

PP-DSE
DAT
PAPER 1

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

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PRACTICE PAPER
DESIGN AND APPLIED TECHNOLOGY PAPER 1
Technology, Design and Society

(2 hours)

This paper must be answered in English

INSTRUCTIONS

1. Answer Question 1 in Section A and any two questions from Section B.
2. Write your answers to Q.1 in the Worksheet provided.
3. Answers to other questions should be written in the Answer Book. Candidates should fasten the Worksheet with string inside the Answer Book upon submission.

Section A - Compulsory question.

1. **Design problem** – plant sprinkler system

ABC Company proposes to design a set of sprinkler systems for outdoor plants in Figure 1. You are required to consider the following:

- conservation of energy and resources
- promotion of corporate identity and brand building
- environment and weather changes
- different types of plants



Figure 1

You are required to:

- analyse the design problem and state the user needs; (6 marks)
- consider appropriate constraints and draw up the design specifications; (6 marks)
- generate a range of design ideas; (12 marks)
- illustrate your final solution with annotated colour sketch(es); (20 marks)
- state the appropriate materials used; (4 marks)
- evaluate your final solution against the design specifications and suggest ways for further improvement. (6 marks)

[A total of 6 marks will be awarded for effective communication in this question.]

Section B - Attempt any two questions in this section.

2. Figures 2(a) – 2(c) show three calculators.



Figure 2(a)



Figure 2(b)



Figure 2(c)

- (a) Compare the design features of the three calculators shown in Figures 2(a) – 2(c) with regard to the following aspects:
 - (i) special applications;
 - (ii) energy sources.

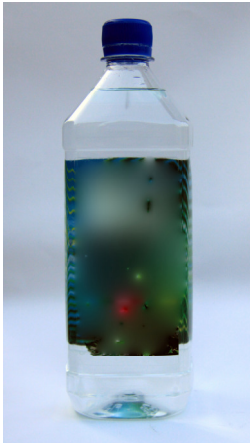
(6 marks)
- (b) State two 'ergonomic' considerations when designing a calculator.

(2 marks)
- (c) With regard to the evolution of technology in calculator design, identify the materials for making the cases of the calculators shown above. Suggest one reason for choosing the appropriate material.

(6 marks)
- (d) With the aid of a coloured sketch, design a calculator with the theme '35th anniversary of Ocean Park'.

(6 marks)

3. Figure 3(a) – 3(c) show three plastic bottles for drinking water.



Bottle 'A'
Figure 3(a)



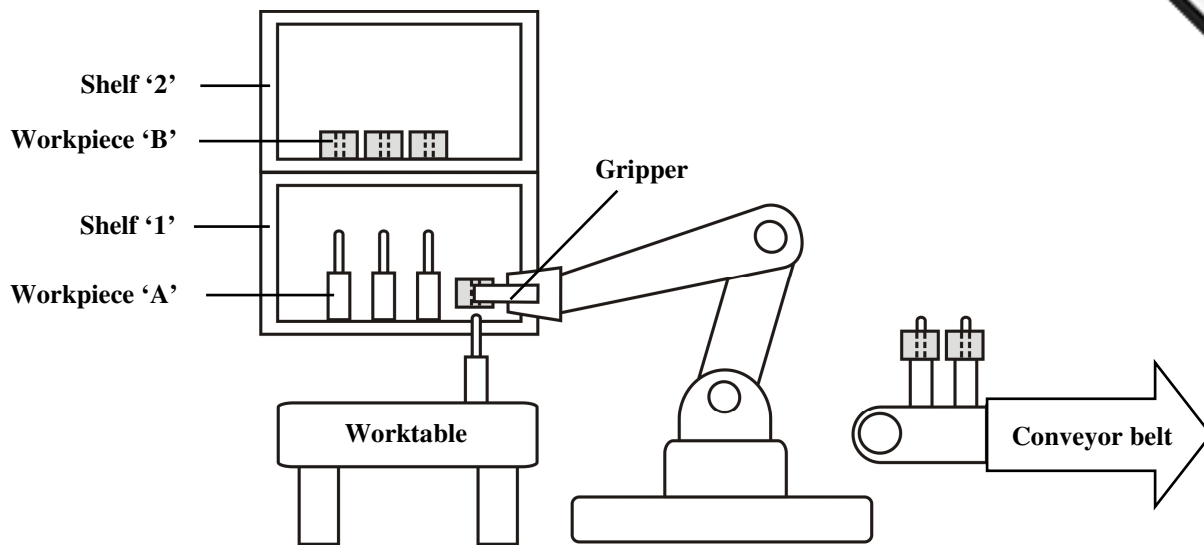
Bottle 'B'
Figure 3(b)



Bottle 'C'
Figure 3(c)

- (a) Compare the design features of bottle 'A' and bottle 'B' with regard to the following aspects:
 - (i) the shape of the bottles;
 - (ii) the design of the caps. (4 marks)
- (b) With the aid of annotated sketches, suggest two methods to strengthen the structure of bottle 'A'. (6 marks)
- (c) State two functions of the concave-shaped bottom of bottle 'B'. (2 marks)
- (d) Bottle 'C' is a 'light-weight and twistable' plastic bottle:
 - (i) state three advantages on the design; (3 marks)
 - (ii) with the aid of annotated sketches, design a device to carry four 770ml bottles of water. (5 marks)

4. Figure 4 shows the layout and flow diagram of a robot arm in assembly work.



Step	Workflow of the robot arm
(1)	Remove the workpiece 'A' from shelf '1' and put in the worktable
(2)	Remove the workpiece 'B' from shelf '2'
(3)	Assemble workpiece 'B' with workpiece 'A'
(4)	Remove the component from the worktable using the conveyor belt
(5)	Return to Step (1)

Figure 4

- (a) In order to correctly assemble workpiece 'B' into workpiece 'A' at the worktable, a sensor for positioning needs to be installed at the end of the robot arm. If the position is not correct, the arm will stop. Using the following appropriate symbol(s), draw the flow chart of the robot arm for the assembly work. (10 marks)

Start / End	Process	Decision	Data (i/o)

- (b) Give the name of one suitable sensor for part (a). (2 marks)
- (c) With the aid of pictorial sketch(es), show the working principal of the gripper shown in Figure 4. (8 marks)

END OF PAPER

**PRACTICE PAPER
DESIGN AND APPLIED TECHNOLOGY
PAPERS 2A - 2D**

(2 hours for Paper 2)

This paper must be answered in English

GENERAL INSTRUCTIONS

1. Candidates should attempt the **two** elective papers (2A – 2E) they chose when registering for the examination. Answers written for papers that candidates have not registered for will **not** be marked.
2. Candidates are advised to spend around one hour for each paper you attempt.
3. Answer any **two** questions for each of the papers you attempt.
4. If you attempt Q.4 of Paper 2B, write your answers to that question in the Worksheet provided. Candidates should fasten the Worksheet with string inside the Answer Book upon submission.

Instructions for Candidates NOT Attempting Paper 2E

5. Write your answers to each of the papers you attempt in a separate Answer Book.
6. The two Answer Books will be collected together at the end of the examination. Fasten them together with the green tag provided.

Instructions for Candidates Attempting Paper 2E

7. Write your answers to Paper 2E in the Question-Answer Book provided.
8. Answers to the other papers you attempt should be written in a separate Answer Book.
9. The Question-Answer Book and the Answer Book will be collected separately at the end of the examination.

PAPER 2A Automation

Candidates who choose this paper should attempt any two questions from Q.1-Q.3. Answers to this paper should be written in a separate Answer Book.

1. Figure 1(a) shows the entrance of a car park with 120 parking spaces. The flow chart in Figure 1(b) shows the logic of the Car Access Control. The features of the Access Control System are:

- the master controller of the system is a programmable logic controller (PLC)
- the barrier is raised and lowered by a motor
- the card reader is used to detect the request of incoming cars
- sensor 1 and 2 are used to detect the vertical and horizontal position of the barrier respectively
- sensor 3 is used to detect a car completely passed through the barrier
- the number of parking spaces available is monitored by the system
- when all spaces are occupied, the 'FULL' sign is turned on to alert drivers

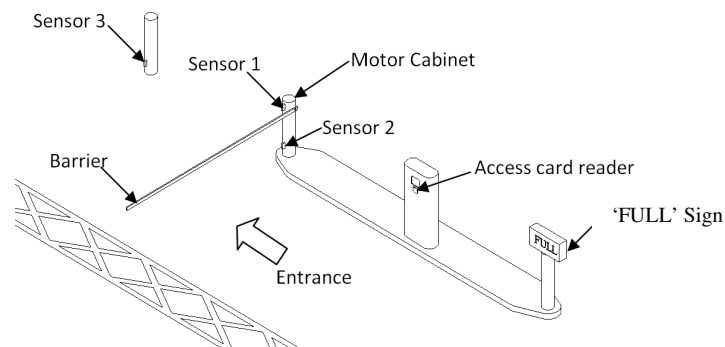


Figure 1(a)

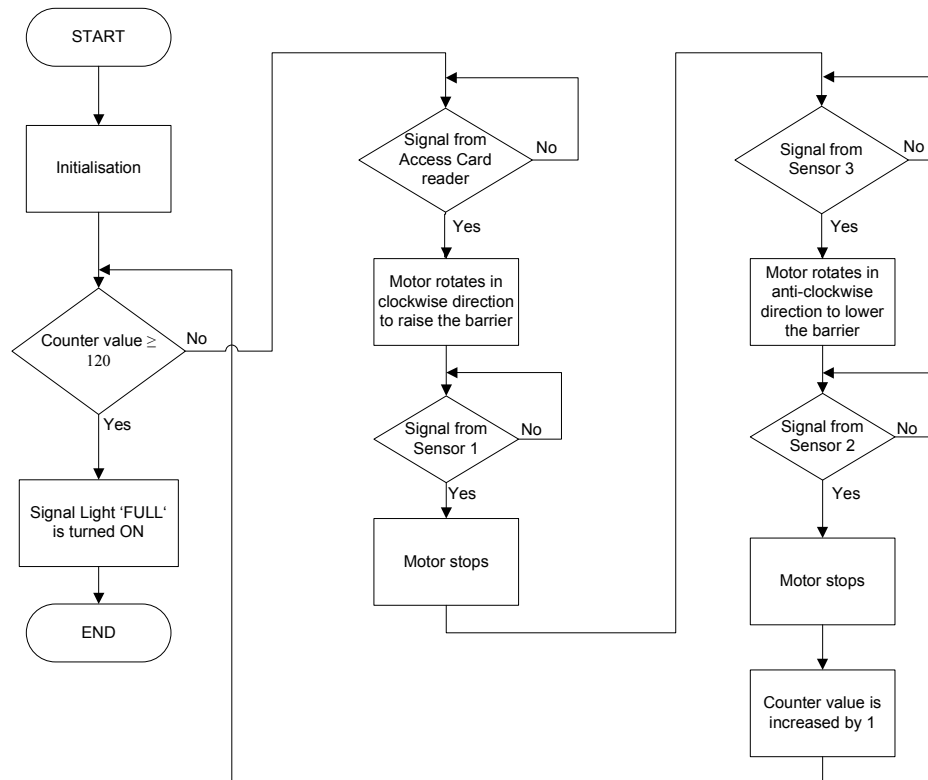


Figure 1(b)

- (a) Based on the flow chart shown in Figure 1(b), identify the input and output devices and complete the missing information for items 3, 4, 7 and 8 of Table 1 in the Answer Book. (4 marks)

Item	Input	Address
1	Signal from Sensor 2 detects the barrier at a horizontal position	I 1
2	Car entry request signal from access card reader	I 2
3		I 3
4		I 4
5	Reset the counter value to 0	I 5

Item	Output	Address
6	Motor rotates anti-clockwise to lower the barrier to a horizontal position	O 1
7		O 2
8		O 3

Item	Counter	Address
9	Counter value < 120: Counter output = 0 Counter value \geq 120: Counter output = 1	C 1

Table 1 – Input/Output Address Table

- (b) Based on the flow chart shown in Figure 1(b) and the I/O Address Table in (a), complete the missing information for operation sequences 2, 3, 4 and 5 of Table 2 and write the answers in the Answer Book. (10 marks)

Operation Sequence	Condition	Output Status
1	Initialization • I 1 = 0	O 1
2	• I 2 = 1 • C1(counter output) = 0 • I 1 = 1	
3		
4		
5		
6	C1(counter output) = 1	O 3

Table 2 – Condition Table

- (c) Based on the condition table shown in Table 2, draw the 'Timing Diagram' of the Access Control System of the car park with annotations. (8 marks)
- (d) Using an annotated sketch, suggest a safety device to stop the barrier immediately in an emergency. (3 marks)

2. Figure 2(a) shows the carriage of a train. The doors are controlled by an 'electro-pneumatic system'.



Figure 2(a)

Figures 2(b) and 2(c) show two simplified diagrams of the electro-pneumatic system. The pneumatic circuit indicates that the doors are at closed position.

- When push button 'PB1' is pressed, solenoid 'SO1' of the control valve is energised to extend the pneumatic cylinder rod to open the doors.
- When push button 'PB2' is pressed, solenoid 'SO2' of the control valve is energised to retract the pneumatic cylinder rod to close the doors.

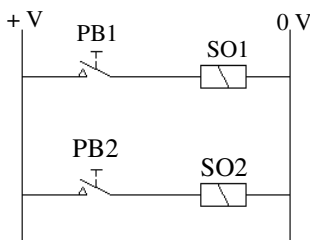


Figure 2(b) ELECTRICAL CIRCUIT

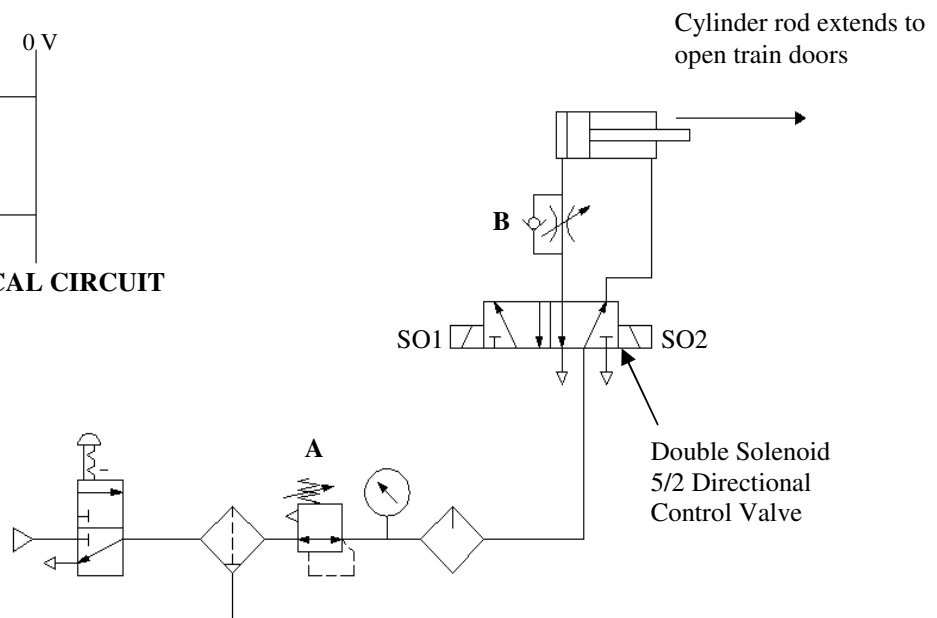


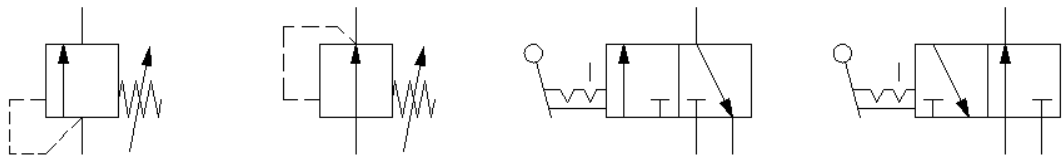
Figure 2(c) PNEUMATIC CIRCUIT

- (a) A double solenoid '5/2' directional control valve shown in Figure 2(c) is used to control the direction of compressed air flow. State the meaning of '5/2'. (2 marks)
- (b) Name the components 'A' and 'B' shown in Figure 2(c) and briefly describe their functions in the circuit. (6 marks)
- (c) Based on Figures 2(b) and 2(c), give the answers of A, B, C & D for the following 'Truth Table'. (2 marks)

Step	PB1	PB2	SO1	SO2	Door Status
1	0	0	0	0	Closed (Initial position)
2	1	0	A	B	opening
3	0	0	0	0	open
4	0	1	C	D	closing

TRUTH TABLE

- (d) (i) Using one of the symbols below, modify and draw the pneumatic circuit shown in Figure 2(c) so that the doors can be stopped immediately in an emergency. (5 marks)



- (ii) Name the symbol of the device that you have selected in (i) and state two of its functions. (4 marks)
- (e) (i) Other than using compressed air, suggest another type of power source and actuator suitable for opening and closing the train doors. (4 marks)
- (ii) Give one advantage of using the actuator that you have suggested in (i). (2 marks)

3. (a) Figure 3(a) shows a dishwasher.

The washing and rinsing sequences of the dishwasher are listed below:

- starts wash cycle by switching on the control switch
- fills with water to a pre-set level
- heats water to a pre-set temperature
- pumps water through water jets to clean the dishes
- drains dirty water
- rinses the dishes with clean water
- drains again
- wash cycle completed

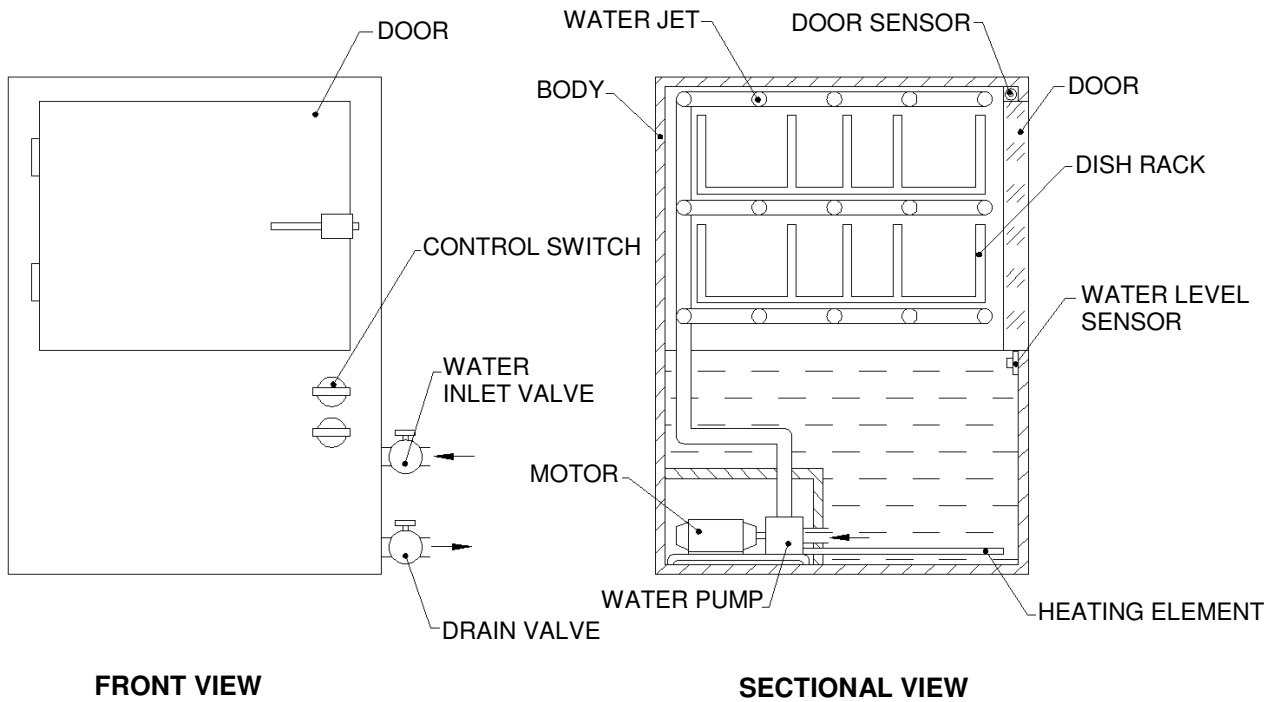


Figure 3(a)

(i) Copy and complete the following system control diagram of the dishwasher in the Answer Book. (6 marks)

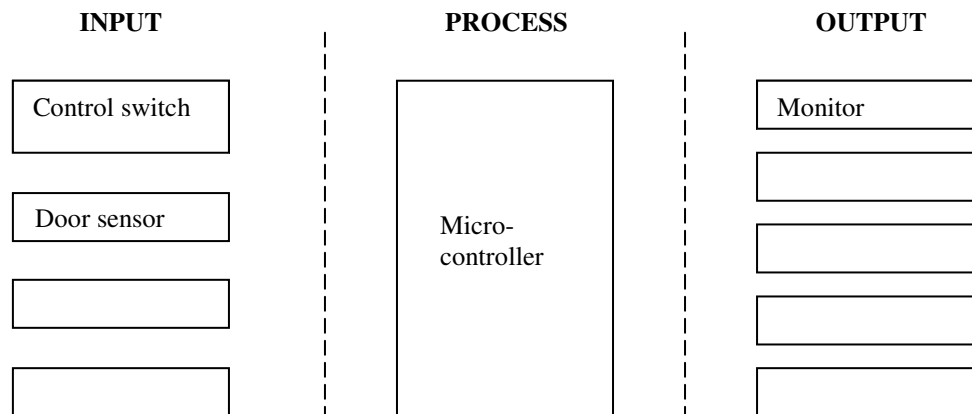


Figure 3(b)

- (ii) Draw a closed-loop block diagram to show how the temperature of water is controlled. (6 marks)
- (iii) Suggest three additional features to improve the dishwasher. (3 marks)
- (b) Figure 3(c) shows a 'SCARA' (Selective Compliance Assembly Robot Arm) robot which is suitable for assembly work in production lines.

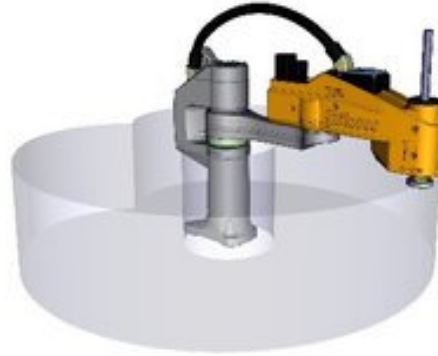


Figure 3(c)

- (i) With the aid of a line diagram, illustrate the motion of a 4-axis 'SCARA' robot. (4 marks)
- (ii) State two specific advantages of a 'SCARA' robot. (2 marks)
- (iii) Suggest one suitable gripper for assembling glass plates in production lines. (2 marks)
- (c) State one advantage of applying robotics in each of the following areas:
- (i) Medical surgery; (1 mark)
- (ii) Military use. (1 mark)

END OF PAPER 2A

PAPER 2B Creative Digital Media

Candidates who choose this paper should attempt any two questions from Q.4-Q.6. Answers to Q.4 should be written in the Worksheet provided.

Answers to other question(s) should be written in a separate Answer Book.

Candidates should fasten the Worksheet with string inside the Answer Book upon submission.

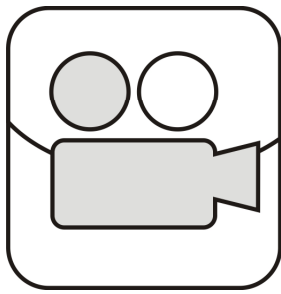
4. Figure 4 shows a digital camera specifically designed for the elderly.



Figure 4

- (a) You are required to create a promotional video of 30 seconds for the digital camera, highlighting the features of 'simple operation' and 'good quality'. Illustrate your ideas with not more than 6 frames for your storyboard. Write your answer on the Worksheet. (20 marks)
- (b) Suggest a slogan of not more than 18 words to promote the digital camera. (5 marks)

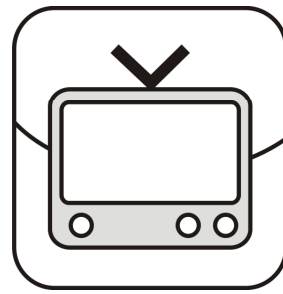
5. Figure 5 shows three icons.



MOVIE



MUSIC



TELEVISION

Figure 5

- (a) If you are going to design some icons for a name card, design and sketch any three of the following:
- (i) telephone;
 - (ii) e-mail;
 - (iii) fax;
 - (iv) address.
- (21 marks)
- (b) State four factors that should be considered when designs are used in printed format. (4 marks)

6. Figure 6 shows the structure of a pop-up card.

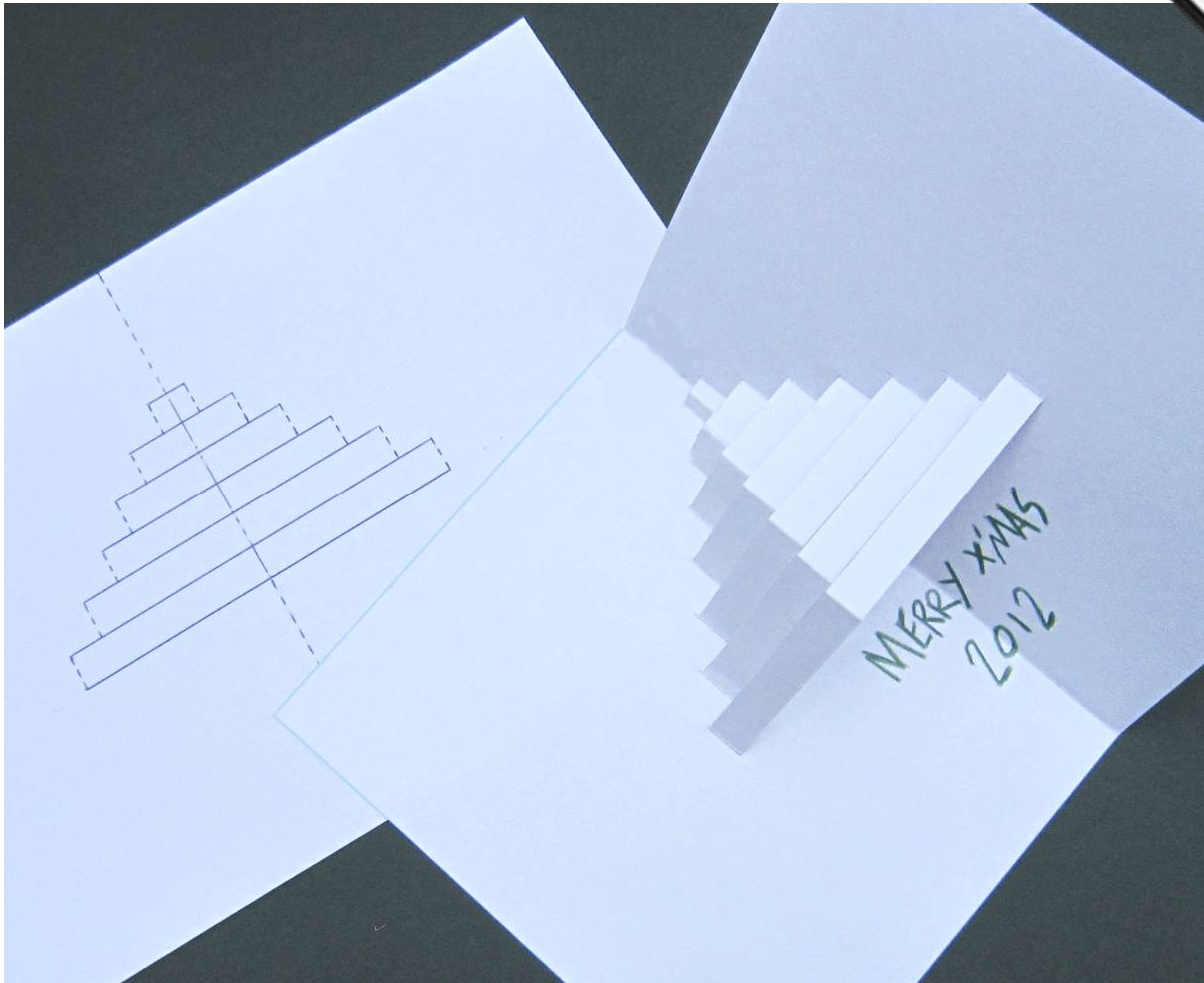


Figure 6

- (a) Suggest four design considerations when designing a pop-up card. (4 marks)
- (b) Suggest two suitable materials for making pop-up cards. (2 marks)
- (c) With the aid of sketches, design and show the structure of a pop-up birthday card. You are required to illustrate the pop-up process(es). (15 marks)
- (d) If the pop-up card in (c) is going to be transformed into an e-card, give two advantages and two disadvantages. (4 marks)

END OF PAPER 2B

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PAPER 2C Design Implementation and Material Processing

Candidates who choose this paper should attempt any two questions from Q.7-Q.9.
Answers to this paper should be written in a separate Answer Book.

7. Figure 7 shows a flower cutter and a nail clipper which incorporate cutting edges.



Flower cutter



Nail clipper

Figure 7

- (a) Name the type of mechanism involved in each cutting tool shown in Figure 7. (2 marks)
- (b) Using a schematic diagram, illustrate the working principle of the mechanism applied in each of the cutting tools. (10 marks)
- (c) Using notes and sketches,
- illustrate and explain one design feature of the cutting edge for each of the tools shown above; (6 marks)
 - illustrate two ergonomic considerations which should be considered when designing one of the above cutting tools. (7 marks)

8. Figure 8 shows a slipper rack which can be flat-packed.

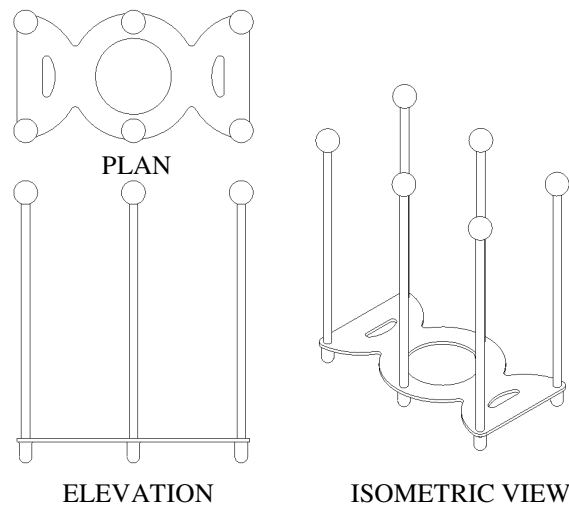
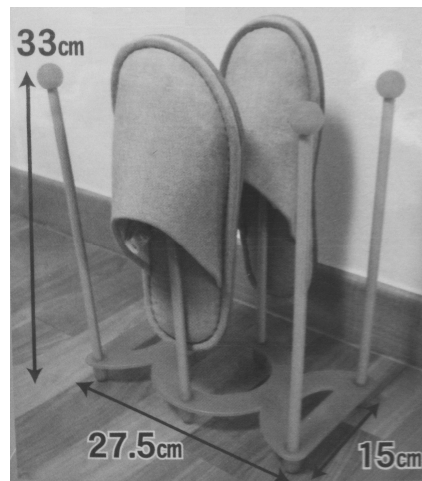


Figure 8

- (a) Using notes and sketches, illustrate how you would make the rack shown in Figure 8 in your school workshop. Your answer should include the materials and joints used. (10 marks)
- (b) In terms of mass production, suggest a suitable material for making the rack. Give two reasons for your choice. (3 marks)
- (c) Using notes and sketches, illustrate the mass production processes for making various parts of the rack. (12 marks)

9. (a) Many large buildings are constructed by using a framework of concrete beams as shown in Figure 9(a).

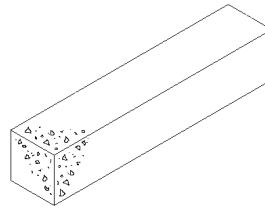


Figure 9(a)

Using notes and sketches,

- (i) illustrate the weakness of a pure concrete beam;
- (ii) show how you would overcome this weakness.

(6 marks)

- (b) Figure 9(b) shows a mild steel angle frame and Figure 9(c) shows the same frame with an additional steel wire.

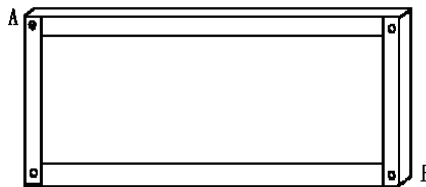


Figure 9(b)

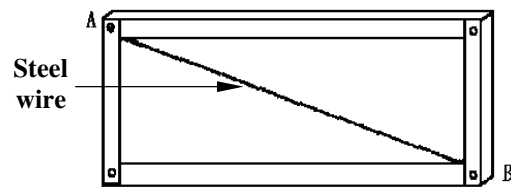


Figure 9(c)

- (i) If 'j' is the number of joints, 'b' is the required number of bars. Using the formula $b = 2j - 3$, calculate the number of bars required in Figure 9(b) to make the frame rigid. (3 marks)
- (ii) Using notes and sketches, explain why the wire used in Figure 9(c) would not make the frame rigid. (4 marks)
- (iii) Using notes and sketches, suggest two methods to make the frame in Figure 9(c) more rigid. (6 marks)

(c) Figure 9(d) shows two mild steel beams with the same length and weight.

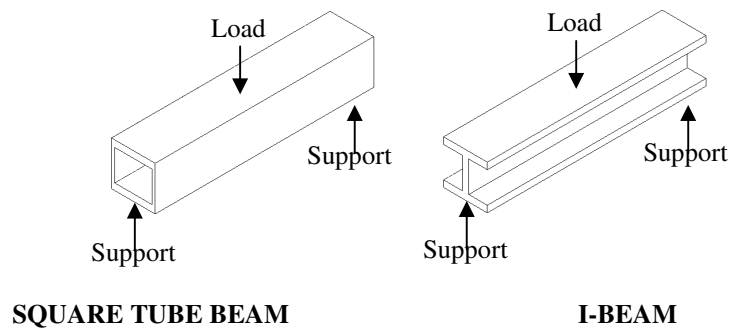


Figure 9(d)

- (i) Using notes and sketches, identify the stronger beam in Figure 9(d) while it is under load. Give two reasons for your choice. (3 marks)
- (ii) Illustrate one method to improve the performance of one of the beams shown in Figure 9(d). (3 marks)

END OF PAPER 2C

PAPER 2D Electronics

Candidates who choose this paper should attempt any two questions from Q.10-Q.12. Answers to this paper should be written in a separate Answer Book.

10. (a) Figure 10(a) shows a circuit diagram.

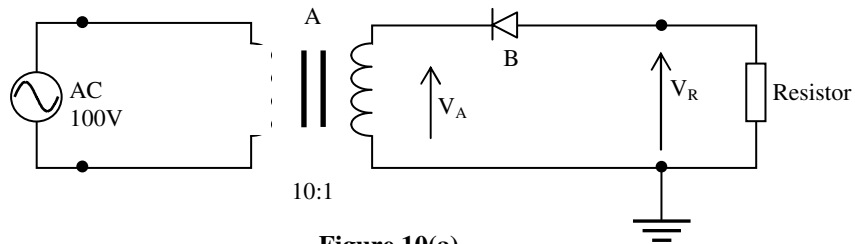


Figure 10(a)

- (i) Name component 'A' and explain the function of 'A' in the circuit. (2 marks)
- (ii) Name component 'B' and describe its characteristics. (2 marks)
- (iii) Figure 10(b) shows the waveform V_A . Sketch the corresponding waveform of the voltage V_R . (2 marks)

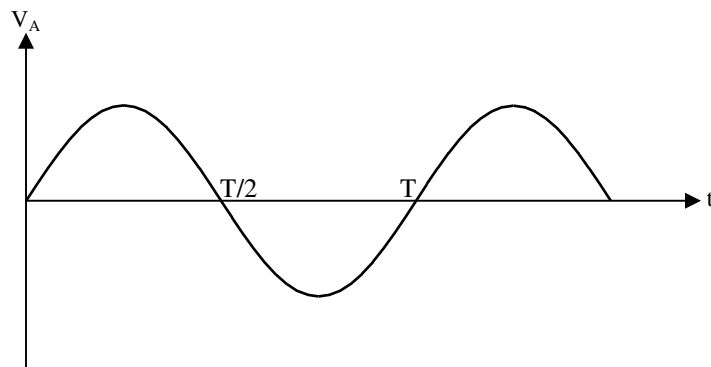
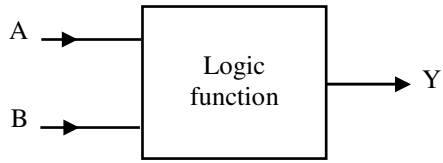


Figure 10(b)

- (iv) Copy the secondary side of Figure 10(a) into your answer book. Draw an arrow to indicate the current flow for the negative half-cycle of V_A . (2 marks)

- (b) The logic function below produces an output $Y=1$, when $A=B$.



- (i) Find the Boolean expression of Y in terms of A and B . (3 marks)
- (ii) Using NAND gates only, sketch the circuit for the logic function. (6 marks)

- (c) Figure 10(c) shows a circuit diagram.

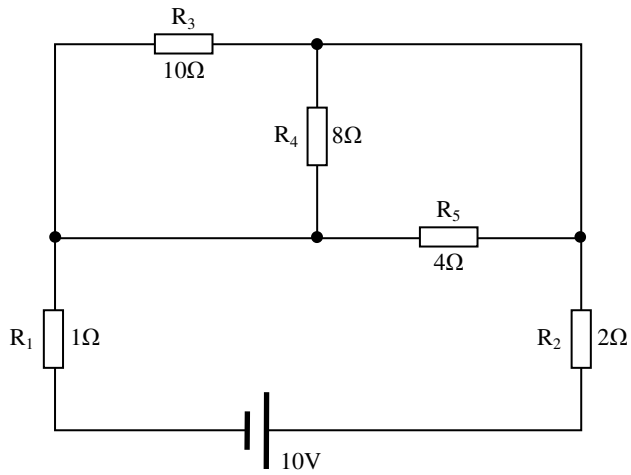


Figure 10 (c)

- (i) Find the total circuit resistance. (3 marks)
- (ii) Find the current through R_4 . (3 marks)
- (iii) Find the total power dissipation of the circuit. (2 marks)

11. (a) State four characteristics of an ideal Op-Amp. (4 marks)
- (b) Figure 11(a) shows an electronic alarm circuit using a typical LDR (resistance decreasing with light received).

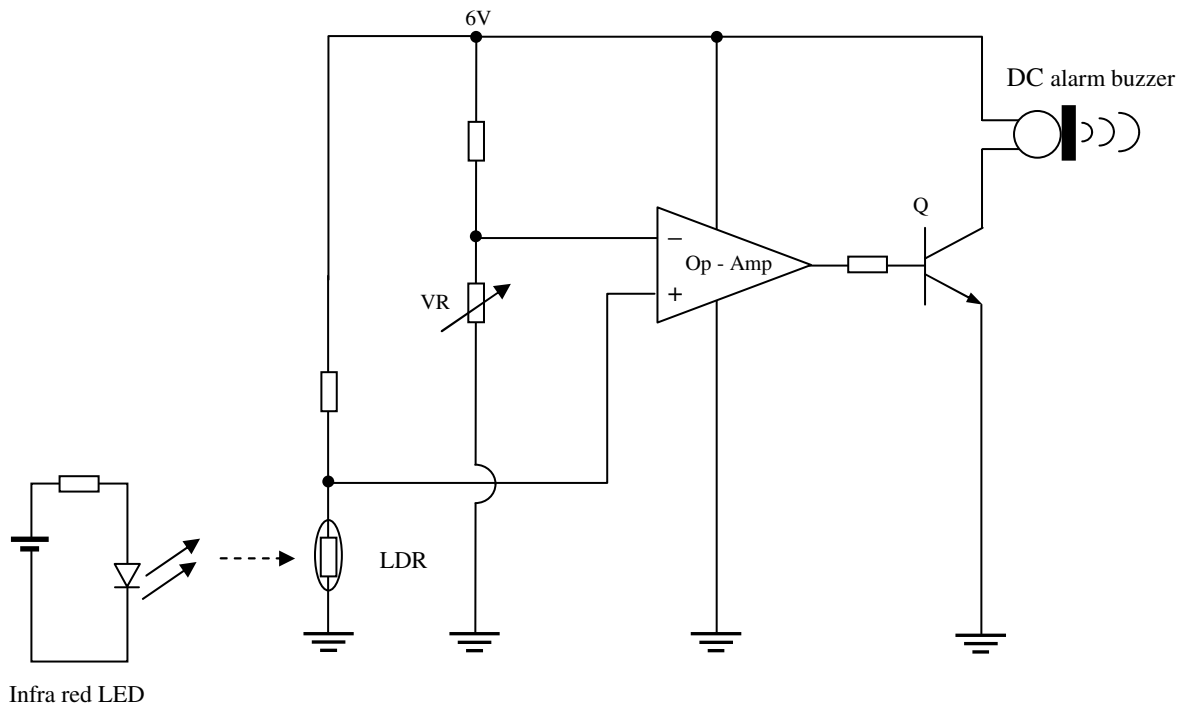


Figure 11(a)

- (i) State two functions of the Op-Amp in the circuit. (2 marks)
- (ii) State the function of Q and give one reason why Q is necessary. (2 marks)
- (iii) Describe briefly the purpose of VR. (2 marks)
- (iv) Under what specific condition will the DC alarm buzzer be activated? (2 marks)

(c) Figure 11(b) shows an Op-Amp and two identical resistors.

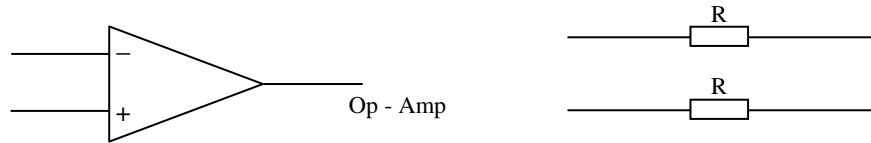
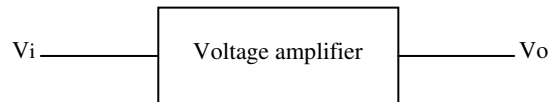


Figure 11(b)

Using the above Op-Amp and resistors, draw a simple voltage amplifier circuit having the following characteristics:

$$\text{Voltage gain} = \frac{V_o}{V_i} = 2$$



Input resistance: no specific requirements

(3 marks)

(d) Figure 11(c) shows a logic circuit using two NAND gates.

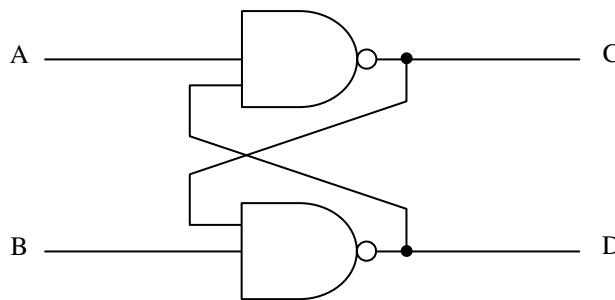


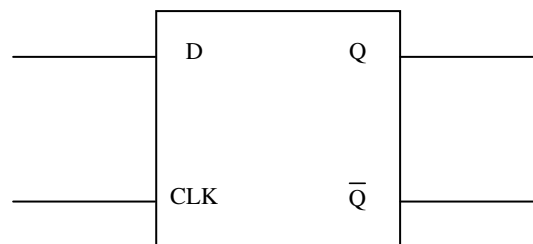
Figure 11(c)

(i) Give the output states of the circuit shown in Figure 11(c) for each of the following input combinations:

- A = 0; B = 0
- A = 1; B = 0
- A = 0; B = 1
- A = 1; B = 1

(4 marks)

(ii) Sketch the truth table of a D-type flip flop.



(2 marks)

(iii) By adding extra NAND gates to the circuit shown in Figure 11(c), construct a D-type flip flop. (4 marks)

12. (a) ROM and RAM are frequently used in microprocessor systems.
- (i) State the full names of ROM and RAM. (2 marks)
 - (ii) Describe briefly the characteristics of ROM and RAM. (2 marks)
 - (iii) State two uses of ROM in microprocessor systems. (2 marks)
 - (iv) State two uses of RAM in microprocessor systems. (2 marks)
- (b) Electronic devices in 'Surface Mount Packages' are frequently used in modern electronic products.
- (i) Give two advantages of using this type of package in electronic products. (2 marks)
 - (ii) State two possible difficulties of using this type of devices in learning and experimental situations. (2 marks)
- (c) Figure 12(a) shows a test setup used to check the height of boxes passing through. Two narrow-beam LEDs are mounted on a pole and two detectors are mounted on another pole to receive light from the LEDs. The detector gives a logic 'High' output when the light from the LED is blocked. Detector 'A' is used to check the height of the box while detector 'B' is used to check the presence of the box.

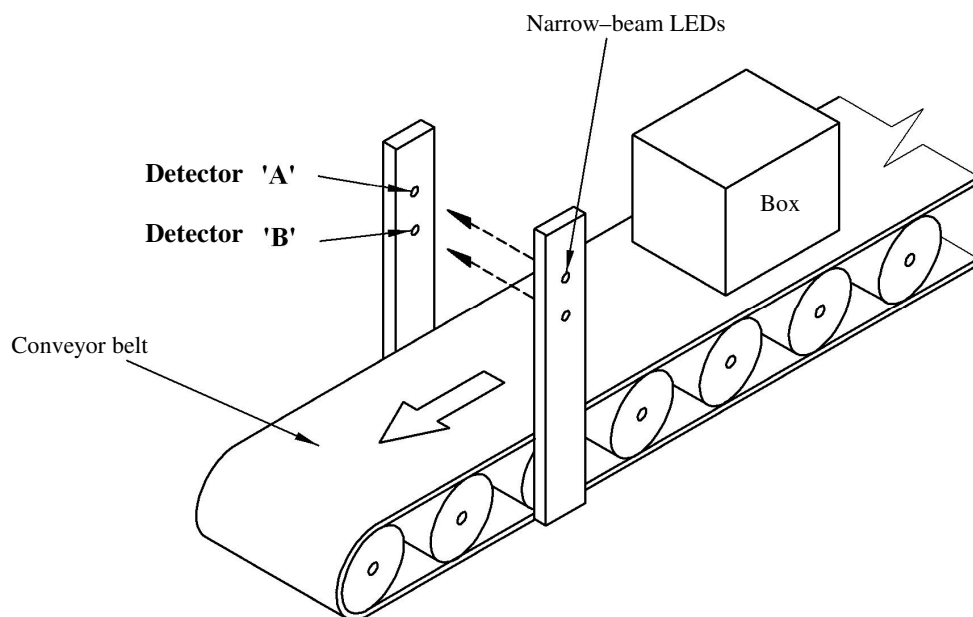


Figure 12(a)

The output signals from the detectors are connected to a micro-controller system as shown in Figure 12(b). The outputs of the micro-controller drive a GREEN indicator and a RED indicator to show the test results as in the table below:

Description	GREEN indicator	RED indicator
No box at check point	OFF	OFF
Height of box within the limit	ON	OFF
Height of box exceeds the limit	OFF	ON

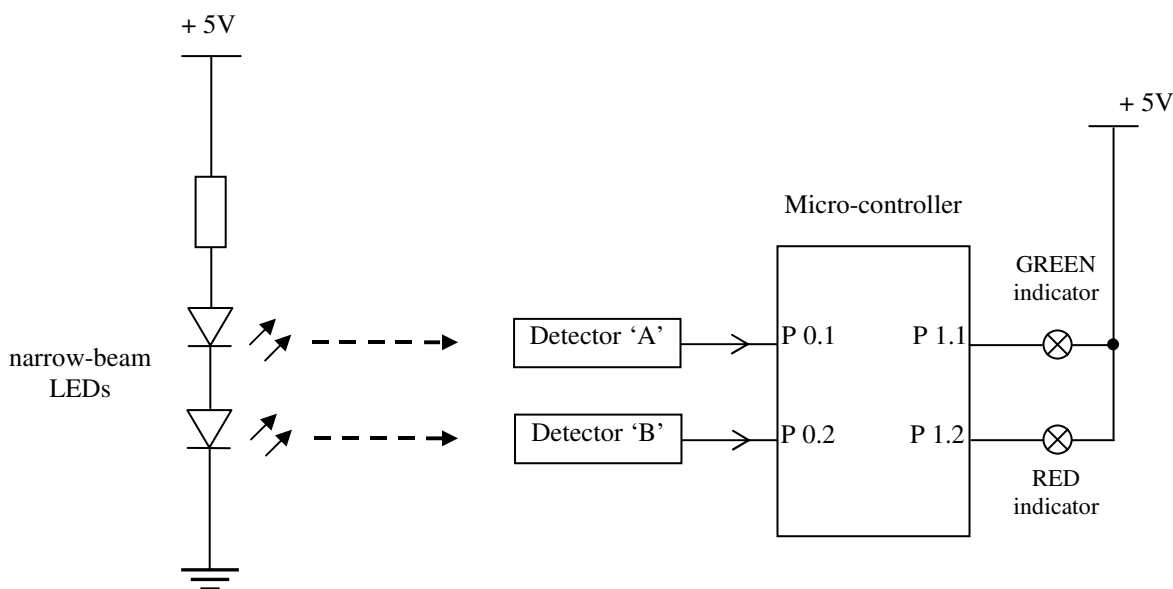


Figure 12(b)

- (i) Copy the following table to your answer book and write the output states of the detectors A and B under the following conditions:

Conditions	Output of Detector 'A'	Output of Detector 'B'
No box at check point		
Height of box within the limit		
Height of box exceeds the limit		

(3 marks)

- (ii) What are the required output states of the output ports to drive the indicators as stated in the table below:

GREEN indicator	RED indicator	Output of P1.1	Output of P1.2
OFF	OFF		
ON	OFF		
OFF	ON		

(3 marks)

- (iii) Write a program in 'pseudo code' to control the micro-controller system. (7 marks)

END OF PAPER 2D

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PRACTICE PAPER
DESIGN AND APPLIED TECHNOLOGY PAPER 2E
Visualisation and CAD Modelling
Question-Answer Book

This paper must be answered in English

INSTRUCTIONS

- (1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1 and 5.
- (2) Refer to the General Instructions on Papers 2A - 2D.
- (3) Answer any **TWO** questions from Q.13 - Q.15.
- (4) Write your answers in the spaces provided in this Question-Answer Book.
- (5) Supplementary answer sheets will be supplied on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this book.
- (6) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.
- (7) Unless otherwise stated:
 - (a) all dimensions given are in millimeters;
 - (b) all solutions must be full size;
 - (c) all construction lines must be left in each solution.
- (8) Use your own judgement for any dimensions not given.

Please stick the barcode labels here.

Candidate Number																				
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To be filled in by the candidate	Marker's Use Only	Examiner's Use Only
	Marker No.	Examiner No.

Question No.	Marks	Marks
Total		

Checker's Use Only	
Checker No.	
Total	



13. (a) Figure 13 shows a photo and a plan view of a set of office desk and chair.

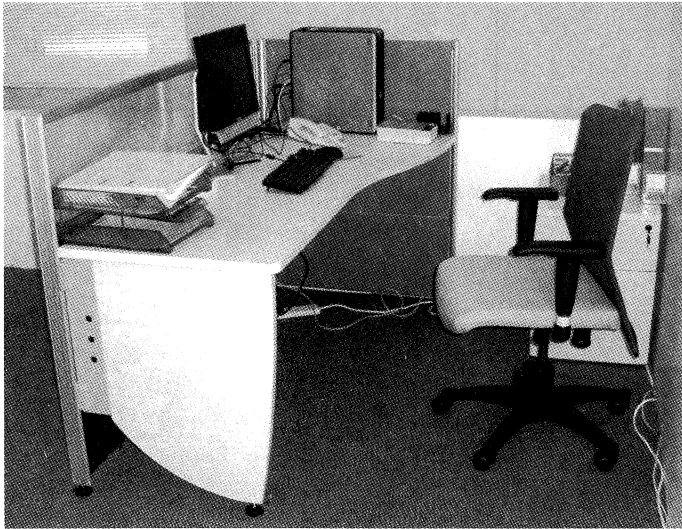
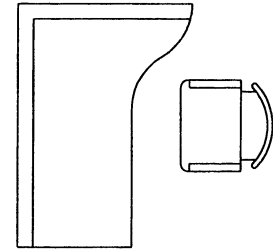


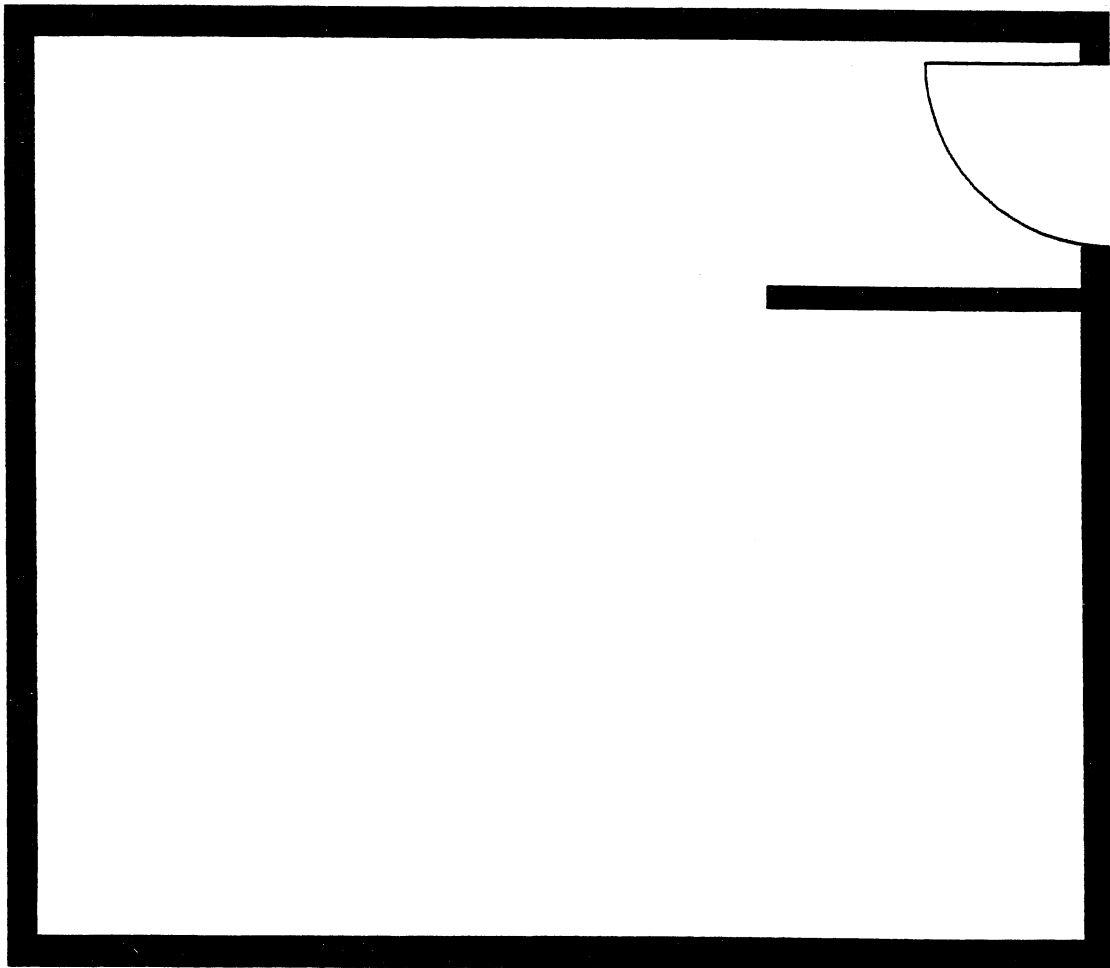
Figure 13(a)



PLAN VIEW
OF A DESK AND CHAIR

Figure 13(b)

Using the information given in Figure 13(b), design and draw the layout of six sets of desks and chairs in the office floor plan below. (15 marks)



OFFICE FLOOR PLAN

- (b) Table 13 shows the details of a recycling survey collected at a housing estate.

Materials	Wasted paper	Glass bottles	Aluminium cans	Tin cans	Plastic bottles
Quantity collected	240 kg	120 kg	150 kg	180 kg	30 kg

Table 13

From the given information, draw a coloured 'pie chart' showing the percentage of each material collected. (10 marks)

14. (a) On the starter sheet below, use the 'Cartesian method' to illustrate the 3D spatial relationship between the two points A(0,0,0) and B(3,4,5).

+
A(0,0,0)

- (b) Using 'Boolean operations', draw annotated sketches on page 5 to show the major steps required in constructing the 3D CAD model of the object shown in Figure 14. (20 marks)

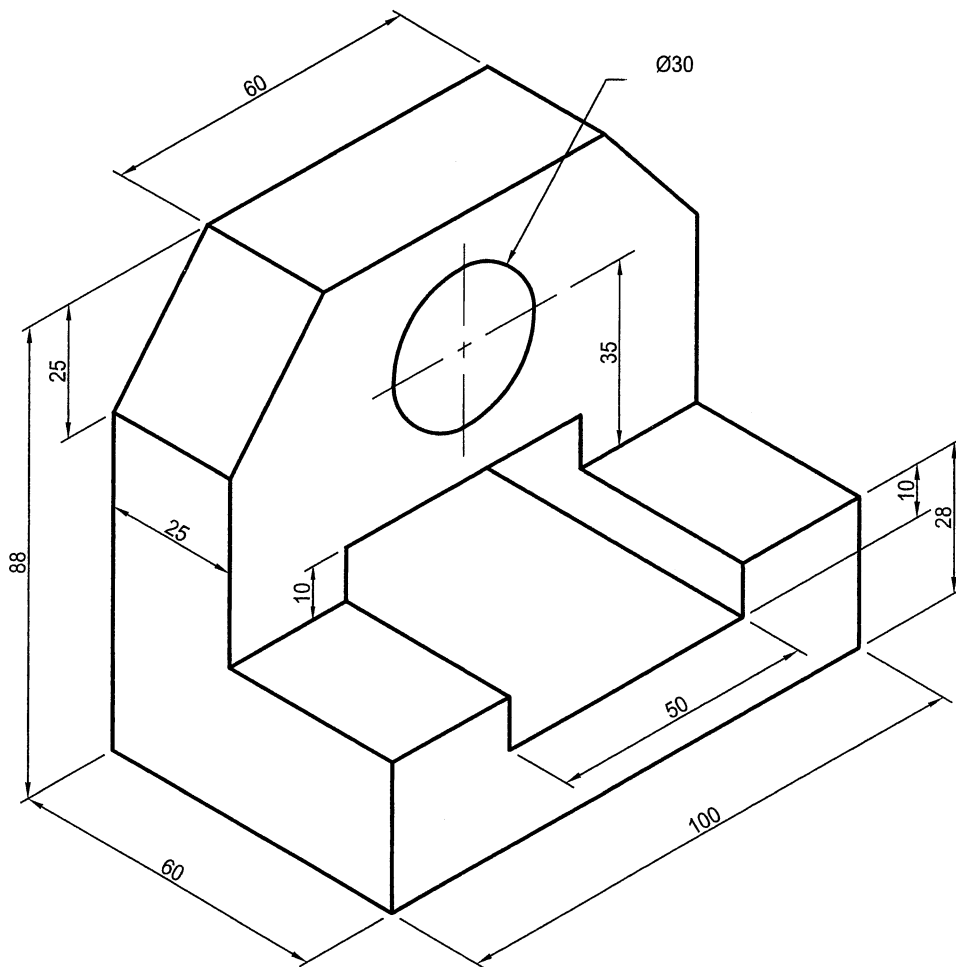


Figure 14

Please stick the bar  here.

Major steps required in constructing the 3D CAD model:

15. (a) Figure 15(a) shows a water tap with an infra-red sensor.

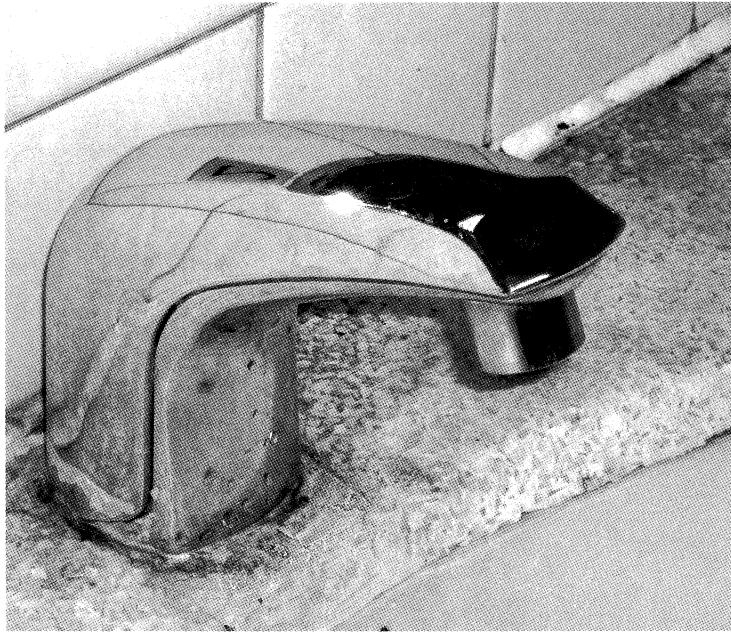


Figure 15(a)

In the space provided below, design and sketch a coloured illustration to show that the water tap is controlled by infra-red sensor. (10 marks)

- (b) If the object shown in Figure 15(b) is rotated to appear as Figure 15(c), draw, full space provided, the appearance of the object in Figure 15(d) with the same rotation. (15)

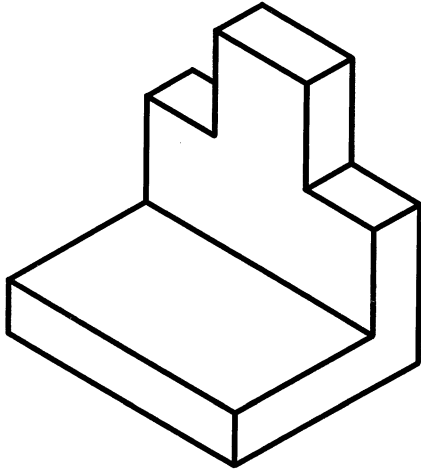


Figure 15(b)

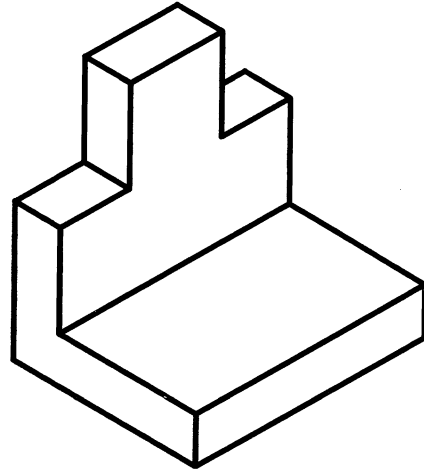


Figure 15(c)

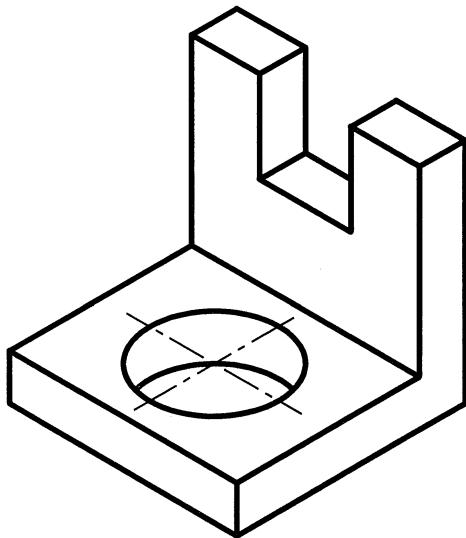
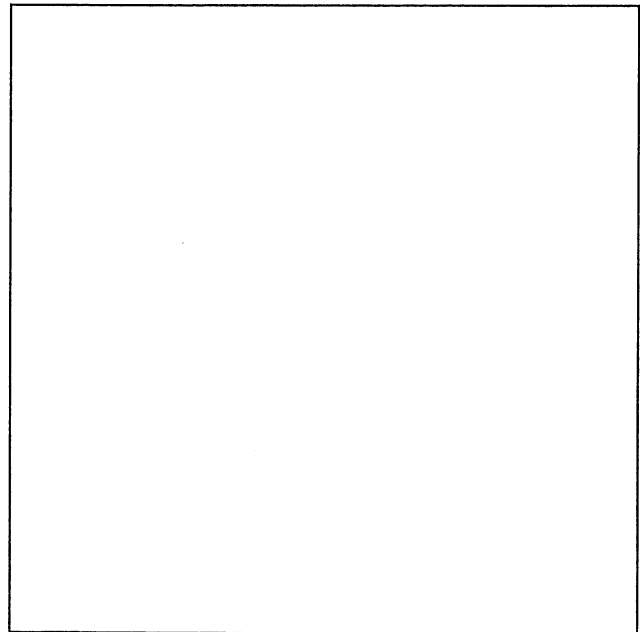


Figure 15(d)



END OF PAPER 2E

Do not write on this page.

Answers written on this page will not be marked.