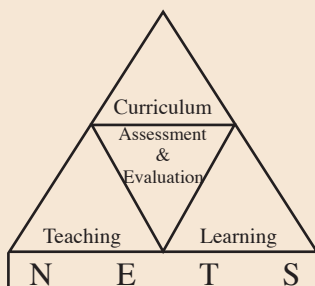




G.C.E.(O.L.) Examination - 2012

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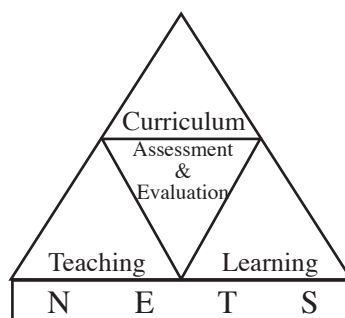


**Research & Development Branch
National Evaluation & Testing Service
Department of Examinations**

G.C.E.(O.L.) Examination - 2012

Evaluation Report

34 - Science



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Department of Examinations**

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Science

Evaluation Report - G.C.E.(O.L.) Examination - 2012

Financial Aid

Transforming the School Education System as the Foundation
of a Knowledge Hub Project (TSEP-WB)

INTRODUCTION

Out of all public examinations in Sri Lanka the largest number of candidates sit the G.C.E.(O.L.) Examination. The certificate received on the results of this examination which is conducted at national level, is used not only to select those who are eligible for higher education but also to secure medium level jobs and it is a basic requirement to follow certain courses of study in International Universities. It is thus accepted due to its validity and reliability as well as its high quality.

Students strive hard to acquire a high achievement level at this examination while their teachers as well as their parents work hard to fulfil the students' expectations. By preparing this Evaluation Report, the Department of Examinations intends to help students in achieving their goals. It is certain that the information included in this Evaluation Report will be equally useful to candidates, teachers, principals, subject directors, in-service advisors, parents and researchers on education.

This evaluation report prepared by the Research and Development Branch is based on the information, observations, ideas and suggestions provided by Chief Examiners, Additional Chief Examiners and Assistant Examiners involved in evaluation of answer scripts and the information drawn through the analyses of candidates' responses using the Classical Test Theory and the Item Response Theory.

This Evaluation Report consists of three parts, I, II and III. Part I contains the objectives of the subject and information on subject achievement. Part II contains expected answers for Paper I and Paper II, the marking scheme and the observations regarding answering questions and suggestions for further improvement. In Part III the factors to be considered by the candidate and suggestions for improvement regarding the learning - teaching process are highlighted. This part will be very useful to organize the learning - teaching process for the students to acquire various competencies and competency levels.

I would like to invite comments and suggestions to improve the quality of this report. I wish to extend my sincere thanks to the Controlling Examiners and other resource personnel for their dedication and contribution in the preparation of this report, and also the Chief / Additional Chief / Assistant Examiners for providing information, while appreciating the commitment of the staff members of the Department of Examinations to make this whole process a success.

W.M.N.J. Pushpakumara
Commissioner General of Examinations

11th November 2013
Research & Development Branch
National Evaluation & Testing Service
Department of Examinations.
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Part I

1. Subject objectives and information on subject achievements

1.1 Subject objectives

After following this course the student will,

- * construct scientific concepts and principles systematically through a joyful learning environment;
- * develop competencies required to solve problems adopting the processes of science and the scientific method appropriately;
- * develop competencies required to manage environmental resources wisely realizing their potentials;
- * develop competencies relevant to the application of scientific knowledge for a healthy life style physically and mentally;
- * develop competencies essential to live communally as a successful citizen who can contribute to country's development and for further education and future employment;
- * develop competencies essential to understand natural phenomena and the scientific foundation of the universe;
- * be keen in using the fitting technology to develop productivity and efficiency to an optimal level when using force and energy; and
- * identify the dynamic nature and limits of science and develop skills for evaluating on scientific criteria the day to day experiences and information communicated by various media.

1.2 Statistical Information on subject achievement

1.2.1 Number of candidates sat for the subject

Medium	School	Private	Total
Sinhala	225417	6064	231481
Tamil	62730	11786	74516
English	9434	3155	12589
Total	297581	21005	318586

Table 1

1.2.2 Grades obtained by the candidates

Grade	School Candidates		Private Candidates		Total	Percentage
	Number	Percentage	Number	Percentage		
A	23526	7.91	577	2.75	24103	7.57
B	25205	8.47	965	4.59	26170	8.21
C	51633	17.35	2310	11.00	53943	16.93
S	96998	32.60	7123	33.91	104121	32.68
W	100219	33.67	10030	47.75	110249	34.61
Total	297581	100.00	21005	100.00	318586	100.00

Table 2

1.2.3 Grades obtained by school candidates who sat the examination for the first time - District wise

District	No. Sat	Distinction (A)		Very Good Pass (B)		Credit Pass (C)		Ordinary pass (S)		Pass (A+B+C+S)		Weak (W)	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1. Colombo	30460	5118	16.80	3926	12.89	6289	20.65	8229	27.02	23562	77.35	6898	22.65
2. Gampaha	25673	2424	9.44	2622	10.21	4997	19.46	7903	30.78	17946	69.90	7727	30.10
3. Kalutara	14625	1417	9.69	1625	11.11	2884	19.72	4427	30.27	10353	70.79	4272	29.21
4. Kandy	19263	1778	9.23	1861	9.66	3558	18.47	5870	30.47	13067	67.83	6196	32.17
5. Matale	6416	371	5.78	468	7.29	1185	18.47	2144	33.42	4168	64.96	2248	35.04
6. Nuwara Eliya	9146	405	4.43	530	5.79	1276	13.95	2967	32.44	5178	56.61	3968	43.39
7. Galle	15027	1710	11.38	1556	10.35	2952	19.64	4588	30.53	10806	71.91	4221	28.09
8. Matara	11323	1199	10.59	1210	10.69	2322	20.51	3514	31.03	8245	72.82	3078	27.18
9. Hambantota	8718	712	8.17	922	10.58	1928	22.12	2772	31.80	6334	72.65	2384	27.35
10. Jaffna	8466	615	7.26	660	7.80	1280	15.12	2619	30.94	5174	61.12	3292	38.88
11. Kilinochchi	1698	37	2.18	52	3.06	178	10.48	447	26.33	714	42.05	984	57.95
12. Mannar	1480	46	3.11	68	4.59	187	12.64	589	39.80	890	60.14	590	39.86
13. Vavuniya	2662	152	5.71	162	6.09	430	16.15	856	32.16	1600	60.11	1062	39.89
14. Mullativu	1405	24	1.71	43	3.06	136	9.68	374	26.62	577	41.07	828	58.93
15. Batticaloa	6630	479	7.22	537	8.10	1170	17.65	2111	31.84	4297	64.81	2333	35.19
16. Ampara	8103	580	7.16	735	9.07	1583	19.54	2900	35.79	5798	71.55	2305	28.45
17. Trincomalee	5948	317	5.33	480	8.07	1052	17.69	2009	33.78	3858	64.86	2090	35.14
18. Kurunegala	21480	1559	7.26	1955	9.10	4309	20.06	7151	33.29	14974	69.71	6506	30.29
19. Puttalam	9404	592	6.30	657	6.99	1535	16.32	3181	33.83	5965	63.43	3439	36.57
20. Anuradhapura	11686	693	5.93	936	8.01	2130	18.23	3764	32.21	7523	64.38	4163	35.62
21. Polonnaruwa	5052	243	4.81	372	7.36	912	18.05	1661	32.88	3188	63.10	1864	36.90
22. Badulla	12454	738	5.93	983	7.89	2176	17.47	4252	34.14	8149	65.43	4305	34.57
23. Monaragala	6515	326	5.00	408	6.26	1141	17.51	2115	32.46	3990	61.24	2525	38.76
24. Ratnapura	14135	1152	8.15	1281	9.06	2423	17.14	4555	32.22	9411	66.58	4724	33.42
25. Kegalle	10811	803	7.43	1007	9.31	2173	20.10	3577	33.09	7560	69.93	3251	30.07
All Island	268580	23490	8.75	25056	9.33	50206	18.69	84575	31.49	183327	68.26	85253	31.74

Table 3

1.2.4 Grades obtained by school candidates who sat the examination for the first time - Zone wise

Educational Zone	No. Sat	Distinction (A)		Very Good Pass (B)		Credit Pass (C)		Ordinary pass (S)		Pass (A+B+C+S)		Weak (W)	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1. Colombo	14256	3547	24.88	2111	14.81	2779	19.49	3032	21.27	11469	80.45	2787	19.55
2. Homagama	3564	191	5.36	269	7.55	648	18.18	1211	33.98	2319	65.07	1245	34.93
3. Jayawardanapura	6890	767	11.13	850	12.34	1614	23.43	2200	31.93	5431	78.82	1459	21.18
4. Piliyandala	5750	613	10.66	696	12.10	1248	21.70	1786	31.06	4343	75.53	1407	24.47
5. Gampaha	7391	1108	14.99	934	12.64	1457	19.71	2091	28.29	5590	75.63	1801	24.37
6. Minuwangoda	4876	290	5.95	416	8.53	859	17.62	1562	32.03	3127	64.13	1749	35.87
7. Negombo	6785	597	8.80	646	9.52	1280	18.87	2119	31.23	4642	68.42	2143	31.58
8. Kelaniya	6621	429	6.48	626	9.45	1401	21.16	2131	32.19	4587	69.28	2034	30.72
9. Kalutara	7130	664	9.31	788	11.05	1447	20.29	2201	30.87	5100	71.53	2030	28.47
10. Matugama	3029	326	10.76	358	11.82	571	18.85	913	30.14	2168	71.57	861	28.43
11. Horana	4466	427	9.56	479	10.73	866	19.39	1313	29.40	3085	69.08	1381	30.92
12. Kandy	6995	1323	18.91	1082	15.47	1521	21.74	1742	24.90	5668	81.03	1327	18.97
13. Denuwara	2026	62	3.06	138	6.81	311	15.35	729	35.98	1240	61.20	786	38.80
14. Gampola	3359	144	4.29	186	5.54	522	15.54	1063	31.65	1915	57.01	1444	42.99
15. Teldeniya	1634	58	3.55	99	6.06	264	16.16	530	32.44	951	58.20	683	41.80
16. Wattagama	2315	90	3.89	162	7.00	404	17.45	798	34.47	1454	62.81	861	37.19
17. Katugastota	2934	101	3.44	194	6.61	536	18.27	1008	34.36	1839	62.68	1095	37.32
18. Matale	3425	307	8.96	326	9.52	704	20.55	1105	32.26	2442	71.30	983	28.70
19. Galewela	2016	43	2.13	93	4.61	348	17.26	712	35.32	1196	59.33	820	40.67
20. Naula	466	10	2.15	28	6.01	68	14.59	178	38.20	284	60.94	182	39.06
21. Wilgamuwa	509	11	2.16	21	4.13	65	12.77	149	29.27	246	48.33	263	51.67
22. Nuwara Eliya	2496	47	1.88	89	3.57	305	12.22	875	35.06	1316	52.72	1180	47.28
23. Kotmale	1240	60	4.84	86	6.94	179	14.44	393	31.69	718	57.90	522	42.10
24. Hatton	2578	132	5.12	152	5.90	367	14.24	799	30.99	1450	56.25	1128	43.75
25. Walapane	1282	54	4.21	70	5.46	169	13.18	429	33.46	722	56.32	560	43.68
26. Hanguranketha	1550	112	7.23	133	8.58	256	16.52	471	30.39	972	62.71	578	37.29
27. Galle	6824	1003	14.70	823	12.06	1432	20.98	1878	27.52	5136	75.26	1688	24.74
28. Elpitiya	3072	223	7.26	280	9.11	599	19.50	1046	34.05	2148	69.92	924	30.08
29. Ambalangoda	3413	413	12.10	340	9.96	613	17.96	1042	30.53	2408	70.55	1005	29.45
30. Udugama	1718	71	4.13	113	6.58	308	17.93	622	36.20	1114	64.84	604	35.16
31. Matara	4999	837	16.74	655	13.10	1030	20.60	1389	27.79	3911	78.24	1088	21.76
32. Akuressa	1993	173	8.68	203	10.19	404	20.27	653	32.76	1433	71.90	560	28.10
33. Mulatiyana	2097	87	4.15	194	9.25	468	22.32	722	34.43	1471	70.15	626	29.85
34. Morawaka	2234	102	4.57	158	7.07	420	18.80	750	33.57	1430	64.01	804	35.99

Educational Zone	No. Sat	Distinction (A)		Very Good Pass (B)		Credit Pass (C)		Ordinary pass (S)		Pass (A+B+C+S)		Weak (W)	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
35. Tangalle	2439	184	7.54	280	11.48	566	23.21	794	32.55	1824	74.78	615	25.22
36. Hambantota	3788	217	5.73	300	7.92	823	21.73	1280	33.79	2620	69.17	1168	30.83
37. Walasmulla	2491	311	12.48	342	13.73	539	21.64	698	28.02	1890	75.87	601	24.13
38. Jaffna	3092	307	9.93	330	10.67	520	16.82	943	30.50	2100	67.92	992	32.08
39. Islands	578	4	0.69	10	1.73	58	10.03	176	30.45	248	42.91	330	57.09
40. Thenmarachchi	964	63	6.54	88	9.13	153	15.87	282	29.25	586	60.79	378	39.21
41. Valikamam	2247	97	4.32	113	5.03	298	13.26	742	33.02	1250	55.63	997	44.37
42. Vadamarachchi	1585	144	9.09	119	7.51	251	15.84	476	30.03	990	62.46	595	37.54
43. Kilinochchi	1698	37	2.18	52	3.06	178	10.48	447	26.33	714	42.05	984	57.95
44. Mannar	1213	46	3.79	63	5.19	169	13.93	477	39.32	755	62.24	458	37.76
45. Madu	267	0	0.00	5	1.87	18	6.74	112	41.95	135	50.56	132	49.44
46. Vavuniya	2092	147	7.03	145	6.93	374	17.88	684	32.70	1350	64.53	742	35.47
47. Vavuniya North	570	5	0.88	17	2.98	56	9.82	172	30.18	250	43.86	320	56.14
48. Mullaitivu	911	20	2.20	31	3.40	101	11.09	249	27.33	401	44.02	510	55.98
49. Thunukkai	494	4	0.81	12	2.43	35	7.09	125	25.30	176	35.63	318	64.37
50. Batticaloa	2139	218	10.19	228	10.66	432	20.20	620	28.99	1498	70.03	641	29.97
51. Kalkudah	1141	30	2.63	35	3.07	134	11.74	340	29.80	539	47.24	602	52.76
52. Paddirippu	1343	66	4.91	89	6.63	181	13.48	430	32.02	766	57.04	577	42.96
53. Batticaloa Central	1336	160	11.98	175	13.10	353	26.42	455	34.06	1143	85.55	193	14.45
54. Batticaloa Western	671	5	0.75	10	1.49	70	10.43	266	39.64	351	52.31	320	47.69
55. Ampara	2230	140	6.28	245	10.99	506	22.69	786	35.25	1677	75.20	553	24.80
56. Kalmunai	2148	207	9.64	194	9.03	389	18.11	799	37.20	1589	73.98	559	26.02
57. Sammanthurai	1150	40	3.48	85	7.39	205	17.83	410	35.65	740	64.35	410	35.65
58. Mahaoya	577	23	3.99	31	5.37	89	15.42	217	37.61	360	62.39	217	37.61
59. Dehiattakandiya	1011	74	7.32	68	6.73	184	18.20	324	32.05	650	64.29	361	35.71
60. Akkaraipattu	987	96	9.73	112	11.35	210	21.28	364	36.88	782	79.23	205	20.77
61. Thirukkowil	720	43	5.97	54	7.50	143	19.86	276	38.33	516	71.67	204	28.33
62. Trincomalee	1813	169	9.32	181	9.98	305	16.82	572	31.55	1227	67.68	586	32.32
63. Mutur	1074	33	3.07	71	6.61	154	14.34	360	33.52	618	57.54	456	42.46
64. Kantale	845	34	4.02	63	7.46	143	16.92	296	35.03	536	63.43	309	36.57
65. Kinnya	1014	32	3.16	85	8.38	245	24.16	370	36.49	732	72.19	282	27.81
66. Trincomalee North	482	6	1.24	26	5.39	62	12.86	135	28.01	229	47.51	253	52.49
67. Kurunegala	5320	659	12.39	623	11.71	1114	20.94	1587	29.83	3983	74.87	1337	25.13
68. Kuliyapitiya	3722	271	7.28	366	9.83	769	20.66	1215	32.64	2621	70.42	1101	29.58
69. Nikaweratiya	2783	156	5.61	235	8.44	597	21.45	977	35.11	1965	70.61	818	29.39
70. Maho	3254	111	3.41	191	5.87	599	18.41	1230	37.80	2131	65.49	1123	34.51
71. Giriulla	3620	182	5.03	326	9.01	765	21.13	1234	34.09	2507	69.25	1113	30.75
72. Ibbagamuwa	2781	180	6.47	214	7.70	465	16.72	908	32.65	1767	63.54	1014	36.46
73. Puttalam	4487	171	3.81	221	4.93	618	13.77	1553	34.61	2563	57.12	1924	42.88
74. Chilaw	4917	421	8.56	436	8.87	917	18.65	1628	33.11	3402	69.19	1515	30.81

Educational Zone	No. Sat	Distinction (A)		Very Good Pass (B)		Credit Pass (C)		Ordinary pass (S)		Pass (A+B+C+S)		Weak (W)	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
75. Anuradhapura	4166	433	10.39	463	11.11	810	19.44	1191	28.59	2897	69.54	1269	30.46
76. Tambuttegama	1967	56	2.85	123	6.25	345	17.54	687	34.93	1211	61.57	756	38.43
77. Kekirawa	2264	101	4.46	160	7.07	425	18.77	739	32.64	1425	62.94	839	37.06
78. Galenbidunuwewa	1565	46	2.94	96	6.13	265	16.93	568	36.29	975	62.30	590	37.70
79. Kebithigollewa	1724	57	3.31	94	5.45	285	16.53	579	33.58	1015	58.87	709	41.13
80. Polonnaruwa	1569	123	7.84	134	8.54	305	19.44	507	32.31	1069	68.13	500	31.87
81. Hingurakgoda	2048	99	4.83	177	8.64	350	17.09	608	29.69	1234	60.25	814	39.75
82. Dimbulagala	1435	21	1.46	61	4.25	257	17.91	546	38.05	885	61.67	550	38.33
83. Badulla	3566	251	7.04	301	8.44	646	18.12	1192	33.43	2390	67.02	1176	32.98
84. Bandarawela	3204	311	9.71	318	9.93	615	19.19	1071	33.43	2315	72.25	889	27.75
85. Mahiyanganaya	2002	87	4.35	135	6.74	311	15.53	638	31.87	1171	58.49	831	41.51
86. Welimada	2662	77	2.89	184	6.91	440	16.53	1001	37.60	1702	63.94	960	36.06
87. Passara	1020	12	1.18	45	4.41	164	16.08	350	34.31	571	55.98	449	44.02
88. Monaragala	2177	108	4.96	124	5.70	381	17.50	687	31.56	1300	59.72	877	40.28
89. Wellawaya	2790	152	5.45	200	7.17	488	17.49	905	32.44	1745	62.54	1045	37.46
90. Bibile	1548	66	4.26	84	5.43	272	17.57	523	33.79	945	61.05	603	38.95
91. Ratnapura	5958	697	11.70	620	10.41	1033	17.34	1808	30.35	4158	69.79	1800	30.21
92. Balangoda	2555	203	7.95	231	9.04	428	16.75	789	30.88	1651	64.62	904	35.38
93. Nivitigala	2282	63	2.76	161	7.06	410	17.97	789	34.57	1423	62.36	859	37.64
94. Embilipitiya	3340	189	5.66	269	8.05	552	16.53	1169	35.00	2179	65.24	1161	34.76
95. Kegalle	4178	480	11.49	483	11.56	918	21.97	1285	30.76	3166	75.78	1012	24.22
96. Mawanella	3369	223	6.62	294	8.73	644	19.12	1110	32.95	2271	67.41	1098	32.59
97. Dehiowita	3264	100	3.06	230	7.05	611	18.72	1182	36.21	2123	65.04	1141	34.96
All Island	268580	23490	8.75	25056	9.33	50206	18.69	84575	31.49	183327	68.26	85253	31.74

Table 4

1.2.5 Marks obtained according to class intervals

Class Interval	Frequency	Frequency Percentage	Cumulative Frequency	Cumulative Frequency Percentage
91 - 100	651	0.20	318586	100.00
81 - 90	8580	2.69	317935	99.80
71 - 80	19907	6.25	309355	97.10
61 - 70	31116	9.77	289448	90.85
51 - 60	51253	16.09	258332	81.09
41 - 50	84579	26.55	207079	65.00
31 - 40	110144	34.57	122500	38.45
21 - 30	12181	3.82	12356	3.88
11 - 20	49	0.02	175	0.05
01 - 10	123	0.04	126	0.04
00 - 00	3	0.00	3	0.00

Table 5

The following example illustrates how information can be retrieved from the above table.

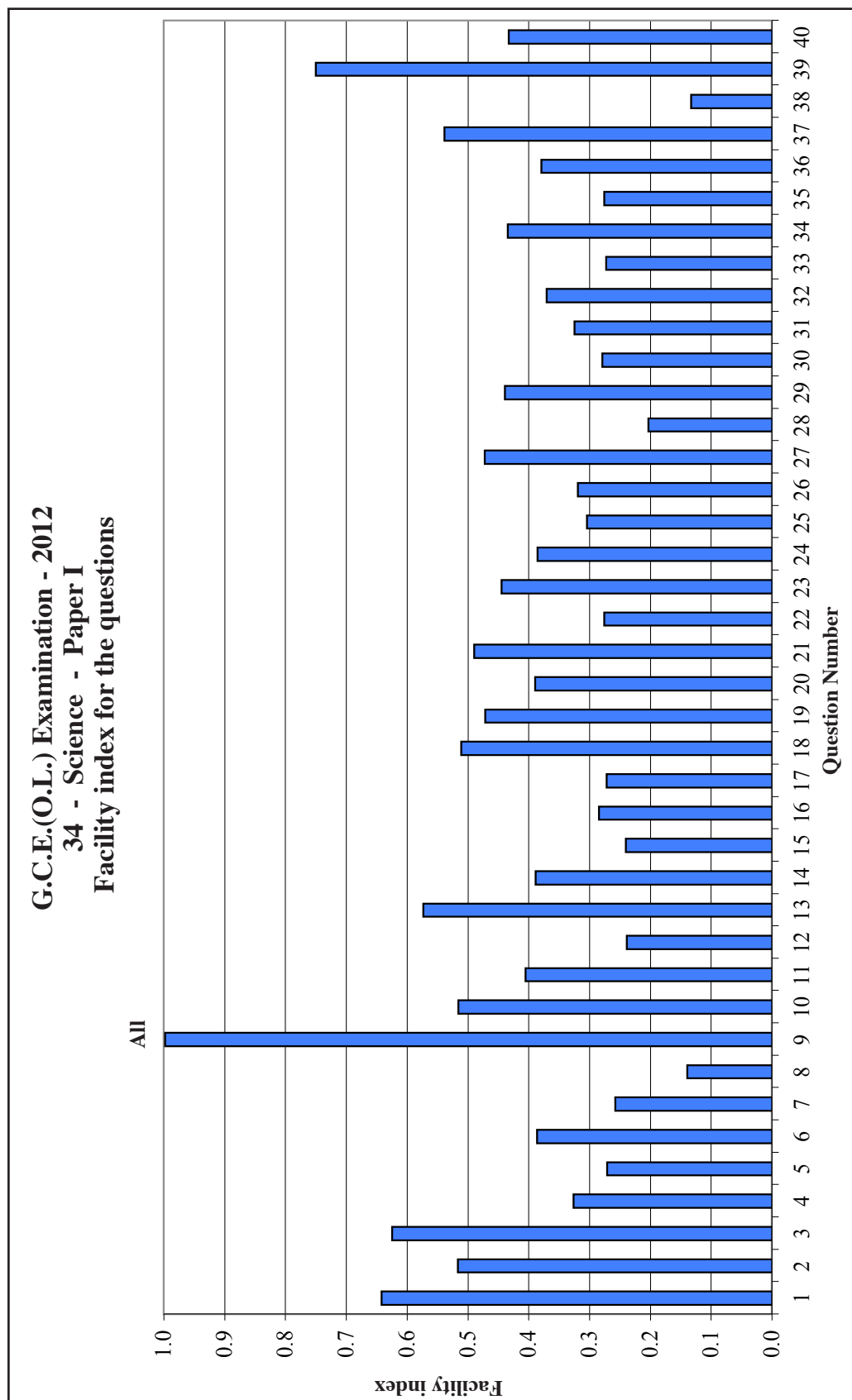
Ex : Taking the class interval 31 - 40 for instance

The number of candidates scoring from 31 to 40 is 110,144. It is 34.57 as a percentage.

The number scoring below 40 marks is 122,500 and it is 38.45 as a percentage.

11.3 Analysis of Subject Achievement

1.3.1 Achievement in Paper I

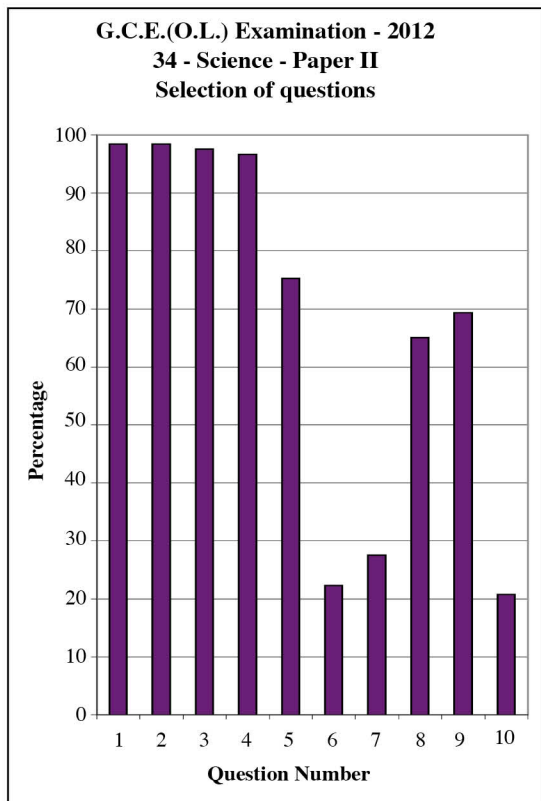


Graph 1 (Prepared using the information collected from form RD/16/05/OL)

Retrieval of information from the above graph can be illustrated by the following example.

Ex : Highest number of candidates have correctly responded to question 39. Its percentage is 75%. Least number of candidates have correctly responded to question 38. Its percentage is 13%.

1.3.2 Selection of questions in Paper II

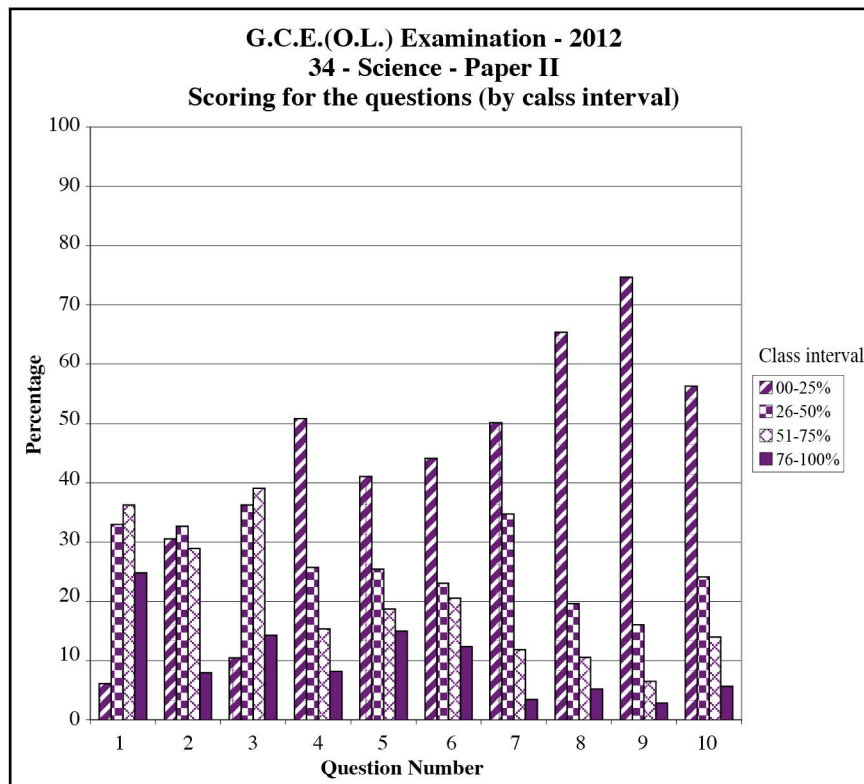


How information can be elicited from this graph is illustrated by the following example.

Ex : Though questions 1 - 4 of paper II were compulsory, a small number has not answered even the compulsory questions. Nearly 97% have answered question 4. The percentage selecting question 10 is about 21%.

Graph 2 (Prepared using the information collected from the form RD/16/02/OL)

1.3.3 Scoring for the questions in Paper II

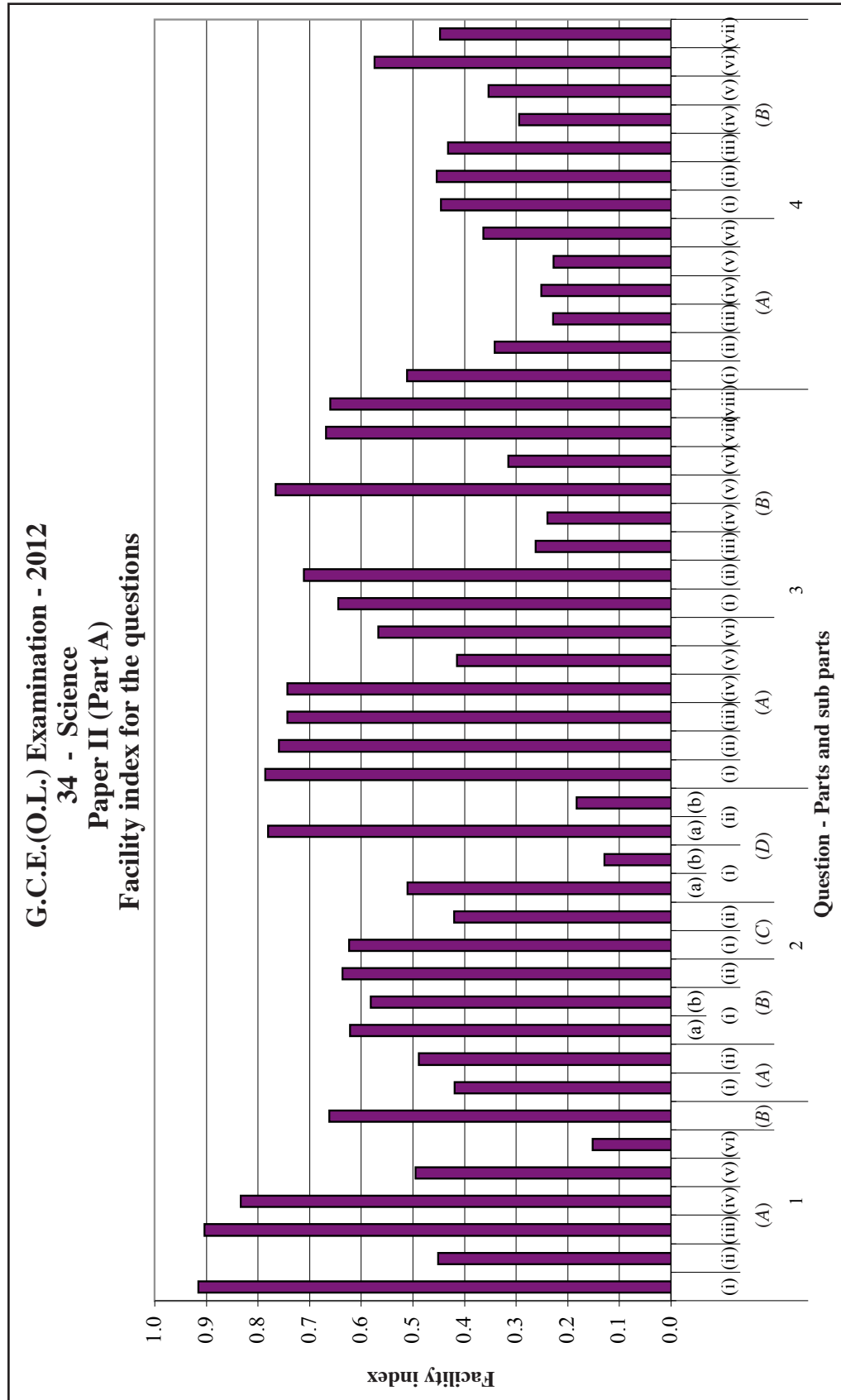


How information can be elicited from this graph is illustrated by the following example.

Ex: Marks allocated for question 1 is 15. Out of this, the number of candidates who obtained marks within the interval of 76-100% which ranges from 11 - 15 marks is 25% similarly, out of the 15 marks allocated, 26% percent of the candidates scored within the interval of 00 - 25 which ranges from 0 - 3 marks

Graph 3 (Prepared using the information collected from the form RD/16/02/OL)

1.3.4 Achievement in Paper II

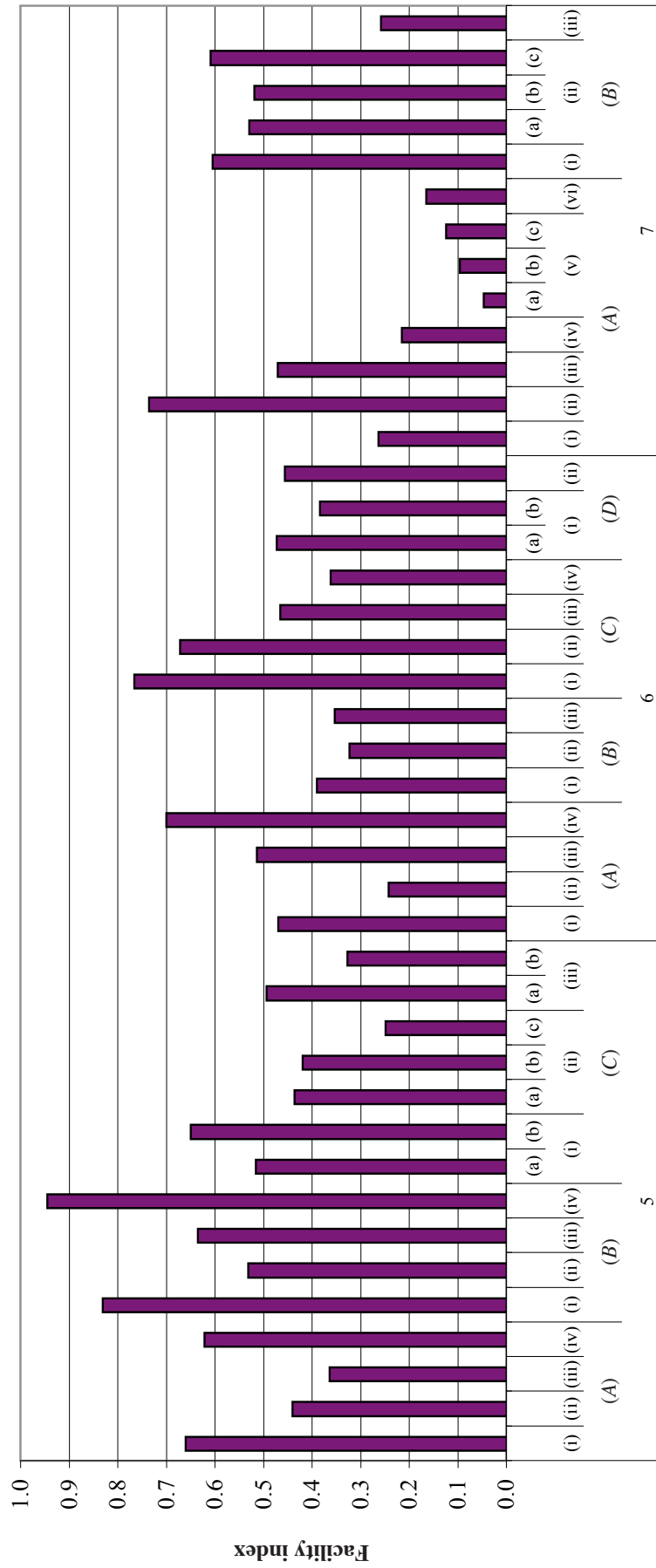


Graph 4.1 (Prepared using the information collected from the form RD/16/04/OL)

How information can be elicited from the above graph is illustrated by the following example.

Ex : The facility of part (A) (i) of question 1 is 92% and the facility of part (A) (vi) is 15%.

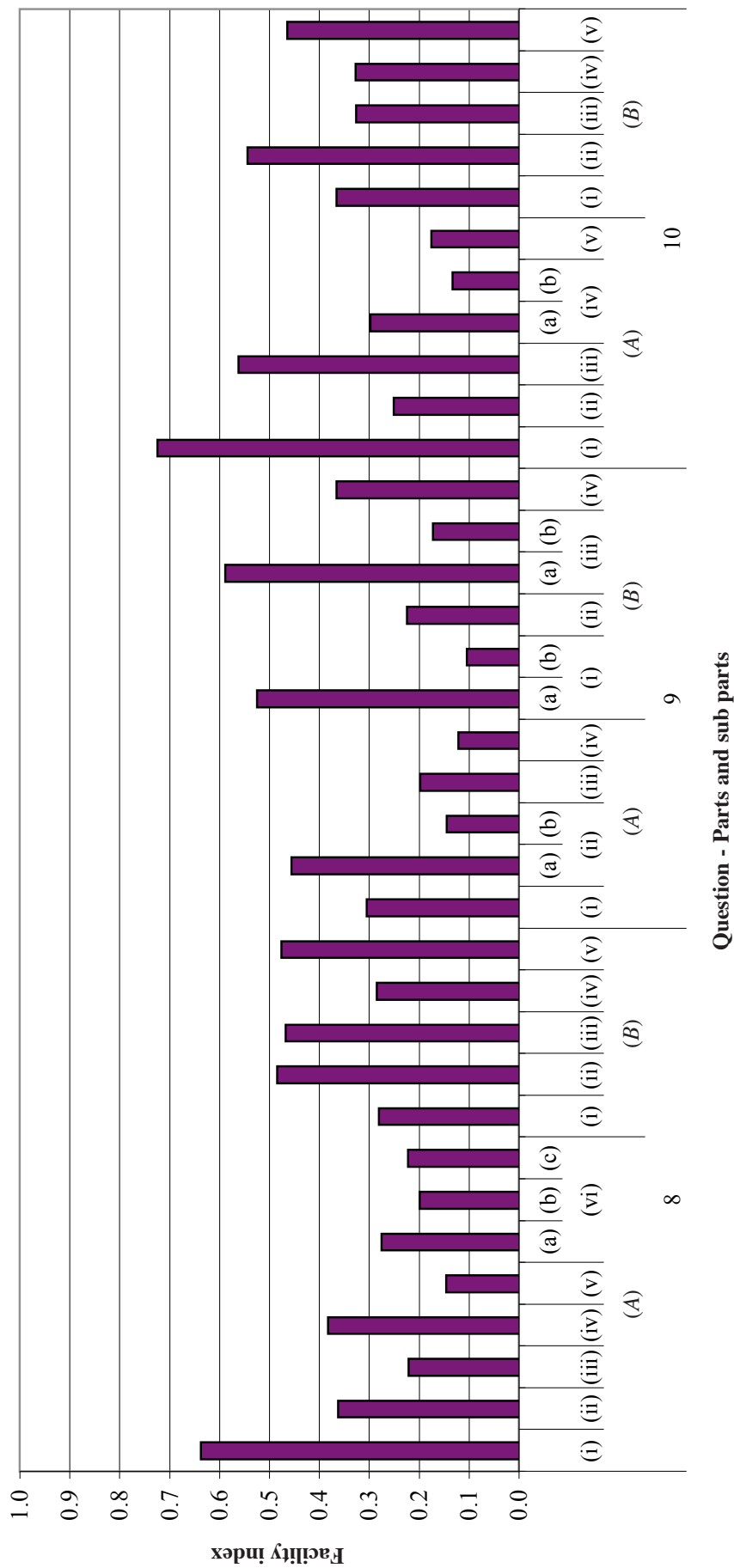
G.C.E.(O.L.) Examination - 2012
34 - Science
Paper II (Part B)
Facility index for the questions



Question - Parts and sub parts

Graph 4.2

G.C.E.(O.L.) Examination - 2012
34 - Science
Paper II (Part B)
Facility index for the questions



Question - Parts and sub parts

Graph 4.3

Part II

2. Information on questions and answers

2.1 Question Paper I and information on answers to Paper I

2.1.1 Structure of the Paper I

Time is 01 hour. Total mark is 40.

- ★ This question paper consists of 40 multiple choice questions each with four options. For questions from 1 - 40, the candidates were expected to select the correct or the most suitable option from the options (1), (2), (3) and (4).
- ★ Questions have been set as follows. 1 - 12 from Biology; 13 - 24 from Chemistry; 25- 36 from Physics; and 37 - 40 from current phenomena.
- ★ Responding to all the questions is expected.

2.1.2 Paper I

- The most essential organelle that should be present in a typical cell to pass hereditary characteristics to the next generation is,
(1) cell membrane. (2) Golgi body. (3) nucleus. (4) mitochondrion.
- A special feature that can be seen in a wind-pollinated flower is the presence of,
(1) nectaries. (2) large, sticky pollen.
(3) branched, hairy stigma. (4) flowers as inflorescence.
- Which of the following components are present in the urine of a healthy person?
(1) urea, glucose, fatty acids and water (2) urea, uric acid, water and salts
(3) urea, glucose, water and salts (4) urea, carbon dioxide, water and salts
- Consider the following industries.
A - Baking industry B - Production of antibiotics C- Yoghurt production
Of these, fungi are used for
(1) A and B only. (2) A and C only. (3) B and C only. (4) all A, B, and C.
- A child who seemed stunted in the young age, started growing to the normal height when a hormone was injected continuously. This hormone could be,
(1) somatotropin. (2) thyroxine. (3) prolactin. (4) adrenalin.
- In which of the following instances does a meiotic division occur?
(1) When the zygote develops into the embryo (2) When the embryo develops into the foetus
(3) When all the somatic cells grow (4) During the production of ova and sperms
- During inspiration,
(1) intercostal muscles contract and diaphragm muscles relax.
(2) intercostal muscles contract and diaphragm muscles contract.
(3) intercostal muscles relax and diaphragm muscles contract.
(4) intercostal muscles relax and diaphragm muscles relax.
- Which of the following statements is correct about enzymes?
(1) Enzymes are catalysts which act only during the digestion of food.
(2) Enzymes are used as detergents to wash clothes.
(3) Electrolysis can be carried out using enzymes.
(4) Enzymes are not destroyed when the temperature is increased.
- Which of the following is a post-fertilisation change?
(1) Turning ovary into the fruit and sepals into the pericarp.
(2) Turning ovules into seeds and wall of the ovary into the seed coat.
(3) Turning ovary into a seed and calyx into the seed coat.
(4) Turning ovules into seeds and sepals into the seed coat.
- Of a plant type in which tallness is the dominant character and shortness is the recessive character, two **heterozygous** plants were crossed. What is the phenotype ratio of the daughter plants?
(1) tall 1 : short 1 (2) tall 1 : short 3 (3) tall 2 : short 1 (4) tall 3 : short 1
- Given below are three statements with regard to photosynthesis and respiration.
A - Respiration is the reverse reaction of the photosynthetic reaction.
B - Photosynthesis produces energy and respiration also produces energy.
C - Organisms with chloroplasts photosynthesise and all organisms respire.
Which of the above statements are correct?
(1) A only (2) A and B only (3) A and C only (4) B and C only
- Two following types of organisms live together in an environment.
A - A group of organisms whose skin has turned dark due to a gene mutation
B - A group of organisms whose skin had turned dark to severe sunlight
Which of the following statements is correct as regards the evolution of the above groups by natural selection?
(1) The characteristic of the organisms in group A only is subject to natural selection.
(2) The characteristic of the organisms in group B only is subject to natural selection.
(3) The above characteristics of the organisms in both A and B groups are subject to natural selection.
(4) The above characteristics of the organisms in both A and B groups are not subject to natural selection.

- To answer questions 13 and 14, use information given in the table.

13. What is the electronic configuration of the element Y?

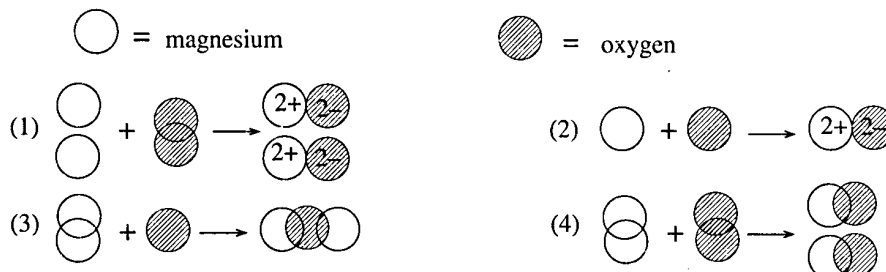
- (1) 2, 4 (2) 2, 6
(3) 2, 8, 2 (4) 2, 8, 6

element	period	group
X	2	II
Y	3	VI

14. What is the formula of the compound formed by the combination of X and Y?

- (1) XY (2) XY₂ (3) X₂Y (4) X(Y)₂

15. Which of the following diagrams best illustrates the particle arrangement taking place when metal magnesium reacts with oxygen gas to form magnesium oxide?



16. An element belonging to the third period of the periodic table, burns in air to give an acidic oxide. What is this element?

- (1) Na (2) Mg (3) Al (4) S

17. What is the feature common to all the three compounds NaHCO₃, Ca(OH)₂ and NH₃?

- (1) Existing in the solid state (2) Being basic
(3) Being ionic compounds (4) Being covalent compounds

18. Which of the following gas can convert iron oxide to iron?

- (1) Oxygen (2) Nitrogen (3) Carbon dioxide (4) Carbon monoxide

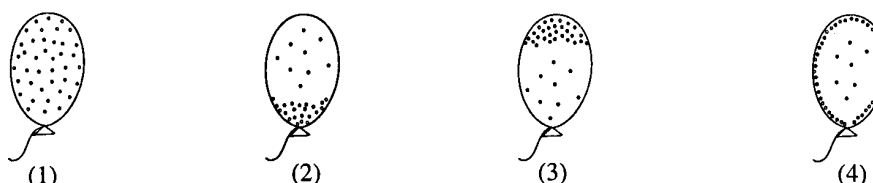
19. There are two identical iron vessels, one fully coated with the metal zinc and the other with the metal tin. Identical parts of both vessels were scratched similarly till the iron surface was exposed. What observation would be expected after keeping the two vessels in an open place for about a week?

- (1) Zinc-coated vessel has rusted more. (2) Tin-coated vessel has rusted more.
(3) Both vessels have rusted to the same extent. (4) Both vessels have not rusted.

20. The reaction between which of the following pairs of reactants will give bleaching powder as a product.

- (1) Ca and Cl₂ (2) CaCO₃ and HCl (3) wet Ca(OH)₂ and Cl₂ (4) CaCO₃ and Cl₂

21. Which diagram best displays how the gas molecules are distributed in a balloon filled with helium gas?



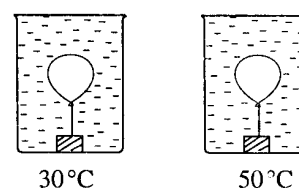
22. Some instances in which a certain gas is used are indicated below.

- Used to burn fuels in rockets.
- Used to produce the oxyacetylene flame.
- Used to purify iron in steel industry.

Which of the following gas conforms to the above information?

- (1) Hydrogen (2) Nitrogen (3) Oxygen (4) Acetylene

23. Two identical vessels are completely filled with water and one is maintained at 30 °C while the other is maintained at 50 °C. Two identical balloons with equal volumes of a gas were immersed in the vessels as shown in the diagram. Select the correct statement with regard to the volumes of water displaced from the beakers after a constant period of time.



- (1) A larger volume of water is displaced from the vessel at 50 °C.
(2) A larger volume of water is displaced from the vessel at 30 °C.
(3) Equal volumes of water get displaced from both vessels.
(4) No adequate information has been provided to come to a conclusion.

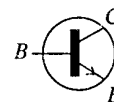
24. Iodine crystals slightly dissolve in a colourless liquid *A* to give a yellowish brown solution. When this brownish solution is thoroughly shaken with another colourless solvent *B*, the layers of *A* and *B* separate and the layer of *B* becomes violet. When *B* layer is separated out and shaken with another colourless liquid *C*, no separation of layers occurs but the violet colour spreads throughout the solution. What could be *A*, *B* and *C* of the following?

<i>A</i>	<i>B</i>	<i>C</i>
(1) Chloroform	Carbon tetrachloride	Water
(2) Carbon tetrachloride	Water	Chloroform
(3) Water	Carbon tetrachloride	Chloroform
(4) Carbon tetrachloride	Chloroform	Water

25. In some thermometers alcohol is used instead of mercury. The main advantage of this is,
 (1) the ability to measure low temperatures. (2) the ability to measure high temperatures.
 (3) the ability to produce locally. (4) the lower weight.

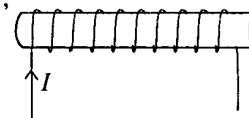
26. Which of the following is the true statement about the transistor shown in the diagram and its action?

- (1) It is a npn transistor and the current flows from the collector to the emitter.
 (2) It is a npn transistor and the current flows from the emitter to the collector.
 (3) It is a pnp transistor and the current flows from the collector to the emitter.
 (4) It is a pnp transistor and the current flows from the emitter to the collector.



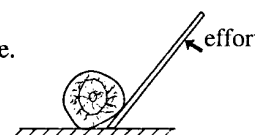
27. As illustrated by the diagram, an insulated copper wire is wound around a plastic tube and a current *I* is passed through it. The magnetic effect created by the coil **cannot** be increased by,

- (1) increasing the number of turns of the coil.
 (2) inserting a core of soft iron wires into the coil.
 (3) increasing the current flowing through the coil.
 (4) using a nichrome wire coil in place of the copper wire.



28. Shown in the diagram is how a crowbar is used to roll a log. Which is the true statement about the use of the crowbar in this event?

- (1) It is a lever of class one and its mechanical advantage is less than one.
 (2) It is a lever of class one and its mechanical advantage is greater than one.
 (3) It is a lever of class two and its mechanical advantage is less than one.
 (4) It is a lever of class two and its mechanical advantage is greater than one.



29. Consider the following statements about the electromagnetic waves.

A - A medium is not required for the propagation of electromagnetic waves.

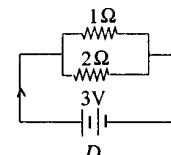
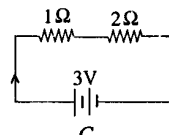
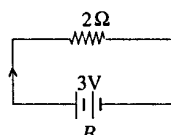
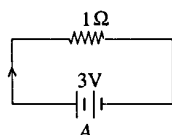
B - Can exist as both transverse and longitudinal waves.

C - Propagated by electrical and magnetic fields which oscillate perpendicular to each other.

Of these, the true statements are,

- (1) *A* and *B* only. (2) *A* and *C* only. (3) *B* and *C* only. (4) all *A*, *B*, and *C*.

- Use the following circuit diagrams to answer the questions 30 and 31.



30. What is the ascending order of the current provided by the battery in each circuit?

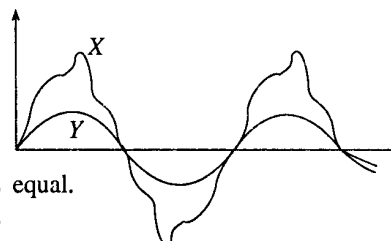
- (1) $C < B < A < D$ (2) $C < B < D < A$ (3) $D < A < B < C$ (4) $C < A < B < D$

31. In which circuit is the greatest amount of heat produced?

- (1) *A* (2) *B* (3) *C* (4) *D*

32. The figure illustrates the way two sound waves *X* and *Y* are displayed by a cathode ray oscilloscope. Which of the following statements is true about *X* and *Y*?

- (1) In *X* and *Y* the pitch is different and loudness is equal.
 (2) In *X* and *Y* the quality of sound is different and the pitch is equal.
 (3) In *X* and *Y* the loudness is different and the quality of sound is equal.
 (4) In *X* and *Y* the quality of sound, loudness and pitch are equal.



33. A stone is thrown vertically up with a velocity of 20 m s^{-1} . The maximum height reached by the stone and the total time taken by it to fall on the ground are
 (1) 20 m and 2 s. (2) 20 m and 4 s. (3) 40 m and 2 s. (4) 40 m and 4 s.

34. Consider the following statements about forces.

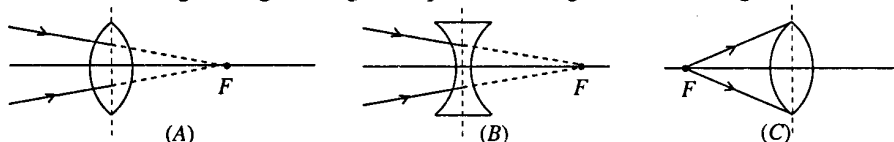
A - Forces always act individually.

B - If three forces happen to come to equilibrium, they should operate on the same plane.

C - There can be a uniform velocity for an object when the resultant force is zero.

Which of the above are true?

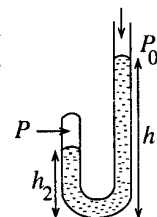
- (1) A and B only. (2) A and C only. (3) B and C only. (4) all A, B, and C.
35. Which of the following settings will give a parallel emergent beam of light?



- (1) A and B (2) A and C (3) B and C (4) A, B, and C

36. As illustrated in the diagram, a column of air is trapped by mercury inside a glass tube sealed at one end. If the atmospheric pressure is P_0 , which of the following expressions gives the pressure P of the gas inside the tube. (Density of mercury is ρ .)

- (1) $P_0 - \rho gh_2$ (2) ρgh_1
 (3) $\rho g(h_1 - h_2)$ (4) $P_0 + \rho g(h_1 - h_2)$



37. Variation in the pattern of climatic changes is a major challenge confronting the world today. What is the environmental hazard that largely contributes to this?

- (1) Depletion of the ozone layer (2) Acid rains
 (3) Global warming (4) Eutrophication

38. Construction of expressways through forest areas cuts off the natural corridors along which the wild animals move. This affects the biodiversity. The best remedy for this situation is

- (1) blockading the sides of expressways with wire meshes.
 (2) constructing the expressways on pillars, in forest areas.
 (3) erecting earth dams and constructing expressways on them.
 (4) constructing expressways always away from the forest areas.

39. In an event of lightning, the risk is **minimum** when,

- (1) standing under a tree at the edge of a ground.
 (2) working in a paddy field.
 (3) seated inside a motor car.
 (4) watching the television inside a house.

40. The sea water wetlands such as Bundala and Anavilundawa of Sri Lanka have been accepted as a world heritage. Existence of endemic living species and the arrival of migratory birds are their special features. Select from the following the statement that most correctly describes the damage caused to such a wetland by the mixing of freshwater drained by a water supply project.

- (1) The living organisms in the wetland environment are destroyed completely due to mixing of freshwater.
 (2) Arrival of tourists stops resulting in the collapse of the tourist industry.
 (3) Endemic living species become extinct due to complete reclamation of wetlands in a short period of time.
 (4) Arrival of migratory birds drops due to gradual removal of living species.

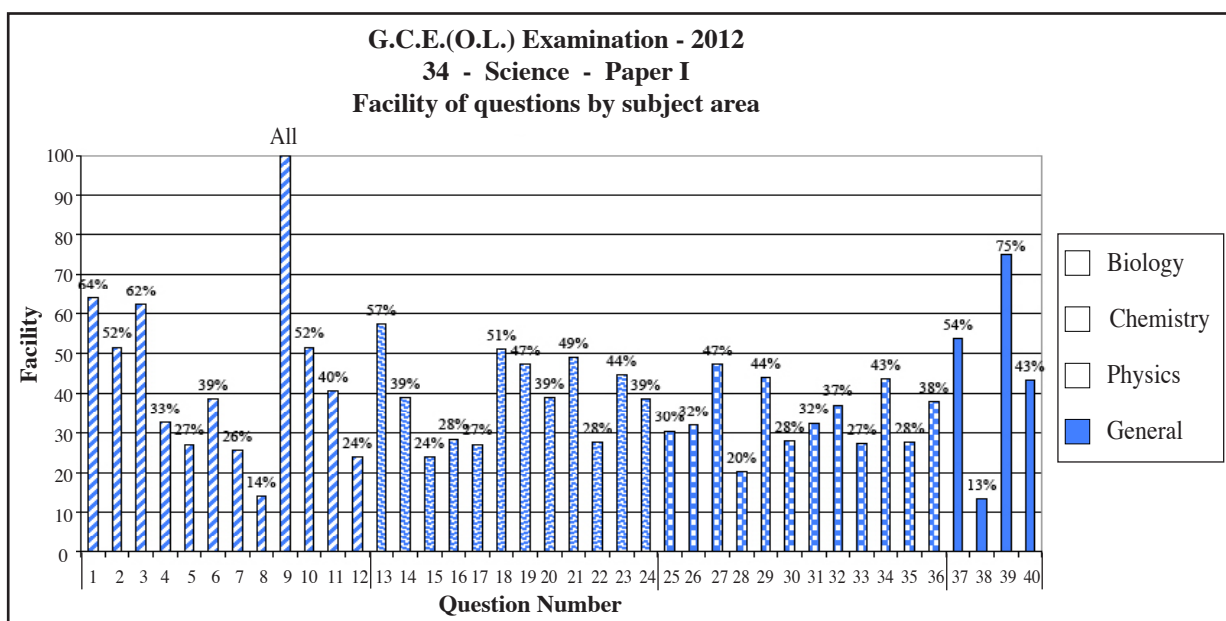
2.1.3 Expected answers and the marking scheme for Paper I

Question No.	Answer	Question No.	Answer
01.	3	21.	1
02.	3	22.	3
03.	2	23.	1
04.	1	24.	3
05.	1	25.	1
06.	4	26.	1
07.	2	27.	4
08.	2	28.	4
09.	(2) All	29.	2
10.	4	30.	1
11.	3	31.	4
12.	1	32.	2
13.	4	33.	2
14.	1	34.	3
15.	1	35.	3
16.	4	36.	4
17.	2	37.	3
18.	4	38.	2
19.	2	39.	3
20.	3	40.	4

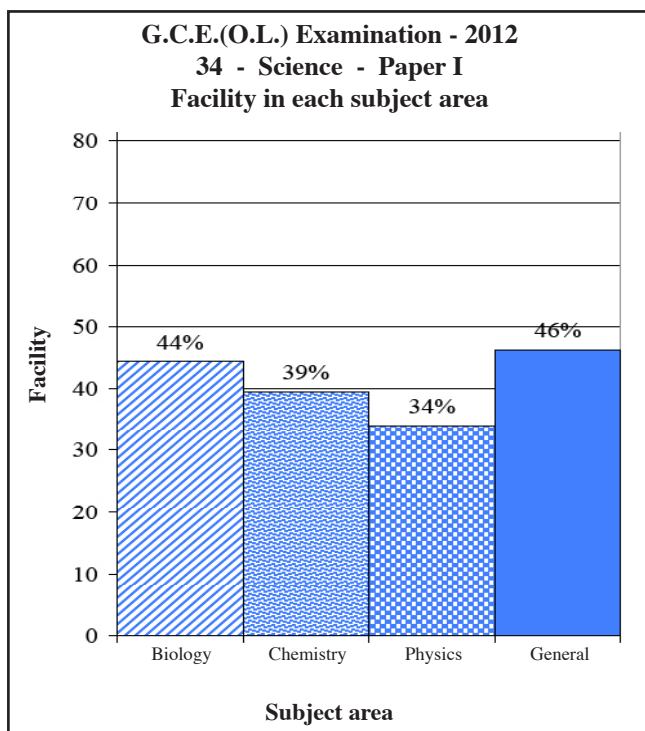
Each correct answer carries 02 marks, amounting the total to 80.

$$\text{Final mark for Paper I} = \frac{80}{2} = 40$$

2.1.4 Observations on the responses to Paper I (by subject area) :



Question Number	Subject area	The question of highest facility and its facility	The question of lowest facility and its facility
1 - 12	Biology	1 (64%)	8 (14%)
13 - 24	Chemistry	13 (57%)	15 (24%)
25 - 36	Physics	27 (47%)	28 (20%)
37 - 40	General	39 (75%)	38 (13%)



Of the major subject areas on which Paper I was set, Biology had been an easier section for 44% of the students. The facility for general questions based on current phenomena (General) is 46%. Chemistry had been a facile part for 39%. The most difficult subject theme in Paper I is Physics. Its facility is 34%.

On the whole, the facility of paper I is 44.9%.

2.1.5 Responses to the options in Paper I - as a percentage

Question Number	Correct Answer	Percentage of students selecting each option				
		1	2	3	4	Missing
1	3	10%	16%	64%	10%	–
2	3	9%	15%	52%	24%	–
3	2	6%	62%	24%	8%	–
4	1	33%	23%	25%	19%	–
5	1	27%	36%	19%	18%	–
6	4	27%	17%	17%	39%	–
7	2	30%	26%	28%	16%	–
8	2	49%	14%	12%	24%	1%
9	(2) All	19%	50%	15%	16%	–
10	4	12%	14%	22%	52%	–
11	3	8%	12%	40%	39%	1%
12	1	24%	37%	27%	12%	–
13	4	13%	15%	14%	57%	1%
14	1	39%	28%	22%	11%	–
15	1	24%	42%	17%	17%	–
16	4	21%	30%	20%	28%	1%
17	2	12%	27%	24%	36%	1%
18	4	16%	16%	16%	51%	1%
19	2	23%	47%	20%	10%	–
20	3	9%	27%	39%	25%	–
21	1	49%	9%	34%	8%	–
22	3	19%	23%	27%	31%	–
23	1	44%	11%	18%	27%	–
24	3	17%	18%	39%	26%	–
25	1	30%	32%	20%	17%	1%
26	1	32%	26%	28%	14%	–
27	4	12%	28%	13%	47%	–
28	4	25%	38%	16%	20%	1%
29	2	16%	44%	23%	17%	–
30	1	28%	31%	28%	13%	–
31	4	16%	8	43%	32%	1%
32	2	15%	37%	33%	14%	1%
33	2	31%	27%	31%	11%	–
34	3	20%	15%	43%	22%	–
35	3	34%	27%	28%	11%	–
36	4	17%	20%	24%	38%	1%
37	3	31%	9%	54%	6%	–
38	2	11%	13%	5%	70%	1%
39	3	11%	7%	75%	7%	–
40	4	26%	5%	25%	43%	1%

- * Under each question the student percentage selecting the correct option is shaded.
- * 'Missing' indicates the percentage of students selecting more than one option.
- * For question 9, all responses were considered correct.

2.1.6 Overall observations, conclusions and suggestions regarding the answers to Paper I

Four specific areas have been considered in setting the question paper I including Biology, Chemistry, Physics and a general section based on current phenomena. The questions 1-12 were set on Biology while questions 13-24 were constructed on chemistry and questions 25-36 were under Physics while questions 37-40 were prepared on current phenomena.

As regards Biology, the first question registers the highest facility (64%). By this question a basic concept is evaluated. Therefore, the facility percentage should be at a higher value. However the facility recorded was low due to inadequacy of the understanding of basic concepts.

Option 1 is the correct answer for question 5 and had been the choice of 27%. But 36% have selected option 2. The reason for their inability to select the correct answer would be due to the usage of the word 'growth hormone' for the hormone that regulates growth rather than somatotropine. Therefore it is useful for the students to be aware of similar names that are being used.

In the area of Biology, question 8 registers the lowest facility. Its correct option is 2. 14% have selected it whereas 49% have selected option 1. 1% have selected none. The reason for this is the students' misconception that enzymes act only in the digestive system. It is important that students should be made aware of the other instances where enzymes play a part except the biological processes.

The percentage selecting correct response for question 12 is 24%. It is the characteristics caused by the changes in genes that are subject to evolution. Because of insufficient understanding of this concept, 37% of the students have taken option 2 as the correct response. Students have misconceived that characteristics acquired due to environmental changes are subject to evolution.

In the field of Chemistry, question 13 with correct option 4 records the highest facility (57%). Distractors 1, 2 and 3 had been selected by 13%, 15% and 14% respectively and 1% have selected none. This question which is based on a very easy concept in Chemistry, yet receiving only 57% correct responses is unsatisfactory.

Less than 30% have been able to answer correctly for questions 15, 16, 17 and 22. By and large, these questions were formed on basic concepts, but the students have apparently failed to grasp the relevant facts.

The correct option of question 15 showing the lowest facility (24%) is 1. However, 42% have chosen option 2. The possible reason could be the inability of students to understand that in nature, oxygen exists as molecules and magnesium as atoms and two atoms of magnesium react with one molecule of oxygen to give two formula units of magnesium oxide. Since the question is given in figurative symbols, the failure to understand it would also be a possible reason for the low score. Appropriate teaching methodology must be employed to teach above concepts.

Physics is the subject area in which the students seem least facile. Its facility is 34%. Less than 35% have given correct responses for the questions 25, 26, 28, 30, 31, 33 and 35. In Physics, no question has exceeded the facility of 47%.

The minimum facility (20%) has been shown for question 28. 4th option is its correct response. 38% have selected option 2. The low facility would have been due to inadequacy of students' understanding that when rolling a stone a crowbar acts as a class 2 lever whereas when lifting a stone it acts as a class 1 lever. Students need to be discerned that to which class a lever belongs depends on the way it is used. The skill of representing the action of levers used in day to day activities by diagrams should also be developed in students.

Option 4 is the correct response for question 31. Its facility is 32%. Nevertheless, 43% have selected option 3. In selecting the correct response, majority of the students have used the idea that the amount of the energy produced increases with the increase in the equivalent resistance. But the students have not understood that with the increase in equivalent resistance, the current decreases, so the quantity of heat energy produced decreases. The correct concept is that if the current is constant, the quantity of heat energy produced increases when the resistance increases and if the voltage is constant, the quantity of heat energy generated increases when the resistance decreases.

Only 27% have selected the correct response for the question 33. The students would have failed to select the correct response for their weakness in calculations using the correct equations of motion and for considering only the time taken by the object to move vertically upwards.

The correct response for question 35 is 3. It has been selected by 28% whereas 34% have selected option 1. The misunderstanding that since in set up B, the convergent beam incident on the focus of the concave lens gives a parallel beam of light after reflection, a convergent beam directed to the focus of a convex lens too would give a parallel beam after reflection.

The minimum facility (13%) for the whole question paper was for question 38. Its correct response is 2. However, 70% of the candidates have chosen response 4 instead of 2 as the answer. The students have not been able to choose the most suitable answer. The students have not understood the fact that the highways cannot always be constructed away from forest areas. When highways are built on pillars in forest areas it does not obstruct natural paths and also it does not affect bio diversity. Therefore, the students should be oriented to think logically about current affairs.

Question 39 holds the highest facility (75%) for the entire question paper. Since this is a subject of the discussed in media it is possible that this would have been an easy question for the students.

The three major sections of the subject Science, Biology, Chemistry and Physics hold the facilities 44, 39 and 34 per cent respectively. In comparison to the previous year, a decrease in the facility percentages of all the three areas is seen, yet the pattern of variation of facility percentages is similar to that in the previous year.

2.2 Paper II and information on answers

2.2.1 Structure of the Paper II

Time 03 hours. Total mark for Paper II is 60.

This paper consists of two parts A and B.

Part A – This contains four structured essay questions and all the questions should be answered in the paper itself. First question is set integrating sections from Physics, Chemistry and Biology. Other three questions are set on Biology, Chemistry and Physics. Each question carries 15 marks and the total mark is 60.

Part B – This comprises six questions, with two questions each from, the sections Chemistry, Physics and Biology. The candidate should select at least one question from each part and answer three questions. Mark allocated for each question is 20, so the total mark is 60.

$$\begin{aligned}\text{Total mark for Paper II} &= 60 + 60 \\ &= 120\end{aligned}$$

$$\text{Final mark for Paper II} = \frac{120}{2} = 60$$

2.2.2 Expected answers, marking scheme and observations and conclusions related to paper II

- ★ The observation related to the answers for paper II have been presented by graphs 2, 3, 4.1, 4.2 and 4.3. The graphical part related to a question is given along with the observations and conclusions on that question.

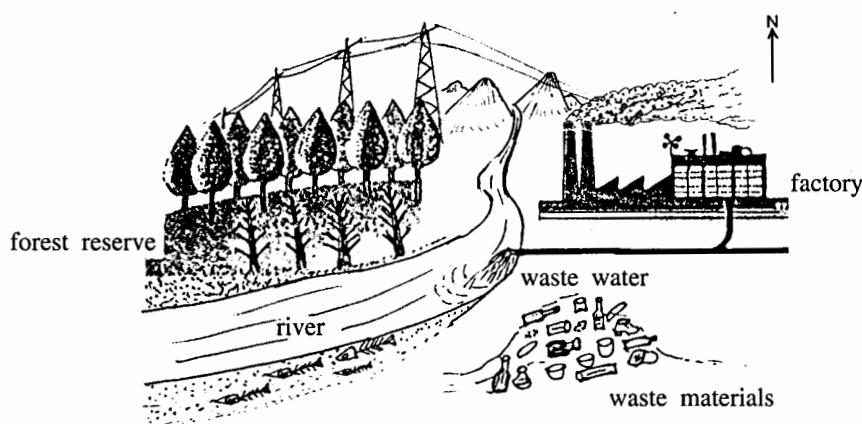
Part A - Structured Essay

Objectives for Question 1

- To develop the ability of answering understanding the integrated nature of science.
- To inquire into the environmental impacts caused by natural phenomena and anthropogenic activities.
- To investigate into the knowledge about how scientific phenomena operate in the environment.
- To inquire into the understanding about the ability of minimizing damages to the environment during the process of development using scientific techniques.
- To inquire into the ability of adopting the skills acquired by the learning process to day to day life.

Question 1

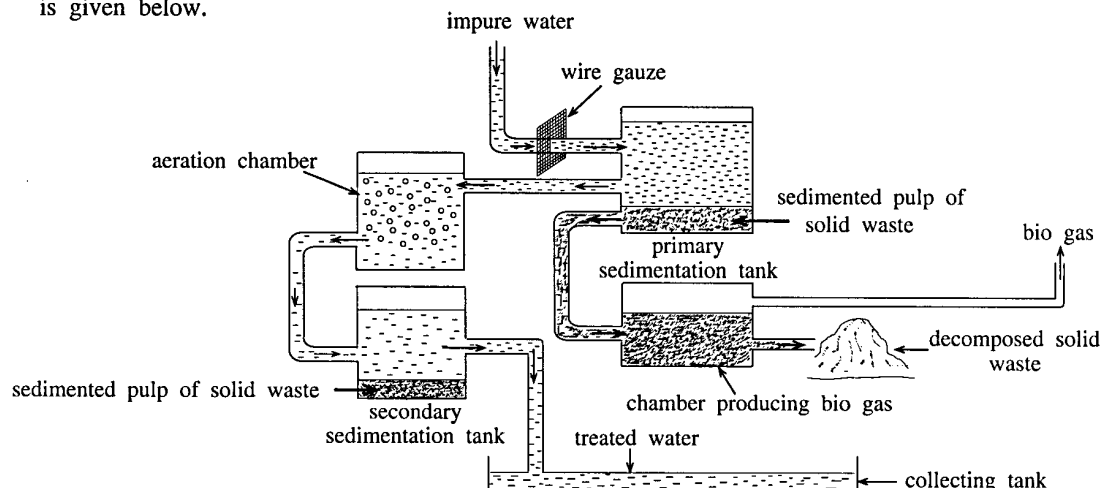
1. (A) The diagram shows a river flowing near a forest reserve and a factory constructed on one of its banks. The waste water containing the organic substances and various chemicals released from the factory is emptied into the river. From the point of receiving the waste water onwards, the river flows very slowly.



- (i) The factory has caused environmental pollution. State **one** confirmatory evidence for this referring to the diagram.
• liberation of smoke/ • effluent water emptied to river/ • dumped wastes/ • dead fishes/ • dead plants (01)
- (ii) The forest reserve reduces atmospheric pollution. State **one** way of effecting this.
• absorption / removal of carbon dioxide (by plants) (01)
• absorption / removal of dust particles (01)
- Within the brackets opposite each of the following statements, mark a tick (✓) if it is correct and a cross (X) if it is incorrect.
- (iii) According to the topographical features of the initial section of the river, production of hydroelectricity is possible. (...✓...) (01)
- (iv) On the occasion shown in the diagram, wind blows from east to west in the area. (...X...) (01)
- (v) Downwards from the point at which the waste water containing poisonous chemicals is drained into the river, the number of micro-organisms decreases rapidly and then increases slowly. (...✓...) (01)
- (vi) A coolness is felt inside the forest reserve because the humidity of air is high due to the water vapour released from trees. (...X...) (01)

04 marks

- (B) In order to minimise the environmental damage caused by the waste products released by the above factory complex, a project has been planned for the treatment of impure water. A schematic diagram of that plan is given below.



Given in the following paragraph is a description of the impure water treatment plan.

From the words given within the brackets, select the word most suitable for each blank and write it on the dotted line.

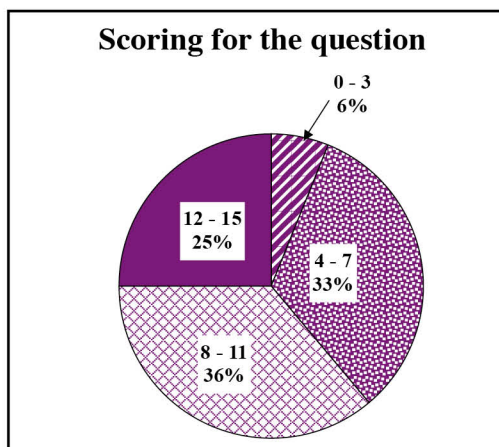
(aerobic, anaerobic, primary, secondary, tertiary, organic, chemical, gravity, energy)

Here, the two (i)primary..... treatment methods namely the filtration through a wire gauze and sedimentation under (ii)gravity..... are used. Aeration which is a (iii)secondary..... treatment method is also a part of this plan. Some wastes are subject to biodegradation by the action of (iv)aerobic..... bacteria. If the water drained into the collecting tank contains harmful ions or special (v)chemical..... substances, it is supposed to be released into the environment after the (vi)tertiary..... treatment. The sedimented solid pulp conveyed to the bio gas chamber is decomposed by the actions of (vii)anaerobic..... bacteria. The gaseous products produced there are used to produce (viii)energy..... and the decomposed solid wastes are used as (ix)organic..... fertilizers.

09 marks

Total marks - 15

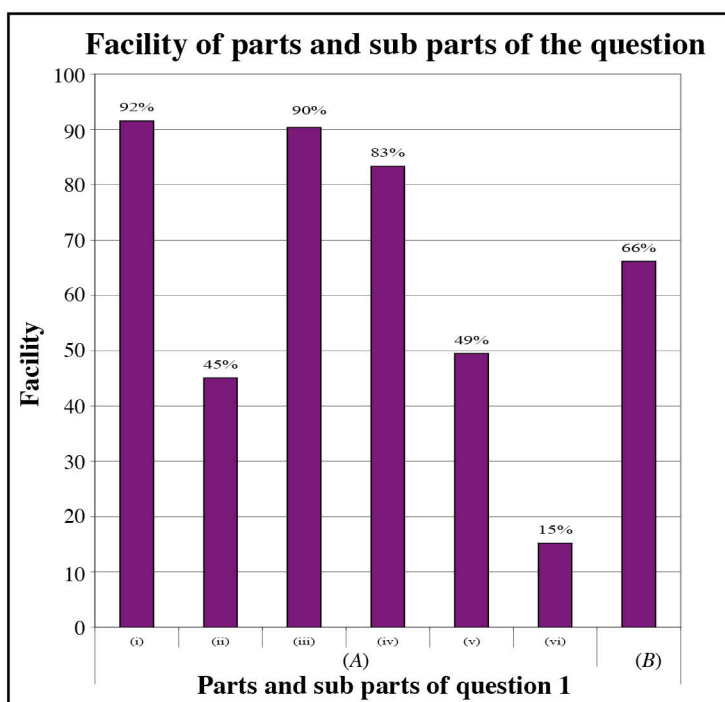
Overall observations and conclusions regarding the answers to Question 1 :



Though question 1 is compulsory, only 98.47% have answered it. The question carries 15 marks. The percentages of candidates scoring within the following four intervals for this question are:

0 - 3	–	6%
4 - 7	–	33%
8 - 11	–	36%
12 - 15	–	25%

The percentage scoring above 12 for this question is 25% while 6% have scored less than 3 marks.



This question comprises 7 sub parts of which the facility of 5 is above 45%. The sub part with minimum facility is (A)(vi) for which the facility is 15%. The most facile sub part (A)(i) has the facility of 92%.

Even though this is a compulsory question, only 98% have answered it.

The facility of sub part (A)(i) is as high as 92%. Seemingly the understanding about the damages caused to the environment by human activities is adequate.

Facility of sub part (A)(ii) is 45%. Presenting a correct fact about how some natural occurrences in the environment supports its wellbeing has been difficult for 55%.

The fact that the facility of sub part (A)(vi) is at a level as low as 15% corroborates the above weakness that arriving at a conclusions scientifically by observing the natural events happening in the environment. During the process of transpiration taking place in the plants of a forest, heat for evaporation of water is absorbed from the environment. Heat is lost from the body too making one feel cool. But most of the students hold the view that the cooling is due to the water vapour transpired by the plants. The learning teaching process needs to be planned in such a way that scientific facts such as these are well established.

The facility of sub part (B) is 66%. In order to further the students' knowledge about the instances where scientific techniques are usefully adopted in day to day activities, it is important to direct them to collect information regarding the places where such project are conducted and organise field trips to see such sites it facilities are available.

Generally the first question is framed on a diagram. By offering more opportunities to answer such questions, students should be made aware about how a given diagram is analysed and information drawn.

Objectives for Question 2

- To inquire into the ability of using keys for classification and standard methods related to it.
- To give a correct understanding about scientific nomenclature.
- To investigate the ability of adopting the knowledge of classification in other occasions.
- To inquire into the ability of distinguishing tissues and identifying their characteristics.

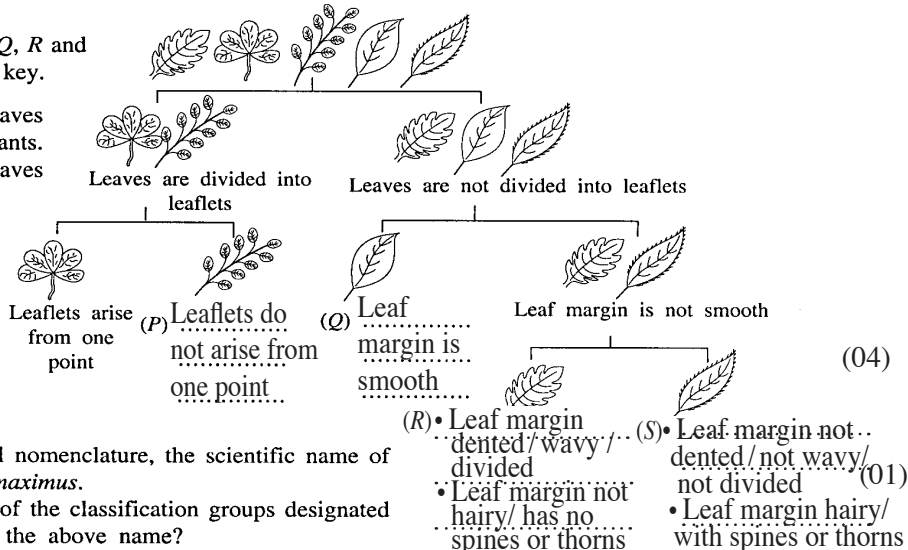
Question 2

2. (A) The diagram shows a dichotomous key constructed to identify the leaves in a collection of leaves according to their features.

(i) Fill in the blanks *P*, *Q*, *R* and *S* in the dichotomous key.

(ii) All in the key are leaves of dicotyledonous plants. What feature of leaves confirms this fact?

Reticulate venation



(B) According to the binomial nomenclature, the scientific name of the elephant is *Elephas maximus*.

(i) What are the names of the classification groups designated by the two parts of the above name?

(a) *Elephas* generic name

(b) *maximus* specific name / trivial name / epithet (02)

(ii) State a rule/standard that should be followed when writing a scientific name according to the systematic nomenclature.

- Should be written in English letters. (02 marks)
- Generic name should be written first followed by the trivial name.
- Should be printed in italics.
- Only the first letter of the generic name should be capitalised.
- When handwritten should be underlined.

(C) When classifying organisms, cell-level organisms as well as the tissue-level organisms can be seen.

(i) As far as the multicellular organisms are concerned, what unit of organisms can the cell be considered?

- building / structural / functional / hereditary / basic unit (01 mark)

(ii) State a feature shown when the cells organise into tissues.

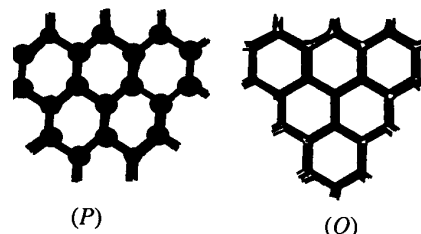
aggregation of a group of cells (of the same type) / cells bound by a matrix / a group of cells adapted to perform a specific function (01 mark)

(D) (i) The diagrams illustrate collenchyma and sclerenchyma tissues.

(a) Which diagram shows the cross section of the sclerenchyma tissue? ...Q..... (01 mark)

(b) State a characteristic which you used to identify that tissue.

- Cell walls thickened uniformly / The corners of the collenchyma cells are thickened but not in sclerenchyma. (01 mark)



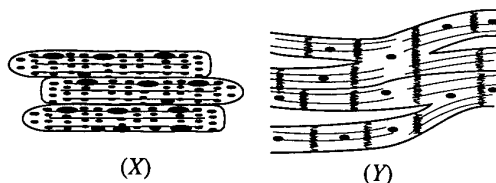
(ii) The diagrams below illustrate the cells of the skeletal muscle tissue and the cardiac muscle tissue.

(a) Which diagram shows the cardiac muscle cells?

...Y..... (01 mark)

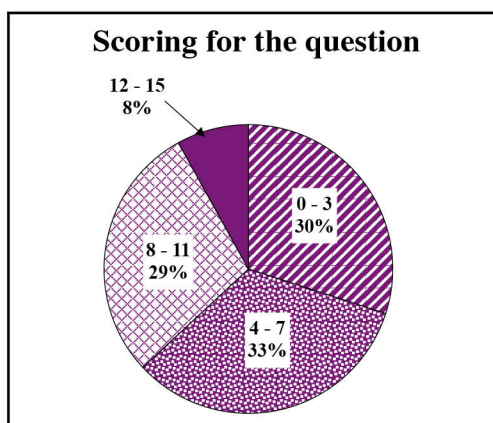
(b) State a characteristic which you used to identify that tissue.

cells are branched / cells with a single nucleus / presence of intercalated / intercalary discs (01 mark)



Total marks - 15

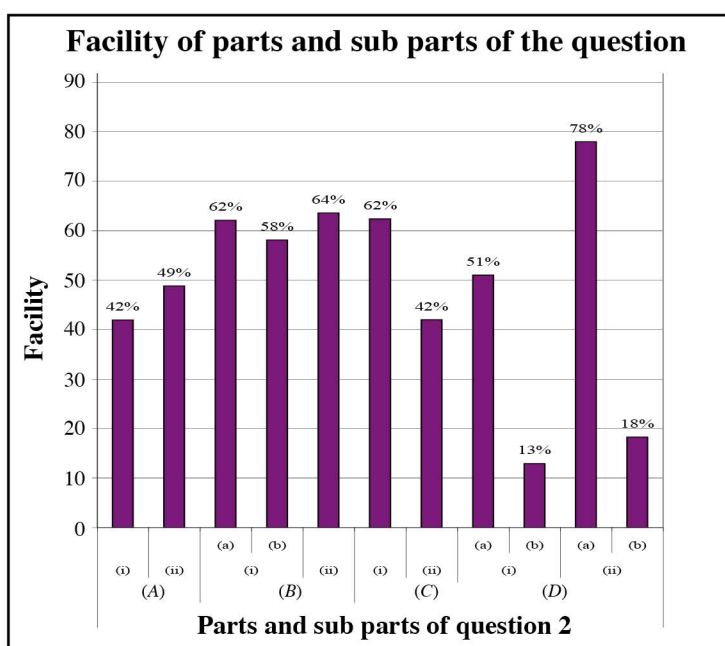
Overall observations and conclusions regarding the answers to Question 2 :



Question 2 is a compulsory question, yet only 98.47% have answered it. The percentages of candidates scoring within the selected intervals are:

0 - 3	–	30%
4 - 7	–	33%
8 - 11	–	29%
12 - 15	–	8%

8% have scored above 12 for this question while 30% have scored less than 3.



The question is composed of 11 sub parts of which 7 report a facility greater than 42%. Sub part (D)(ii)(a) had been the easiest and its facility is 78%. The most difficult sub part (D)(i)(b) has a facility of 13%.

Of 15 marks allocated to this question belonging to the field of Biology, 30% receiving marks in the interval 0 - 3 is not satisfactory.

Facility of sub part (A)(i) is 42%. When classifying objects or living beings, criteria relating to pattern - building need to be identified. In applying such an identified criterion in building up a dichotomous key, inadequacy of students' understanding in using the relevant feature and the opposite of it is evident.

49% is the facility of sub part (A)(ii). Notwithstanding knowledge is imported from the lower grades on this basic concept used in the classification, of plants, the students have failed to apply it in evaluation. The 'yes' and 'no' concept of the dichotomous key should be developed. It should also be stressed that only external features should be used in this context.

Facility of sub parts (B)(i)(a) and (i)(b) are 62% and 58% respectively. Students have taken a commendable effort to use the knowledge and understanding in classification and the understanding related to the standards/rules to be followed therein should be promoted further.

Facility of sub parts (D)(i)(a) is 51%. Sub parts (D)(i)(b) holds facility of 13% while the facilities of sub part (D)(ii)(b) is at a low level of 18%. This witnesses that the ability of analytical thinking essential for using appropriately the features identifiable in tissues is at a low ebb.

In sub parts (D)(i)(b) students have identified the sclerenchyma tissue but they were unsuccessful in identifying and describing the feature that helped its identification. When identifying one out of a given set, student have not understood that characteristics should be stated comparatively rather than stating singly.

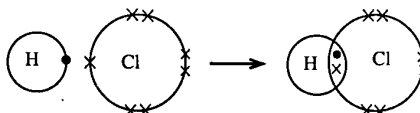
In sub parts (D)(ii)(b), though the cardiac muscle tissue was identified correctly, candidates have stated that 'muscles are branched' in place of muscle cells. So, it is important that they should be realized it is the cells that are branched.

Objectives for Question 3

- To examine the knowledge about the chemical bond in the HCl molecule.
- To examine the ability of classifying chemical reactions.
- To examine the knowledge about the isotopes of an element.
- To examine the skill of determining the relative molecular mass.
- To examine the understanding about the ionisation of HCl in aqueous solution.
- To examine the knowledge about the acidic/basic nature of various substances.
- To examine the knowledge about food preservatives.
- To examine the ability of determining the quality of packaged food.
- To examine the knowledge and understanding about the expected uses of different packing materials.

Question 3

3. (A) The dot and cross diagram illustrates how a hydrogen chloride molecule (HCl) is formed by the combination of a hydrogen atom (H) and a chlorine atom (Cl). Given below are some statements with regard to the phenomenon illustrated by the diagram. Select from the words given within brackets the most suitable word for the blank space in each statement and **underline** it.



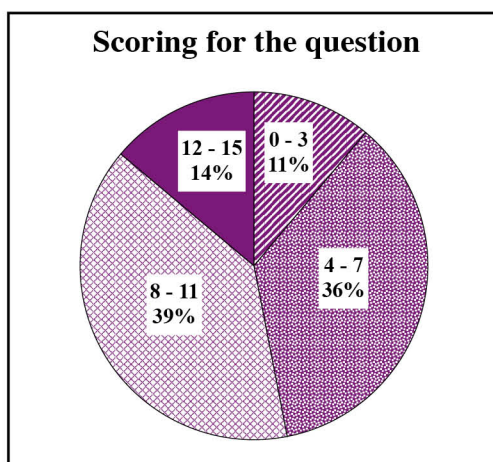
- The HCl molecule is formed by the(01)..... (covalent / ionic / intermolecular) bond formed between a H atom and a Cl atom.
 -(01)..... (Protons/Neutrons/Electrons) participate in the above bond.
 - HCl can be produced by the(01)..... (decomposition / combination / displacement) reaction taking place between hydrogen gas and chlorine gas.
 - A HCl molecule can be formed by the combination of a ${}^1_1\text{H}$ or ${}^2_1\text{H}$ or ${}^3_1\text{H}$ atom and a ${}^{35}_{17}\text{Cl}$ or ${}^{37}_{17}\text{Cl}$ atoms. These symbols designate the(01)..... (allotropic forms / isotopes / polymers) of those elements.
 - A ${}^1_1\text{H}$ atom and a ${}^{37}_{17}\text{Cl}$ atom participated to form the above HCl molecule. The relative molecular mass of that HCl molecule is(01)..... (18/36/38).
 - Pure HCl liquid is composed of HCl molecules. But in the aqueous solution the HCl molecules are dissociated into(01)..... (H^+ / H^- / H^{2+}) ions and(01)..... (C^+ / Cl^- / Cl^{2-}) ions. (07 marks)
- (B) The table presents information on some domestically used chemical substances/food materials and their packing materials.

Chemical substance/Food materials	Packing material
(A) Margarine	(a) oil paper and cardboard
(B) Canned fish	(b) tin-coated iron
(C) Vinegar	(c) plastic
(D) Soap	(d) polythene - coated paper
(E) Antacid tablets	(e) thin aluminium foil sandwiched between two layers of an artificial polymer

- From the **chemical substances/food materials** given in the table, select **one** that matches with each of the following descriptions and write the corresponding letter on the dotted line opposite each.
 - Turns blue litmus red C
 - Shows basic properties D/E
 - Produced by reacting strong bases such as NaOH with plant/animal fat D
 - Contains artificial antioxidants A
 - Not suitable to buy if the container is distorted B (05 marks)
- From the **packing materials** given in the table, select **one** that matches with each of the following descriptions and write the corresponding letter on the dotted line opposite each.
 - Subject easily to biodegradation and chemical decay a
 - Can be recycled easily c
 - Minimises the damages that would be caused by exposure to harmful radiation and water vapour and other active gases b/e (03 marks)

Total marks - 15

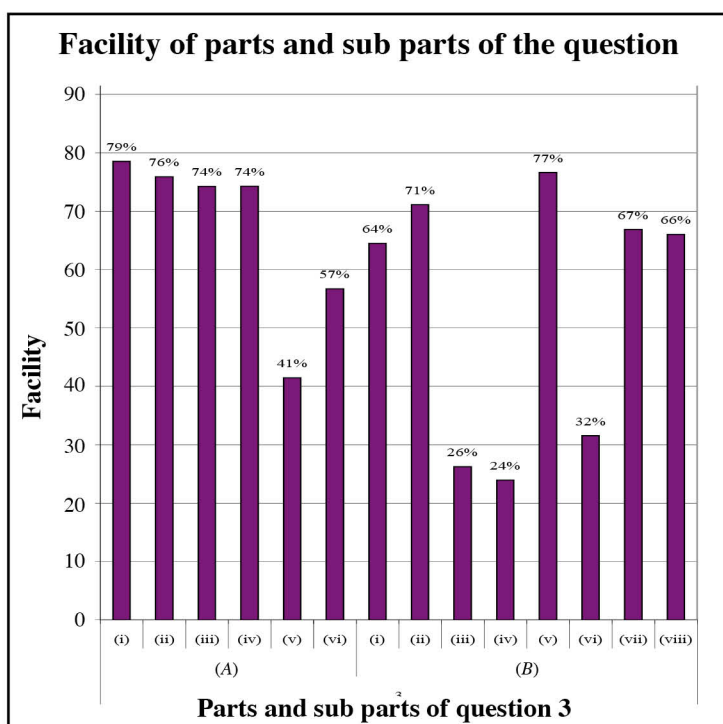
Overall observations and conclusions regarding the answers to Question 3 :



The question 3, also compulsory was responded by 97.56%. The total mark the question embodies is 15. Scoring spreads as follows among the selected intervals:

0 - 3	–	11%
4 - 7	–	36%
8 - 11	–	39%
12 - 15	–	14%

The percentage scoring above 12 is 14% and the percentage scoring below 3 is 11%.



There are 14 sub parts in the question. Of them, the facility of 11 stands above 40%. The easiest sub part (A)(i) holds a facility of 79% while the least facile sub part (B)(iv) has a facility of 24%.

The facility percentages of sub parts (A)(i), (ii), (iii), (iv) lie at an adequate level relative to other sub parts.

41% is the facility of sub part (A)(v). Students are used to use relative atomic masses to calculate the relative molecular masses. But students seem to lack adequate understanding in the fact that the sub atomic particles protons and neutrons are responsible for the mass of an atom and the molecular mass can be found through them.

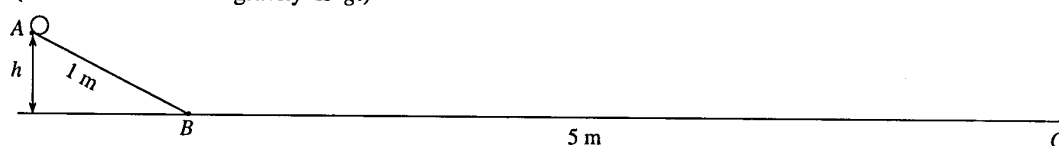
The sub parts (B)(iii), (iv) and (vi) show relatively low facilities 26%, 24% and 32% respectively. Apparently the students have a difficulty in understanding the technical terms in these questions. It is very important to take action to improve the knowledge of technical terms used in science.

Objectives for Question 4

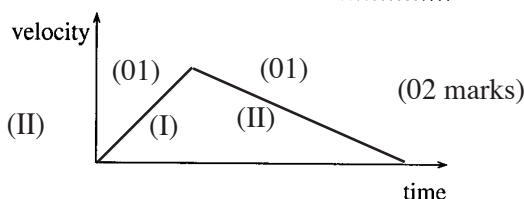
- To examine the knowledge of expressions for kinetic energy and potential energy.
- To examine the understanding and the ability to apply the law of conservation of energy.
- To examine the use of a mathematical expression to find the value of a given physical variable.
- To examine the ability of explaining the impacts on motion.
- To examine the ability of constructing a velocity - time graph corresponding to a motion.
- To examine the understanding about optically denser/rarer media.
- To examine the understanding about the total internal reflection and the critical angle.
- To examine the ability to identify the total angle of rotation when a ray rotates.

Question 4

4. (A) A metal gutter 1 m long is kept inclined to the horizontal ground as shown in the diagram. Its end A is at a height h from the ground. A smooth glass ball of mass m is released from the position A. It slides down the gutter, comes to B, then travels 5 m on the horizontal ground and finally comes to rest at C. (acceleration due to gravity is g .)

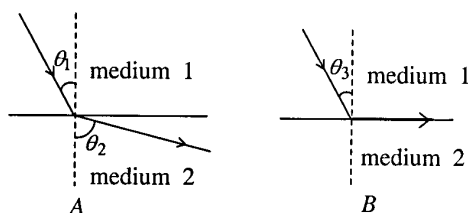


- (i) Using the symbols given, write an expression for the potential energy of the ball at A.
 mgh (01 mark)
- (ii) At B, the velocity of the ball is V . Using the symbols given, write an expression for the kinetic energy of the ball at B.
 $\frac{1}{2} m v^2$ (01 mark)
- (iii) Write a relationship that includes the expressions given in (i) and (ii) above to find V .
 $mgh = \frac{1}{2} m v^2$ (01 mark)
- (iv) If $h = 0.2$ m and $g = 10 \text{ m s}^{-2}$, find the value of V .
 $10 \times 0.2 = \frac{1}{2} v^2$
 $v^2 = 4$
 $v = 2 \text{ m s}^{-1}$ (01 mark)
- (v) State the reason why the glass ball comes to rest at C.
 • friction / loss of energy (01 mark)
- (vi) Sketch the velocity-time graph for the full motion of the ball from A to C.
 Give marks to the graph which indicates an acceleration by part (I) and retardation by part (II)



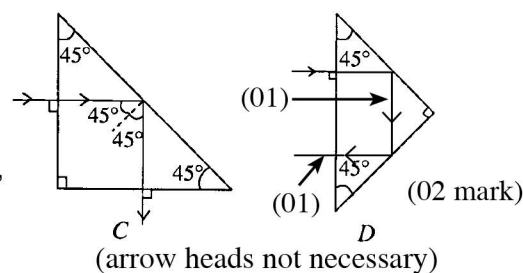
- (B) The figures A and B indicate two instances where light propagates from medium 1 to medium 2.

- (i) Which of these is the optically denser medium?
 medium 1 (01 mark)
- (ii) What is the value of the angle of refraction in figure B?
 90° (01 mark)
- (iii) What special name has been assigned to the angle of incidence θ_3 ?
 critical angle (01 mark)



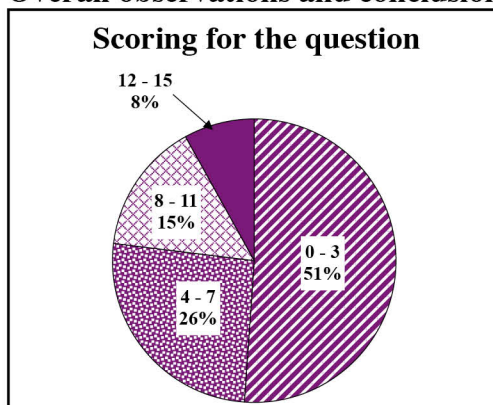
- (iv) For the instance A, ${}_1n_2 = \frac{\sin \theta_1}{\sin \theta_2}$ For the instance B, ${}_1n_2 = \frac{\sin \theta_3}{\sin 90} / \frac{\sin \theta_3}{1} / \sin \theta_3$ (01 mark)

- (v) Figure C illustrates how a 45° prism is used to turn a ray of light through 90° . Less than which value should the critical angle for glass be, if this is to occur?
 (should be less than) 45° (01 mark)
- (vi) If a light ray strikes the same prism as indicated in figure D, draw its path in figure D till it emerges from the prism.
- (vii) What is the full angle through which the ray has turned in the case of D? 180° (01 mark)



Total marks - 15

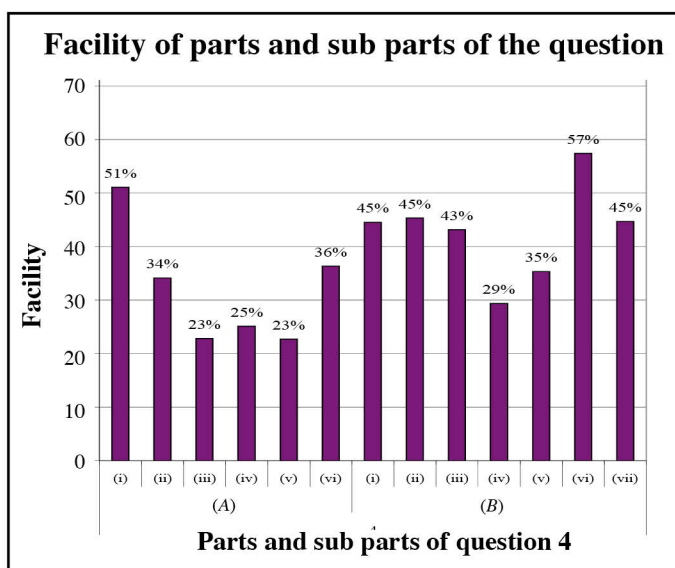
Overall observations and conclusions regarding the answers to Question 4 :



Despite the question 4 is compulsory, it has been responded by 96.62%. The question carries 15 marks. The percentages of scores falling within the selected percentages are:

0 - 3	-	51%
4 - 7	-	26%
8 - 11	-	15%
12 - 15	-	8%

8% have scored above 12 for this question and the percentage getting less than 3 marks is 51%.



The question comprises 13 sub parts. Six sub parts of them have a facility of 40%. Sub part (B)(vi) turns out to be the easiest and has a facility of 57%. Minimum facility (23%) is recorded by two sub parts (A)(iii) and (v).

The facility of sub parts (A)(ii), (iii), (iv), (v) is at a lower level of 35%. Students have shown a difficulty in identifying relevant variables and building up the essential formula and also in computing the quantities using relevant formula and measurements. The facility of (A)(iv), (25%) is greater than that of (A)(iii), (23%). Calculation in (iv) has to be done using the relationship in (iii), so the above result is not realistic. The greater facility of (iv) over that of (iii) would be due to the fact that when figures are substituted in mgh the answer for 'v' is 2. Moreover, the students have failed to identify how the motion of a body would be affected how its motion changes accordingly. Hence, there is a need to write equations showing the relationships among the variables and develop the skill of solving problems using those equations. It is also important to practice the usage of correct units. These skills can be developed by getting students to solve problems of this type as much as possible.

The facility of two sub parts (B)(i) and (ii) stands at 45%. Students have shown a difficulty in identifying rarer and denser media. It is also seen that the understanding about the critical angle and total internal reflection is not adequate.

As regards the sub parts (B)(iv) and (v), the facilities stand at relatively low levels of 29% and 35% respectively. This situation can be overcome by getting the students to use the law of refraction in different occasions and solving problems related to them.

Part B - Essay Questions

- Answer **three** questions, selecting **one** question each from the sections Biology, Chemistry and Physics.

Objectives for Question 5

- To inquire into the understanding about the methods and precautions followed in an scientific experiment.
- To inquire into the attention about the other factors that should be emphasized when arriving at a conclusion using data.
- To inquire into the ability of understanding that the facts disclosed through experiments are valid under certain conditions and limits.
- To inquire into the structure and function of the eye.
- To inquire into the knowledge about the defects of vision and remedies for them.

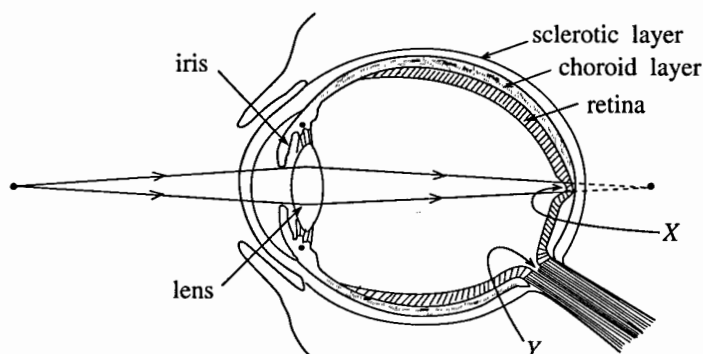
Question 5

Biology

5. (A) An experiment was conducted to study a process by which water is lost from the leaves of dicotyledonous plants. Four identical leaves were taken and labelled *a*, *b*, *c* and *d*. In three of them vaseline was applied as indicated in the table covering their petioles as well. The leaves were then suspended in a dry atmosphere during the day time. The initial mass of the leaves and their mass after four hours were measured and the **difference** is indicated in the table.

Leaf	How treated	The difference in mass after 4 hours/g
<i>a</i>	vaseline applied on both sides of the leaf	0.00
<i>b</i>	vaseline applied only on the upper surface of the leaf	0.70
<i>c</i>	vaseline applied only on the lower surface of the leaf	0.20
<i>d</i>	no vaseline applied on any side	0.80

- (i) The above experiment was designed to study a process by which water is lost from plant leaves. What is that process?
- (ii) Explain why the mass of '*a*' did not change but the mass of '*d*' changed after four hours.
- (iii) The difference in mass in '*c*' was less than that in '*b*'. What is the reason for this?
- (iv) In addition to the process you stated in (i) above, state another means by which water is lost from plant leaves.
- (B) (i) Name a substance that is translocated from the root system to leaves of a plant by the ascent of sap?
- (ii) Name **one** factor that affects the ascent of sap.
- (iii) Through what tissue in plants is food transported?
- (iv) If a woody plant is ring barked (bark removed in the form of a ring), the part of the stem above the ring enlarges after some time. What is the reason for this?
- (C) The diagram illustrates the structure of the longitudinal section of a mammalian eye. It also depicts how the divergent light rays coming from a near object are focussed.



- (i) (a) What is the defect of vision evident in the eye in the diagram?
(b) Name the lens type one has to wear as spectacles to remedy it.
- (ii) (a) Name the sites *X* and *Y* in the diagram.
(b) State separately what the result would be if light rays coming from an object were focussed to the *X* and *Y*.
(c) Explain the reasons for your answer.
- (iii) (a) Name the **two** types of light-sensitive cells that are related to vision and found in retina.
(b) What type of light-sensitive cells could be found in abundance in the retina of nocturnal animals?

5 (A) (i) transpiration / loss of water by transpiration (01 mark)

- (ii) • In "a" transpiration is prevented because stomatal apertures are closed on both sides. (01)
• In "d" transpiration takes place because stomatal apertures are open on both sides. (01)
(02 marks)

- (iii) • There are less stomata on the upper surface / more stomata on the lower surface. (01)
• In "b" transpiration is more because the lower surface is exposed. /
In "c" transpiration is less because the lower surface is covered. (01) (02 marks)

For (ii) and (iii) give marks even if explained in terms of loss of / evaporation of water implicitly showing the knowledge of transpiration.

(iv) guttation / cuticular evaporation / cuticular transpiration (01 mark)

(B) (i) water / mineral salts (01 mark)

(ii) transpiration pull / root pressure / mass flow / cohesive and adhesive force of water / capillarity (01 mark)

(iii) phloem (01 mark)

* (iv) storage of food transported by phloem
(award marks if either attempted or any answer is given) (01 mark)

(C) (i) (a) long sight (01 mark)

(b) convex / convergent lens (01 mark)

(ii) (a) *X* - yellow spot / fovea (01)
Y - blind spot (01) (02 marks)

(b) *X* - gives a clear / acute vision (01)
Y - not seen (01) (02 marks)

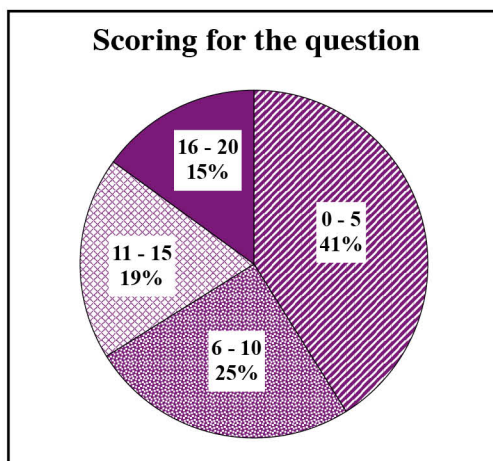
(c) In the yellow spot (fovea) only the light sensitive cells / vision cells /
(only) cones are present (in abundance) (01)
In the blind spot light sensitive cells / vision cells / rods and cones are absent (01)
(02 marks)

(iii) (a) rods and cones (01 mark)

(b) rods (01 mark)

Total marks - 20

Overall observations and conclusions regarding the answers to Question 5 :



75.28% of the candidates have selected this question. Marks allocated for this question are 20. The percentages of students obtaining marks in the following intervals are:

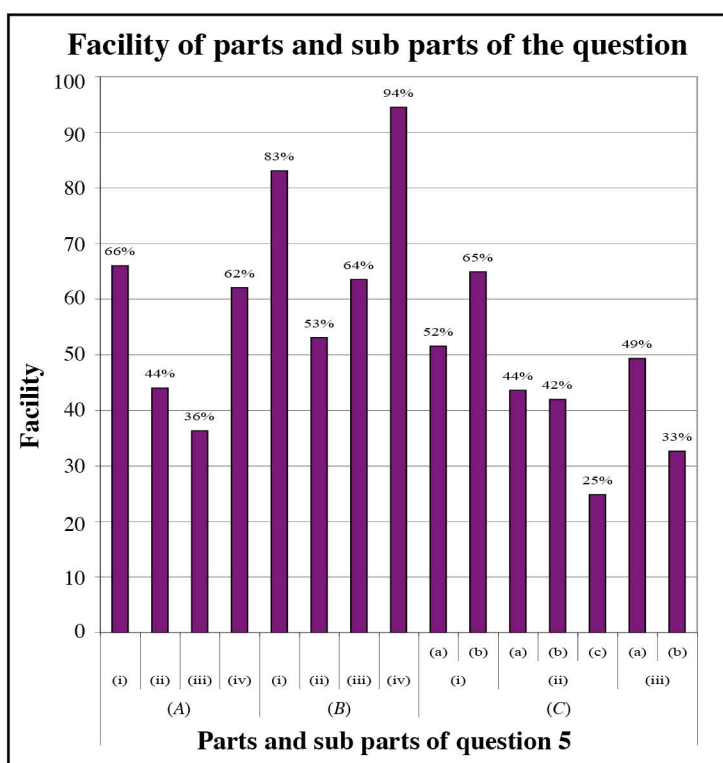
0 - 5 – 41%

6 - 10 – 25%

11 - 15 – 19%

16 - 20 – 15%

15% have scored above 16 for this question while the percentage scoring below 5 is 41%



The question embodies 15 sub parts of which 12 have a facility over 40%. The facility of the three remaining parts is below 39%. The sub part of lowest facility is (C)(ii)(c) and its facility is 25%. The sub part (B)(iv) holds the highest facility of 94%.

The facilities of sub parts (A)(ii) and (iii) are 44% and 36% respectively. Both these sub parts aim to examine how the students arrive at conclusions based on data gathered from experiments. This skill seems to be low in students. The possible reason for this is that the students are not given enough opportunities to practice drawing conclusions from the information collected through practical activities. This situation can be avoided by offering more opportunities to use practical settings for activities.

Sub part (C)(iii)(a) which expects the statement of two types of light-sensitive cells records a facility of 49%. But the facility of sub part (C)(ii)(c) is 25% and the facility of sub part (C)(iii)(b) is 33%. In order to increase the facility of these sub parts, it is important to understand the functions of the respective cell types as well as the locations of the blind spot and the yellow spot. The understanding of the functioning of the eye can also be raised by using diagrams, models and audio-visual media.

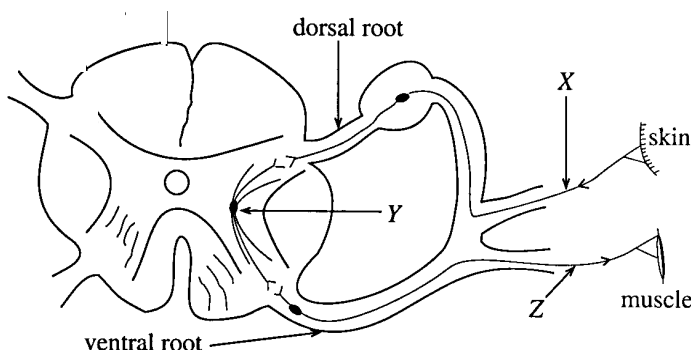
Objectives for Question 6

- To investigate the ability to explain functions according to the features identified through diagrams.
- To inquire into the knowledge in reflex actions and reflex arc.
- To inquire into the ability of representing organisational levels of life by diagrams.
- To inquire into the features relating to the identification of organisational levels of life.
- To inquire into the fertilisation, implantation, gametogenesis and the action of hormones.
- To inquire into the components in blood and their structural and functional relationships.

Question 6

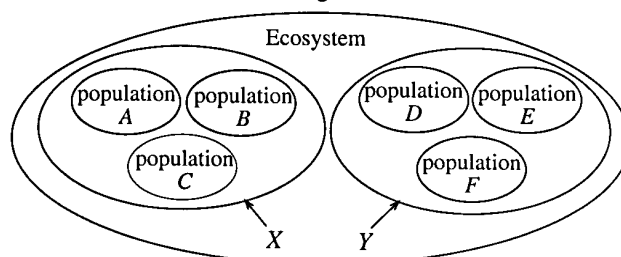
6. (A) The diagram shows a cross section of the spinal cord and the path along which a nervous impulse is transmitted through it.

- Name any **two** of X, Y and Z.
- What is a reflex action?
- In the event the skin of the hand gets burnt, the person immediately pulls the hand away. Write schematically using arrows, the path along which the impulse travels during this reaction.
- Of white matter and grey matter, what lies towards the outer part of the **brain**?



- (B) The diagram illustrates how several organisational levels of life are arranged.

- What is the organisational level indicated by X and Y?
- What are the characteristics of a population?
- Write an example so that the **characteristics** of a population are illustrated.



- (C) Reproduction is the process that ensures the continuous perpetuation (persistence) of all living beings. The production of reproductive cells of humans, the sperms and ova, and many other processes are controlled by hormones.

- Name a hormone that affects the production of ova.
- In which part of the female reproductive system does the fertilisation occur?
- State a function carried out by the placenta for the embryo implanted in the uterus.
- How are the non-identical twins born?

- (D) (i) In Dengue victims, some components in the blood decrease.
- Of them which component decreases most rapidly?
 - What function is performed by that component in blood?
- (ii) Blood groups are classified according to the antigens present in blood cells. Antigens are of three types A, B and Rh. Of these which antigen/antigens is/are contained in the blood group O⁺?

- 6 (A) (i) X - sensory / afferent neuron or sensory / afferent nerve (02 marks)
 Y - intermediate / internuncial neuron / interneuron or intermediate / internuncial nerve
 Z - motor / efferent neuron or motor / efferent nerve
 (one mark each for any two)

- (ii) a sudden response to a stimulus without conscious thought or
 a sudden involuntary / autonomous response to a stimulus

- (iii) • skin $\xrightarrow{(01)}$ sensory / afferent neuron $\xrightarrow{(01)}$ intermediate / internuncial neuron
 muscle $\xleftarrow{(01)}$ motor / efferent neuron $\xleftarrow{(01)}$ intermediate / internuncial neuron
 (03 marks)

OR

- skin $\xrightarrow{(01)}$ X $\xrightarrow{(01)}$ Y $\xrightarrow{(01)}$ Z $\xrightarrow{(01)}$ muscle

- (iv) white matter (01 mark)
 (Give marks for grey matter also / for the error in the diagram)

- (B) (i) community (01 mark)

- (ii) • living within a fixed period of time (01)
 • living in a specific area (01)
 • belonging to the same species (01) (03 marks)

- (iii) For a correct answer stating a geographical area, specified period and a single species
 e.g. Number of deer in Yala sancutuary in the year 2001 (01 mark)

- (C) (i) FSH / Follicle Stimulating Hormone / Oestrogen / Progesterone (01 mark)

- (ii) Fallopian tube (01 mark)

- (iii) • supplying respiratory gases
 • supply of nutrition / nutritive substances / hormones / antibodies
 • removal of excretory / nitrogenous excretory products
 • control of the entry of harmful substances / microorganisms (01 mark)
 (one mark for any one of the above)

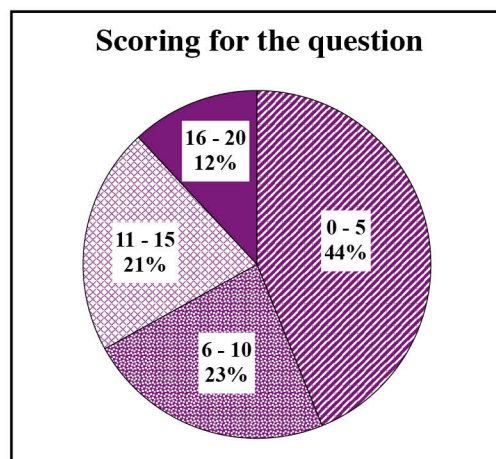
- (iv) By the fertilization of more than one ovum separately. (01 mark)

- (D) (i) (a) platelets (01 mark)
 (b) clotting of blood (01 mark)

- (ii) Rh⁺ / presence of the Rh factor (01 mark)

Total marks - 20

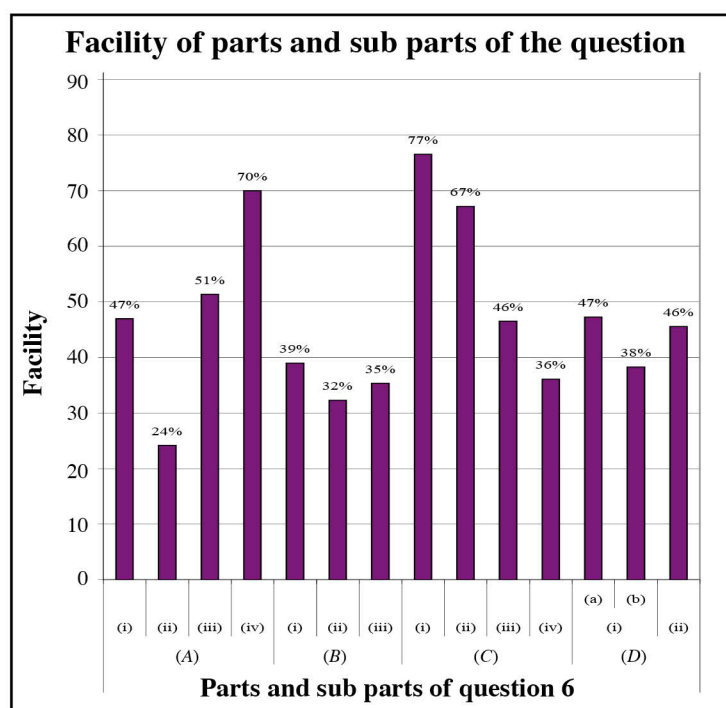
Overall observations and conclusions regarding the answers to Question 6 :



Nearly 22.3% have selected question 6. Of the two Biology questions in section B, this is the less popular. The question carries 20 marks. The percentages of candidates falling into the four selected intervals are:

0 - 5	– 44%
6 - 10	– 23%
11 - 15	– 21%
16 - 20	– 12%

The percentage scoring above 16 for this question is 12% while 44% have scored below 5.



The question comprises 14 sub parts. Of them, 8 sub parts hold a facility above 46%. The most difficult sub parts hold a facility above 46%. The most difficult sub part (A)(ii) reports a facility of 24%. The easiest sub part has been (C)(i). Its facility is 77%.

The facility of sub part 6 (A)(ii) is 24%. The facility of its sub parts (i) and (iii) is also low. Failure is noticeable in identifying the parts and their functions using the diagram. This implies that students have not acquired an adequate knowledge and understanding relating to reflex actions and the reflex arc during the learning teaching process. It is also important that appropriate technical terms are used in occasions such as the introduction of the reflex arc. It is also important to make students recall that there are spinal reflexes as well as cerebral reflexes and all reflexes occur quickly without consciousness or thinking.

The facility of sub parts (B)(i), (ii), (iii) - i.e. 39%, 32% and 35% are closer in magnitude. Students display a weakness in identifying the knowledge conveyed through a figural or mathematical presentation and build up the organisational levels sequentially. The low facility for (B)(ii) may be due to not stating all the features of a population when it is stated.

The facility of (C)(iv) is relatively low (36%) probably due to the gaps in the understanding of the correct description of identical twins and non - identical twins.

Part 6(D)(i) is based on the current problem, Dengue fever. But the correct answer has been overlooked for the incompleteness in understanding of the complications caused by it and the composition and functions of blood. This has led to the lowering of the facility index of (D)(i).

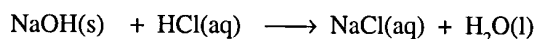
Use of learning aids such as appropriate diagrams will make students understand the subject matter better,

Objectives for Question 7

- To examine the knowledge and understanding on reaction rates and the factors affecting it.
- To examine the understanding about how factors affecting the results can be controlled when conducting an experiment.
- To examine the knowledge about the classification of chemical reactions.
- To examine the knowledge about the simple tests for identifying gasses.
- To examine the ability of arriving at conclusions logically based on observations.
- To examine the ability of designing a simple experiment.
- To examine the knowledge on the practical use of simple chemicals.

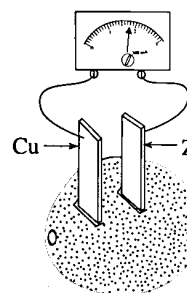
Question 7

7. (A) An experiment was designed to determine the heat change associated with the following chemical reaction.



In the experiment, 50 cm³ of a dilute HCl solution were taken into a beaker and 2 g of solid NaOH were added to it. Then the mixture was stirred so that the reactants mixed well. The initial temperature of the mixture and the maximum temperature of it were recorded.

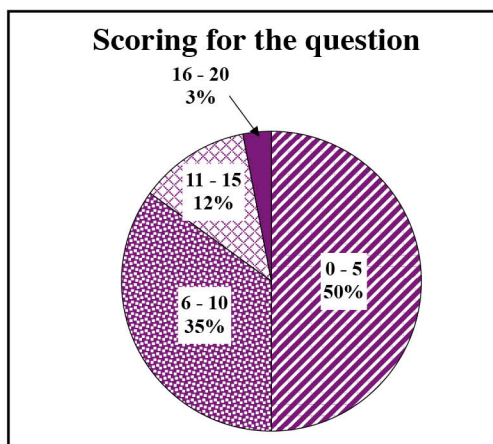
- State an evidence in support of the fact that a chemical reaction between NaOH and HCl occurred here.
 - Taking the mass of the reaction mixture as m , its specific heat capacity as c and the observed temperature change as θ , write an equation to calculate the heat change Q occurred in the beaker.
 - What is the amount of NaOH used for the experiment in moles? (Na = 23, O = 16, H = 1)
 - The heat change occurred in the beaker during the experiment was 3 kJ. What would be the heat change when 1 mole of solid NaOH completely reacts with a dilute HCl solution?
 - This experiment conducted in the school laboratory is based on several assumptions. State **one** assumption made in each of the following instances.
 - Determining the mass of the solution.
 - Assigning a value for the specific heat capacity of the solution.
 - Rise in the temperature of the reaction mixture.
 - The above experiment is erroneous due to loss of heat. Suggest a measure that can be taken to minimise this error when conducting this experiment in the school laboratory.
- (B) Two plates of Zn and Cu were pushed into a lime closer to but without touching each other and connected to a galvanometer as shown in the diagram.
- State the observation which confirms that electricity is produced by the interaction of metals with the contents of the lime.
 - The above set up demonstrates a simple cell. In this cell, name the items that function as the following components.
 - cathode
 - anode
 - electrolyte
 - From which to which metal plate does the electron current flow in the simple cell demonstrated? Give reasons for your answer.



- 7 (A) (i) increase in temperature (of the reaction mixture) / evolution of heat / heating of the beaker (02 marks)
- (ii) $Q = m c \theta$ (02 marks)
- (iii) Molar mass of NaOH = $(23 + 16 + 1)$
 = 40 g mol^{-1} (01)
 Amount of moles of NaOH used = $\frac{2(\text{g})}{40(\text{g mol}^{-1})}$ (01)
 = 0.05 mol (02 marks)
 (Give 02 marks for the correct answer also)
- (iv) Heat change associated with 0.05 moles of NaOH = 3 kJ
 Heat change associated with 1 mole of NaOH = $\frac{3(\text{kJ})}{0.05(\text{mol})} \times 1(\text{mol})$ (01)
 = 60 kJ (01) (02 marks)
 (No marks if the unit is missing)
- (v) (a) Density of the reaction mixture / solution is equal to the density of water. (01 mark)
 (b) Specific heat capacity of the solution is equal to that of water. (01 mark)
 (c) All the heat produced by the reaction is used to raise the temperature of the solution / No heat is lost. (01 mark)
 For (a), (b) and (c) give marks even though these ideas are expressed in different words.
 e.g. Density of the solution is 1 g cm^{-3} .
- (vi) Covering the reaction mixture with an insulating material (Also give marks for stating an example for a heat insulating material) (02 marks)
- (B) (i) Deflection of the galvanometer pointer (01 mark)
- (ii) (a) Cu plate (01 mark)
 (b) Zn plate (01 mark)
 (c) lime (juice) / citric acid (01 mark)
- (iii) From Zn to Cu (01)
 Zn is more reactive / Zn gets oxidised / Zn is converted to Zn^{2+} (01).
 The electrons removed by Zn flow to the Cu plate. (01) (03 marks)

Total Marks - 20

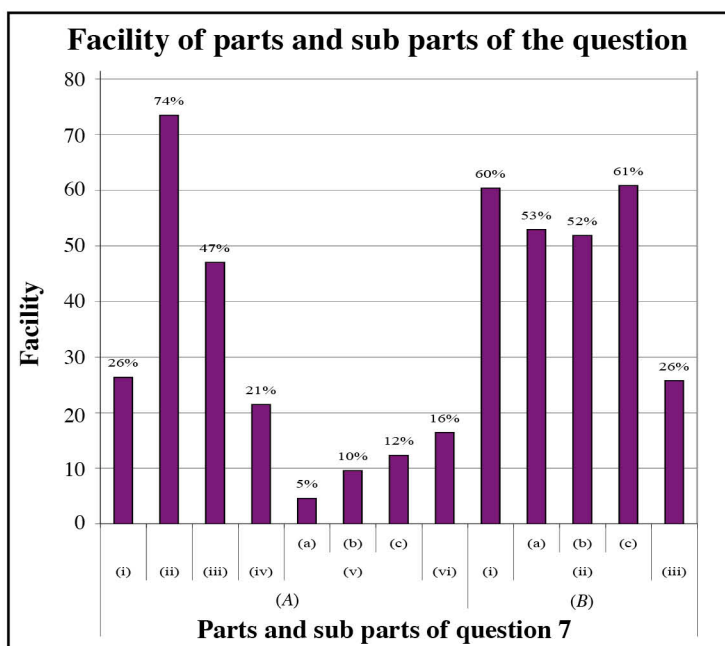
Overall observations and conclusions regarding the answers to Question 7 :



The percentage selecting question 7 is 27.53%. Of the two Chemistry questions in part B, this is the one selected by less number of candidates. Allocated to this question are 20 marks. The following percentage of candidates have scored within the given intervals for this question.

0 - 5	–	50%
6 - 10	–	35%
11 - 15	–	12%
16 - 20	–	3%

As regards this question, 3% have scored above 16 while 50% have scored below 5.



The question consists of 13 sub parts. Of them 6 sub parts have a facility greater than 47%. The sub parts of highest facility is (A)(ii) and its facility is 74%. The sub part of lowest facility is (A)(v)(a) and its facility is 5%.

Of the two Chemistry question in the paper, only a low percentage (27%) have selected this question. Of the total 20 marks only 3% have scored within the range 16 - 20.

Facility of sub part (A)(i) is 26%. In this activity, the only evidence for a chemical reaction to occur is the change in temperature. Though the information provided includes this, students have failed to identify it. Causing their irrelevant answers.

Facility of sub part (A)(iv) is 21%. A weakness is shown in calculating the changes in heat energy corresponding to the amount of moles.

Facilities for sub parts (A)(v)(a), (b), (c) - 5%, 10% and 12% respectively - are also low. Though practical activities are carried out in laboratories, lack of an understanding in students about the assumptions made and occasions in which they should be used due to postponement of calculations after taking readings would be the probable reason for this. Therefore, students should be directed to do the necessary calculations, every occasion this kind of activities are conducted. It is important that mostly assumptions are made when an experiment/activity is designed and to emphasize that they are 'assumptions'.

The facility of sub part (A)(vi) is also 16%. Students' level of understanding about the ways of minimizing heat loss is low. Thus the necessary concepts should be built at the very moment the activities are carried out.

The facility of sub part (B)(iii) is 26%. The reason for this is the failure of students to explain the reason though they know from which to which electrodes the electrons flow. Hence it is necessary to explain to students how the difference in reactivity of the two metals affects the flow of electrons at the very occasion of doing the practical activity for demonstrating the action of a simple cell. It should be explained that the flow of electron pressure/potential to that at a lower level.

Objectives for Question 8

- To examine the understanding of homogeneous and heterogeneous mixtures.
- To examine the knowledge relating to different ways of expressing the composition of mixtures.
- To direct to calculate the composition of a given mixture.
- To examine the understanding for selecting laboratory equipment to suit the need.
- To examine the knowledge about the composition and building unit of rubber.
- To inquire into the knowledge about the metrolac used in rubber industry.
- To examine the knowledge about the chemical used to coagulate rubber.
- To inquire into the knowledge about the chemical substances used to vulcanize rubber.

Question 8

8. (A) Given below are information as regards several mixtures prepared by a group of students.

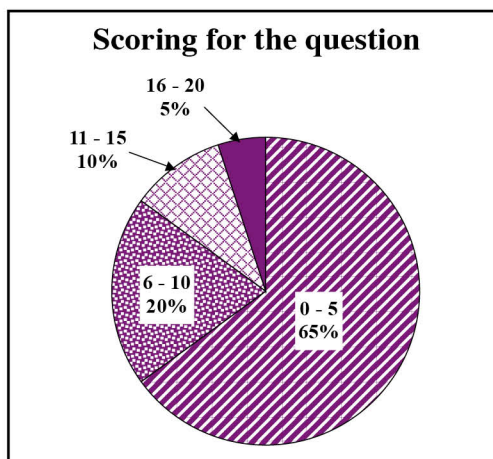
Mixture	Method of preparation
A	Adding some powdered chalk to a test tube about half filled with water and shaking thoroughly.
B	Adding 1 - 2 drops of coconut oil to a test tube about half filled with water and shaking thoroughly.
C	Taking 15.00 cm ³ of alcohol to a 100 cm ³ volumetric flask, adding water till the total volume was 100.00 cm ³ and mixing well.
D	Dissolving 25 g of sugar in 175 g of water completely.
E	Adding 18.00 g of glucose (C ₆ H ₁₂ O ₆) to a 250 cm ³ volumetric flask, adding water till the total volume was 250.00 cm ³ and mixing well.

- (i) Of the above mixtures, give **two** examples for heterogeneous mixtures.
- (ii) As per the data given, what is the best method to express the composition of the mixture C?
- (iii) What is the composition of the mixture D as a percentage by weight (w/w %)?
- (iv) What is the amount of glucose in moles, used to prepare the solution E? (H = 1, C = 12, O = 16)
- (v) What is the concentration of the solution E?
- (vi) Name the instrument/instruments that should be used for the following:
- (a) To measure 15.00 cm³ of alcohol very accurately to prepare the solution C.
- (b) To transfer completely the 18.00 g of glucose weighed in a watch glass to the volumetric flask in preparing solution E.
- (c) To measure out very accurately a sample of 25.00 cm³ from the volumetric flask that contains the solution E prepared.
- (B) Natural rubber is obtained from the latex of the rubber tree. Rubber is a polymer.
- (i) What organic compound produces natural rubber on polymerization?
- (ii) Apart from rubber, write **two** other components present in rubber latex.
- (iii) What property of rubber latex is measured by the metrolac?
- (iv) Name a chemical substance that can be used to coagulate rubber latex.
- (v) Elasticity of rubber is improved by vulcanization. What is the element mainly used to vulcanize rubber?

- 8 (A) (i) A and B (02 marks)
- (ii) As a ratio / percentage by volume / $\frac{V}{V}$ / $\frac{V}{V}$ % (02 marks)
- (iii) $\frac{W}{W} \% = \frac{25(g)}{200(g)} \times 100$ (01) = 12.5% (01) (02 marks)
- (iv) $(12 \times 6) + (1 \times 12) + (16 \times 6) = 180 \text{ g cm}^3$ (01)
 $\frac{18(g)}{180(g \text{ mol}^{-1})} = 0.1 \text{ (mol)}$ (01) (02 marks)
- (v) $\frac{0.1 \text{ (mol)} \times 1000(\text{cm}^3 \text{ dm}^{-3})}{250(\text{cm}^3)}$ (01) = 0.4 mol dm^{-3} (01)
 For the correct unit even if the numerical answer is wrong. (01)
 (Also give marks for giving the concentration as, $\frac{0.1 \text{ mol}}{250 \text{ cm}^3} = 0.004 \text{ mol cm}^{-3}$) (03 marks)
- (vi) (a) burette / graduated pipette / (suitable) measuring cylinder (01 mark)
 (b) funnel and wash bottle (01 each) (02 marks)
 (c) pipette (01 mark)
- (B) (i) isoprene / 2-methylbuta-1,3-diene / $\text{CH}_2 = \underset{\text{CH}_3}{\text{C}} - \text{CH} = \text{CH}_2$ (01 mark)
- (ii) resin / water / sugar / protein (01 each for any two) (01 mark)
- (iii) density / Dry Rubber Content / DRC (01 mark)
- (iv) formic acid / acetic acid / (dilute) acids / a named acid (01 mark)
- (v) Sulphur / S (01 mark)

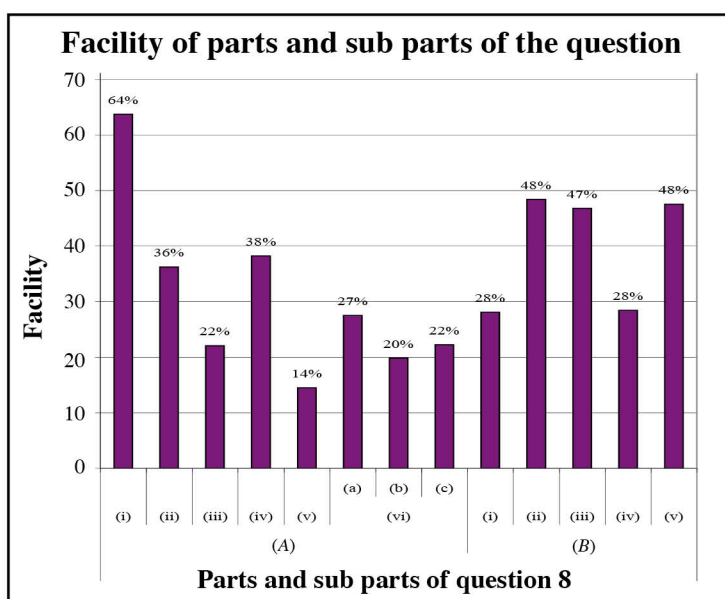
Total marks - 20

Overall observations and conclusions regarding the answers to Question 8 :



65.05% have selected question 8 which embodies 20 marks. The percentage of candidates whose marks fall into the four selected intervals are:

0 - 5	- 65%
6 - 10	- 20%
11 - 15	- 10%
16 - 20	- 5%



The question breaks down into 13 sub parts of which 4 have a facility greater than 47%. The sub part of lowest facility is (A)(i) and its facility is 64%. Least facile part (A)(v) holds a facility of 14%.

Though about 65% of the candidates have had this question in their choice, the facility percentages for the sub parts are not at a satisfactory level.

Facility percentages for the sub parts (A)(ii), (iii), (iv) and (v) are 36, 22, 38 and 14 percent respectively. All these parts have queried into the understanding relating to the methods of giving the composition of a solution and calculations based on them. It is apparent that students have not captured adequately the, knowledge relating to this aspect in their learning teaching process. The very low facility percentages they have received for sub parts (A)(vi)(a), (b), (c) witness the fact that the practical activities conducted in the laboratory to develop the skill of preparing solutions with known concentrations have not contributed to promote the knowledge and understanding of students. They also are poor in identifying the correct equipment.

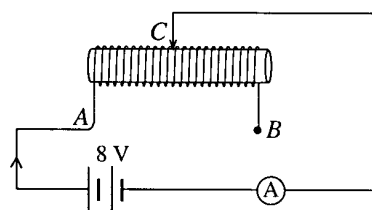
Part (B) inquires into the knowledge on the substances and the methods used in the production process of the rubber industry and how the quality of the products are improved. The facility of all the sub parts related to this is at a level less than 50%. Hence it is evident that the knowledge given only by classroom teaching is not adequate to realize the object in this regard. So, organizing field trips to relevant factories are recommended to strengthen students' knowledge whenever possible.

Objectives for Question 9

- To examine the understanding about how the nature of surfaces affects the absorption of radiation.
- To examine the understanding on how the quantity of heat supplied and the thermal capacity affect the increase in temperature.
- To examine whether the students can identify as the principle of the rheostat the fact that the resistance of a conductor can be changed by changing its length.
- To examine the skill of connecting the equipment of an electrical circuit correctly.
- To examine whether Ohm's law can be correctly used to solve a problem.

Question 9

9. (A) A variable resistor is made by winding a nichrome wire around a plastic tube so that the turns are close but not touching one another. The terminal *C* can be slid along the coil keeping the contact with it. A battery and an ammeter are connected to this resistor as shown in the diagram.



- To which terminal of the ammeter should the negative terminal of the battery be connected?
 - What sort of a change would the ammeter show when the terminal *C* is moved towards *A*?
 - Explain the reason for the change in current displayed by the ammeter reading.
 - At a certain position the resistance of the coil from *A* to *C* was $6\ \Omega$. At that position, what would be the ammeter reading?
 - Explain why the metal copper is **not** suitable to make resistors like this.
- (B) *A* and *B* are two aluminium vessels and *C* and *D* are two styrofoam (rigiform) vessels similar to them. Added into those vessels are equal volumes of water at 30°C . The vessels are closed with wooden lids each fixed with a thermometer. The outer surfaces of them are painted as indicated in the table. The vessels were kept in an open place so that they all received sunlight equally. When the temperature of *A* had risen to 35°C , the temperatures of other vessels T_B , T_C and T_D were read and recorded.

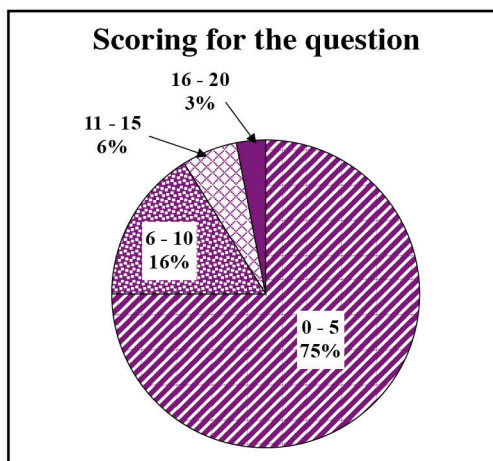
Vessel	Substance made up of	Colour of the outer surface	Final temperature/ $^\circ\text{C}$
<i>A</i>	aluminium	white	35
<i>B</i>	aluminium	black	T_B
<i>C</i>	styrofoam	white	T_C
<i>D</i>	styrofoam	black	T_D

- Of the vessels *A* and *B*, which shows the highest temperature?
 - Give reasons for your conclusion.
- In vessels *C* and *D*, the temperature didn't rise considerably during the time of the experiment. Explain the reason for this observation.
- The specific heat capacity of a liquid is less than that of water. Suppose a mass of this liquid equal to that of water was added to a vessel identical to *A*. Then, during the time of the experiment, would the temperature reached by *A* be less than or more than or equal to 35°C ?
 - Give reasons for your answer.
- In what way does the heat required to raise the temperature of water get transferred from the sun to the vessel?

- 9 (A) (i) negative / – (terminal) (02 marks)
- (ii) (a) increases (01)
(b) (increase in current) due to decrease in resistance (02) } (03 marks)
- (iii) $V = IR$
 $8 = I \times 6$ (01)
 $I = \frac{8}{6}$
 $I = 1 \frac{1}{3} \text{ (A)} / 1.33 \text{ (A)}$ (01) } (02 marks)
- (iv) Resistivity (of copper) is less / conductivity (of copper) is more (than that of nichrome) (02 marks)
- (B) (i) (a) B (01)
(b) Because black surfaces absorb more (heat) radiation. (02) } (03 marks)
- (ii) Because styrofoam is a (heat) insulator / not a conductor (of heat) / poor conductor (of heat) (02 marks)
- (iii) (a) more (than 35 °C) (01)
(b)
- Since the liquid has a lower specific heat capacity, the heat capacity (01)
of that volume mass of liquid is lower. When equal quantity of heat is supplied,
the (01) (01)
temperature of that volume / mass of liquid rises more. (04 marks)
- OR
- When the same quantity of heat is supplied to two equal masses of liquids, (01) (01)
temperature rises more in the liquid of lower specific heat capacity. (01)
- For (a) and (b) also award marks as follows provided the reason in (b) conforms to the answer for (a).
- (a) equal (to 35 °C)
(b) vessel A was not changed
- (iv) (As) radiation / heat radiation / infrared radiation / IR (02 marks)

Total marks - 20

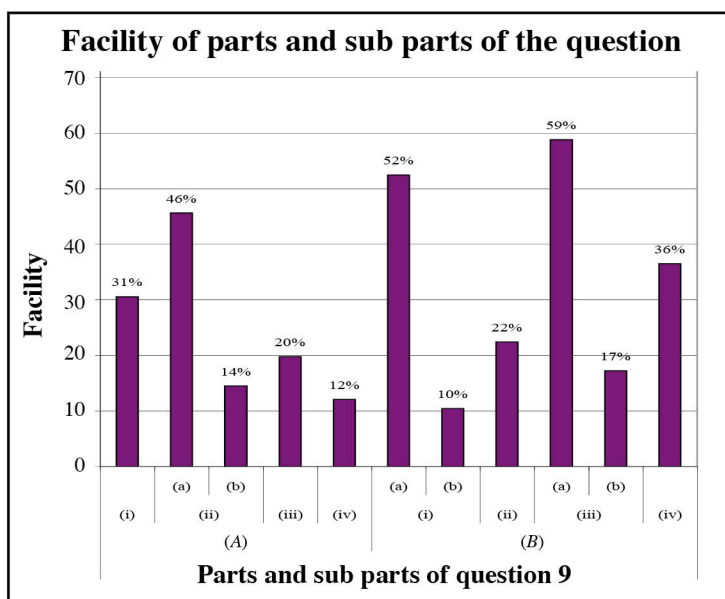
Overall observations and conclusions regarding the answers to Question 9 :



The percentage of candidates answering this question is 69.35%. The question carries 20 marks. The percentage obtaining marks in the following four intervals are:

0 - 5	- 75%
6 - 10	- 16%
11 - 15	- 6%
16 - 20	- 3%

3% have scored above 16, but 75% have obtained less than 5 marks for this question.



The question has 11 sub parts of which 3 records a facility greater than 46%. The most difficult sub part (B)(i)(b) of this question holds a facility of 10% while 59% is the facility of the easiest sub part, (B)(iii)(a).

The percentage choosing this question is 69.4%. Marks allocated to the question is 20. 91% of the students have scored less than 10 for this question.

The sub parts of (A) facilities equal to or less than 46%. The skills of constructing circuits using equipment and getting readings from them have not been developed adequately. Weaknesses are also evident in identifying relationships using the readings taken. Also the students are less skillful in calculations substituting correct figures in the relationships derived. It is necessary that the students are engaged in practical activities for developing practical skills related to the construction of circuits correctly using equipment and taking readings from them. Developing the skill of analysing an event and drawing conclusions from it is also a requirement. The minimum facility (12%) in part A is for sub part A (iv). The probable reason for this is the difficulty in understanding the difference between the resistance and resistivity.

The facility percentage of sub part (B)(i)(b) is 10%. The reason for this is not acquiring knowledge and understanding about how the nature of a surface affects absorption of radiated heat through relevant activities.

Facility of sub part (B)(ii) is 22%. Students have not understood that styrofoam which is a thermal insulator does not conduct heat.

Facility of sub part (B)(iii)(b) is also low (19%). Incompleteness of knowledge and understanding about the effect of specific heat capacity and thermal capacity on the change of temperature has caused this.

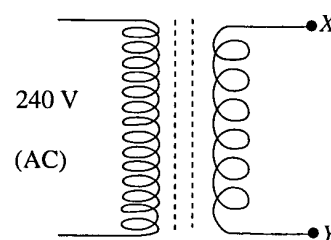
The subject matter can be better conveyed to the students by incorporating model practical experiments into the classroom learning - teaching process and relating them to real life situations.

Objectives for Question 10

- To examine the understanding of the principle and application of a transformer.
- To examine the ability to calculate the output potential of a transformer.
- To examine the understanding about the need of using transformers in transmitting power.
- To examine the understanding of how diodes act in rectifying circuits.
- To examine the understanding of the differences between a direct current produced by a battery and a direct current produced by a rectifier circuit.
- To examine the knowledge about how a capacitor is practically used to minimize the above difference.
- To examine the ability to explain correctly how each diode of a rectifier circuit contributes to rectification.

Question 10

10. (A) Given in the diagram is a transformer used in power packs for the purpose of obtaining a potential difference of 6 V from a 240 V alternating current (AC) supply.

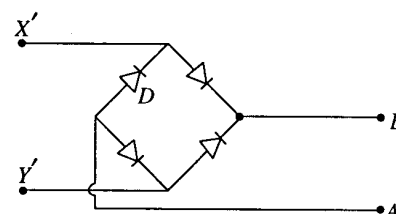


- To what type does this transformer belong?
- On what principle of physics is the transformer made?
- In a transformer the 'turns ratio' $\left(\frac{N_p}{N_s}\right)$ is equal to the potential

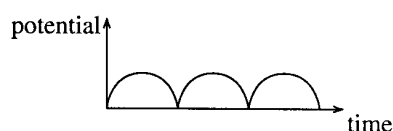
difference ratio $\left(\frac{V_p}{V_s}\right)$. In the above transformer, if the number of turns in the coil to which 240 V are supplied is 1200, calculate the number of turns there should be in the secondary coil.

- When transmitting energy from power houses to the national grid, step up transformers are used. What change is effected by this when transmitting the current generated in a power house?
 - What is the advantage brought about by this?
- In some power packs resistors are used in place of the transformer. State one **disadvantage** of such a usage.

- (B) A direct current power supply is made by connecting the terminals X' and Y' of a diode bridge circuit to the X and Y terminals of the above transformer.



- What is the advantage of using a four diode bridge instead of a single diode for rectification?
- In this, a voltmeter is connected across A and B to measure the output voltage. Of the terminals A and B, to which end should the positive terminal of the voltmeter be connected?
- The graph shows how the output voltage of the circuit changes with time. Indicate by a graph, how the direct current voltage obtained from a battery varies against time.
- In order to minimise the variation of the output voltage given by the rectifier circuit, **what** equipment should be connected to the power supply circuit and **how** should it be connected?



10 (A) (i) Step down (transformer)

(01 mark)

(ii) electromagnetic induction

(02 marks)

(iii) $\frac{N_p}{N_s} = \frac{V_p}{V_s}$

$$\frac{1200}{N_s} = \frac{240}{6} \quad (01)$$

$$N_s = \frac{1200 \times 6}{240} = 30 \quad (01)$$

} (02 marks)

(iv) (a) Current is decreased / Potential difference is increased /
Voltage is increased (01)

(b) (During transmission) the loss of energy (in the form of heat)
is reduced (02)

} (03 marks)

(v) (A greater) heat / power loss occurs.

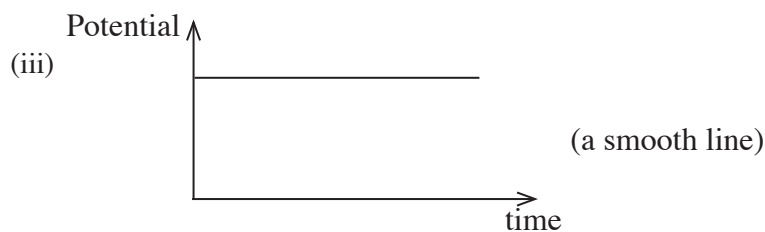
(02 marks)

(B) (i) Complete rectification of the wave / Rectification of both halves of the wave.

(02 marks)

(ii) (To terminal) B

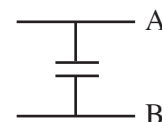
(01 mark)



(02 marks)

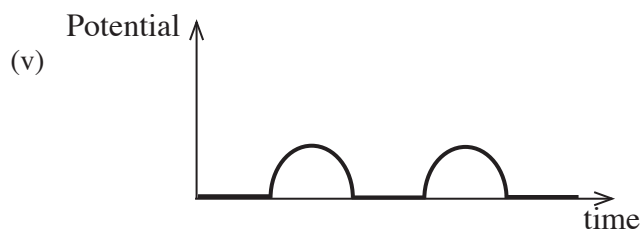
(iv) A capacitor / condenser should be connected (01)
(parallel) to the terminals A and B. (02)

OR



for the diagram } (03)

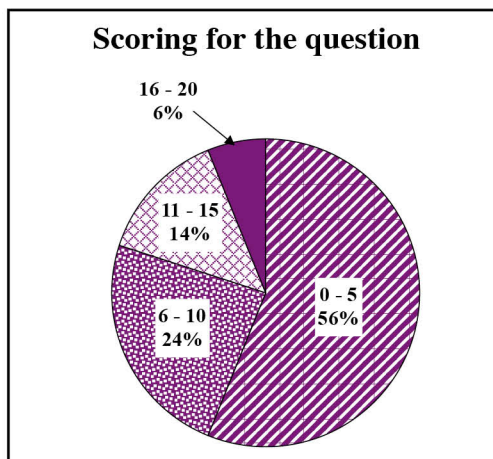
(A and B may change)



(02 marks)

Total marks - 20

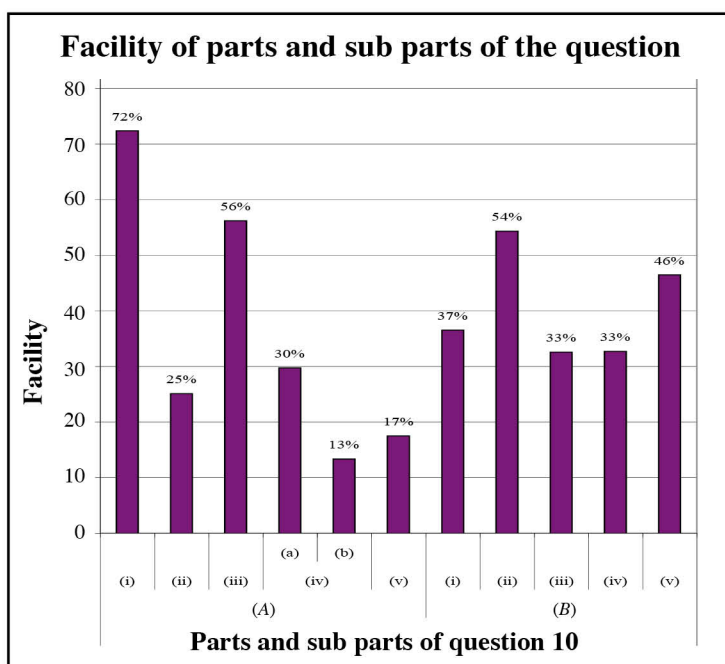
Overall observations and conclusions regarding the answers to Question 10 :



The percentage of candidates who have chosen question 10 is 20.78%. The percentage obtaining marks in the respective intervals are:

0 - 5	–	56%
6 - 10	–	24%
11 - 15	–	14%
16 - 20	–	6%

The percentage scoring above 16 for this question is 6% whereas the percentage scoring below 5 is 56%.



The question comprises 11 sub parts. Of them, the facility of 4 sub parts is more than 46%. The most difficult sub part is (A)(iv)(b) and its facility is 13%. Sub part (A)(i) holding a facility of 72% seems to be the easiest.

The facility of sub part (A)(ii) is 25%. Candidates have successfully identified the type of the transformer by studying the diagram. But the facility value has gone down owing to the inadequacy of understanding about electromagnetic induction, the physical principle on which it is based.

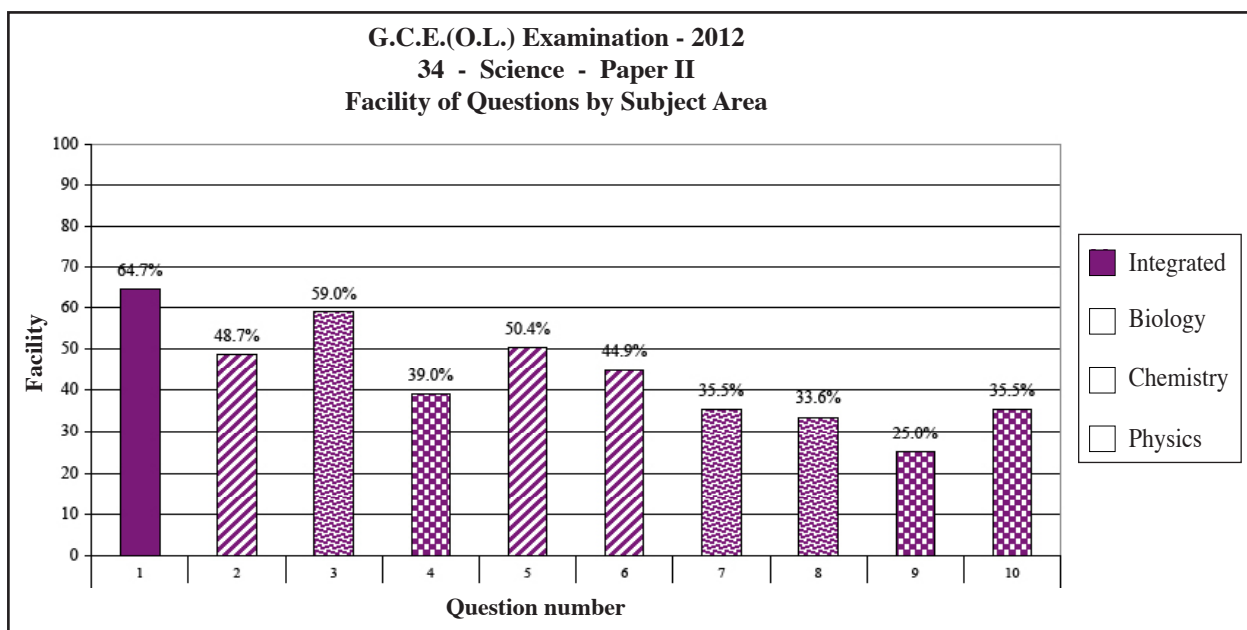
The facilities of sub parts (A)(iv)(a) and (b) are 30% and 13% respectively. According to the principle on which the transformer is constructed, what exists between the potential difference and the current is an inversely proportional relationship. For transformers this can be explained using the relationship $V_p \times I_p = V_s \times I_s$. The candidates need to be given an understanding about the national grid of power supply and its need.

The understanding about the relationship between the current flowing through a conductor and the loss of thermal energy by it seems scant.

Facility of sub part (A)(v) is only 17%. Lack of adequate understanding about the loss of energy due to the use of resistors would be a reason for this.

Except part (B)(ii), other sub parts show a facility less than 50%. This situation could be remedied by improving further the knowledge of the action of diodes in rectifier circuits. Also, it is indispensable that the understanding of accessories such as transistors, diodes, capacitors and resistors used in electronic circuitry and their action be uplifted through practical activities.

2.2.3 Overall observations and conclusions regarding the answers to paper II



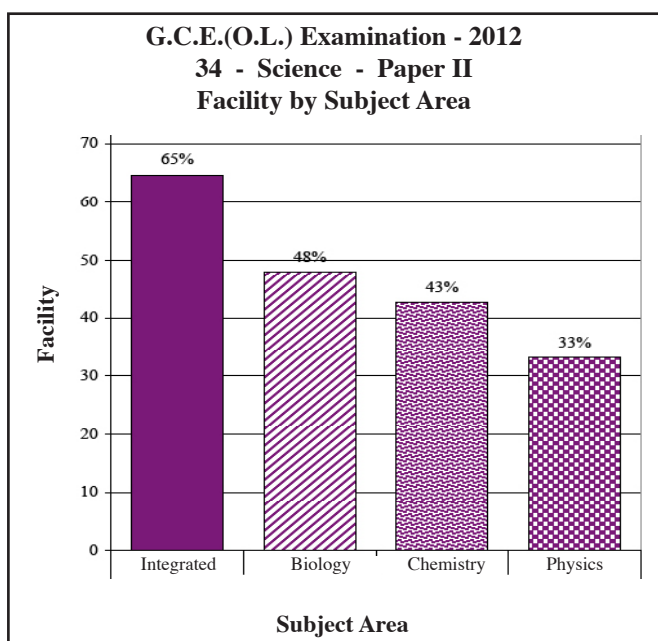
In the structured essay question paper, 48.7% have successfully responded to the Biology question. 39% have been successful in the Physics question. Successful answers for the Chemistry question have been presented by 59%. The integrated question is the one of highest facility in the structured essay question paper. 64.7% have answered it successfully.

As regards the essay questions, question 5 holds a facility of 50.4% and question 6 reports a facility of 44.9% under Biology question paper. 64.7% have answered it successfully.

Of Chemistry questions 35.5% have succeeded in answering question 7 whereas the facility of question 8 stands at 33.6%. 64.7% have answered it successfully.

In the case of Physics, question 9 holds a facility of 25% and question 10 claims a facility of 35.5%.

When essay questions are considered, candidates have shown a greater degree of success in answering Biology questions. This implies that, relative to other subject areas, students' level of cognition and understanding is higher in the field of Biology. However, the students' achievement in Physics is at a lower level.



When the facility indices for the questions in Paper II of G.C.E.(O.L.) Examination 2012 are considered, the percentages of students presenting answers for the respective areas are as follows.

Biology	48%
Chemistry	43%
Physics	33%
Integrated	65%

Compared to Chemistry and Physics, it is apparent that the students have better assimilated the subject matter in Biology.

Hence, if the learning teaching process is adjusted laying more emphasis on the sections which appear difficult for the students, the achievement level of science can be raised.

Part III

3 Facts to be considered when answering questions and suggestions :

3.1. Facts to be considered when answering :

Common instructions :

- * The candidates should read well and understand the basic instructions given in the question paper. They should be considerate as to the facts such as how many questions be answered in each section, which questions are compulsory, what time is affordable and how much can be scored. They also should read the questions carefully and select the questions with a clear mind set.
- * When responding to the questions in Paper I, one response which is the most correct needs to be selected. Also, only one cross must be marked clearly.
- * When answering questions in Paper II, every new question should be started on a new page.
- * Answers should be written in clear and correct handwriting.
- * The candidate's index number should be written in every page in the relevant box.
- * Numbers of questions, parts and sub parts should be indicated correctly.
- * Long descriptions shouldn't be given when short specific answers are expected. Similarly short answers should be avoided in places where descriptive answers are preferred.
- * According to the way the question is posed, facts should be presented logically and analytically.
- * When answering Paper II, all the sub parts given under the main question should be read carefully and only the target answer relevant to each sub part should be written.
- * Care should be taken to manage time properly when answering questions.
- * Corrector fluid should not be used when writing answers.
- * Candidates shouldn't use red and green pens in writing answers.
- * When handing over the answer scripts, all the pages should be arranged so that answers for the same question come in correct sequence and tied up securely.

Special instructions :

- * The technical terms in science should be used in appropriate places.
- * When diagrams are needed, they should be drawn very clearly and labeled.
- * In calculations, each and every step should be indicated clearly.
- * Units should be used correctly where necessary.
- * Standard forms should be used when writing scientific names and symbols.
- * When writing chemical equations at relevant places, they should always be balanced.
- * When drawing graphs, the 'x' and 'y' axes should be named correctly and where necessary the units too should be stated.

3.2. Comments and suggestions about the teaching learning process :

- * Science is a process of producing knowledge. It is an exercise that depends both on careful observations made on existing events as well as the theories formulated to give meaning to such observations. The body of knowledge in science is subject to constant change as a result of man's curiosity about the environment and the process of looking inquisitively and rationally at the world for understanding. Scientific knowledge transcends the limits of the knowledge in common range which most of the people have.
- * The major outcome of science education is to inculcate the competencies of understanding about action and scientific information, scientific attitude, interest toward science, scientific appreciation, science literary and the ethics of science in students. The Science teacher should teach Science in such as way that the students develop such competencies.
- * When imparting knowledge in Science, unlike in other subjects, the most appropriate methods should be adopted. The principle aim of teaching Science is to accustom students to apply the process in Science. The scientific method comprises the main steps, initial observation, assumption, building up hypotheses, testing hypotheses, retesting and arriving at conclusion. Identification of the process of science and getting students to use it when learning Science is the task of the teacher. Through this the students are oriented to apply the scientific method and solve problems.
- * When teaching Science, adoption of appropriate methodologies set out in Teacher Instruction Manuals and using them by the teacher would create a successful learning teaching program. The normal learning teaching process taking place in the classroom as well as many pursuits such as group activities, laboratory experiments, field work, projects, field trips and exhibitions are connected with this subject. In all such events, the teacher should organise his learning teaching process ensuring maximum and correct involvement of students giving opportunities to use different media and try outs.
- * The students can understand most of the abstract concepts he encounters in science only if he is offered opportunities to form the basic concepts which lays foundation for them methodically. Use of learning aids appropriately and inquiring into experiences and previous knowledge are also important in this regard.
- * In order to reinforce the knowledge and understanding gained through the classroom learning teaching process, much support can be drawn from laboratory experiments, videos and the internet as well as the modern technological equipments such as multimedia projectors. It is required that only the relevant equipments be used in laboratory experiments as well as classroom activities. When using them, students' concern should be drawn towards their own safety as well as the safety of the apparatus. If alternatives are used in absence of the required equipment, raising awareness about them is also important.
- * In the classroom learning teaching process, opportunities should be offered for the group activities conducted under the teacher's supervision. This paves way to form a leadership from the groups themselves and also to share and exchange knowledge among the members of the groups.

- * Assessing students using the subject - bound standards to see whether they have achieved the relevant competency levels during their involvement in the learning teaching process or afterwards is momentous. When planning the assessment procedure, there is a need to be considerate about the objectives such as knowledge and understanding, manipulating information, problem solving, experimenting, skills, inquiry, relationships, reasoning and communication.
- * Paying teacher's attention only about the correctness of the students' answers is not sufficient to develop recall and skills in them. The performance of the students should be meticulously surveyed and assisted by giving feedback according to their special needs after grouping them.