2502/206
BUILDING SERVICES, MACHINE INSTALLATION, REFRIGERATION, AIR CONDITIONING AND VENTILATION
Oct./Nov. 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)

MODULE II

BUILDING SERVICES, MACHINE INSTALLATION, REFRIGERATION, AIR CONDITIONING AND VENTILATION

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Non-programmable scientific calculator;
Tables of Thermodynamic and transport properties of Fluids.
*This paper consists of **SEVEN** questions in **TWO** sections; **A** and **B**.*
*Answer any **FIVE** choosing **THREE** questions from section **A** and **TWO** questions from section **B**.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 6 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A

*Answer any **THREE** questions from this section.*

1. (a) Explain **four** benefits of an air conditioning system for human comfort. (4 marks)

(b) With the aid of a diagram, explain the operation of a dual-duct air conditioning system. (6 marks)

(c) Explain **three** functions of a service valve in a refrigeration system. (3 marks)

(d) (i) Highlight **four** desirable properties of refrigerants.

(ii) Explain **three** advantages of secondary refrigerants. (7 marks)

2. (a) State **four** reasons why circular ducts are preferred over rectangular ducts. (2 marks)

(b) Explain **four** causes of noise in duct work of a ventilation system. (4 marks)

(c) With the aid of a sketch describe the operation of a vapour refrigeration system. (5 marks)

(d) (i) Highlight **four** benefits of a hermetic compressor. (2 marks)

(ii) With the aid of a diagram, describe the operation of a thermostatic expansion valve in vapour compression refrigeration system. (7 marks)

3. (a) State the function of each of the following units in a refrigeration system.

(i) condenser;
(ii) drier;
(iii) evaporator. (3 marks)

(b) State **three** causes and **three** remedies for each of the following problems of a vapour compression system.

(i) compressor short cycle;
(ii) low suction pressure. (6 marks)

(c) Explain **four** differences between a practical and an ideal vapour compression cycle. (6 marks)

(d) With the aid of a P-h diagram, explain the effect of superheating a refrigerant before compression. (5 marks)

4. (a) Explain the following methods of duct sizing stating two advantages of each.

(i) Equal pressure drop;
(ii) Static regain.

(6 marks)

(b) Figure 1, shows a duct system. If the velocity after the fan outlet is not to exceed 7.5 m/s and velocity in any branch must not exceed 3.5 m/s, size the duct and determine its rectangular equivalent using chart 1 and table 1.

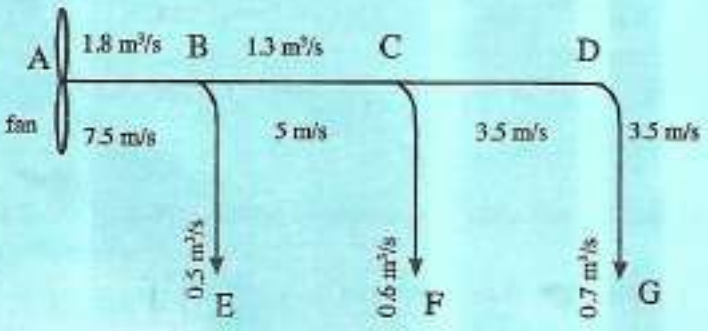

Fig. 1

(7 marks)

(c) Highlight **six** functions of a ventilation system. (3 marks)

(d) With the aid of a diagram, describe viscous filter used in ventilation. (4 marks)

SECTION B

*Answer any **TWO** questions from this section.*

5. (a) State **four** causes of vibrations in machines. (4 marks)

(b) Outline **four** types of vibration control materials stating **one** desirable property of each. (8 marks)

(c) With the aid of a diagram, describe an indirect cold water supply system to a two storey building. (5 marks)

(d) Highlight **six** benefits of using a zeolite water softener. (3 marks)

6. (a) Outline **two** methods of machine installation. (4 marks)

(b) Outline **four** functions of water distribution reservoirs. (4 marks)

(c) With the aid of a diagram, explain the procedure for back-washing a rapid gravity water filter. (6 marks)

(d) Outline **three** operational problems of a rapid gravity filters. (6 marks)

7. (a) Explain the following types of lifts:

(i) Electric traction;
(ii) Hydraulic.

(4 marks)

(b) With the aid of a diagram, describe a double wrap roping in electric lift. (5 marks)

(c) State **six** maintenance checks carried out on a lift. (3 marks)

(d) (i) Explain **three** differences between parallel and crisscross escalator layouts. (3 marks)

(ii) Highlight **four** safety measures during operational of escalators and **six** maintenance checks carried out on an escalator. (5 marks)

CHART 1

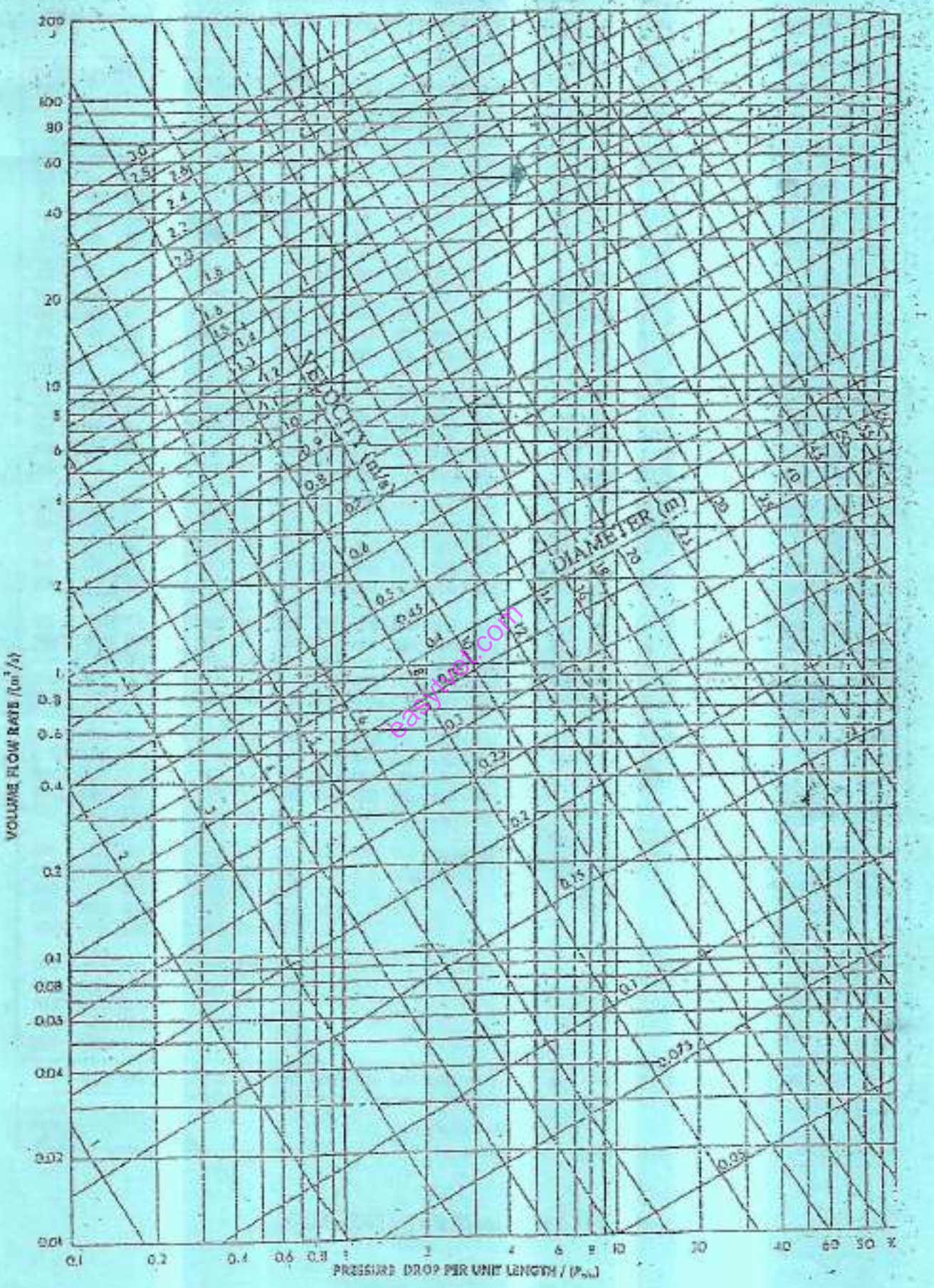

Table 1: Equal volume flow rate, pressure drop and surface roughness.
Read diameters above stepped line up to top scale and diameters below stepped line down to bottom scale.

Diam. of side, b	Diameter of side of duct, a																				Diam. of side, b
	100	125	150	175	200	225	250	300	350	400	450	500	550	600	650	700	750	800	850	900	
100	110	123	134	145	154	163	171	185	199	211	222	232	242	251	260	268	276	284	291	298	100
125	347	118	151	162	173	183	192	209	223	239	251	263	275	285	295	305	314	323	331	339	125
150	385	394	165	178	190	202	212	231	248	264	278	291	304	316	327	338	348	358	368	377	150
175	421	430	440	193	206	218	230	251	269	287	303	317	331	344	357	369	380	391	401	411	175
200	454	464	474	484	220	233	246	269	289	308	325	341	356	371	384	397	409	421	433	444	200
225	485	496	507	517	527	248	261	286	308	328	346	364	380	395	410	424	437	450	462	474	225
250	515	527	538	549	560	570	275	301	325	346	366	385	402	419	434	449	463	477	490	503	250
300	570	583	596	608	620	632	643	330	357	381	401	424	443	462	479	496	512	527	542	556	300
350	620	635	649	662	676	689	701	714	385	412	436	459	481	501	520	538	556	573	589	605	350
400	667	683	698	713	727	741	755	768	794	441	467	492	515	537	558	578	597	616	633	650	400
450	710	727	744	760	776	791	806	820	848	874	496	521	547	571	595	615	636	655	674	693	450
500	751	770	787	804	821	837	853	869	898	927	954	551	577	603	627	650	672	693	713	733	500
550	790	810	828	847	864	882	898	915	946	976	1005	1033	606	633	658	682	706	728	749	770	550
600	827	848	867	887	905	924	941	959	992	1024	1054	1084	1112	661	689	713	738	761	784	806	600
650	862	884	905	925	945	964	982	1001	1036	1069	1101	1131	1162	1191	716	743	769	793	817	840	650
700	896	919	940	962	982	1002	1022	1041	1077	1113	1146	1179	1210	1240	1269	771	798	824	849	873	700
750	928	952	975	997	1018	1039	1059	1079	1118	1154	1190	1223	1256	1287	1316	1343	826	853	879	904	750
800	959	984	1008	1031	1053	1075	1096	1117	1157	1195	1231	1267	1301	1333	1365	1396	1426	881	908	934	800
850	989	1015	1039	1063	1086	1109	1131	1152	1194	1234	1272	1308	1344	1378	1411	1443	1474	1504	936	963	850
900	1018	1044	1070	1095	1119	1142	1165	1187	1230	1271	1311	1349	1385	1421	1455	1488	1520	1551	1581	991	900
950	1046	1073	1100	1125	1150	1174	1198	1221	1265	1308	1349	1388	1426	1462	1498	1532	1565	1597	1629	1659	950
1000		1101	1128	1155	1180	1205	1230	1254	1299	1343	1385	1426	1465	1503	1539	1575	1609	1642	1675	1706	1000
1050			1156	1184	1210	1236	1261	1285	1332	1378	1421	1463	1503	1542	1580	1616	1652	1686	1719	1752	1050
1100				1211	1239	1265	1291	1316	1365	1411	1456	1499	1540	1580	1619	1657	1693	1729	1763	1797	1100
1150					1266	1294	1320	1345	1396	1444	1490	1534	1577	1618	1658	1696	1734	1770	1806	1840	1150
1200						1322	1349	1375	1427	1476	1523	1568	1612	1654	1695	1735	1773	1811	1847	1882	1200
1250							1377	1404	1456	1507	1555	1602	1646	1690	1732	1772	1812	1850	1888	1924	1250
1300								1432	1486	1537	1587	1634	1680	1725	1768	1809	1850	1889	1927	1965	1300
1400									1542	1596	1648	1697	1745	1792	1837	1881	1923	1964	2004	2043	1400
1500										1652	1706	1758	1808	1857	1904	1949	1993	2036	2078	2119	1500
1600											1762	1815	1868	1919	1968	2015	2061	2106	2149	2192	1600
1700												1872	1926	1979	2029	2078	2126	2173	2218	2262	1700
1800													1982	2036	2089	2140	2189	2237	2284	2330	1800
1900														2092	2147	2199	2250	2300	2348	2395	1900
2000															2203	2257	2310	2361	2411	2459	2000
2100																2313	2367	2420	2471	2521	2100
2200																	2423	2477	2530	2582	2200
2300																		2533	2587	2640	2300
2400																			2643	2697	2400
2500																				2753	2500
	950	1000	1050	1100	1150	1200	1250	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	
Diam. of side, b	Diameter of side of duct, a																				Diam. of side, b

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