54/26

L-1/T-1/CSE Date: 25/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations (2019-2020)

Sub: **CSE 101** (Structured Programming Language)

Full Marks: 180 Section Marks: 90 Time: 2 Hours (Sections A + B)

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. a) Give equivalent logical expressions of the following without negation: **(6)**

   i. !(a > b)
   ii. !(a <= b && c <= d)
   iii. !(a+1 = = b+1)
   iv. !(a < 1 || b < 2 && c < 3)

   b) Starting from integer x print n odd numbers. Both n and x will be input to your program. **(7)**

   c) Convert the following if-else statement into a switch-case statement. You may use nested switch-case as needed. **(7)**

```
if(a > b && a > c)
        printf("a is the boss");
else
        printf("a is not the boss");
```

   c) Suppose you are given an integer n and a digit d. Write a program to build another integer r where d is inserted in front of n. For example if n = 532 and d = 8, then r will be set to 8532. **(10)**

2. (a) Write down the following two functions with the specified task mentioned beside each. Assume that always a negative value will be supplied in the parameter x of both of the functions. **You are not allowed to use any branching or repetition statement(s) to perform these tasks.** **(15)**

   (i) **int truncate (float x)** – discards the fractional part and returns the integer.

   (ii) **int rounding (float x)** – returns the nearest integer. In case of tie, it returns the larger one.

   (iii) **int ceiling (float x)** – returns the smallest integer not less than x.

   (b) Write down a recursive function **int rstrcmp(char s[ ], char t[ ], int i)** that recursively compares two strings and **returns 0** if both strings are the same, **returns -1** if the first string s lexicographically precedes the second string t and **returns 1** otherwise. An initial call to this function can be rstrcmp(s, t, 0) to indicate that the comparison starts from the beginning. **(15)**

3. (a) Write down a program that prints all distinct elements within a set of integers within an array A with respect to another set of integers within an array B. The size and the elements of both arrays will be input to your program. Assume that all elements are unique within an array. For example if A= {15, 7, 9} and B = {1, 2, 3, 15}, your program shall print **7, 9** **(15)**

   (b) Write down a program that counts and prints the number of non-repeated elements located within the two diagonals of a matrix A of size M x N. For the following matrix it should print 2 because 5 and 7 are the only two diagonal elements that do not appear anywhere else.

$$A = \begin{matrix} 1 & 2 & 1 \\ 3 & 3 & 4 \\ 5 & 6 & 7 \end{matrix}$$ **(15)**

4. (a) Write down a program that searches for a reverse of a word within a sentence. Both the word and the sentence will be input to your program. If found, print the first position only and print NOT FOUND otherwise. **(15)**

   (b) Write down a function that counts the number of words in a string. Assume that words in the string are separated by **one or more** white space characters. **(15)**

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USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – B

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

5. (a) Assume that you have an integer array called *numbers*. The number of integers stored in that array is given by an integer variable named *n*. Write a code snippet to check whether the array is sorted (either in increasing or in decreasing order) or not. You cannot use array indexing, instead use pointer arithmetic and pointer dereferencing operator in your code. **(10)**

(b) Write a function that implements matrix multiplication operation. The prototype of your function must be: **(20)**

```
int** mult(int** A, int rA, int cA, int** B, int rB, int cB)
```

Here *A* represents the first matrix, and *rA* and *cA* respectively represent its row and column sizes. Similar interpretation holds for *B*, *rB* and *cB*. Dynamically allocate memory to store the computed matrix and return a pointer to it. The function should return NULL if multiplication is not possible. Then write the main function to read 2 matrices from console in row major order. Use dynamic memory allocation to store the matrices. Call the above function to produce the multiplication result. Then from main function, output the result to console.

6. (a) Write a function that takes an unsigned integer as parameter and checks whether its bit pattern forms a palindrome or not. Recall that a palindrome is a word, phrase, or sequence that reads the same backwards as forwards. For example, the bit pattern "01001100" is not a palindrome, but "01100110" is. **(10)**

(b) In RGBA color model, each pixel has 4 attributes: 3 attributes are the intensities of Red Green and Blue colors. The other attribute, A for Alpha, represents the opacity of the pixel. One byte is used for each attribute value. Thus each attribute can assume a value between 0 and 255. In a 32-bit integer these attributes are encoded as follows: **(20)**

ALPHA	BLUE	GREEN	RED

Write a program that takes a 32-bit unsigned integer as input that represents the RGBA value of a pixel. The program must output the RED, GREEN, BLUE and ALPHA intensities of that pixel.

7. (a) Define a structure *District* to store some year-long weather related information about a district of Bangladesh. The structure should contain the following information: **(10)**

```
Id (Integer identifier of district, between 1 and 64)
Temperature (An array of 365 real numbers)
Humidity (An array of 365 real numbers)
Rain (An array of 365 real numbers)
```

Then declare an array named *districts* of type *District*.

(b) You are given a text file named *data.txt* that contains daily weather information about the districts of Bangladesh. Each line contains data in the following pattern: **(20)**

<district id> <day of year> <temperature> <humidity> <rain>

For example, the line "1 50 30 75 10" would mean on the 50th day of the year, the district with identifier 1 had an average temperature of 30 degrees Celsius; the humidity was 75% and the amount of rain was 10 cm. Information for 365 days is available for all the 64 districts, but may not be in any particular order. Your task is to process all the lines and generate topic wise reports as follows: For each of the weather attributes (temperature, humidity, rain), create a file with the attribute name. Each line of the file should contain a district's id, followed by the average value of the attribute across 365 days for that district. The first line should have information about district# 1, the second about the district# 2 and so on.

8. (a) Write a program to copy the content of a file to another file. Use the concept of command line argument to get the name of the source and destination files. Be careful to handle errors related to file operations and command line argument processing. **(10)**

(b) Consider a file containing **binary data** that represents an image as follows. The first 2 integers respectively represent the height (h) and width (w) of the image. Then there are $h \times w$ integers representing each pixel value in RGBA color model. The first w integers represent the pixels in the first scan line (row) of the image, subsequent w integers the second scan line and so on. However, some pixel values are corrupted and need to be corrected. Write a program that reads from console the name of the image file and the number of erroneous pixels. Then for each erroneous pixel it reads 3 integers: row and column number (0-based indexing) of the pixel followed by the correct value for that pixel. It then makes necessary corrections to the image file. You must use the concept of random access to only update the faulty pixels. Do not unnecessarily read/write any other pixels. **(20)**

L-1/T-1/CSE Date: 21/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-1/T-1 B.Sc. Engineering Examinations **2019-2020**

Sub: **ME 165** (Basic Mechanical Engineering)

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**
Assume a reasonable value for any missing data
Students may use property table

1. (a) Do diesel or gasoline engines operate at higher compression ratios? Why? **(7.5)**

   (b) What is the typical fuel of SI (Spark Ignition) engine? Will this fuel be suitable in CI (compression ignition) engine? If yes or no, what is the reason? **(7.5)**

   (c) A 4 liter SI V8 engine that operates on a four-stroke cycle at 4000 RPM. The compression ratio is 10. The engine is square (stroke length = cylinder bore). Calculate cylinder bore, stroke length, average piston speed, clearance volume of one cylinder. **(15)**

2. (a) In a fine morning, weather temperature is 15°C and relative humidity is 100%. What is the wet bulb temperature? Will dew point temperature be higher or lower than 25°C? **(5)**

   (b) Which statements are true for following figure? **(5)**
   - I) Relative humidity at point 2 is higher than point 1
   - II) Relative humidity at point 2 is higher than point 3
   - III) Relative humidity at point 3 is higher than point 1
   - IV) Relative humidity at point 3 is higher than point 2

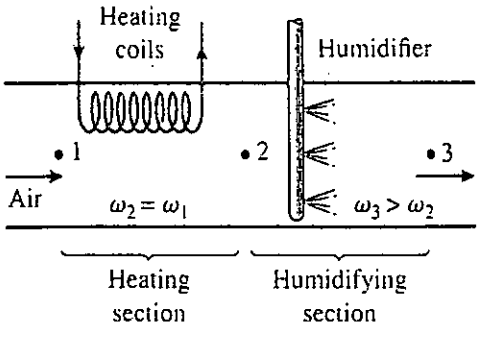

Fig. for Q-2(b)

   (c) In an air standard Otto cycle, the compression begins at 35°C and 0.1 MPa. Find work done per kg of air and the cycle efficiency, if the heat added is 1.675 MJ/kg and the compression ratio is 7. **(20)**

3. (a) How does an absorption refrigeration system differ from a vapor-compression **(10)**

refrigeration system?

(b) A refrigerator uses refrigerant 134a as the working fluid and operates on an ideal vapor compression refrigeration cycle between 0.14 and 0.8 MPa. Determine this system's COP and the amount of power required to service a 150 kW cooling load (Q_L). **(20)**

4. (a) What is the most common end-effector that provides the equivalent of a thumb and an opposing finger? **(5)**

(b) Write three robot control methods and Explain. **(10)**

(c) Develop following expression for cutoff ratio, r_c for an air-standard Diesel cycle, **(15)**

$$r_c = \frac{q_{in}}{C_p T_1 r^{k-1}}$$

Where, Cp is specific heat capacity, T is temperature, k is specific heat ratio and r is compression ratio, and q_{in} is heat input.

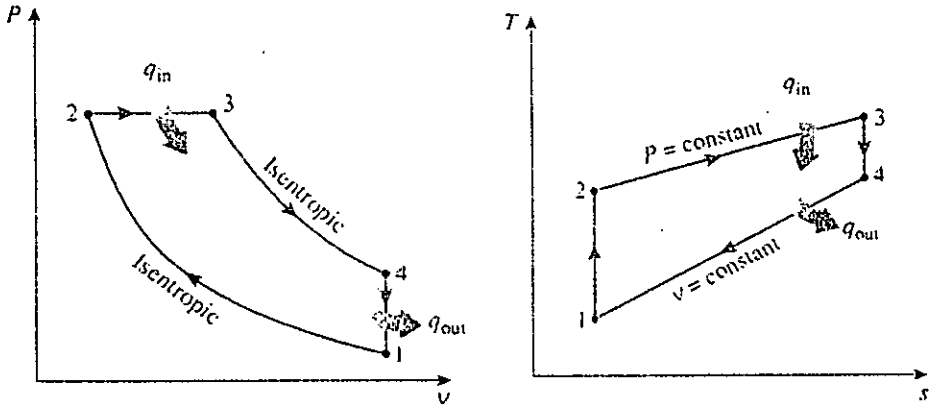

Fig. for Q-4(c): P-v and T-s diagram for an ideal diesel cycle.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-1/T-1 B.Sc. Engineering Examinations **2019-2020**

Sub: **ME 165** (Basic Mechanical Engineering)

Full Marks: 180 Time: 2 Hours

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USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-B

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

5. (a) Two links AB and DE are connected by a bell crank as shown in Figure for Question no. 5(a). Knowing that the tension in link AB is ***P*** N, determine (a) the tension in link DE (acting in vertical direction), (b) the reaction at C. **(25)**

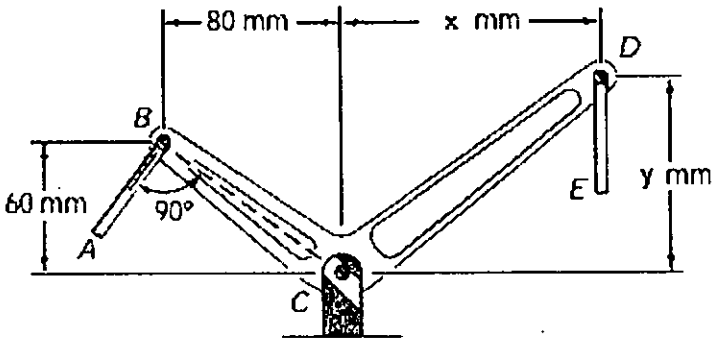

Fig. for Q-5(a)

[Hints: Take, P = 450+3×(Last three digits of your student ID), x=75+(Last three digits of your student ID) and y=60+(Last three digits of your student ID).}

(b) Why equilibrium of particles is different from equilibrium of rigid bodies?- explain briefly with necessary example. **(5)**

6. For the frame and loading shown, determine the components of all forces acting on member *ABD*. **(30)**

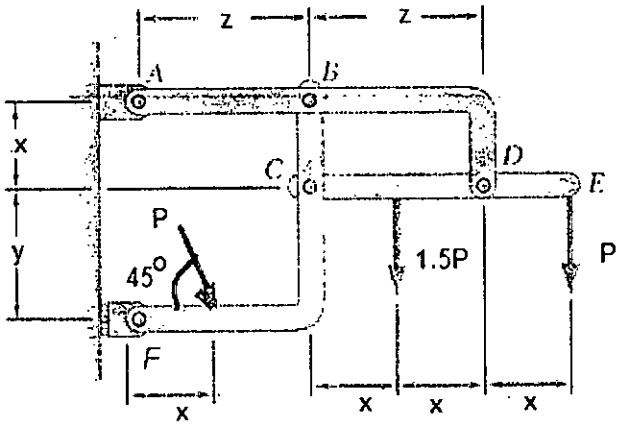

Fig. for Q-6 (Dimensions are in mm and Forces are in kN)

[Hints: Take: x=200+2×(Last three digits of your student ID), y=300+3×(Last three digits of your student ID), z=400+4×(Last three digits of your student ID) and P=200+(Last three digits of your student ID).]

7. Car B is traveling along the curved road with a speed of x m/s while decreasing its speed at y m/s^2. At this same instant car C is traveling along the straight road with a speed of $2x$ m/s while decelerating at $1.5y$ m/s^2. Determine the velocity and acceleration of car B relative to car C. **(30)**

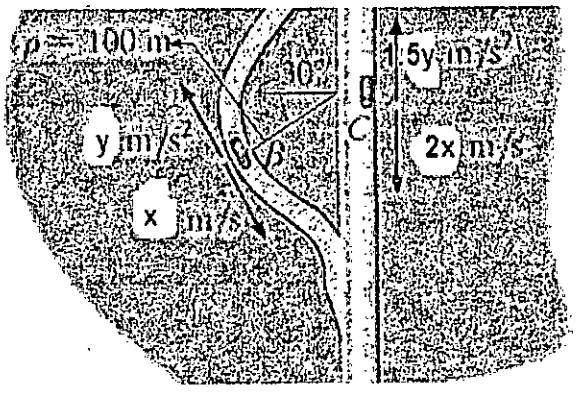

Fig. for Q-7

[Hints: Take: x=15+0.02×(Last three digits of your student ID) and y=2+0.01×(Last three digits of your student ID).]

8. Determine the constant force F which must be applied to the cord in order to cause the x kg block A to have a speed of y m/s when it has been displaced z m upward starting from rest. Neglect the weight of the pulleys and cord. **(30)**

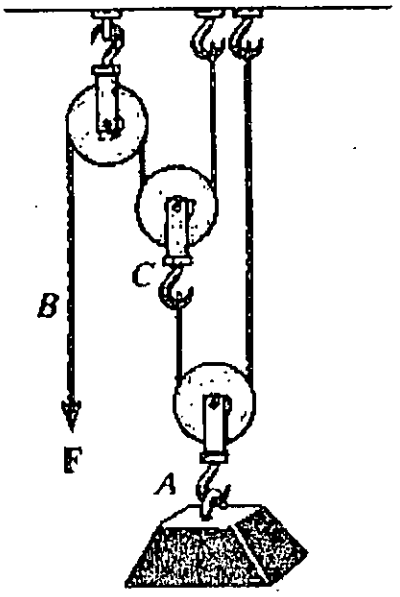

Fig. for Q-8

[Hints: Take: x=20+0.1×(Last three digits of your student ID), y=2+0.01×(Last three digits of your student ID) and z=5+0.02×(Last three digits of your student ID).]

TABLE A–2

Ideal-gas specific heats of various common gases

(*a*) At 300 K

Gas	Formula	Gas constant, R kJ/kg·K	c_p kJ/kg·K	c_v kJ/kg·K	k
Air	—	0.2870	1.005	0.718	1.400
Argon	Ar	0.2081	0.5203	0.3122	1.667
Butane	C_4H_{10}	0.1433	1.7164	1.5734	1.091
Carbon dioxide	CO_2	0.1889	0.846	0.657	1.289
Carbon monoxide	CO	0.2968	1.040	0.744	1.400
Ethane	C_2H_6	0.2765	1.7662	1.4897	1.186
Ethylene	C_2H_4	0.2964	1.5482	1.2518	1.237
Helium	He	2.0769	5.1926	3.1156	1.667
Hydrogen	H_2	4.1240	14.307	10.183	1.405
Methane	CH_4	0.5182	2.2537	1.7354	1.299
Neon	Ne	0.4119	1.0299	0.6179	1.667
Nitrogen	N_2	0.2968	1.039	0.743	1.400
Octane	C_8H_{18}	0.0729	1.7113	1.6385	1.044
Oxygen	O_2	0.2598	0.918	0.658	1.395
Propane	C_3H_8	0.1885	1.6794	1.4909	1.126
Steam	H_2O	0.4615	1.8723	1.4108	1.327

Note: The unit kJ/kg·K is equivalent to kJ/kg·°C.

Source: Chemical and Process Thermodynamics 3/E by Kyle, B. G., © 2000. Adapted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

TABLE A–11

Saturated refrigerant-134a—Temperature table

		Specific volume, m^3/kg		*Internal energy,* kJ/kg			*Enthalpy,* kJ/kg			*Entropy,* kJ/kg·K		
Temp., T °C	Sat. press., P_{sat} kPa	Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
−40	51.25	0.0007054	0.36081	−0.036	207.40	207.37	0.000	225.86	225.86	0.00000	0.96866	0.96866
−38	56.86	0.0007083	0.32732	2.475	206.04	208.51	2.515	224.61	227.12	0.01072	0.95511	0.96584
−36	62.95	0.0007112	0.29751	4.992	204.67	209.66	5.037	223.35	228.39	0.02138	0.94176	0.96315
−34	69.56	0.0007142	0.27090	7.517	203.29	210.81	7.566	222.09	229.65	0.03199	0.92859	0.96058
−32	76.71	0.0007172	0.24711	10.05	201.91	211.96	10.10	220.81	230.91	0.04253	0.91560	0.95813
−30	84.43	0.0007203	0.22580	12.59	200.52	213.11	12.65	219.52	232.17	0.05301	0.90278	0.95579
−28	92.76	0.0007234	0.20666	15.13	199.12	214.25	15.20	218.22	233.43	0.06344	0.89012	0.95356
−26	101.73	0.0007265	0.18946	17.69	197.72	215.40	17.76	216.92	234.68	0.07382	0.87762	0.95144
−24	111.37	0.0007297	0.17395	20.25	196.30	216.55	20.33	215.59	235.92	0.08414	0.86527	0.94941
−22	121.72	0.0007329	0.15995	22.82	194.88	217.70	22.91	214.26	s237.17	0.09441	0.85307	0.94748
−20	132.82	0.0007362	0.14729	25.39	193.45	218.84	25.49	212.91	238.41	0.10463	0.84101	0.94564
−18	144.69	0.0007396	0.13583	27.98	192.01	219.98	28.09	211.55	239.64	0.11481	0.82908	0.94389
−16	157.38	0.0007430	0.12542	30.57	190.56	221.13	30.69	210.18	240.87	0.12493	0.81729	0.94222
−14	170.93	0.0007464	0.11597	33.17	189.09	222.27	33.30	208.79	242.09	0.13501	0.80561	0.94063
−12	185.37	0.0007499	0.10736	35.78	187.62	223.40	35.92	207.38	243.30	0.14504	0.79406	0.93911
−10	200.74	0.0007535	0.099516	38.40	186.14	224.54	38.55	205.96	244.51	0.15504	0.78263	0.93766
−8	217.08	0.0007571	0.092352	41.03	184.64	225.67	41.19	204.52	245.72	0.16498	0.77130	0.93629
−6	234.44	0.0007608	0.085802	43.66	183.13	226.80	43.84	203.07	246.91	0.17489	0.76008	0.93497
−4	252.85	0.0007646	0.079804	46.31	181.61	227.92	46.50	201.60	248.10	0.18476	0.74896	0.93372
−2	272.36	0.0007684	0.074304	48.96	180.08	229.04	49.17	200.11	249.28	0.19459	0.73794	0.93253
0	293.01	0.0007723	0.069255	51.63	178.53	230.16	51.86	198.60	250.45	0.20439	0.72701	0.93139
2	314.84	0.0007763	0.064612	54.30	176.97	231.27	54.55	197.07	251.61	0.21415	0.71616	0.93031
4	337.90	0.0007804	0.060338	56.99	175.39	232.38	57.25	195.51	252.77	0.22387	0.70540	0.92927
6	362.23	0.0007845	0.056398	59.68	173.80	233.48	59.97	193.94	253.91	0.23356	0.69471	0.92828
8	387.88	0.0007887	0.052762	62.39	172.19	234.58	62.69	192.35	255.04	0.24323	0.68410	0.92733
10	414.89	0.0007930	0.049403	65.10	170.56	235.67	65.43	190.73	256.16	0.25286	0.67356	0.92641
12	443.31	0.0007975	0.046295	67.83	168.92	236.75	68.18	189.09	257.27	0.26246	0.66308	0.92554
14	473.19	0.0008020	0.043417	70.57	167.26	237.83	70.95	187.42	258.37	0.27204	0.65266	0.92470
16	504.58	0.0008066	0.040748	73.32	165.58	238.90	73.73	185.73	259.46	0.28159	0.64230	0.92389
18	537.52	0.0008113	0.038271	76.08	163.88	239.96	76.52	184.01	260.53	0.29112	0.63198	0.92310

TABLE A–12

Saturated refrigerant-134a—Pressure table

		Specific volume, m^3/kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg·K		
Press., P kPa	Sat. temp., T_{sat} °C	Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
60	−36.95	0.0007098	0.31121	3.798	205.32	209.12	3.841	223.95	227.79	0.01634	0.94807	0.96441
70	−33.87	0.0007144	0.26929	7.680	203.20	210.88	7.730	222.00	229.73	0.03267	0.92775	0.96042
80	−31.13	0.0007185	0.23753	11.15	201.30	212.46	11.21	220.25	231.46	0.04711	0.90999	0.95710
90	−28.65	0.0007223	0.21263	14.31	199.57	213.88	14.37	218.65	233.02	0.06008	0.89419	0.95427
100	−26.37	0.0007259	0.19254	17.21	197.98	215.19	17.28	217.16	234.44	0.07188	0.87995	0.95183
120	−22.32	0.0007324	0.16212	22.40	195.11	217.51	22.49	214.48	236.97	0.09275	0.85503	0.94779
140	−18.77	0.0007383	0.14014	26.98	192.57	219.54	27.08	212.08	239.16	0.11087	0.83368	0.94456
160	−15.60	0.0007437	0.12348	31.09	190.27	221.35	31.21	209.90	241.11	0.12693	0.81496	0.94190
180	−12.73	0.0007487	0.11041	34.83	188.16	222.99	34.97	207.90	242.86	0.14139	0.79826	0.93965
200	−10.09	0.0007533	0.099867	38.28	186.21	224.48	38.43	206.03	244.46	0.15457	0.78316	0.93773
240	−5.38	0.0007620	0.083897	44.48	182.67	227.14	44.66	202.62	247.28	0.17794	0.75664	0.93458
280	−1.25	0.0007699	0.072352	49.97	179.50	229.46	50.18	199.54	249.72	0.19829	0.73381	0.93210
320	2.46	0.0007772	0.063604	54.92	176.61	231.52	55.16	196.71	251.88	0.21637	0.71369	0.93006
360	5.82	0.0007841	0.056738	59.44	173.94	233.38	59.72	194.08	253.81	0.23270	0.69566	0.92836
400	8.91	0.0007907	0.051201	63.62	171.45	235.07	63.94	191.62	255.55	0.24761	0.67929	0.92691
450	12.46	0.0007985	0.045619	68.45	168.54	237.00	68.81	188.71	257.53	0.26465	0.66069	0.92535
500	15.71	0.0008059	0.041118	72.93	165.82	238.75	73.33	185.98	259.30	0.28023	0.64377	0.92400
550	18.73	0.0008130	0.037408	77.10	163.25	240.35	77.54	183.38	260.92	0.29461	0.62821	0.92282
600	21.55	0.0008199	0.034295	81.02	160.81	241.83	81.51	180.90	262.40	0.30799	0.61378	0.92177
650	24.20	0.0008266	0.031646	84.72	158.48	243.20	85.26	178.51	263.77	0.32051	0.60030	0.92081
700	26.69	0.0008331	0.029361	88.24	156.24	244.48	88.82	176.21	265.03	0.33230	0.58763	0.91994
750	29.06	0.0008395	0.027371	91.59	154.08	245.67	92.22	173.98	266.20	0.34345	0.57567	0.91912
800	31.31	0.0008458	0.025621	94.79	152.00	246.79	95.47	171.82	267.29	0.35404	0.56431	0.91835
850	33.45	0.0008520	0.024069	97.87	149.98	247.85	98.60	169.71	268.31	0.36413	0.55349	0.91762
900	35.51	0.0008580	0.022683	100.83	148.01	248.85	101.61	167.66	269.26	0.37377	0.54315	0.91692
950	37.48	0.0008641	0.021438	103.69	146.10	249.79	104.51	165.64	270.15	0.38301	0.53323	0.91624
1000	39.37	0.0008700	0.020313	106.45	144.23	250.68	107.32	163.67	270.99	0.39189	0.52368	0.91558
1200	46.29	0.0008934	0.016715	116.70	137.11	253.81	117.77	156.10	273.87	0.42441	0.48863	0.91303
1400	52.40	0.0009166	0.014107	125.94	130.43	256.37	127.22	148.90	276.12	0.45315	0.45734	0.91050
1600	57.88	0.0009400	0.012123	134.43	124.04	258.47	135.93	141.93	277.86	0.47911	0.42873	0.90784
1800	62.87	0.0009639	0.010559	142.33	117.83	260.17	144.07	135.11	279.17	0.50294	0.40204	0.90498
2000	67.45	0.0009886	0.009288	149.78	111.73	261.51	151.76	128.33	280.09	0.52509	0.37675	0.90184
2500	77.54	0.0010566	0.006936	166.99	96.47	263.45	169.63	111.16	280.79	0.57531	0.31695	0.89226
3000	86.16	0.0011406	0.005275	183.04	80.22	263.26	186.46	92.63	279.09	0.62118	0.25776	0.87894

Superheated refrigerant-134a (*Continued*)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg·K
	P = 0.50 MPa (T_{sat} = 15.71°C)			
Sat.	0.041118	238.75	259.30	0.9240
20	0.042115	242.40	263.46	0.9383
30	0.044338	250.84	273.01	0.9703
40	0.046456	259.26	282.48	1.0011
50	0.048499	267.72	291.96	1.0309
60	0.050485	276.25	301.50	1.0599
70	0.052427	284.89	311.10	1.0883
80	0.054331	293.64	320.80	1.1162
90	0.056205	302.51	330.61	1.1436
100	0.058053	311.50	340.53	1.1705
110	0.059880	320.63	350.57	1.1971
120	0.061687	329.89	360.73	1.2233
130	0.063479	339.29	371.03	1.2491
140	0.065256	348.83	381.46	1.2747
150	0.067021	358.51	392.02	1.2999
160	0.068775	368.33	402.72	1.3249
	P = 0.80 MPa (T_{sat} = 31.31°C)			
Sat.	0.025621	246.79	267.29	0.9183
40	0.027035	254.82	276.45	0.9480
50	0.028547	263.86	286.69	0.9802
60	0.029973	272.83	296.81	1.0110
70	0.031340	281.81	306.88	1.0408
80	0.032659	290.84	316.97	1.0698
90	0.033941	299.95	327.10	1.0981
100	0.035193	309.15	337.30	1.1258
110	0.036420	318.45	347.59	1.1530
120	0.037625	327.87	357.97	1.1798
130	0.038813	337.40	368.45	1.2061
140	0.039985	347.06	379.05	1.2321
150	0.041143	356.85	389.76	1.2577
160	0.042290	366.76	400.59	1.2830
170	0.043427	376.81	411.55	1.3080
180	0.044554	386.99	422.64	1.3327

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **PHY 109** (Heat & Thermodynamics, Electricity & Magnetism, Waves & Oscillation and Mechanics)

Full Marks: 240 Time: 2 Hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) What happens to the electric field intensity in a capacitor when a dielectric material is inserted into it? Draw the capacitor with and without dielectric and clarify your answer in terms of the molecular theory. **[20]**

(b) A 20 μF air insulated parallel plate capacitor is charged to 300 V. The capacitor is then disconnected from the charging battery, and its plate separation is doubled. Find the stored energy (i) before and (ii) after the plate separation increases. Where does the extra energy come from? **[20]**

2. (a) Why do two wires with current flowing in the same direction attract each other, and two wires with current flowing in opposite directions repel? How do these attractive and repulsive forces form? Explain using appropriate figures. **[20]**

(b) Two long parallel wires carrying currents i_1 and i_2 in opposite directions as shown in Fig. 1. What are the magnitude and direction of the net magnetic field at point P? Given that $i_1 = 10$ A and $i_2 = 30$ A and $d = 5.5$ cm. **[20]**

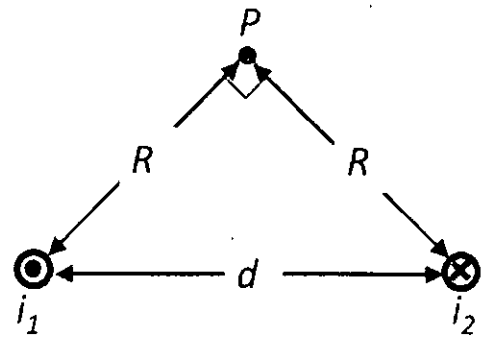

Fig. 1

3. (a) The Wheatstone bridge shown below (Fig. 2) has four resistors, three of equal resistance $R_1 = R_3 = R_4 = 10\Omega$ and one temperature-varying platinum resistor R_T. A voltage $V_{in} = 1V$ is provided to the system by a battery as shown. V_o is defined as the voltage difference between points a and b, and is given by the **[15]**

general Wheatstone bridge equation, $V_o = V_{in}\left(\frac{R_4}{R_1+R_4} - \frac{R_3}{R_T+R_3}\right)$. Resistance R_T is given by $R_T = R_o[1 - \alpha(T - T_o)]$. where α is the temperature coefficient of platinum, $\alpha = 0.00385\ /°C$. Given that $R_o = 10\Omega$ and $T_o = 0°C$.

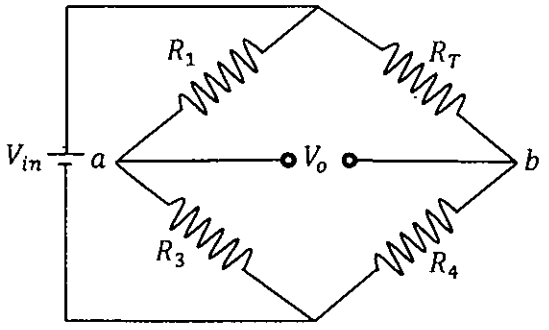

Fig. 2

Explain why the platinum is used in platinum resistance thermometer instead of other metals? Write an equation for V_o in terms of T.

(b) Find V_o at $T = 20°C$, $T = 30°C$, $T = 40°C$, and $T = 50°C$. Plot a graph with V_o as ordinate and T as abscissa. Find the V_o that would be expected at $T = 37°C$. **[25]**

4. (a) The Van der Waal's equation for a gas is plotted at several temperatures as shown in Fig. 3. From the plot, answer the following questions: **[30]**

(i) Do any of these isotherms seemingly exhibit ideal gas behavior? If so, which one(s) and why?

(ii) Estimate critical temperature, pressure and volume for this gas. Identify the gas from the estimated critical-point properties (Critical-point properties of different gases are given in Table 1).

(iii) Estimate the molar volume of the liquid and vapor phases at a temperature of 273 K and a pressure of 4 MPa.

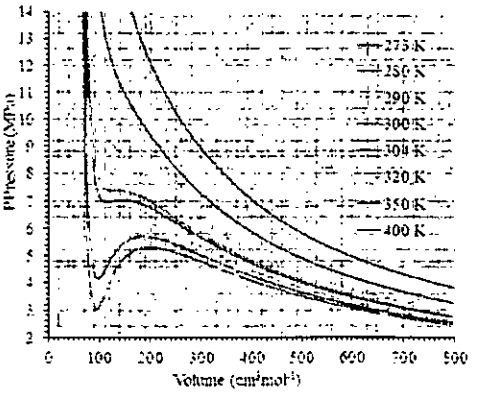

Fig. 3

Table -1: Critical-point properties of different gases

Substance	Temperature, K	Pressure, MPa
Air	132.5	3.77
Ammonia	405.5	11.28
Argon	151	4.86
Benzene	562	4.92
Bromine	584	10.34
n-Butane	425.2	3.80
Carbon dioxide	304.2	7.39
Carbon monoxide	133	3.50
Carbon tetrachloride	556.4	4.56
Chlorine	417	7.71
Chloroform	536.6	5.47
Dichlorodifluoromethane (R-12)	384.7	4.01
Dichlorofluoromethane (R-21)	451.7	5.17
Ethane	305.5	4.48
Ethyl alcohol	516	6.38
Ethylene	282.4	5.12
Helium	5.3	0.23

(b) The critical temperature and pressure of Helium -263°C and 2.22 atoms. **[10]**

respectively. Calculate the radius of a Helium atom.

SECTION-B

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

5. (a) Write down the properties of wave functions. **[10]**

(b) A wave function is defined as **[30]**

$$\Psi(x.0) = \begin{cases} 3x^2 + 5 & -6<x<3 \\ -2x + 3 & 3<x<7 \\ 0 & \text{otherwise} \end{cases}$$

(i) Normalize the wave function.
(ii) Plot $\Psi(x.0)$ as a function of x.
(iii) What is the probability of finding the particle to the right of $x = 0$.

6. (a) How time-dependent form of Schrodinger equation is different than that of time-independent form? **[08]**

(b) Calculate the expectation values of position, and kinetic energy for the 4^{th} excited state of a particle inside an infinite square well. **[32]**

7. (a) Explain how two mutually perpendicular simple harmonic motions having amplitude a and b, phase difference φ and time periods in the ratio of 1:2 acting simultaneously on a particle can be compounded. Discuss the formation of Lissajous' figures when the phase differences are $\frac{\pi}{2}$ *and* π. **[25]**

(b) A block of mass 680 g is suspended from a spring whose spring constant is 65 N/m. The block is pulled a distance of 11 cm from its equilibrium position at $x = 0$ on a frictionless surface and released from rest at $t = 0$. **[15]**

(i) What are the time period and frequency of the resulting motion?
(ii) What is the amplitude of oscillation?
(iii) What is the maximum speed of the oscillating block and where is the block when it has this speed?

8. (a) In a plane progressive wave, energy is transferred continuously in the direction of propagation of the wave. Find the expression for the energy transferred per second and intensity of a plane progressive wave. **[20]**

(b) A wave travelling along a string is described by, $y(x,t) = 0.00327\sin(72.1x - 2.72t)$ in which the numerical constants are in SI units. Find the following answer: **[20]**

(i) What are the wavelength and frequency of this wave?
(ii) What is the velocity of this wave?
(iii) What is the displacement y at $x = 22.5\ cm\ and\ t = 18.9\ s$.

L-1/T-1/CSE **Date: 18/01/2021**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **MATH 145** (Differential Calculus, Integral Calculus and Co-ordinate Geometry)

Full Marks: 180 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION -A

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

1. (a) Suppose $f(x) = \begin{cases} s(x), & for \quad -\infty < x \leq \pi \\ \frac{\pi^2}{4} + 1, & for \quad \pi < x \leq 2\pi \\ t(x), & for \quad 2\pi < x < \infty \end{cases}$ **(15)**

where

- $y = s(x)$ is found by translating the graph of $y = x^2$, $\frac{\pi}{2}$ units right and then moving it 1 unit upward.
- $y = t(x)$ is generated using following steps sequentially
  - I. Translate the graph of $y = |x|$, 2π units right.
  - II. Reflect the result of (I) about x-axis
  - III. Move the entire resultant $\frac{\pi^2}{4}$ units upward.

Now sketch the graph of $f(x)$ and check the differentiability at $x = \pi$.

(b) Evaluate: $\lim_{x\to\infty} \left(\frac{c_1^{\frac{1}{x}} + c_2^{\frac{1}{x}} + c_3^{\frac{1}{x}} + \cdots + c_n^{\frac{1}{x}}}{n} \right)^{nx}$ **(15)**

2. (a) If $y = m\sin(\ln x) + r\cos(\ln x)$, Then find the value of $x^2 y_{n+2} + (2n+1)y_{n+1} + (n^2+1)y_n$. **(15)**

(b) Show that **(15)**

$$x^2\frac{\partial^2 u}{\partial x^2} + y^2\frac{\partial^2 u}{\partial y^2} + z^2\frac{\partial^2 u}{\partial z^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + 2yz\frac{\partial^2 u}{\partial y \partial z} + 2zx\frac{\partial^2 u}{\partial z \partial x} = n(n-1)u.$$

where $u = x^n f\left(\frac{y}{x}, \frac{z}{x}\right)$.

3. (a) A man is floating in a rowboat 1 mile from the (straight) shoreline of a large lake. A town is located on the shoreline 1 mile from the point on the shoreline closest to the man. As suggested in the following Figure, he intends to row in a straight line to some point P on the shoreline and then walk the remaining distance to the town. To what point should he row in order to reach his destination in the least time if he can walk 4 mi/h and row 2 mi/h? **(15)**

L-1/T-1/CSE **Date: 11/01/2021**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-I B.Sc. Engineering Examination 2018-19

Sub: **EEE 163** (Introduction to Electrical Engineering)

Full Marks: 180 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 page(s) in this question paper.

SECTION – A

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

All the symbols have their usual meanings

Assume reasonable values for missing data.

1. (a) Find V_1 of the circuit shown in Fig. for Q. 1(a). Explain why voltage division cannot be used to determine V_1. (15)

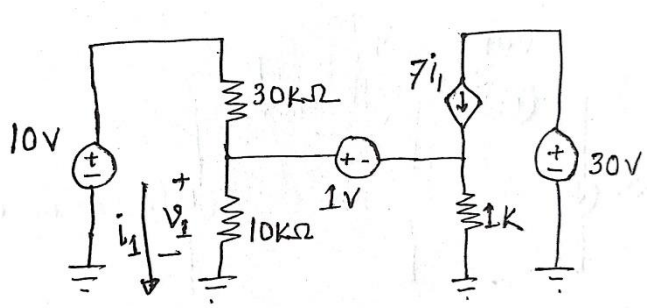

Fig. for Q. 1(a)

(b) The variable resistor (R_o) in the circuit shown in Fig. for Q. 1(b) is adjusted until the power dissipated in the resistor (R_o) is 250 W. Find the values of R_o which satisfy this condition. (15)

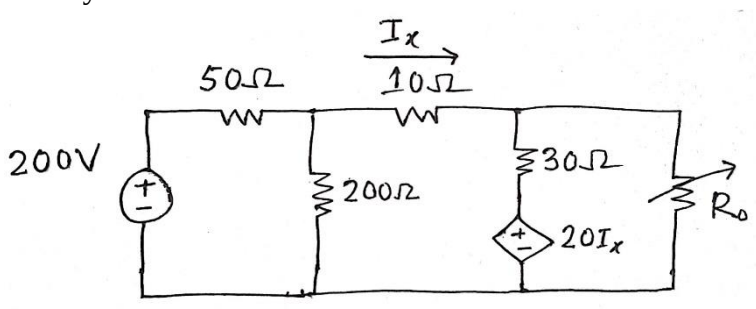

Fig. for Q. 1(b)

2. (a) Find the equivalent resistance between terminals 'a' and 'b' in the circuit shown in Fig. for Q. 2(a). (15)

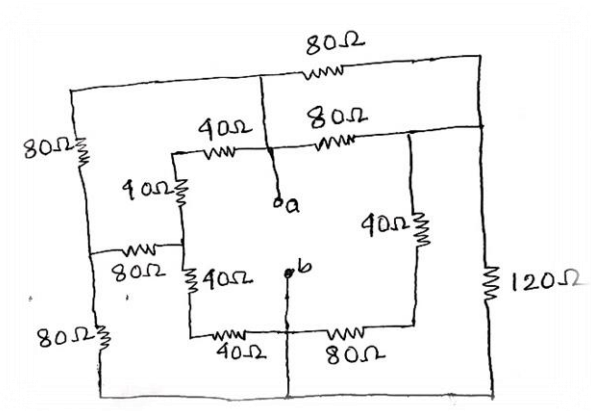

Fig. for Q. 2(a) (15)

(b) Find I_o in the network shown in Fig. for Q. 2(b) using the nodal analysis.

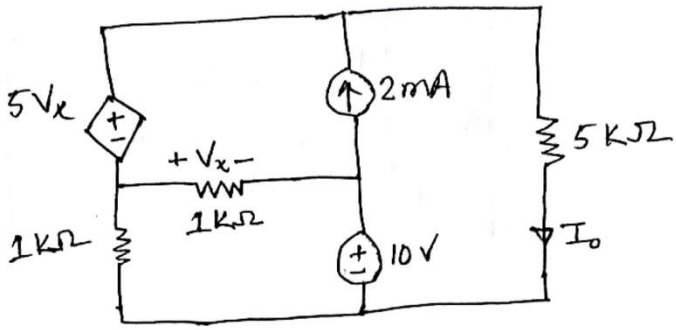

Fig. for Q. 2(b)

3. (a) Find the values of R_1 and R_2 in the following circuit if the voltmeter and ammeter read 6 V and 0.6 A, respectively. (15)

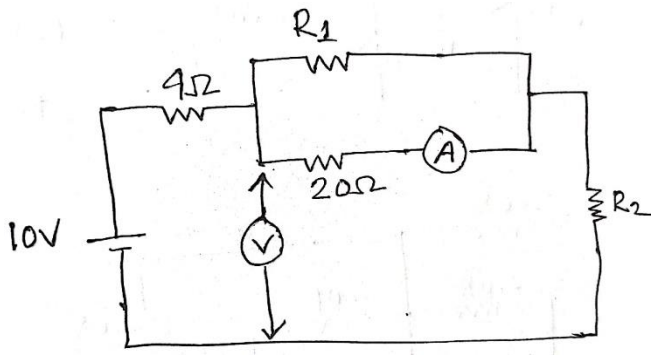

Fig. for Q. 3(a)

(b) For the circuit shown in Fig. for Q. 3(b), find R_l so that maximum power will be transferred from the left of section a-b to the right of section a-b. What is that power? (15)

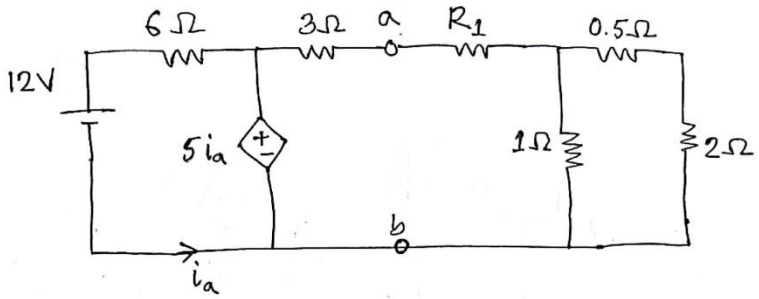

Fig. for Q. 3(b)

4 (a) Calculate i_o in the op amp circuit of Fig. for Q. 4(a) 15

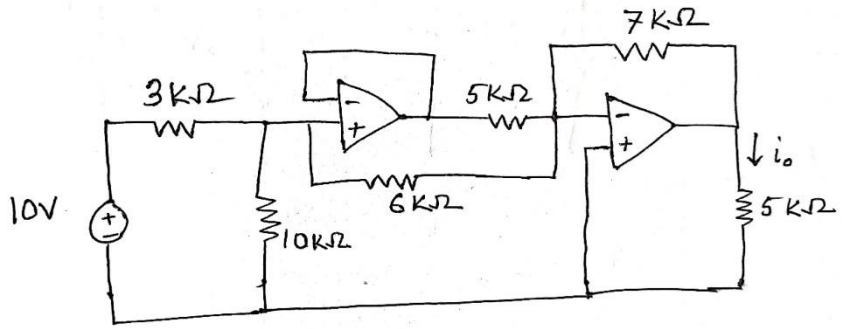

Fig. for Q. 4(a)

(b) In Fig. for Q. 4(b), find V_x by applying series of source transformations. 15

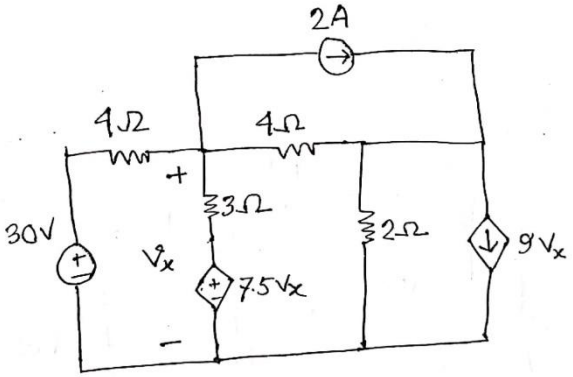

Fig. for Q. 4(b)

SECTION – B

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

All the symbols have their usual meanings

Assume reasonable values for missing data.

5. (a) In the circuit of Figure for Q.5a, find the average power absorbed by the 8 ohms resistor. (20)

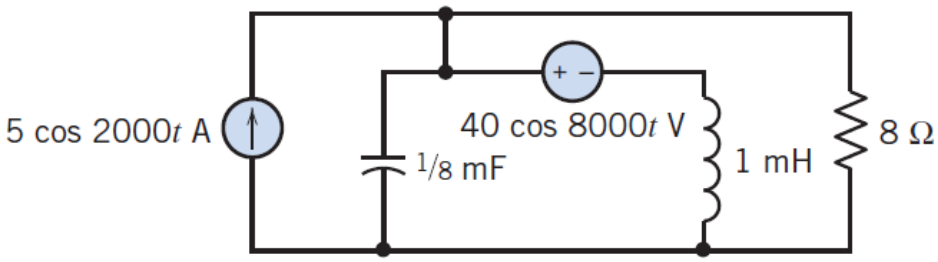

Figure for Q. 5a

(b) Find the rms value of the waveforms of Figure for Q. 5b. (10)

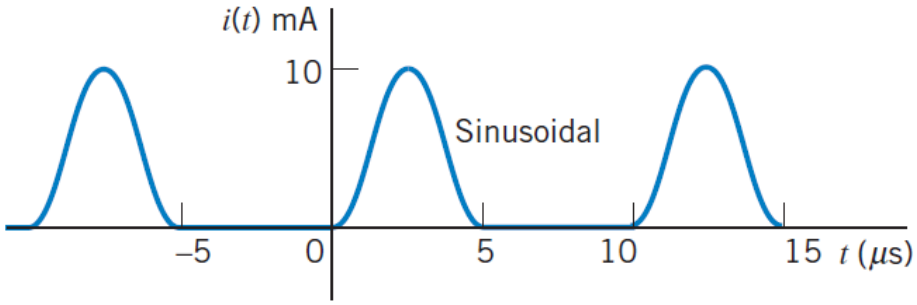

Figure for Q. 5b

6. (a) The variable resistor R in the circuit of Figure for Q. 6a is adjusted until it absorbs the maximum average power. Find R and the maximum average power absorbed. (15)

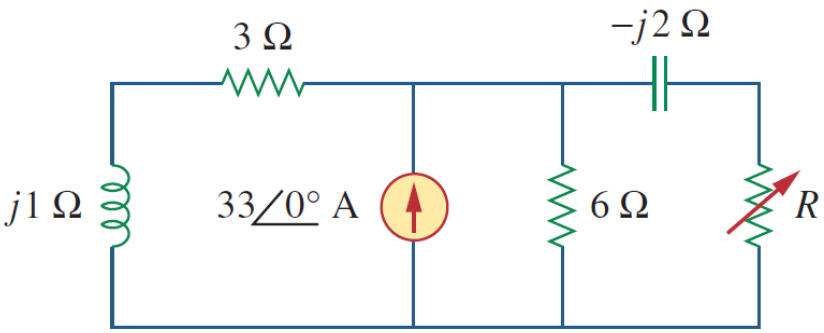

Figure for Q. 6a

(b) Find the complex power delivered and the power factor seen by the voltage source for the circuit in Figure for Q. 6b. (15)

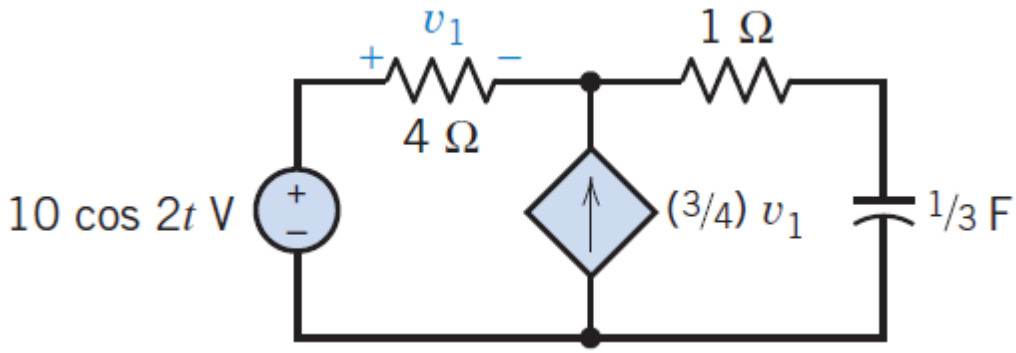

Figure for Q. 6b

7. (a) Design an active low-pass filter with a cutoff frequency of 10 kHz and a voltage gain of 40 dB. (20)

(b) A balanced three-phase load receives 15 kW at a power factor of 0.8 lagging when the line voltage is 480 V rms. Represent this load as a balanced Y-connected load. (10)

8 (a) Design a passive bandpass filter characterized by a bandwidth of 1 MHz and a high-frequency cutoff of 1.1 MHz (15)

(b) Find the voltage v(t) in a circuit described by the integro differential equation (15)

$$2\frac{dv}{dt} + 5v + 10\int v\,dt = 50\cos(5t - 30^\circ)$$