ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව **ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව** විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of **இலங்கைப் SriLanka பரீட்சைத் திணைக்களம்**ns, Sri Lanka Department of Examinations, Sri Lanka
ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභා දෙ **Department of Examinations, Sri Lanka** ම ලංකා දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப **Department of Examinations, Sri Lanka**க்களம் இலங்கைப் பரீட்சைத் திணைக்களம்

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

ඉංජිනේරු තාක්ෂණවේදය	**II**			
பொறியியல் தொழினுட்பவியல்	**II**	**65**	**E**	**II**
Engineering Technology	**II**			

පැය තුනයි	අමතර කියවීම් කාලය	-	මිනිත්තු 10 යි
மூன்று மணித்தியாலம்	மேலதிக வாசிப்பு நேரம்	-	10 நிமிடங்கள்
Three hours	**Additional Reading Time**	-	**10 minutes**

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index No. : ....

Important :

* This question paper comprises of **four** parts, **A**, **B**, **C** and **D**. The total time allotted for **all four parts** is **three hours**.

* Use of **non-programmable calculators is allowed**.

PART A — Structured Essay :
(pages 2 - 9)

Answer **all** the questions **on the question paper itself**. Write your answers in the space provided for each question. Note that the space provided is sufficient for the answers and that extensive answers are **not** expected.

PARTS B, C and D — Essay :
(pages 10 - 15)

Essay question paper contains **six** questions, Answer **four** questions selecting at least one question from each part. Use the papers supplied for this purpose.

At the end of the time allotted for this paper, tie the four parts **A**, **B**, **C** and **D** *together as a single answer script* so that Part A is on top and hand it over to the supervisor.

For Examiners' Use Only

65 - Engineering Technology II		
Part	Question Nos.	Marks Awarded
A	1	
	2	
	3	
	4	
B	5	
	6	
C	7	
	8	
D	9	
	10	
Total		

Total

In numbers	
In words	

Code Number and Signature

| Marking Examiner 1	
Marking Examiner 2	
Marks checked by	
Supervised by	

PART A — Structured Essay

Answer all four questions on this question paper itself.
(Marks allocated for each question is 75.)

1. Shown below is a 3-dimensional drawing of a lid-less hollow box made of a 1 mm thick galvanized steel sheet. To fabricate the above box according to the given dimensions, draw the **development** on the given grid sheet using the **geometric instrument set**. The scale to be used is 1:1. On the given grid sheet, consider that one small square is 5 mm × 5 mm. Mark the **least number of dimensions** required for the production of the box. **Correct placement** of the development within the grid sheet is a **must**. Here, all dimensions are in millimetres. Ignore the bending allowances and bond allowances.
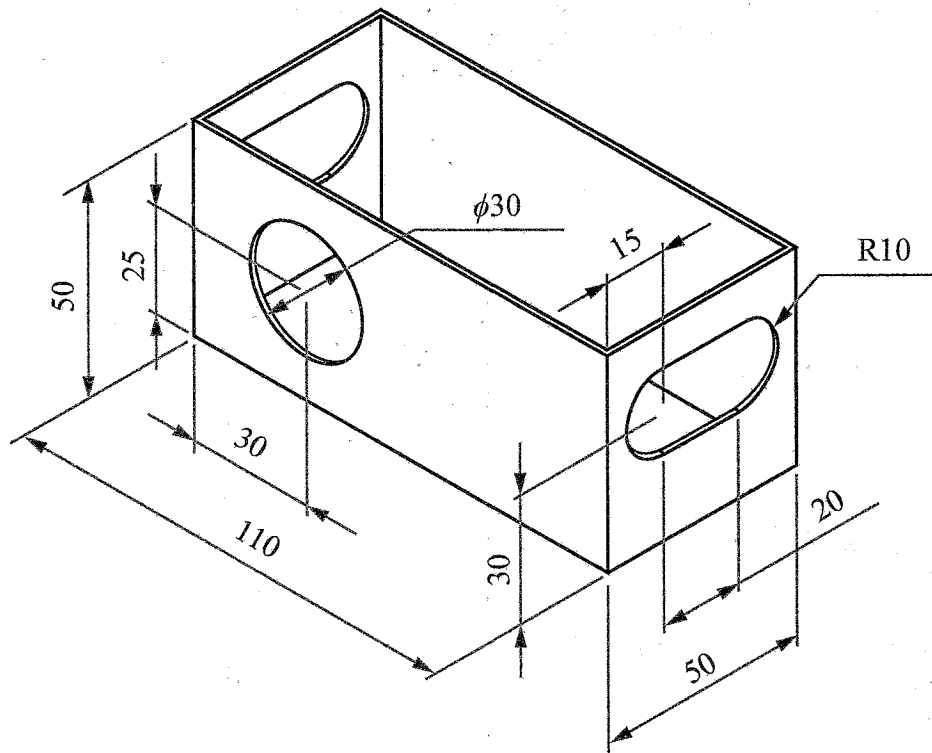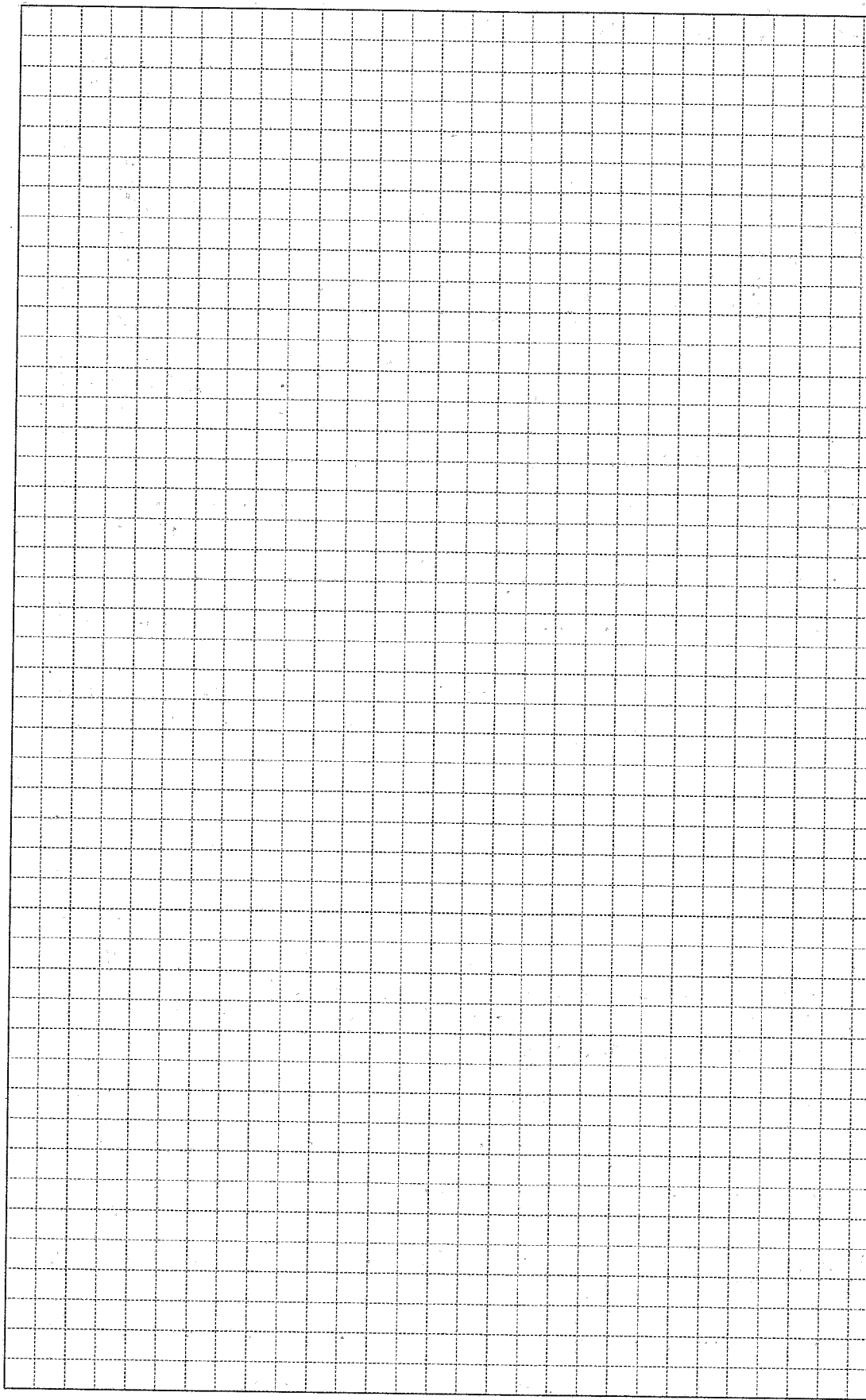

(This figure is not drawn according to a scale)

Q. 1

75

(75 marks)

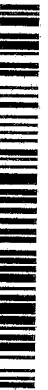DRAWN BY : ABC PERERA

CHECKED BY : S SIVAM

SCALE : 1:1
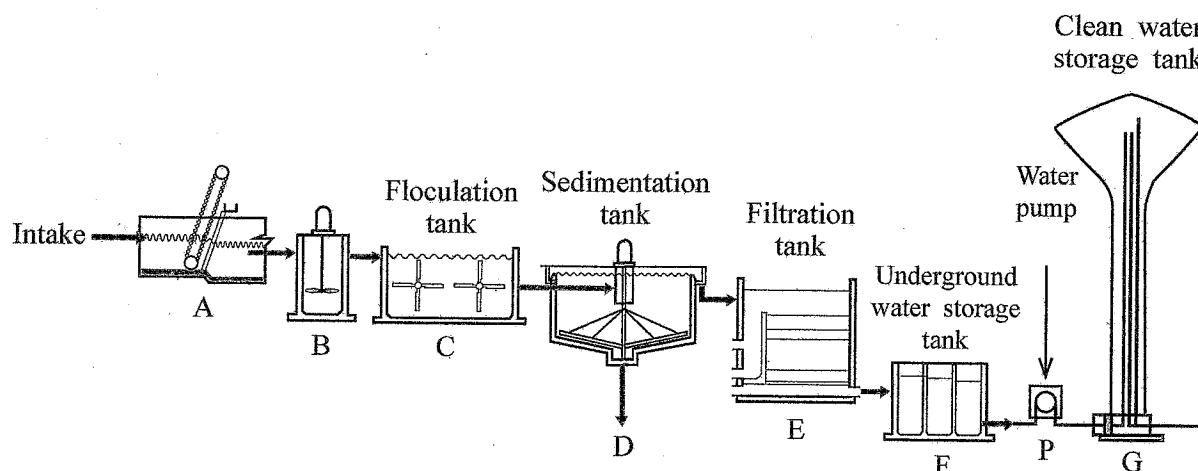
000466

2. To supply drinking water to a suburban area, a water purification plant is proposed to be constructed. The total population of this area is 20,000. The main units of the proposed water purification plant are shown in the following figure.

(*a*) State the name of the unit denoted by 'A' and its main function.

(1) Name of the unit : ....

(05 *marks*)

(2) Main function : ....

....

(05 *marks*)

(*b*) Alum is used as a coagulant agent at 'B'. Here, the suspended particles in water are subjected to flocculation and allowed to settle at the bottom of the sedimentation tank. Explain this process of flocculation scientifically.

....

....

....

(10 *marks*)

(*c*) The above clean water storage tank (G) should have the capacity to store water for at least 2 days consumption for the entire population. Considering that the water consumption per person is 120 litres per day and water wastage via distribution pipes is 30%, calculate the capacity of the clean water storage tank.

....

....

....

(20 *marks*)

(*d*) State the **two** off-set types that can be used to find the location of the above clean water storage tank (G) with respect to a particular survey line.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(e) An electric water pump (P) is used to supply water to the above clean water storage tank (G). A temperature sensitive switch (T) is used to prevent this pump from excessive heating. This switch outputs "logic 1" at high temperature and "logic 0" at lower temperatures. In addition, water level sensitive switch (W) is used to prevent overflowing this tank. This switch outputs "logic 1" at overflowing level and "logic 0" at lower water levels. The pump should switch off at high temperature or when the water reaches the overflow level of the tank.

(i) Considering the operation of the pump as "logic 1", derive the truth table for the operation.

W	T	P

(05 *marks*)

(ii) Draw the gate circuit related to the above truth table.

(05 *marks*)

(iii) The following electronic circuit is proposed for the above temperature sensitive switch (T). If the resistance of the thermister in this circuit (R_T) increases with respect to the increase in the temperature, explain the functionality of the circuit.

12 V

R_T 1 kΩ

O/P

5 kΩ

....

....

....

....
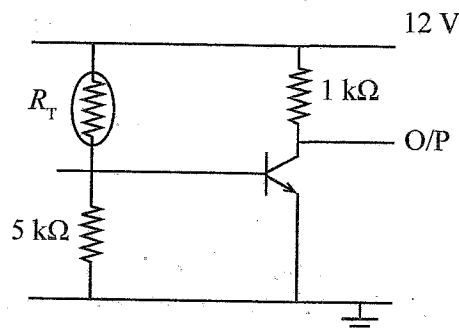
(05 *marks*)

(iv) Considering that $V_{CE(SAT)}$ = 0.2 V, state the output voltage at "logic 0" and "logic 1".

O/P Logic	Output Voltage (V)
0	
1	

(05 marks)

(v) Calculate I_C when the transistor is at saturation.

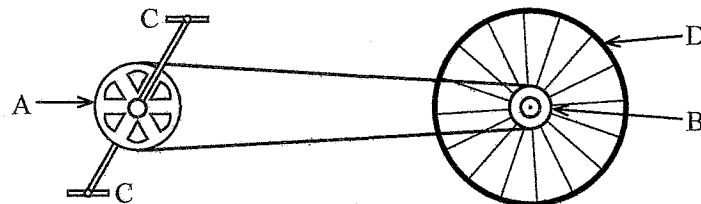..

(05 marks)

3. (a) Shown below is a diagram of a power transmission system of a standard/conventional bicycle. In this bicycle, the diameter of the rear wheel (D) is 700 mm while sprocket wheel A has 80 teeth and sprocket wheel B has 20 teeth.

(i) What is the motion type that acts on the paddles (C) of the bicycle to create a rotational motion in the sprocket wheel B?

....

(05 marks)

(ii) What should be the rotational speed of the wheel (D) in revolutions per minute (rpm) to manoeuvre the bicycle at a speed of 6.6 km/h?

....

....

(10 marks)

(iii) To maintain the above 6.6 km/h speed, what is the rotational speed in revolutions per minute (rpm) that needs to be maintained at the sprocket wheel A of the chain drive?

....

....

(10 marks)

(iv) When the rear wheel (D) rotates in this bicycle in the forward direction, paddles (C) should not be rotated by it. What is the mechanism used in bicycles for this?

....

(05 marks)

(*b*) (i) An engineering technology professional has decided to operate this bicycle using an electric motor as well. With this decision, it was decided to convert its existing braking system to a hydraulic braking system. In this design, a brake disc was incorporated to the rear wheel and in order to achieve the maximum braking force, it had to be designed to apply a 1000 N force on it. Calculate the force in Newtons (N), which should be applied on the piston of the main cylinder by the handle in this situation.

(In the braking system, the cross sectional area of the cylinder near the wheel is 2000 mm². The cross sectional area of the main cylinder being used for this is 100 mm².)

....

....

....

....

(10 *marks*)

(ii) Write **two** characteristics that must be present in the fluid being used in a hydraulic braking system.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(*c*) It has been decided to use a battery to supply power needed for this motor. Its specification is 48 V/21 Ah.

(i) Propose a suitable type of motor for this application.

....

(05 *marks*)

(ii) The power of the motor is 250 W. At this power, calculate the running time of the bicycle only by the battery. (Neglect all the losses)

....

....

(10 *marks*)

(iii) This battery is expected to be charged by the residential electricity supply. How many units of electricity are required to fully charge the completely drained battery.

....

....

(10 *marks*)

Q.3

75

4. Three engineering technology professionals have decided together to start a business to operate a vehicle spare-part sales business.

(*a*) In this business, it is required to formulate a logistics process to fulfil the customer needs. The factors that need to be focussed here are transport, storage, and research and development.

(i) State **two** reasons for this business to require transportation facilities.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(ii) State **two** reasons for this business to require storage facilities.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(iii) It is intended to use racks to store vehicle spare-parts in this business premises. Storing spare-parts on racks can give rise to different ergonomic hazards. Write **two** strategies that can be used to avoid risks arising from such hazards.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(b) In order to forecast the sales of this business, time-series data obtained for 5 years from a similar business is shown in the table below.

Year	Sales (Quantity)
1	2200
2	2600
3	2800
4	2900
5	2950

(i) Plot the above data on the following graph.
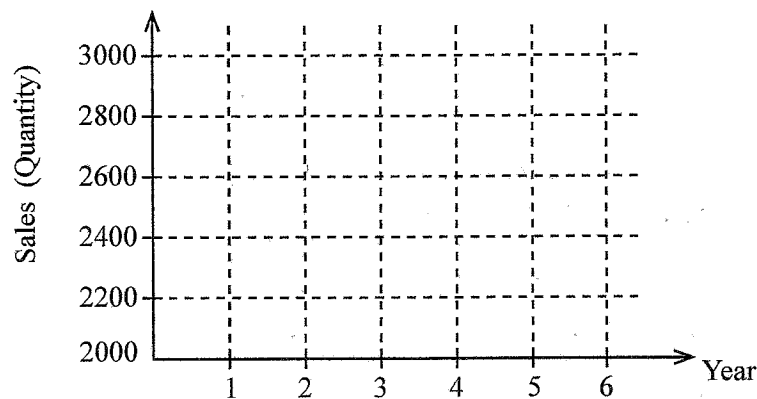
(10 *marks*)

(ii) Considering the plotted data in (b) (i), briefly explain how the sales of the above business have taken place within the five-year period.

....

....

(10 *marks*)

(iii) According to the graph in (b) (i) above, if the other factors are assumed to be static, forecast the sales in the sixth year.

....

(10 *marks*)

(iv) The annual financial information (from 01/01/2023 to 31/12/2023) of this spare-part business is shown below.

Description	Amount (Rs.)
Sales income	400,000.00
Value of the stock at the beginning of the year	50,000.00
Value of the stock at the end of the year	25,000.00
Building rental	300,000.00
Expenditure for equipment repair	350,000.00
Electricity bill	90,000.00
Telephone bill	30,000.00
Purchases (motor spare-parts)	250,000.00
Discounts received	100,000.00
Commissions received	50,000.00
Banking fees	10,000.00

Calculate the annual net profit/loss of this business using the profit/loss account sheet below.

The profit/loss statement for the spare-part business for the year ending 31.12.2023

(15 marks)

Q. 4

75

** **

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

ඉංජිනේරු තාක්ෂණවේදය **II**
பொறியியற் தொழினுட்பவியல் **II**
Engineering Technology **II**

[65] [E] [II]

Instructions:

* *Answer **four** questions only selecting at least **one** question each from parts **B**, **C** and **D**.*
* *Marks allocated for each question is **100**.*

Part B - Essay (Civil Technology)

5. Shown in the figure are the named *Y–Y* sectional front elevation and the plan of a proposed bus stop. Its roof should be made of concrete and should rest on brick walls *A* and *B* of 3000 mm height, 2500 mm length and one-brick wide. The portion between the two brick walls at the back is a half wall (*C*) that is one-brick wide, and the front side of the bus stop should be open. All of these brick walls should not be plastered and they should be constructed with an attractive finish.

SECTIONAL FRONT ELEVATION *Y–Y*
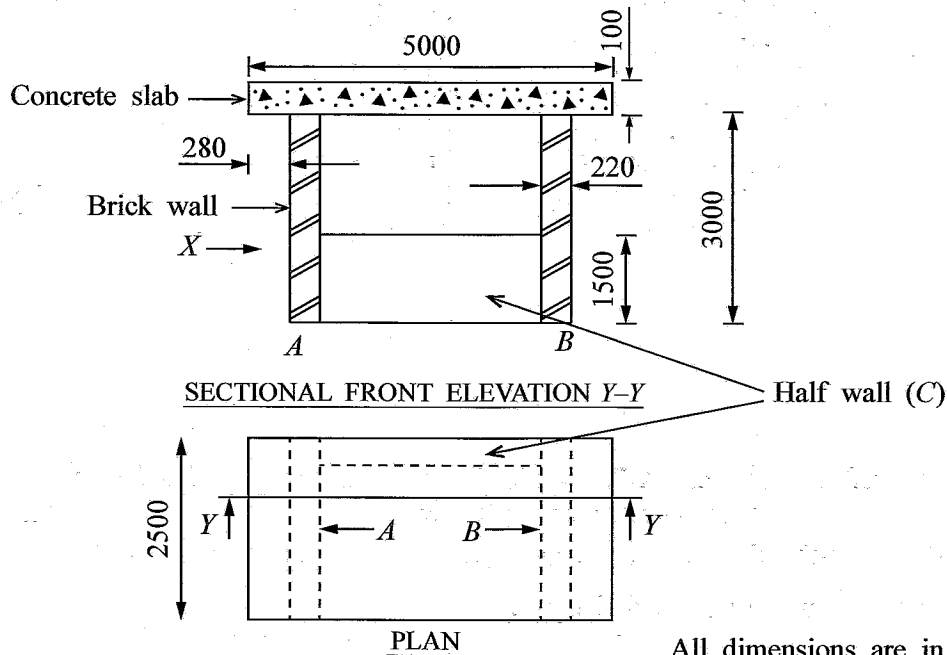
PLAN   All dimensions are in millimetres.

(*a*) (i) Name the most suitable bond type for laying bricks in these walls? (05 *marks*)

(ii) Calculate the quantity of bricks required to lay one course of bricks in wall *A*. (The thickness of a mortar joint can be maintained from 8 mm to 12 mm.) (15 *marks*)

(iii) Using a rough sketch, show the side view of the wall *A* when looking from the *X* direction. (Showing two brick layers is sufficient) (10 *marks*)

(iv) For the roof slab above, calculate the volumes of raw materials that are needed to prepare a concrete mixture of 1:2:4. (Consider that the ratio between the volumes of the wet mixture and the dry raw materials is 1:1.4.) (20 *marks*)

(v) Calculate the force acting on a 1 m length at the base of wall *A*. (Consider that the unit weight of concrete is 24 kN/m^3 and the unit weight of the brick wall is 18 kN/m^3). (20 *marks*)

(b) (i) State the type of strength that is enhanced by employing reinforcements in the concrete slab. (05 *marks*)

(ii) Stating technological reasons, briefly describe a fact that should be considered when determining the quantities of reinforcements for the above concrete slab. (10 *marks*)

(c) (i) The first coat applied on a certain surface when painting is called the primary coat. Briefly describe **two** functions performed by the primary coats. (10 *marks*)

(ii) Name the type of primary coat which can only be used on wood and metal surfaces. (05 *marks*)

6. (a) As shown in the cross sectional figure below, a 100 m long, concrete wall has been constructed along the ground with level difference and the *ABCD* soil section associated with it has been improved.
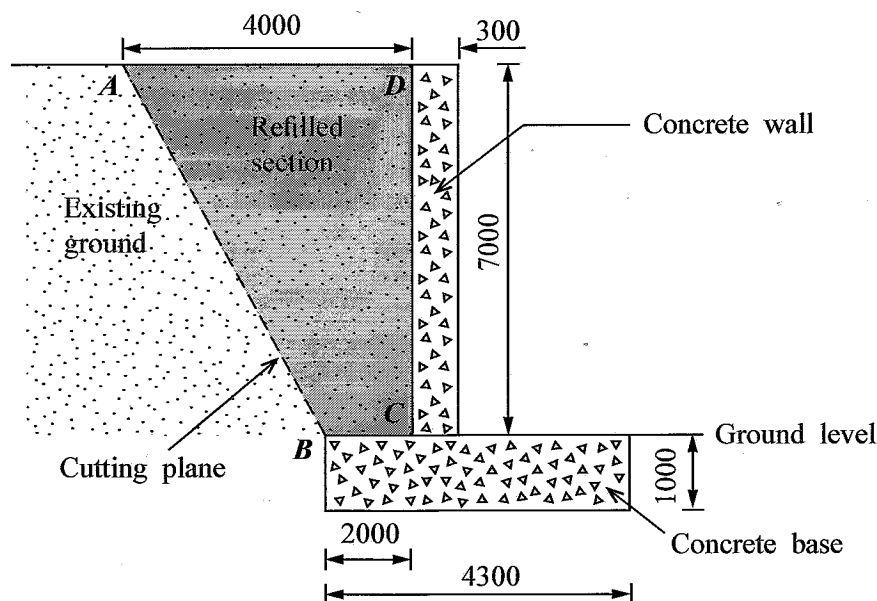
All dimensions are in millimetres.

The darkened soil section *ABCD* was cut along line *AB* and removed, a geotextile was laid along *BC* and *CD* to filter water, and afterwards the *ABCD* section was refilled.

Take the quantities for the work items given below according to SLS 573.

(i) Concrete for the wall and the base

(ii) Excavating soil in section *ABCD*

(iii) Geotextile (area) (30 *marks*)

(b) Rates for equipment and workers related to soil excavation in section *ABCD* as depicted in (a).

Rate

For the excavator   —   Rs. 1,200.00/45 min

For the excavator operator—   Rs. 3,500.00/Day

For the excavator helper   —   Rs. 2,800.00/Day

If the excavation rate of the excavator is 25 m³ of soil per hour and working hours per day is 7 hrs, using the above data, calculate the equipment cost and the labour cost separately to excavate the soil section. (20 *marks*)

(c) Shown below are a few readings taken in a levelling process carried out using one instrument station.

2.0 m, 1.5 m, 2.5 m, 1.0 m, 3.0 m

If the reduced level of the first location is 90.5 m, insert the above records into a table prepared according to the rise-fall method and calculate the reduced levels of the other locations.

(30 *marks*)

(d) Shown below is a field book entry with the offset records that were taken from a survey line XY during a surveying activity to find the area of a square geological feature surrounded by P, Q, R, and S.
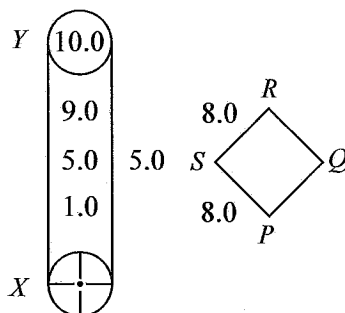
(i) Represent the location of P, Q, R, and S with respect to the above survey line to the scale of 1:100. (15 *marks*)

(ii) Calculate the actual area of PQRS. (05 *marks*)

Part C - Essay (Electrical and Electronic Technology)

7. (a) State an advantage and a disadvantage of wind energy compared to solar energy. (10 *marks*)

(b) An inductive load L, a 100 μF capacitor, and a 10 Ω resistor are connected in series to make a circuit. This circuit is connected to a 230 V/50 Hz AC supply. The power factor of this circuit was observed to be one (pf = 1.00). Calculate the following.

(i) The RMS value of the current flowing in the circuit (05 *marks*)

(ii) The peak value of the current flowing in the circuit (05 *marks*)

(iii) The value of the inductive load L (20 *marks*)

(iv) The electrical energy consumed by the circuit within 10 hours, in kWh (10 *marks*)

(c) According to the regulations of the Institution of Engineering and Technology (IET), "every installation shall be divided into circuits." Explain **two** reasons for this. (20 *marks*)

(d) The power supply of a house was disconnected due to the activation of the Residual Current Circuit Breaker (RCCB). Even when the owner of the house tried to bring it back to normal, it activated and the supply was disconnected. Then, he switched off all the Miniature Circuit Breakers (MCBs) and brought the RCCB to normal, but again it activated and the supply was disconnected. Then, he switched off all the light switches and brought the RCCB to normal, but again it activated and the supply was disconnected. Finally, he disconnected all appliances plugged to socket outlets and brought the RCCB to normal and it remained as normal successfully.
Explaining the factor/s that has/have affected this situation, scientifically explain the scenarios related to each observation stated above. (30 *marks*)

8. (*a*) (i) Draw the circuit diagram of a full-wave rectified DC single power supply using a center-tapped transformer. (05 *marks*)

(ii) The following circuit is proposed for stabilizing the output voltage of the circuit in (*a*)(i) above. In this,
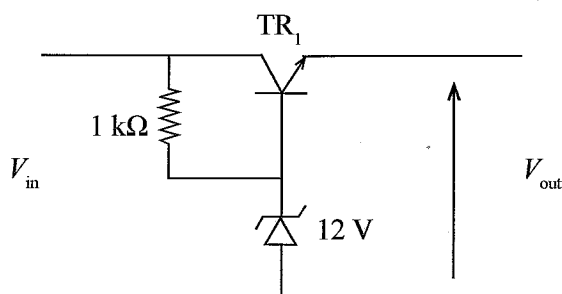
(1) Explain the importance of TR_1 transistor. (05 *marks*)

(2) What is the operating region of TR_1 transistor? (05 *marks*)

(3) When $V_{BE} = 0.7$ V in TR_1 transistor, calculate the output voltage of the circuit. (10 *marks*)

(4) Considering that the input voltage as 15 V, calculate the current across the 1 kΩ resistor. (10 *marks*)

(*b*) The following is an electronic circuit that can be used to control street lamps automatically.
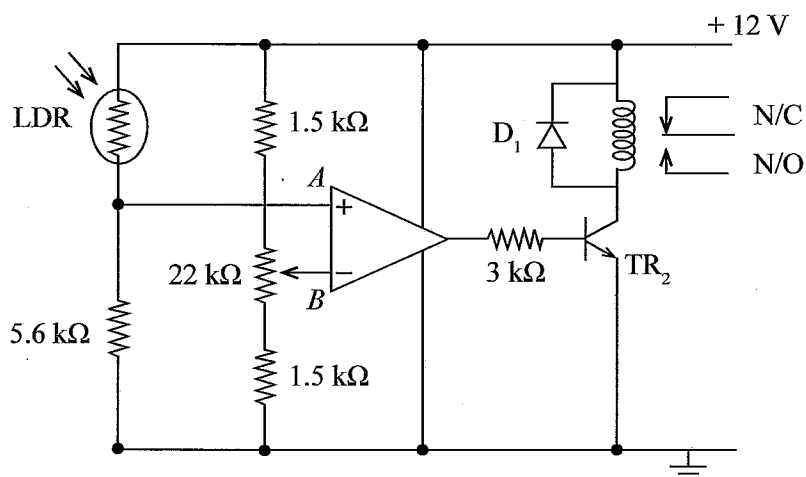
The relationship between the resistance and illuminance of the above LDR is shown below.
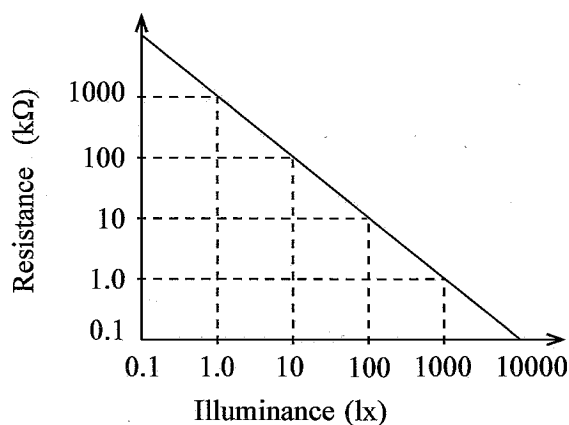
(i) In relation to the above circuit, explain the operation of the op-amp. (05 *marks*)

(ii) In relation to the above circuit, state the operating regions of TR_2 transistor. (05 *marks*)

(iii) In order to get the circuit to operate at 100 lx illuminance, calculate the voltage that must be present at the inverting terminal (*B*). (10 *marks*)

(iv) In relation to (b)(iii) above, show the position of the adjustment of the 22 kΩ variable resistor as a ratio between the resistances. (10 *marks*)

(v) Taking the maximum output voltage of the op-amp as +12 V and $V_{BE} = 0.8$ V in transistor TR_2, calculate its base current (I_B). (10 *marks*)

(vi) Explain the function of diode D_1. (05 *marks*)

(vii) Taking $V_{CE} = 0.2$ V, and the resistance of the relay coil as 200 Ω, calculate the collector current (I_C). (10 *marks*)

(viii) Using a circuit diagram, draw how the street lamp should be connected to the circuit above. (05 *marks*)

(ix) Calculate the range of the current gain that must be present in the transistors that can be used in place of the transistor TR_2 above. (05 *marks*)

Part D - Essay (Mechanical Technology)

9. (a) The damper (shock absorber) is very important to appropriately sustain the functionality of the suspension system of a motor vehicle.

(i) State the primary function of a shock absorber. (15 *marks*)

(ii) Explain a strategy that is being used in a shock absorber to carry out the function stated in (a)(i) above. (20 *marks*)

(iii) It was observed that the rubber bush which is at the top end of the shock absorber, located at the place where it is fixed to the chassis is split. Briefly describe **two** ways this reduces the suspension process of the motor vehicle. (20 *marks*)

(b) The diagram below shows an instance where the front two wheels are turned to the left in a steering system being used in a motor vehicle. Here, $AD = BC = 1700$ mm and $AB = CD = 2600$ mm. As shown in the diagram, the front wheel which is on the inside of the bend is turned by an angle $\alpha = 23°$. Calculate the following.
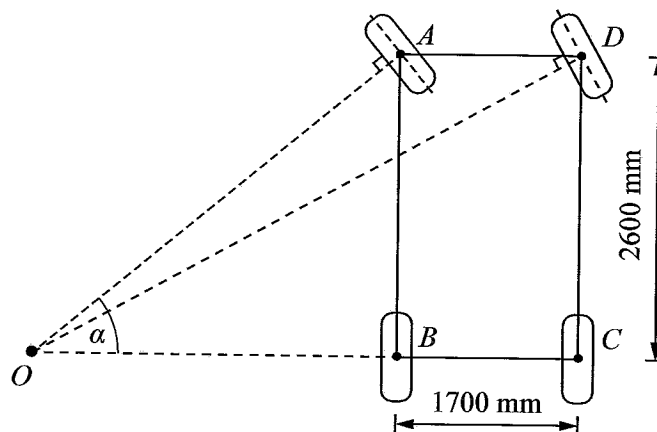
(i) Radius travelled by the front wheel (OA) which is on the inside of the bend. (10 *marks*)

(ii) Radius travelled by the front wheel (OD) which is on the outside of the bend. (20 *marks*)

(c) It is observed that the motor vehicle mentioned in (b) is a front engine, rear wheel drive vehicle.

(i) Explain the nature of the motion of the rear wheels while taking the turn. (10 *marks*)

(ii) State a technique used in the power transmission system to maintain the nature of the motion mentioned in (c)(i). (05 *marks*)

[*see page fifteen*

10. (*a*) It is required to prepare plans employing appropriate techniques in order to maintain the quality of a product to be manufactured. However, the quality of the product can become poor due to the weaknesses of the manufacturer. Using **four** facts, explain weaknesses of such a manufacturer. (20 *marks*)

(*b*) It is required to manufacture a supporting base plate with a rectangular hole as shown in the figure to install a machine weighing 2 t. The length needs to be 1000 mm, width needs to be 800 mm and the thickness needs to be 15 mm.
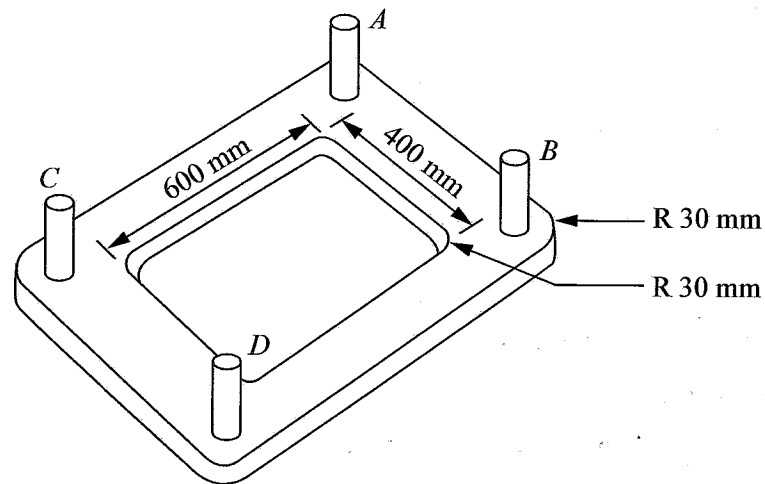
A, *B*, *C* and *D* are M30 double-ended threaded stud bolts. It has been proposed to manufacture this base plate using a 1200 mm × 1200 mm × 16 mm steel plate.

Describe the steps needed to manufacture this using shaping and milling machines/instruments and relevant cutting tools. (60 *marks*)

(*c*) The above plate is to be installed horizontally on a concrete. Describe the technological procedure that needs to be followed together with associated strategies and steps, for this. (20 *marks*)

✳ ✳ ✳

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

ඉංජිනේරු තාක්ෂණවේදය **I**		පැය දෙකයි
பொறியியற் தொழினுட்பவியல் **I**	**65 E I**	இரண்டு மணித்தியாலம்
Engineering Technology I		*Two hours*

Instructions:

* *Answer **all** questions.*
* *Write your **Index Number** in the space provided in the answer sheet.*
* *Instructions are given on the back of the answer sheet. Follow them carefully.*
* *In each of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate** and mark your response on the answer sheet with a cross (×) in accordance with the instructions given on the back of the answer sheet.*
* *Each question carries **01** mark totalling to **50**.*
* *Use of non-programmable calculators is allowed.*

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1. The capacitance of a capacitor denoted as 15 pF is
   (1) 15×10^{-15} F.   (2) 15×10^{-12} F.   (3) 15×10^{-9} F.
   (4) 15×10^{-6} F.   (5) 15×10^{-3} F.

2. Consider the following statements regarding engineering standards and specifications.
   A - Standards and specifications confirm that the wastage and defects are minimised in production.
   B - ISO 9001(2015) is a specification related to quality management systems.
   C - There can be contradictions among standards being used in the world.

   Out of the above statements, the correct statement/s is/are
   (1) A only.   (2) B only.   (3) A and C only.
   (4) B and C only.   (5) A, B, and C all.

3. Consider the following statements regarding engineering technology.
   A - Design of the computer can be considered as a turning point in engineering technology.
   B - Through modelling and simulation of production processes using computer software, today's production sector is being focused towards a new direction.
   C - By providing internet facilities, Sri Lankan goods and services can be connected to the global supply chains.

   Out of the above statements, the correct statement/s is/are
   (1) A only.   (2) B only.   (3) A and C only.
   (4) B and C only.   (5) A, B and C all.

4. A dimension of a production drawing is depicted as ϕ 20.0 ± 0.1 mm. This means that the diameter of this component should be
   (1) not less than 9.95 mm and not more than 10.05 mm.
   (2) not less than 19.9 mm and not more than 20.1 mm.
   (3) 19.9 mm or 20.1 mm.
   (4) not less than 39.8 mm and not more than 40.2 mm.
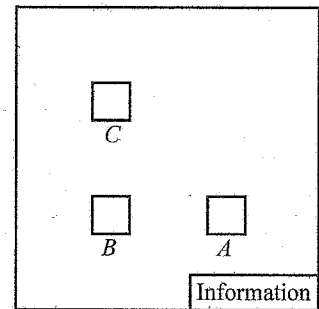   (5) not less than 39.9 mm and not more than 40.1 mm.

5. What is the correct arrangement of an engineering drawing, drawn according to the first angle projection method? (In the following figures, A represents the front elevation, B represents the end elevation and C represents the plan.)
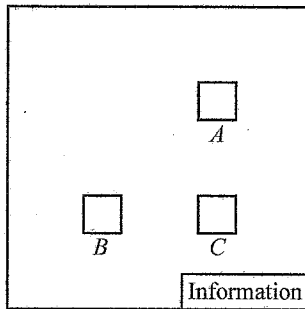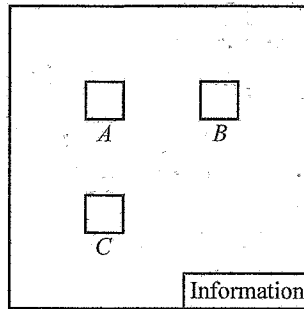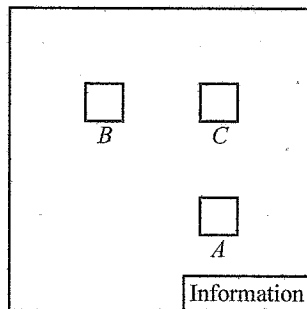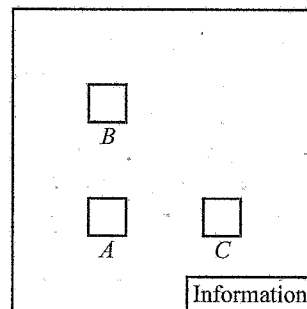

6. Consider the following statements regarding production and business development.

    A - Involvement of entrepreneurs is essential to add new goods and services to the market.
    B - All new inventions get added to the market as a good or a service.
    C - The personality traits inherent in entrepreneurs can be further developed.

Out of the above statements, the correct statement/s is/are

  (1) B only.   (2) A and B only.   (3) A and C only.
  (4) B and C only.   (5) A, B, and C all.

7. The following facts have been revealed by a market research conducted in Sri Lanka.

    A - There is a trainable workforce.
    B - There is a demand for reconditioned vehicle spare parts due to the prevailing situation.
    C - Currently, there is a scarcity of production machinery.
    D - Although there are micro credit facilities, it is difficult to obtain them.

Out of the above statements, for a business of reconditioned vehicle spare parts,

  (1) A can be identified as an opportunity while B can be identified as a strength.
  (2) A can be identified as a strength while C can be identified as a weakness.
  (3) A can be identified as an opportunity while C can be identified as a threat.
  (4) A can be identified as a strength while D can be identified as a weakness.
  (5) A can be identified as an opportunity while D can be identified as a threat.

8. Consider the following statements regarding lane markings on a highway system.

    A - Lanes are marked to minimise accident risks by minimising the hazards.
    B - Lanes are marked to minimise the accident risks by minimising the possibility of accidents.
    C - By marking lanes, hazards are highlighted to the drivers.

Out of the above statements, the correct statement/s is/are

  (1) A only.   (2) B only.   (3) A and C only.
  (4) B and C only.   (5) A, B, and C all.

[See page three

9. 'Bond' of a brick wall is
   (1) laying bricks to avoid locating continuous vertical joints.
   (2) laying bricks to strengthen the bonds between bricks.
   (3) laying bricks to maintain an equal gap between courses.
   (4) laying bricks to have all types of standard brick bats.
   (5) laying bricks to have a systematic bond pattern.

10. When constructing a road, plants used to push soil, spread soil evenly on the ground, and compact soil respectively are
    (1) Bulldozer, Backhoe loader, and Vibratory roller.
    (2) Backhoe loader, Bulldozer, and Poker vibrator.
    (3) Dragline, Excavator, and Poker vibrator.
    (4) Excavator, Motor grader, and Vibratory roller.
    (5) Bulldozer, Motor grader, and Vibratory roller.

● As shown in the figure below, there is a building at a higher elevation than a road. The soil in this land adjacent to the road has been cut and levelled to the road level. Use the figure to answer questions 11 and 12.
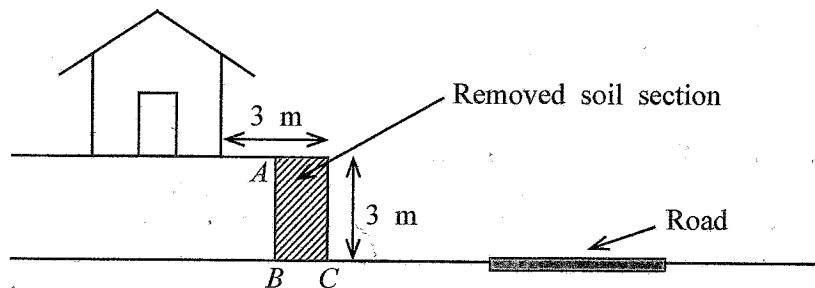
11. Sometime after the removal of soil from the land, crack marks were visible on the wall near the door. The scientific reason for this is the
    (1) reduction of the bearing capacity of the soil, where the building is located.
    (2) soil being pushed out due to the pressure exerted by the building.
    (3) imbalance in the ground surface due to the weight of the building.
    (4) increment of the pressure exerted on the building due to the removal of the soil.
    (5) increment of the pressure exerted by the building due to the removal of the soil.

12. An action that can be taken to arrest the crack propagation is to
    (1) construct a horizontal concrete slab covering BC.
    (2) construct a vertical concrete wall covering AB.
    (3) employ concrete beams through B.
    (4) employ concrete beams through A and B.
    (5) employ concrete beams along AC.

13. A fact **not** considered when locating 'windows' of a building is
    (1) wind direction.   (2) location of the room.   (3) size of the room.
    (4) thickness of walls in the room.   (5) direction of receiving sun light.

14. Transpiration related to the water cycle is the
    (1) process of water falling under gravity as rain.
    (2) process of removal of water as vapour from plants.
    (3) process of absorbing rain water into soil via soil strata.
    (4) process of rain water directly falling on to leaves, branches, and grass.
    (5) process of transformation of water from the vapour state to liquid state.

15. A physical property that should **not** be present in drinking water is
    (1) having sufficient hardness.   (2) being at room temperature.
    (3) having a neutral taste.   (4) transparency.
    (5) having a neutral smell.

16. Following facts were presented by a student on the basic requirements of a sewerage system.
    A - Minimum diameter which can be used in the sewerage pipes should be 100 mm.
    B - When connecting a branch to the main waste line, the connecting angle should be kept greater than 45°.
    C - A manhole should be located where ever a blockage is expected.
    Out of the above facts, the correct requirement/s is/are

    (1) B only.   (2) A and B only.   (3) A and C only.
    (4) B and C only.   (5) A, B, and C all.

17. Consider the following documents.
    A - Query sheet
    B - Profit/loss statement
    C - Measurement sheet
    Out of the above, document/s used by a quantity surveyor is/are

    (1) A only.   (2) B only.   (3) A and C only.
    (4) B and C only.   (5) A, B, and C all.

18. Profit percentage stated in a BOQ is **not** depended on
    (1) bank interest rates.   (2) risks involved in the project.
    (3) duration of the project.   (4) political stability of the country.
    (5) salary of labourers.

19. The direct distance between two cities is 48 km. If the distance between the cities on a map drawn to a scale is 9.6 cm, what is the scale of the map?
    (1) 1:50   (2) 1:500   (3) 1:5,000   (4) 1:50,000   (5) 1:500,000

20. The following incomplete table is related to a levelling process.

Level Station	Back Sight Reading	Intermediate Sight Reading	Fore Sight Reading	Rise	Fall	Reduced Level	Remarks
1	A					B	
2		1.5			1.0	C	
3			1.0	0.5		100.0	

   The suitable values for A and B places, in the table, respectively are
   (1) 0.5 m and 99.5 m.   (2) 0.5 m and 100.5 m.   (3) 1.0 m and 100.5 m.
   (4) 1.5 m and 99.5 m.   (5) 1.5 m and 100.0 m.

21. Following are a few statements about land surveying and levelling.
    A - In land surveying and levelling, measurements are taken to determine the absolute position of a place.
    B - The effect of errors on a survey can be minimised by measuring from whole to part.
    C - A levelling process must be started either from a bench mark or a temporary bench mark.
    Out of the above statements, the correct statement/s is/are

    (1) A only.   (2) B only.   (3) A and C only.
    (4) B and C only.   (5) A, B, and C all.

22. Some measurements taken from a theodolite survey are shown below.

Survey Line	Bearing (Degrees)	Length (m)
AB	090	10
BC	000	10
CD	270	20

According to above measurements, with respect to point A, point D is situated,
(1) in the North direction.
(2) in between North and East direction.
(3) in between North and West direction.
(4) in between South and East direction.
(5) coincident with A.

23. Consider the following statements regarding an electrical circuit with a power factor equal to one (1).

    A - The total power absorbed from the source is used for productive work.
    B - The circuit could be a purely resistive.
   C - Inductive and capacitive reactive powers could be equal.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) C only.   (3) A and B only.
(4) B and C only.   (5) A, B, and C all.

24. When installing domestic electrical wiring, Residual Current Circuit Breaker (RCCB) is used to
(1) protect electrical equipment from overloads.
(2) protect electrical equipment from overvoltages.
(3) protect users of the installation from electric shock.
(4) protect the installation from lightning.
(5) isolate the installation from the supply in case of a repair.

25. Consider following statements related to time constant (T) of a simple RC circuit.

    A - Time constant is equal to the product of R and C.
    B - Time constant represents the time taken for the capacitor to charge from zero (0) to 63% of the source voltage.
    C - Time needed for the capacitor to get fully charged is equal to five (5) times the time constant.

Out of the above statements the correct statement/s is/are

(1) A only.   (2) B only.   (3) C only.
(4) A and B only.   (5) A, B, and C all.

26. Five incandescent bulbs A, B, C, D, and E having a rated voltage of 12 V and rated powers of 3 W, 6 W, 12 W, 18 W, and 24 W are connected to a 12 V DC source as shown in the circuit given below.
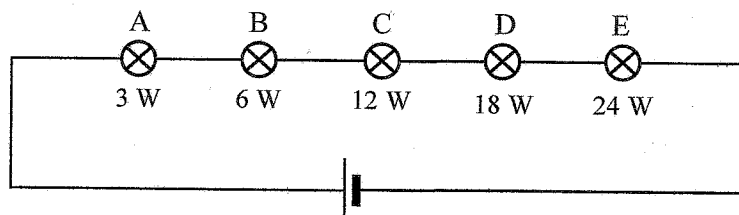
Out of the above bulbs, the bulb that glows with the highest brightness is
(1) A.   (2) B.   (3) C.   (4) D.   (5) E.

27. An ideal transformer has 100 turns in the primary winding and 200 turns in the secondary winding. The input voltage of the transformer is 230 V.

Consider the following statements regarding the above transformer.

       A - Output voltage of the transformer is 460 V.

       B - Current in the primary and secondary windings are equal.

       C - Power in the primary and secondary windings are not equal.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) B only.   (3) A and B only.

(4) A and C only.   (5) A, B and C all.

28. 16 cells rated 3.2 V/100 Ah are connected in series to make a battery to be used in an off-grid solar panel system.

Consider the following statements regarding the above battery.

       A - Voltage of the battery is 51.2 V.

       B - Maximum capacity that can be stored in the battery is 100 Ah.

       C - Maximum power that can be drawn from the battery is 5.12 kW.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) B only.   (3) A and B only.

(4) A and C only.   (5) A, B, and C all.

29. A motor is to be selected for a conveyor system that works at a constant speed with a low load. The most suitable DC motor for this application is a

(1) series motor.

(2) shunt motor.

(3) compound motor.

(4) squirrel cage motor.

(5) wound motor.

30. Consider the following input signal (V_{in}) and the circuit with an ideal diode.
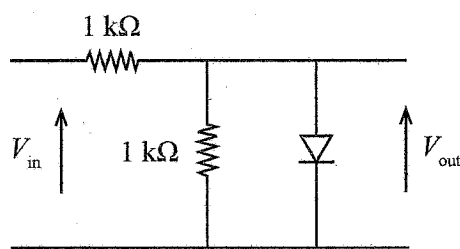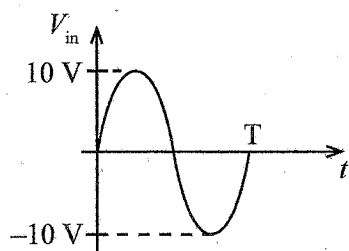
Which figure shows its output signal (V_{out})?

0000835
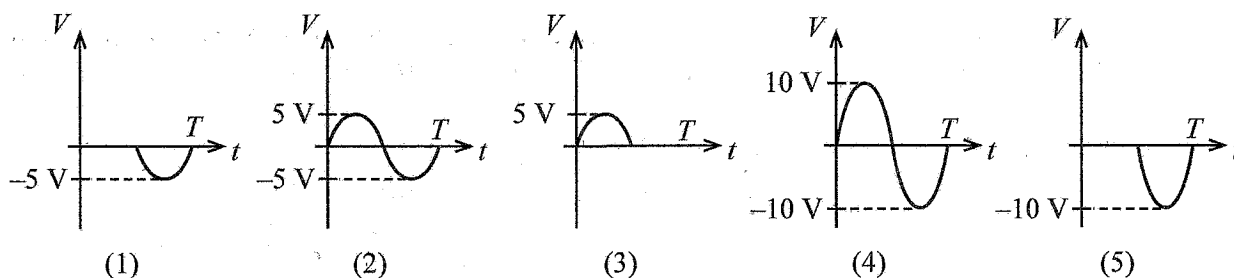
31. What is the most appropriate graph which represents the relationship between I_B and I_C of a transistor?

(1)   (2)   (3)   (4)   (5)
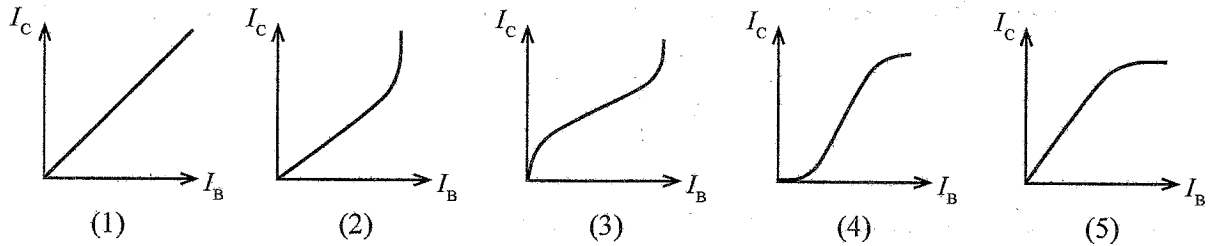
32. In the transistor amplifier circuit shown in the figure, at the Q point, the base current (I_{BQ}), collector current (I_{CQ}) and the voltage across the collector and emittor (V_{CEQ}) respectively are,

(1) 7.81 μA, 0.78 mA, and 2.11 V.

(2) 7.81 μA, 0.78 mA, and 5 V.

(3) 23.8 μA, 2.3 mA, and 2.11 V.

(4) 23.8 μA, 2.3 mA, and 5 V.

(5) 51.7 μA, 5.1 mA, and 5 V.
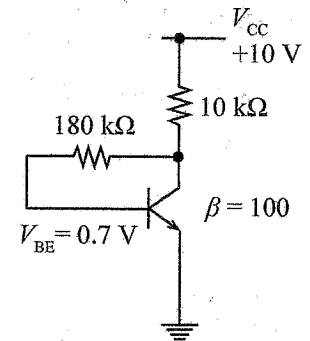
33. The circuit shows a situation where a junction field effect transistor (JFET) is used as an amplifier. If the drain voltage (V_D) is 7 V, drain current (I_D) and gate-source voltage (V_{GS}) are respectively

(1) 1.52 mA and –3.47 V.

(2) 1.52 mA and –1.8 V.

(3) 1.52 mA and 1.8 V.

(4) 2.27 mA and –3.47 V.

(5) 2.27 mA and 3.47 V.
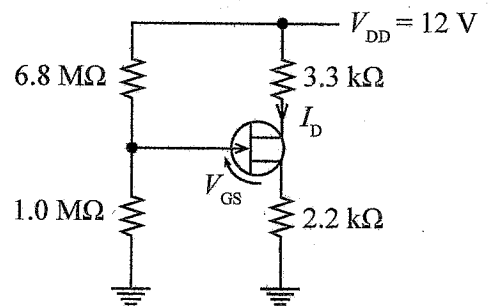
34. Consider the input signal (V_{in}) and operational amplifier circuit shown in the figure.
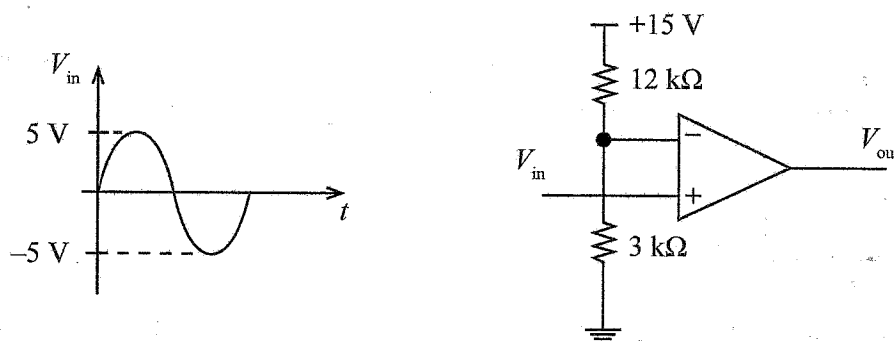

What is the figure showing the output signal (V_{out})?

(1)   (2)   (3)   (4)   (5)
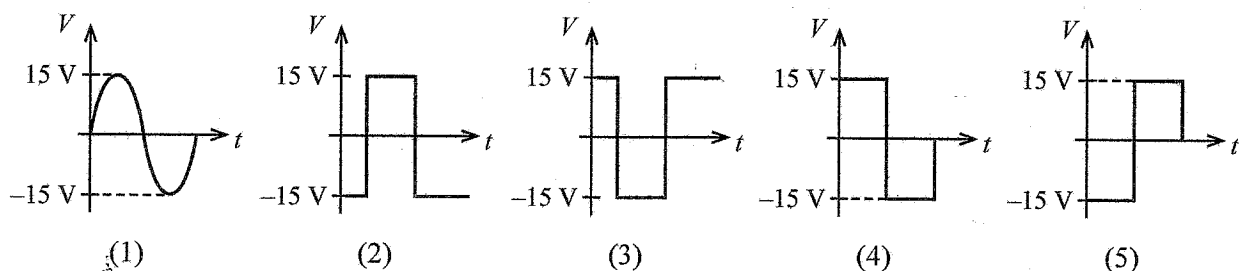
35. *X* is a digital electronic circuit. *P* and *Q*, are its inputs and *L, M, N,* and *O* are outputs. *LMNO* represents the square of the number represented by *PQ*. *P* is the most significant number of the binary number *PQ* while *L* is the most significant number of the binary number *LMNO*.
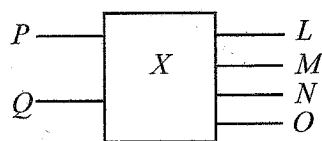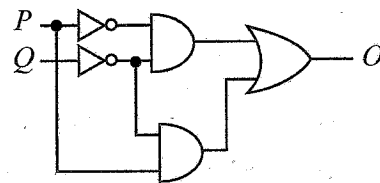

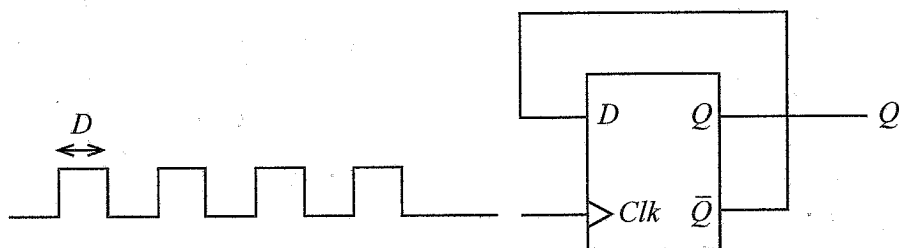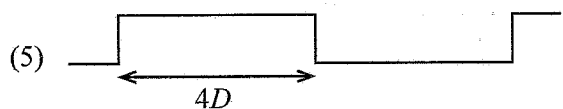*A, B* and *C* are three proposed circuits for output *O*.
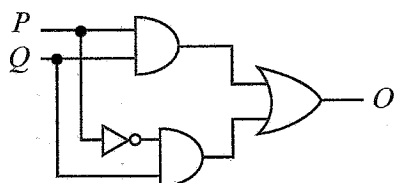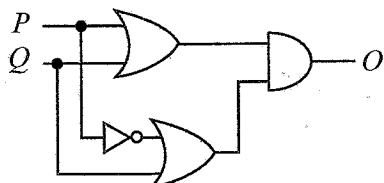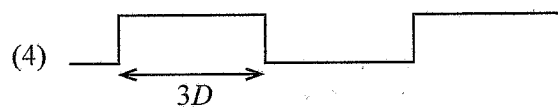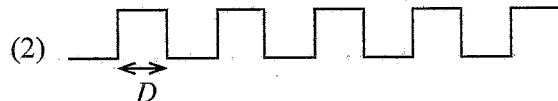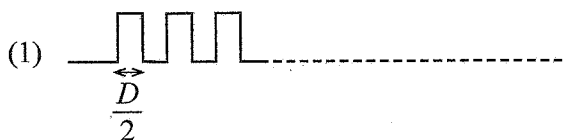

| (A) | (B) | (C) |

Out of the circuits A, B, and C, the circuit/s suitable for output *O* is/are

(1) A only.
(2) B only.
(3) C only.
(4) A and B only.
(5) A and C only.

36. The figure shows a digital electronic circuit with a D-type flip-flop

What is the most suitable figure which represents the output signal of *Q*?

37. When a wrench with a 15 cm long shank is used to tighten a bolt, a 100 N of force should be applied at the end of the shank. If a wrench with a 45 cm long shank is used for this, how much force should be applied at the end of its shank?

(1) $100 \times \dfrac{15}{45} \, \text{N}$

(2) $100 \times \dfrac{45}{15} \, \text{N}$

(3) $100 \times \left(\dfrac{(45+15)}{15} \right) \text{N}$

(4) $100 \times \left(\dfrac{(45+15)}{45} \right) \text{N}$

(5) $100 \times \left(\dfrac{45}{(45+15)} \right) \text{N}$

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38. The figure shows a portion of a spur gear drive. Here, A is driven by an electric motor rated 750 W/1200 rpm. The numbers of teeth on A, B, and C are 50, 20, and 100 respectively. The mechanical efficiency between a spur gear pair is 90%. The figure is not drawn to a scale. The rotating speed and power output of C are respectively

(1) 600 rpm and 607.5 W.
(2) 600 rpm and 675.0 W.
(3) 2400 rpm and 607.5 W.
(4) 2400 rpm and 675.0 W.
(5) 3000 rpm and 675.0 W.
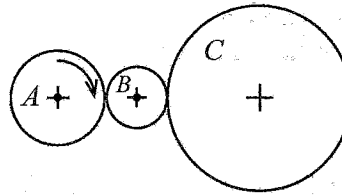
39. Out of the pumps given below, which is **not** a rotary type pump?
(1) Centrifugal pump   (2) Gear pump   (3) Screw pump
(4) Piston pump   (5) Vane pump

40. An internal combustion engine has a compression ratio of 11:1 and a clearance volume of 50 cm^3. What is the swept volume of the engine?
(1) 0.020 cm^3 (2) 0.022 cm^3 (3) 0.220 cm^3 (4) 500 cm^3 (5) 550 cm^3

41. Consider the following statements regarding the reactions occurring within a two-way catalytic converter.

    A - Unburnt hydrocarbons are subjected to reaction
    B - Carbon monoxide is subjected to reaction
    C - Nitrogen oxides are subjected to reaction

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) C only.   (3) A and B only.
(4) B and C only.   (5) A, B, and C all.

42. Out of the following, which is **not** a liquid fuel?
(1) Propane   (2) Petrol   (3) Bio diesel   (4) Kerosene   (5) Ethanol

43. There is a motor vehicle that weighs 10,000 N on a 5,000 mm long 3,000 mm wide raft that has a flat bottom which is floating horizontally. If the weight of the raft is neglected, the pressure exerted on the bottom of it, in SI units, is
(1) 1.25.   (2) 2.   (3) 3.33.   (4) 667.   (5) 1,500.

44. The production process used to manufacture aluminium panels used for making window frames is
(1) Twisting.   (2) Forging.   (3) Rolling.
(4) Extrusion.   (5) Material removal.

45. A metal piece is required to be cut using a computer numerically controlled (CNC) machine. For this, the required codes need to be prepared. Consider the following statements regarding this.

    A - The machine has a keypad, and codes can be fed to the machine using it.
    B - There are specialised software for writing codes, and codes can be automatically generated and fed to the machine.
    C - Associated codes can be prepared using a computer, and the codes can be fed to the machine.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) A and B only.   (3) A and C only.
(4) B and C only.   (5) A, B, and C all.

46. Consider the following statements about measuring equipment.

      A - Micrometer screw guage is a linear measuring equipment.

      B - Conventional Ammeter is a measuring equipment with sensors and transducers.

      C - The zero error must be always deducted from the reading to correct the zero error of a vernier calliper.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) B only.   (3) A and B only.

(4) A and C only.   (5) A, B, and C all.

47. Consider the following statements about the materials used for production activities.

      A - Metals and non metals are commonly used in production of machine parts.

      B - Due to inherent weaknesses of pure metals they are not used in machine parts.

      C - Steel containing carbon cannot be classified as a ferous metal.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) A and B only.   (3) A and C only.

(4) B and C only.   (5) A, B, and C all.
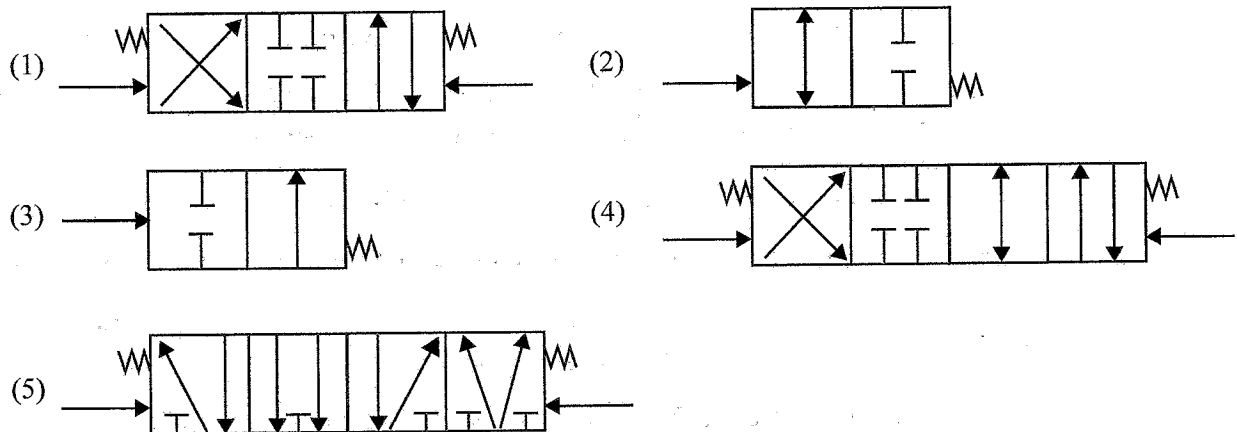
48. Consider the following statements regarding the usage of a 60:40 mixture of ethylene glycol and water in an automotive cooling system.

      A - Freezing point can be brought down to a value below 0 °C.

      B - Temperature of the coolant will not go above 60 °C.

      C - Corrosion of the radiator can be minimised.

Out of the above statements, the correct statement/s is/are

(1) A only.   (2) B only.   (3) A and C only.

(4) B and C only.   (5) A, B, and C all.

49. What is the figure showing a 4/3 direction control valve?

50. Out of the following statements, which statement is **incorrect** regarding the maintenance of a 12 V lead-acid battery where the negative terminal is connected to the chassis?

(1) It is a must to regularly check and top up the electrolyte level with distilled water.

(2) It is a must to periodically check the battery's state of charge using a hydrometer.

(3) The typical charging voltage is approximately 14 V.

(4) Faulty batteries can be tested using a High-Rate Discharge Tester.

(5) When disconnecting the electrical cables, positive terminal should be disconnected first.

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