that estimates $900,000 of total manufacturing overhead for an estimated activity level of 75,000 machine-hours. During the year, a large quantity of furniture on the market resulted in cutting back production and a buildup of furniture in the company's warehouse. The company's cost records revealed the following actual cost and operating data for the year: **(35)**

Machine-hours	60,000
Manufacturing overhead cost	$850,000
Inventories at year-end:	
Raw materials	$30,000
Work in process (includes overhead applied of $36,000)	$100,000
Finished goods (includes overhead applied of $180,000)	$500,000
Cost of goods sold (includes overhead applied of $504,000)	$ 1,400,000

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Required:

(i) Compute the under-applied or over-applied overhead.

(ii) Assume that the company closes any under applied or over applied overhead directly to Cost of Goods Sold. Prepare the appropriate journal entry.

(iii) Assume that the company allocates any under applied or over applied overhead proportionally to Work in Process, Finished Goods and Cost of Goods Sold. Prepare the appropriate journal entry.

(iv) How much higher or lower will net operating income be if the under applied or over applied overhead is allocated to Work in Process, Finished Goods and Cost of Goods sold rather than being closed to Cost of Goods sold?

6. Milano Pizza is a small neighborhood pizzeria that has a small area for in–store dining as well as offering take-out and free home delivery services. The pizzeria's owner has determined that the shop has two major cost drivers-the number of pizzas sold and the number of deliveries made. Data concerning the pizzeria's costs appear below: **(35)**

	Fixed Cost per Month	Cost per Pizza	Cost per Delivery
Pizza ingredients		$3.80	
Kitchen staff	$5,220		
Utilities	$630	$0.05	
Delivery person			$3.50
Delivery vehicle	$540		$1.50
Equipment depreciation	$275		
Rent	$1,830		
Miscellaneous	$820	$0.15	

In November, the pizzeria budgeted for 1,200 pizzas at an average selling price of $13.50 per pizza and for 180 deliveries.

Data concerning the pizzeria's operations in November appear below:

	Actual Results
Pizzas	1,240
Deliveries	174
Revenue	$17,420
Pizza ingredients	$4,985
Kitchen staff	$5,281
Utilities	$984
Delivery person	$609
Delivery vehicle	$655
Equipment depreciation	$275
Rent	$1,830
Miscellaneous	$954

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Contd...Q.No. 6

Required:

(i) Prepare a flexible budget performance report that shows both activity variances and revenue and spending variances for the pizzeria for November.

(ii) Explain the activity variances.

7. (a) Commercial Services.Com Corporation provides business-to-business services on the Internet. Data concerning the most recent year appear below: **(18)**

Sales	$3,000,000
Net operating income	$150,000
Average operating assets	$750,000

Required:

Consider each question below independently. Carry out all computations to two decimal places.

(i) Compute the company's return on investment (ROI).

(ii) The entrepreneur who founded the company is convinced that sales will increase next year by 50% and that net operating income will increase by 200%, with no increase in average operating assets. What would be the company's ROI?

(iii) The chief financial officer of the company believes a more realistic scenario would be a $1,000,000 increase in sales, requiring a $250,000 increase in average operating assets, with a resulting $200,000 increase in net operating income. What would be the company's ROI in this scenario?

(b) Glade Company produces a single product. The costs of producing and selling a single unit of this product at the company's current activity level of 8,000 units per month are: **(17)**

Direct materials	$2.50
Direct labor	$3.00
Variable manufacturing overhead	$0.50
Fixed manufacturing overhead	$4.25
Variable selling and administrative expenses	$1.50
Fixed selling and administrative expenses	$2.00

The normal selling price is $15 per unit. The company's capacity is 10,000 units per month. An order has been received a potential customer overseas for 2,000 units at a price of $12.00 per unit. This order would not affect regular sales.

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Contd...Q.No. 7(b)

Required:

(i) If the order is accepted, by how much will monthly profits increase or decrease? (The order would not change the company's total fixed costs.)

(ii) Assume the company has 500 units of this product left over from last year that are inferior to the current model. The units must be sold through regular channels at reduced prices. What unit cost is relevant for establishing a minimum selling price for these units? Explain.

8. Tiger Computers, Inc., of Singapore is considering the purchase of an automated etching machine for use in the production of its circuit boards. The machine would cost $900,000. (All currency amounts are in Singapore dollars.) An additional $650,000 would be required for installation costs and for software. Management believes that the automated machine would provide substantial annual reductions in cost, as shown below: **(35)**

	Annual Reduction in Costs
Labor costs.....	$240,000
Material costs.....	$96,000

The new machine would require considerable maintenance work to keep it in proper adjustment. The company's engineers estimate that maintenance costs would increase by $4,250 per month if the machine were purchased. In addition, the machine would require a $90,000 overhaul at the end of the sixth year.

The new etching machine would be usable for 10 years; after which it would be sold for its scrap value of $210,000. It would replace an old etching machine that can be sold now for its scrap value of $70,000. Tiger Computers, Inc., requires a return of at least 18% on investments of this type.

Required:

(Ignore income taxes)

(i) Compute the net annual cost savings promised by the new etching machine.

(ii) Using the data from (1) above and other data from the problem, compute the new machine's net present value. (Use the incremental-cost approach.) Would you recommend that the machine be purchased? Explain.

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Contd...Q.No. 8

(iii) Assume that management can identify several intangible benefits associated with the new machine, including greater flexibility in shifting from one type of circuit board to another, improved quality of output, and faster delivery as a result of reduced throughput time. What dollar value per year would management have to attach to these intangible benefits in order to make the new etching machine an acceptable investment?

Table - 1

Appendix 14B: Present Value Tables

EXHIBIT 14B-1

Present Value of $1; $\frac{1}{(1+r)^n}$

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820	0.813	0.806	0.800
2	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694	0.683	0.672	0.661	0.650	0.640
3	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579	0.564	0.551	0.537	0.524	0.512
4	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482	0.467	0.451	0.437	0.423	0.410
5	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402	0.386	0.370	0.355	0.341	0.328
6	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335	0.319	0.303	0.289	0.275	0.262
7	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279	0.263	0.249	0.235	0.222	0.210
8	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233	0.218	0.204	0.191	0.179	0.168
9	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194	0.180	0.167	0.155	0.144	0.134
10	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162	0.149	0.137	0.126	0.116	0.107
11	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135	0.123	0.112	0.103	0.094	0.086
12	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112	0.102	0.092	0.083	0.076	0.069
13	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093	0.084	0.075	0.068	0.061	0.055
14	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078	0.069	0.062	0.055	0.049	0.044
15	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065	0.057	0.051	0.045	0.040	0.035
16	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054	0.047	0.042	0.036	0.032	0.028
17	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045	0.039	0.034	0.030	0.026	0.023
18	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038	0.032	0.028	0.024	0.021	0.018
19	0.475	0.396	0.331	0.277	0.232	0.194	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031	0.027	0.023	0.020	0.017	0.014
20	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026	0.022	0.019	0.016	0.014	0.012
21	0.439	0.359	0.294	0.242	0.199	0.164	0.135	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.026	0.022	0.018	0.015	0.013	0.011	0.009
22	0.422	0.342	0.278	0.226	0.184	0.150	0.123	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.022	0.018	0.015	0.013	0.011	0.009	0.007
23	0.406	0.326	0.262	0.211	0.170	0.138	0.112	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.018	0.015	0.012	0.010	0.009	0.007	0.006
24	0.390	0.310	0.247	0.197	0.158	0.126	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013	0.010	0.008	0.007	0.006	0.005
25	0.375	0.295	0.233	0.184	0.146	0.116	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010	0.009	0.007	0.006	0.005	0.004
26	0.361	0.281	0.220	0.172	0.135	0.106	0.084	0.066	0.053	0.042	0.033	0.026	0.021	0.017	0.014	0.011	0.009	0.007	0.006	0.005	0.004	0.003
27	0.347	0.268	0.207	0.161	0.125	0.098	0.076	0.060	0.047	0.037	0.029	0.023	0.018	0.014	0.011	0.009	0.007	0.006	0.005	0.004	0.003	0.002
28	0.333	0.255	0.196	0.150	0.116	0.090	0.069	0.054	0.042	0.033	0.026	0.020	0.016	0.012	0.010	0.008	0.006	0.005	0.004	0.003	0.002	0.002
29	0.321	0.243	0.185	0.141	0.107	0.082	0.063	0.048	0.037	0.029	0.022	0.017	0.014	0.011	0.008	0.006	0.005	0.004	0.003	0.002	0.002	0.002
30	0.308	0.231	0.174	0.131	0.099	0.075	0.057	0.044	0.033	0.026	0.020	0.015	0.012	0.009	0.007	0.005	0.004	0.003	0.003	0.002	0.002	0.001
40	0.208	0.142	0.097	0.067	0.046	0.032	0.022	0.015	0.011	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000

Table - 2

EXHIBIT 14B-2

Present Value of an Annuity of $1 in Arrears; $\frac{1}{r}\left[1 - \frac{1}{(1+r)^n}\right]$

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820	0.813	0.806	0.800
2	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	1.509	1.492	1.474	1.457	1.440
3	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	2.074	2.042	2.011	1.981	1.952
4	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	2.540	2.494	2.448	2.404	2.362
5	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	2.926	2.864	2.803	2.745	2.689
6	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	3.245	3.167	3.092	3.020	2.951
7	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	3.508	3.416	3.327	3.242	3.161
8	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	3.726	3.619	3.518	3.421	3.329
9	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	3.905	3.786	3.673	3.566	3.463
10	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192	4.054	3.923	3.799	3.682	3.571
11	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	4.177	4.035	3.902	3.776	3.656
12	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	4.278	4.127	3.985	3.851	3.725
13	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	4.362	4.203	4.053	3.912	3.780
14	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	4.432	4.265	4.108	3.962	3.824
15	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	4.489	4.315	4.153	4.001	3.859
16	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730	4.536	4.357	4.189	4.033	3.887
17	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775	4.576	4.391	4.219	4.059	3.910
18	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812	4.608	4.419	4.243	4.080	3.928
19	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843	4.635	4.442	4.263	4.097	3.942
20	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870	4.657	4.460	4.279	4.110	3.954
21	14.029	12.821	11.764	10.836	10.017	9.292	8.649	8.075	7.562	7.102	6.687	6.312	5.973	5.665	5.384	5.127	4.891	4.675	4.476	4.292	4.121	3.963
22	14.451	13.163	12.042	11.061	10.201	9.442	8.772	8.176	7.645	7.170	6.743	6.359	6.011	5.696	5.410	5.149	4.909	4.690	4.488	4.302	4.130	3.970
23	14.857	13.489	12.303	11.272	10.371	9.580	8.883	8.266	7.718	7.230	6.792	6.399	6.044	5.723	5.432	5.167	4.925	4.703	4.499	4.311	4.137	3.976
24	15.247	13.799	12.550	11.469	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937	4.713	4.507	4.318	4.143	3.981
25	15.622	14.094	12.783	11.654	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948	4.721	4.514	4.323	4.147	3.985
26	15.983	14.375	13.003	11.826	10.810	9.929	9.161	8.488	7.896	7.372	6.906	6.491	6.118	5.783	5.480	5.206	4.956	4.728	4.520	4.328	4.151	3.988
27	16.330	14.643	13.211	11.987	10.935	10.027	9.237	8.548	7.943	7.409	6.935	6.514	6.136	5.798	5.492	5.215	4.964	4.734	4.524	4.332	4.154	3.990
28	16.663	14.898	13.406	12.137	11.051	10.116	9.307	8.602	7.984	7.441	6.961	6.534	6.152	5.810	5.502	5.223	4.970	4.739	4.528	4.335	4.157	3.992
29	16.984	15.141	13.591	12.278	11.158	10.198	9.370	8.650	8.022	7.470	6.983	6.551	6.166	5.820	5.510	5.229	4.975	4.743	4.531	4.337	4.159	3.994
30	17.292	15.372	13.765	12.409	11.258	10.274	9.427	8.694	8.055	7.496	7.003	6.566	6.177	5.829	5.517	5.235	4.979	4.746	4.534	4.339	4.160	3.995
40	19.793	17.159	15.046	13.332	11.925	10.757	9.779	8.951	8.244	7.634	7.105	6.642	6.233	5.871	5.548	5.258	4.997	4.760	4.544	4.347	4.166	3.999

L-1/T-1/IPE **Date : 28/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **HUM 211** (Sociology)

Full Marks : 140 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**.

1. (a) Define industrialization and deindustrialization. Write down the important characteristics of capitalism. (13 ⅓)

   (b) Illustrate the positive and negative impacts of capitalism on a society. (10)

2. (a) What do you mean by natural green-house and man-made green house? How can we save the environment and make it greener? (13 ⅓)

   (b) Discuss the negative impacts of global warming. (10)

3. (a) Briefly discuss the concept of social change, and mention the main causes of social change. (10)

   (b) Write down the different sources of social change. (13 ⅓)

4. Write short notes on any THREE of the following: (23 ⅓)

   (a) Social consequences of Industrial Revolution

   (b) Refuse, reduce, reuse and recycle (4Rs)

   (c) Growth of cities

   (d) Blue economy

SECTION – B

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

5. (a) What do you understand by value neutrality? How can we maintain value neutral position by using sociological imagination? (10)

   (b) Discuss the functionalist theoretical perspective of sociology. (13 ⅓)

Contd P/2

HUM 211/IPE

6. (a) What do you understand by social inequality? Explain the nature of caste system and class system of social stratification. (10)

   (b) Briefly discuss different types of social mobility with examples. (13 ⅓)

7. (a) Briefly explain G. Herbert Mead's theory of socialization. (10)

   (b) How does socialization shape human behaviour? Write your answer highlighting the roles of different agents of socialization. (13 ⅓)

8. Write short notes on any THREE of the following: (23 ⅓)

   (a) Social norms and social values.

   (b) Ethnocentrism and cultural relativism.

   (c) Sub-culture and counter culture.

   (d) Anticipatory socialization and re-socialization.

L-1/T-1/IPE **Date: 19/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **PHY 117** (Structure of Matter, Electricity, Magnetism & Modern Physics)

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.

1. (a) What is primitive cell? How can you draw the Winger-Seitz primitive cell? Explain with suitable diagram how much portion of face-centered cubic (fcc) structure is occupied by atoms? **(15)**

   (b) Describe NaCl crystal structure with necessary diagram and explain the reason for calling it a fcc structure. **(10)**

   (c) For the simple cubic lattice, if the spacing of lattice planes (212) is 0.68Å, calculate the atomic radius. **(10)**

2. (a) Explain how can you define a crystal plane. Find the relation between Miller indices (hkl) and inter-planer distance (d_{hkl}) for a cubic crystal system. **(15)**

   (b) Derive Bragg's law in X-ray diffraction. Why normal light cannot be used to analyse crystal structure. **(10)**

   (c) X-rays with a wavelength of 1.54 Å are used to calculate the spacing of (200) plane in platinum. The Bragg angle for this reflection is 22.4°. What is the side of the unit cell of the platinum crystal? **(10)**

3. (a) Explain the formation of different energy bands in a solid and hence distinguish between diamond, germanium and sodium crystals. **(13)**

   (b) What is an intrinsic semiconductor? Explain with the help of a diagram how can you convert an intrinsic semiconductor into an n-type or p-type extrinsic semiconductor. **(10)**

   (c) Explain the following: **(12)**

   i) Co-ordination number

   ii) Ionic bond in solids

   iii) Schottky defect.

Contd P/2

PHY 117

4. (a) State and explain Gauss's law. Derive Coulomb's law from Gauss' law. **(10)**

(b) Consider a section of infinitely long cylindrical plastic rod with a uniformly distributed positive charge and the charge per unit length of the rod is λ. Derive the expression of electric field E at a distance r from the charged rod. **(15)**

(c) A nonuniform electric field given by $\overline{E} = 6.0\,x\hat{i} + 5.0\,\hat{j}$ pierces the Gaussian cube shown in Fig. for Q. No. 4(c). (E is in Newtons per coulomb and x is in meters.) What is the electric flux through the right face, the left face, and the top face? **(10)**

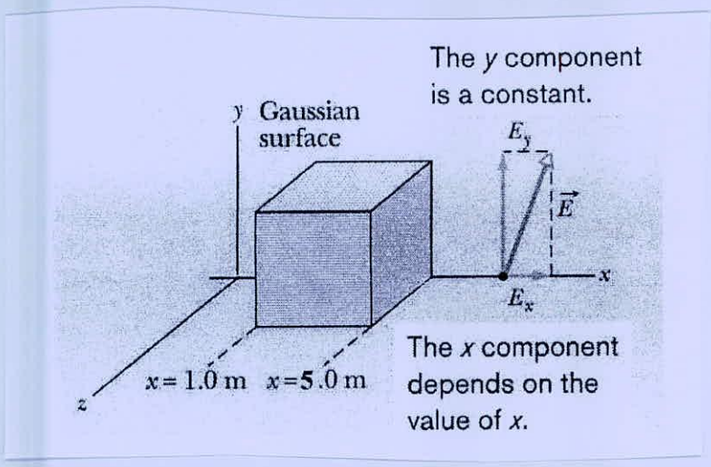

Fig. for Q. No. 4(c).

SECTION – B

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

5. (a) Explain quantization of charges. **(5)**

(b) Consider a thin ring of radius, R, with a uniform positive linear charge density, λ, around its circumference. Imagine the ring to be made of plastic or some other insulator, so that the charges can be regarded as fixed in place. Derive the equation for the electric field at point, P, a distance z from the plane of the ring along its central axis. Explain the condition when (i) the charge on the ring is negative, instead of positive as we have assumed, (ii) z>>R, and (iii) z = 0 and R is finite, respectively. **(20)**

PHY 117

Contd... Q. No. 5

(c) Figure for Q. No. 5 (c) shows a plastic rod having a uniformly distributed charge -Q. The rod has been bent in a 120° circular arc of radius r. The coordinate axes are such that the axis of symmetry of the rod lies along the x axis and the origin is at the center of curvature P of the rod. Find the electric field due to the rod at point P in terms of Q and r. **(10)**

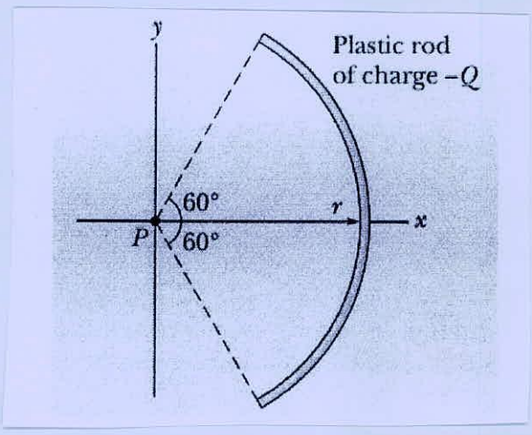

Fig. for Q. No. 5(c).

6. (a) State and explain Kirchhoff's current law and Kirchhoff's voltage law with proper diagram. **(7)**

(b) Consider an RC series circuit consisting of the capacitor C, an ideal battery of emf E, and a resistance R. Solve the first order differential equation that relates the rate of change of charge to the charge on the capacitor to derive the equations charge $q(t)$ and potential difference $V_C(t)$ across the capacitor during the charging process. What is time constant? **(18)**

(c) Based on the figure for Q. No. 6(c) shown in below, explain the action of the magnetic force on a current carrying wire. Hence show that the magnitude of the magnetic force F_B is given by $F_B = iLB \sin\phi$, the terms have their usual meaning. **(10)**

PHY 117

Contd... Q. No. 6(c)

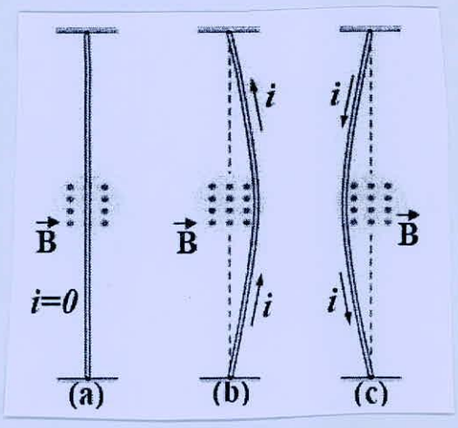

Fig. for Q. No. 6(c).

7. (a) What are the failures of the wave theory of light to explain the photoelectric effect? **(7)**

(b) Show that the change in wavelength of a photon during Compton scattering is proportional to $\sin^2\frac{\theta}{2}$. **(18)**

(c) A photon of 2 MeV collides with a free and stationary electron. The recoil electron scatters off at 90°. Calculate the energy of the scattered photon and kinetic energy of the recoil electron. **(10)**

8. (a) Write a short note on the magic number for nucleons. **(7)**

(b) Derive an expression for the semi-empirical mass formula with volume energy, surface energy, and Coulomb energy. **(18)**

(c) In a nuclear reactor, the energy released per fission of $_{92}U^{235}$ is 210 MeV. Assume that the mass of an atom is equal to the sum of masses of nucleons, the mass of a proton and a neutron are 1.673×10^{-27} kg and 1.675×10^{-27} kg, respectively. If the reactor operates at a power level of 500 MW, calculate the rate of consumption of $_{92}U^{235}$ per year. **(10)**

L-I/T-I/IPE **Date : 25/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-I/T-I B. Sc. Engineering Examinations 2020-2021

Sub : **CHEM 119** (Chemistry-I)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonable values for missing data, if any. Symbols carry their usual meanings.

SECTION – A

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

1. (a) Draw Lewis structure and predict the geometry of the following compounds using VSEPR model: ClF_3, XeF_2, IF_5 **(9)**

   (b) In molecular orbitals diagram, the energy of $\pi 2p$ orbital is lower than that of $\sigma 2p$ for B_2, C_2, and N_2. For O_2 and F_2 the energy of $\sigma 2p$ orbital is lower than the $\pi 2p$. Why does this happen? Explain with molecular orbital diagrams. **(20)**

   (c) What is the orbital hybridization of a central atom that has one lone pair and bonds to: (i) three other atoms; (ii) four other atoms; (iii) five other atoms? **(6)**

2. (a) Draw the orbital energy levels in a single electron system (like H) and that in a multi-electron system. Why is the orbital energy levels pattern different in these two systems? Discuss briefly. **(15)**

   (b) The work function of potassium is 3.68×10^{-19} J. (i) What is the minimum frequency of light needed to eject electrons from the metal? (ii) Calculate the kinetic energy of the ejected electrons when light of frequency equal to 8.62×10^{14} s^{-1} is used for irradiation. **(12)**

   (c) How does de Broglie's hypothesis account for the fact that the energies of the electron in a hydrogen atom are quantized? **(8)**

3. (a) State periodic law. Explain general trend in electron affinities in any period of the main group element. **(15)**

   (b) Within any period, values of first ionization energy tend to increase with atomic number, except for small drops at the group IIIA and VIA elements. Explain. **(10)**

   (c) A metallic element, M, reacts vigorously with water to form a solution of MOH. If M is in Period 4, what is the name of this metal? Write down ground state electronic configuration of this atom? **(4)**

   (d) For each of the following pairs, indicate which one of the two species is larger: (i) N^{3-} or F^-; (ii) Mg^{2+} or Ca^{2+}; (c) Fe^{2+} or Fe^{3+}. **(6)**

Contd P/2

CHEM 119

4. (a) Explain with molecular orbital diagram: why the bond order of N_2 is greater than that of N_2^+, but the bond order of O_2 is less than that of O_2^+. **(15)**

   (b) Calculate the wavelength of the "particle" in the following two cases: (i) The fastest serve in tennis is about 150 miles per hour, or 68 m/s. Calculate the wavelength associated with a 6.0×10^{-2} kg tennis ball traveling at this speed. (ii) Calculate the wavelength associated with an electron (9.1094×10^{-31} kg) moving at 68 m/s. **(10)**

   (c) Using Valence Bond Theory, show and discuss the formation of SF_6 molecule. **(10)**

SECTION – B

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

5. (a) What are meant by hydrogen ion and hydroxyl ion exponents? Derive mathematically the relationship between the exponents that hold for all the dilute solutions at 25°C. **(7+8=15)**

   (b) Water can act either as a weak acid or a weak base - give reasons. The copper etching solutions were prepared by diluting a concentrated HNO_3 to 2.0 M and 0.30 M HNO_3. Calculate $[H_3O^+]$ and pOH of the solutions at 25°C. **(10+10=20)**

6. (a) What is Ringer solution and state how it helps to recover health due to dehydration. Describe an electrical approach to distinguish between the electrolytic and non-electrolytic body fluids. **(7+8=15)**

   (b) Illustrate a solubility curve and explain its continuous and inverted regions. Using the concept of solubility curve, explain how NaCl can be separated from its mixture with other salts for industrial purposes. **(10+10=20)**

7. (a) State and explain the 3rd form of Henry's law. Prove that the volume of a gas dissolved in a given volume of solvent at a constant temperature is independent of pressure. **(7+8=15)**

   (b) What is the driving force behind osmosis? Explain the mechanism of preserving food using osmotic phenomenon. What concentration of sodium chloride is needed to produce an aqueous solution isotonic with blood (osmotic pressure, $\Pi = 7.70$ atm at 25°C). **(10+10=20)**

8. (a) Distinguish between primary cell and rechargeable cell. Sketch and describe each components of a H_2/O_2 fuel cell. **(7+8=15)**

   (b) How steel bumper of an automobile can be electroplated with chromium? The discharge reaction for a lithium-ion disulfide battery can be represented as:

   $$FeS_2\ (s) + 4Li\ (s) \rightarrow Fe\ (s) + 2Li_2S\ (s)$$

   Calculate the quantity of charge (in coulombs) that can be provided by a fully charged 1.5 V lithium-ion disulfide battery, if the mass of Li in the battery is 0.453 g (molar mass of Li is 6.941 g). **(10+10=20)**

L-1/T-1/IPE **Date: 16/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **MATH 191** (Differential and Integral Calculus)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Discuss the continuity and differentiability of the function **(20⅔)**

$$f(x)=\begin{cases}5x-4, & 0<x\le 1\\ 4x^2-3x, & 1<x\le 2\\ 3x+4, & x>2\end{cases}$$ at the point $x=2$

Also, sketch the graph of the function and interpret.

(b) Evaluate: $\lim\limits_{x\to 0}\left[\dfrac{2(\cosh x-1)}{x^2}\right]^{1/x^2}$. **(12)**

(c) Find the nth derivative of $y=\sin^5 x\cos^4 x$. **(14)**

2. (a) State Leibnitz's theorem. If $y=x\cos(\ln x)$, then find **(20⅔)**

$$x^2y_{n+2}+(2n-1)xy_{n+1}+(n^2-2n+2)y_n$$

(b) Verify Cauchy's mean value theorem for the functions $f(x)=x^2-2x+3$ and $g(x)=x^3-7x^2+26x-5$ in the interval [–1, 1]. **(14)**

(c) Expand $2x^3+7x^2+x-1$ in powers of $(x-2)$. **(12)**

3. (a) Find the maximum and minimum values of the function $f(x)=4^x-8x\ln 2$. Also, discuss the concavity and find the point of inflection. **(20⅔)**

(b) Owners of a car rental company have determined that if they charge customers p dollars per day to rent a car, where $50\le p\le 200$, the number of cars n they rent per day can be modeled by the linear function $n(p)=1000-5p$. If they charge \$50 per day or less, they will rent all their cars. If they charge \$200 per day or more, they will not rent any car. Assuming the owners plan to charge customers between \$50 per day and \$200 per day to rent a car, how much should they charge to maximize their revenue? **(12)**

(c) State Euler's theorem of homogeneous functions. If $u=\tan^{-1}\left[(x^3+y^3)/(x+y)\right]$, show that $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}=\sin 2u$. **(14)**

Contd P/2

4. (a) Find the pedal equation of the parabola $y^2 = 4ax$ with respect to its focus. **(20⅔)**

(b) Find the radius of curvature of the cardioid $r = a(1+\cos\theta)$ at any point (r, θ)). **(12)**

(c) Find all the asymptotes of the curve $x^3 - 2x^2y + xy^2 + x^2 - xy + 2 = 0$. **(14)**

SECTION – B

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

5. Workout the following integrals:

(a) $\int \frac{dx}{(1+x)\sqrt{(1+x-x^2)}}$. **(16)**

(b) $\int \frac{dx}{13+3\cos x+4\sin x}$. **(15)**

(c) $\int \frac{x^2+x+1}{\sqrt{x^2+2x+3}}\,dx$. **(15⅔)**

6. (a) Obtain a reduction formula for $\int \cos^m x \cos nx\,dx$ and hence find $\int \cos^4 x \cos 3x\,dx$. **(16⅔)**

(b) Evaluate $\int_{\alpha}^{\beta} \sqrt{(x-\alpha)(x-\beta)}\,dx$. **(15)**

(c) Evaluate $\int_0^1 \frac{\log(1+x)}{1+x^2}\,dx$. **(15)**

7. (a) Show that $\int_0^{\infty} \frac{x^2\,dx}{(x^2+a^2)(x^2+b^2)} = \frac{\pi}{2(a+b)}$ $[a, b > 0]$. **(16)**

(b) Show that $\Gamma\left(n+\frac{1}{2}\right) = \frac{\Gamma(2n+1)\sqrt{\pi}}{2^{2n}\Gamma(n+1)}$. **(15)**

(c) Find the area of the loop of the curve $y^2 = x^2(x+a)$. **(15⅔)**

8. (a) Transform into polar coordinates and hence find the area included between the folium of Descartes $x^3 + y^3 = 3axy$ and its asymptote. **(16⅔)**

(b) Find the perimeter of the loop of the curve $9ay^2 = (x-5a)^2(x-2a)$. **(15)**

(c) Find the volume of the solid generated by revolution of one arc of the cycloid $x = a(\theta - \sin\theta)$; $y = a(1-\cos\theta)$ about its base. **(15)**
