ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

ඉංජිනේරු තාක්ෂණවේදය I பொறியியற் தொழினுட்பவியல் I **Engineering Technology I**	**65 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***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 at the back of the answer sheet.*
* *Each question carries **01** mark totalling to **50**.*
* ***Use of non-programmable calculators is allowed.***

1. A length measuring instrument has a graduation error. It shows 1 mm less for every true centimeter. Side of a square with a true length 20 cm was measured using this instrument. When calculated using these measurements the area of the square is

(1) 324 cm^2. (2) 361 cm^2. (3) 400 cm^2. (4) 441 cm^2. (5) 484 cm^2.

2. Consider the following statements related to the national electricity supply in Sri Lanka.

A - 230 V supply voltage is a standard.
B - 230 V supply voltage is a specification.
C - 230 V supply voltage is a regulation.

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.

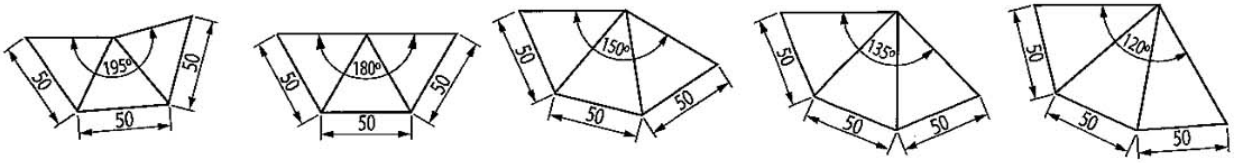
3. Consider the following statements relevant to the production sector in Sri Lanka.

A - Export of local products positively affects the local economy.
B - Use of import-substitutions positively affects the local economy.
C - Banning of raw material imports positively affects the local economy.

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.

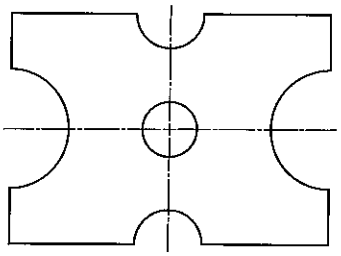
4. What is the correct development of a bottomless equilateral tetrahedron with 50 mm a side?



(1) (2) (3) (4) (5)

[See page two

5. The machine component shown below is symmetric about the centrelines. In order to manufacture this component the minimum number of dimensions required to be shown on the engineering drawing is



(1) 4. (2) 5. (3) 6. (4) 7. (5) 8.

6. Consider the following statements regarding market surveys in a business process.

A - Questionnaires can be effectively used to collect data on customer requirements.
B - A market survey report is required to register a business in Sri Lanka.
C - Data captured through interviews is considered as secondary data.

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 and C only.

7. What is the correct statement regarding basic management functions?

(1) Management ability is an inborn skill and it cannot be enhanced by training.
(2) Creativity is an inborn skill and cannot be enhanced by training.
(3) Organising means identification of aims of the business.
(4) Directing means managing resources to meet objectives.
(5) In the business sector, appraisal means paying adequate salaries for the work performed.

8. Consider the following statements regarding health and safety.

A - A hazard is an accident affecting a life, health, property or the environment.
B - Risk depends on the probability of an accident.
C - All hazards can be eliminated by proper training.

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 and C only.

9. When constructing long brick walls, for the structural safety a thin gap is kept in every 3.5 m. The specific material property considered here is

(1) plasticity. (2) malleability. (3) expansivity. (4) ductility. (5) elasticity.

10. Consider the following statements regarding concrete formwork.

A - Formwork should be durable to use many times.
B - Formwork should be capable of being removed without any surface damages after the concrete has set.
C - Formwork should be capable of withstanding the loads of fresh concrete, handling equipment and workers in the concreting process.

Of the above statements, the correct statement/s is/are

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

11. The part in a simple foundation which restricts the absorbtion of water in the ground into the walls of a building is the

(1) damp proof membrane. (2) damp proof course.
(3) screed concrete. (4) plinth wall.
(5) skirting line.

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12. The depth of a birdsmouth joint specifically influences the
(1) load-bearing capacity of the wall plate.
(2) load-bearing capacity of the rafter.
(3) slip of the wall plate on the wall.
(4) slip of the rafter at the joint between the rafter and the wall plate.
(5) slip of the rafter at the joint between the ridge plate and the rafter.

13. When concreting the main purpose of the cover blocks is
(1) to ensure the safety of the users.
(2) to protect the reinforcement from external loads.
(3) to protect the reinforcement from external weather conditions.
(4) to ensure the placement of the reinforcement when concreting.
(5) to ensure the shape of the reinforcement when concreting.

14. Consider the following statements regarding the soakage pit.
A - Cross section of a soakage pit must be circular.
B - Soakage pit is suitable for lands with clay soils which soak waste water slowly.
C - Soakage pit is used when the ground water table is at least 2 m below the bottom of the soakage pit.

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 and C only.

15. What is the type of valve that can be used to maintain a certain water level of a water tank?
(1) Non-return valve (2) Float operated valve (3) Gate valve
(4) Stop valve (5) Foot valve

16. Consider the following statements regarding solid waste management.
A - Use of soft drink bottles as coconut oil containers can be categorised as recycling.
B - Use of kitchen waste to produce compost can be categorised as digestion.
C - Buying products with minimal packing materials can be categorised as reduced usage.

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) B and C only.

17. In a construction project, the contractor requested Rs. 6,000 per square meter for floor tiling. The floor area to be tiled is 150 m^2. The contractor estimates the material cost as Rs. 300,000, labour wages as Rs. 200,000, and overheads as Rs. 60,000. The profit obtained by the contractor from this project is
(1) Rs. 340,000. (2) Rs. 460,000. (3) Rs. 560,000.
(4) Rs. 600,000. (5) Rs. 900,000.

18. Consider the following statements regarding cost estimation of a proposed project.
A - It will reduce wastage of the project.
B - It will increase the project efficiency.
C - It will increase the flexibility of selection of construction techniques during the construction stage.

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

19. The length of a survey line is 25 m. When the line is represented with a 1:500 scale, the length of the line is
(1) 0.5 cm. (2) 2.5 cm. (3) 5 cm. (4) 25 cm. (5) 50 cm.

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● Use the data given below to answer questions **20** and **21**.

The levelling staff readings taken in a levelling process and the points where the readings were taken are given below.

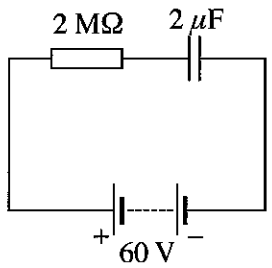
Reading	Point
1.5 m	On the benchmark with 55.0 m reduced level
2.0 m	On *A*
2.5 m	On *B*

20. The reduced level of point *A* is
(1) 53.5 m. (2) 54.5 m. (3) 55.0 m. (4) 55.5 m. (5) 56.5 m.

21. A level surface with the reduced level of 54.5 m is needed to be created on point *B*. In order to obtain this surface, point *B* should be
(1) filled by 0.5 m. (2) cut by 1.0 m. (3) filled by 1.5 m.
(4) cut by 2.0 m. (5) cut by 2.5 m.

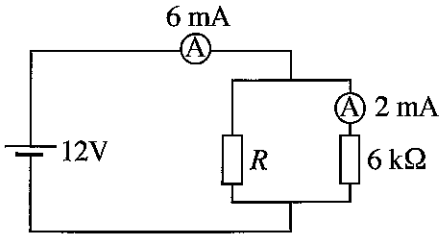
22. What is the correct statement regarding theodolite traverses?
(1) Always the land is divided into quadrilaterals.
(2) Only angular errors are considered.
(3) Co-ordinates can be taken directly.
(4) Offset measurements are taken for land features.
(5) Height-related measurements can be taken directly.

23. Consider the given circuit diagram.



Time taken for the capacitor to get fully charged is approximately
(1) 4 s. (2) 8 s. (3) 12 s. (4) 16 s. (5) 20 s.

24. Consider the given circuit diagram.



Here, the value of resistance *R* is
(1) 3 Ω. (2) 6 Ω. (3) 3 kΩ. (4) 6 kΩ. (5) 12 kΩ.

25. When an alternating current is allowed to pass through an emersion heater immersed in water for 2 minutes, temperature of the water raised to its boiling point. When a direct current of 3 A was allowed to pass through the same heater under identical conditions, it took 8 minutes to raise the water to its boiling point. If there are no heat losses from the water, what is the root mean square value of the alternating current passed through the resistor of the heater?
(1) 2 A (2) 4 A (3) 6 A (4) 8 A (5) 10 A

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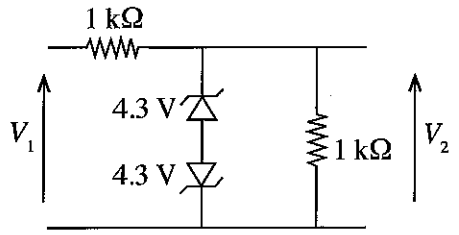
26. The component which is **not** a part of a hydro-electric generation system is the
(1) pressure tunnel. (2) surge chamber. (3) penstock.
(4) turbine. (5) step-down transformer.

27. Out of the following electrical equipment types, what is the most efficient equipment type?
(1) Transformers
(2) Direct current generators
(3) Alternators
(4) Direct current series motors
(5) Three-phase induction motors

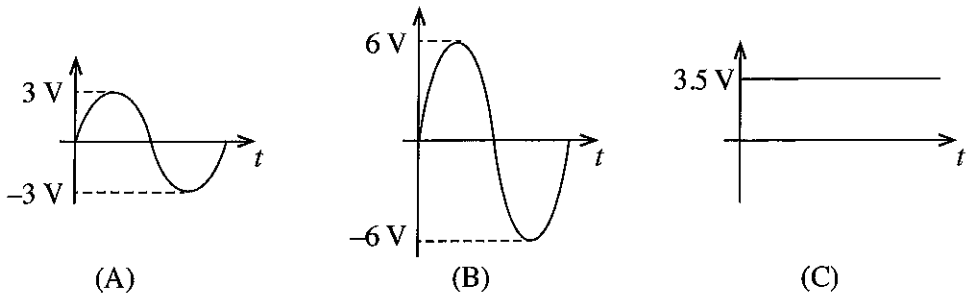
28. A self-exited direct current generator is operated at the rated speed. However, electricity is not generated from it. A technician has suggested the following facts as causes for this fault.
A - Reduction of residual magnetism of the electric generator
B - Reduction of insulation resistance of the windings
C - Broken windings
Of the above facts, the correct fact/s is/are,
(1) A only. (2) B only. (3) C only.
(4) A and B only. (5) A and C only.

29. A single-phase ceiling fan was not used for a few months. When it was switched on to operate the fan, it did not start to rotate, and when the blades were given a gentle push, it started to rotate. After operating the fan for sometime, it was switched off. When it was switched on next time, again it failed to rotate. The most probable cause for this is
(1) solidification of the lubricant of the bearing.
(2) reduction of the insulation resistance of the fan motor.
(3) damaged motor windings.
(4) faulty capacitor of the fan motor.
(5) increased resistance of motor windings of the fan.

30. Shown below is part of a protection circuit diagram used in an input circuit.



Which of the below wave/s, is/are **not** possible to obtain as V_2 output?



(A) (B) (C)

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

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31. Consider the following mathematical expressions in relation to the operation of a transistor.

A - $V_{CE} < 0.2$ V

B - $V_{CE} \geq 0.2$ V

C - $I_C < \beta I_B$

D - $I_C \geq \beta I_B$

Of the above expressions, the correct expression/s for a transistor operating in the saturation region is/are

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

(4) A and C only. (5) A and D only.

32. The given circuit diagram shows a junction field effect transistor which works as an amplifier. If the drain voltage (V_D) is 6 V, drain current (I_D) is 0.5 mA and the voltage between drain and gate (V_{GS}) is –147 mV, R_D and R_S respectively are

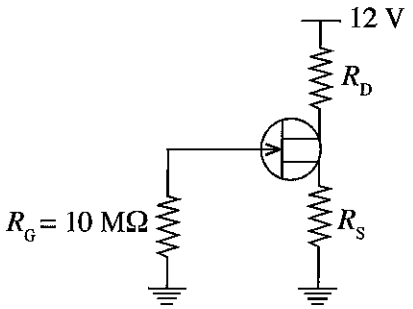
(1) 294 Ω and 294 Ω.

(2) 294 Ω and 12 kΩ.

(3) 12 kΩ and 294 Ω.

(4) 12 kΩ and 12 kΩ.

(5) 24 kΩ and 12 kΩ.



33. The voltage gain of the given operational amplifier circuit is

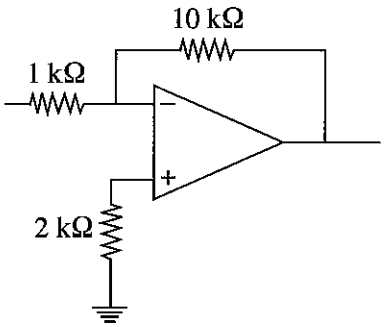
(1) –11.

(2) –10.

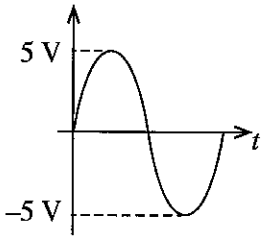
(3) –5.

(4) 10.

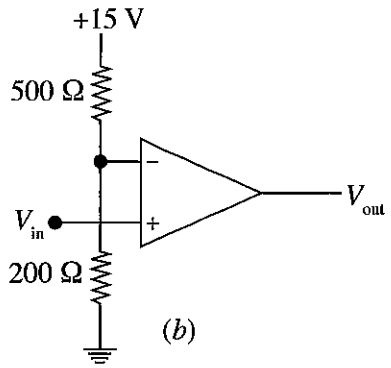
(5) 11.



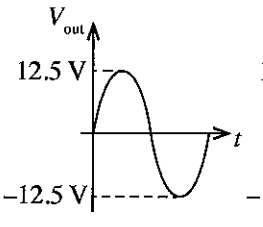
34. Consider the operational amplifier circuit given in figure (*b*) below. When the signal shown in figure (*a*) is given as the input signal, which graph shows the output signal correctly?



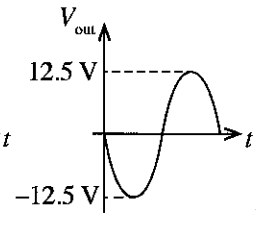
(*a*)



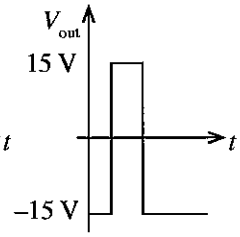
(*b*)



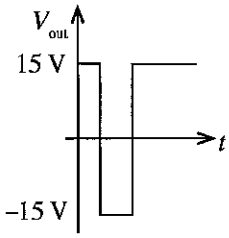
(1)



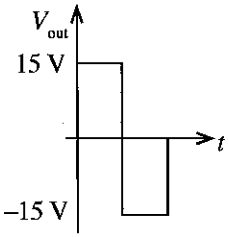
(2)



(3)



(4)



(5)

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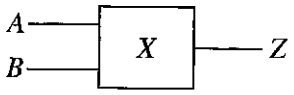
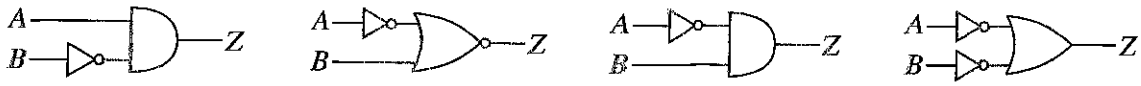
35. X in the given circuit diagram is a digital electronic circuit. Its inputs are A and B and the output is Z. When the digital value of A is greater than the digital value of B, Z gives logic '1' and in all the other cases, the output (Z) gives logic '0'.



Consider the following circuits which are proposed for X.

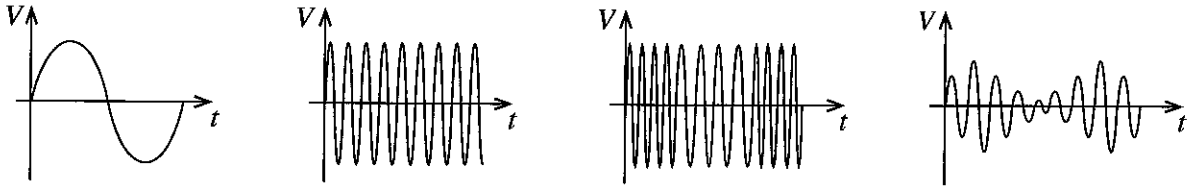


(A) (B) (C) (D)

Which circuit/s best describe/s the operation of the circuit X?

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

36. Consider the following waves in relation to modulation.



(A) (B) (C) (D)

Signal, carrier, amplitude modulated signal and frequency modulated signal are shown respectively by

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

37. The reason for using a sliding joint in the propeller shaft in an automotive power transmission system is

(1) to absorb the vibrations resulting from uneven surfaces of the road.
(2) to accommodate the changes of relative distance between the gear box and the differential.
(3) to provide different torques for left and right wheels when turning.
(4) to reduce the centrifugal force when turning.
(5) to reduce the weight transfer to the front wheels when braking.

38. In a spark ignition engine, it was observed that the engine does not start even though the starter motor works. Following statements have been suggested as reasons for this.

A - Spark plug gap is smaller than the recommended value.
B - The intake air-fuel mixture is of stoichiometric ratio.
C - Deposition of Carbon on the piston head.

Of the above statements, the correct reason/s is/are

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

39. A condition that can arise due to a faulty thermostatic control valve is

(1) the coolant liquid reacting with the radiator core.
(2) deposition of salts inside the cooling jackets.
(3) decay of pigments in the coolant liquid.
(4) coolant temperature being lower than the optimum.
(5) reduction of the boiling point of the coolant.

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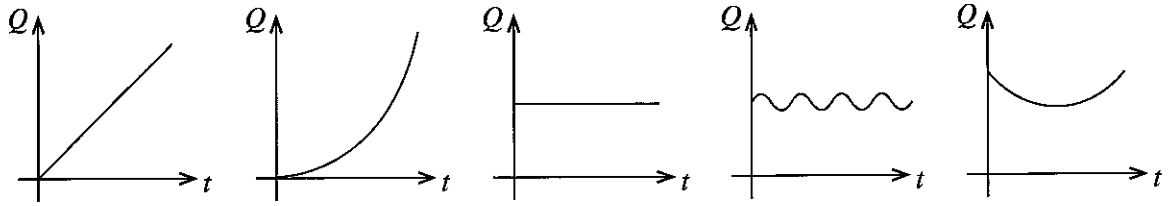
40. Suddenly, the brake system of a vehicle was found not working properly while driving on a continuous downhill road. The following statements were suggested as reasons for this.

A - High engine rotation speed due to driving on a low gear.
B - Formation of vapour bubbles in the brake fluid due to over-heating caused by frequent braking.
C - Reduction of power assistance (brake boost) on the braking system due to high engine speed.

Of the above statements the correct cause/s is/are

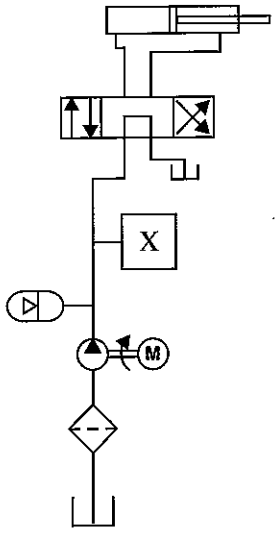
(1) A only. (2) B only. (3) C only.
(4) A and B only. (5) B and C only.

41. Which graph shows the variation of volume discharge rate (Q) with time (t), for a gear pump rotating at a constant speed?



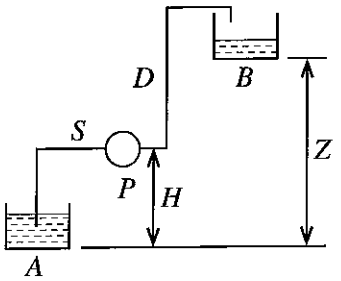
(1) (2) (3) (4) (5)

42. The essential component indicated by 'X' in the given hydraulic circuit diagram is a



(1) hydraulic filter.
(2) accumulator.
(3) solenoid.
(4) non-return valve.
(5) pressure relief valve.

43. As shown in the given figure, water is pumped from tank A to tank B using pump P. A method that **cannot** be used to reduce the power consumed by pump P is



(1) reduce the lengths of pipes S and D.
(2) reduce the number of fittings used in pipes S and D.
(3) use larger diameter pipes for S and D.
(4) reduce the height Z, between the tanks A and B.
(5) reduce the height H, between A and P.

44. Of the following statements regarding motion conversion mechanisms, what is the **incorrect** statement?

(1) Slider crank mechanism converts rotatory motion to linear motion.
(2) Rack and pinion mechanism converts rotary motion to linear motion.
(3) Worm and wheel mechanism converts linear motion to rotary motion.
(4) Cam mechanism converts rotary motion to linear motion.
(5) Lead screw mechanism converts rotary motion to linear motion.

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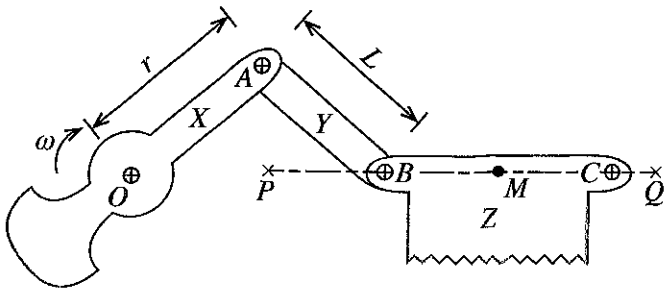
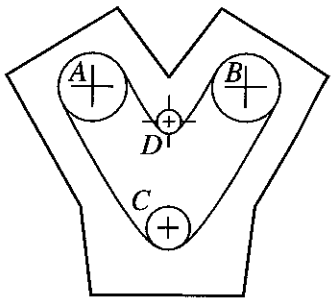
45. Schematic diagram of a reciprocating mechanism used in a mechanical saw is shown below.



Linkage X rotates about O and linkage Y is pivoted at A and B. The point M located on saw Z reciprocates horizontally from P to Q. If the length of OA is r and the length of AB is L, the length of PQ is

(1) L. (2) $L-r$. (3) $2r$. (4) $L-2r$. (5) $L+2r$.

46. The timing chain and sprocket arrangement of a v-shaped four stroke spark ignition engine is shown below.



A and B sprockets are directly connected to the cam shafts while sprocket C is directly connected to the crank shaft. If the number of sprockets in wheel C is 30, the number of sprockets in wheel A is

(1) 60. (2) 90. (3) 120. (4) 150. (5) 180.

47. When producing mamoties, the reason for heating the sharp edge till it becomes red-hot and instantly dipping in water is to

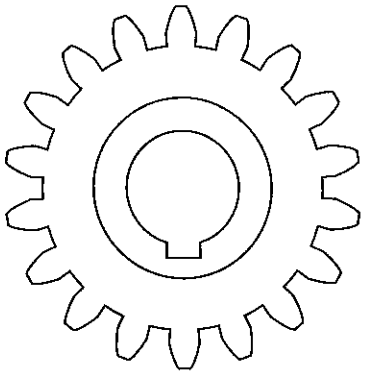
(1) increase brittleness.
(2) increase elasticity.
(3) increase ductility.
(4) increase hardness.
(5) increase plasticity.

48. The main benefit received by aligning a certain product to standards like ISO or SLS is

(1) increasing trustworthiness of the customers on the production organisation.
(2) increasing trustworthiness of the customers on the standards organisation.
(3) increasing trustworthiness of the customers on the product.
(4) increasing trustworthiness of the customers on the production process.
(5) increasing trustworthiness of the customers on the standards certificates.

[*See page ten*

49. In order to manufacture the machine component shown in the figure using a solid cylindrical workpiece, the required machines, in sequence, are



(1) lathe machine, milling machine and boring machine.
(2) milling machine, lathe machine and drilling machine.
(3) drilling machine, lathe machine and milling machine.
(4) lathe machine, milling machine and shaping machine.
(5) lathe machine, boring machine and shaping machine.

50. If a 6 mm thick steel plate is provided to fabricate a chimney of 1 m diameter and 1.5 m length, the most suitable method that should be used to fabricate the chimney respectively is
(1) rolling and welding.
(2) extruding and applying bolts.
(3) extruding and welding.
(4) forging and welding.
(5) forging and gluing.

* * *

AL/2021(2022)/65/E-II

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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

පැය තුනයි
மூன்று மணித்தியாலம்
Three hours

අමතර කියවීම් කාලය - මිනිත්තු 10 යි
மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
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 - 8)

*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 9 - 14)

*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	

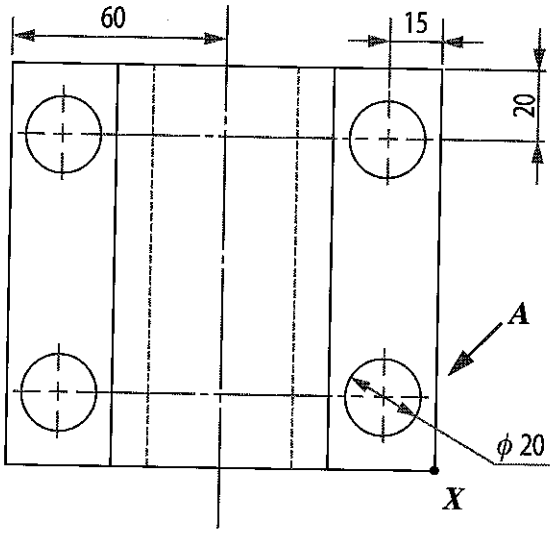
[see page two

PART A – Structured Essay

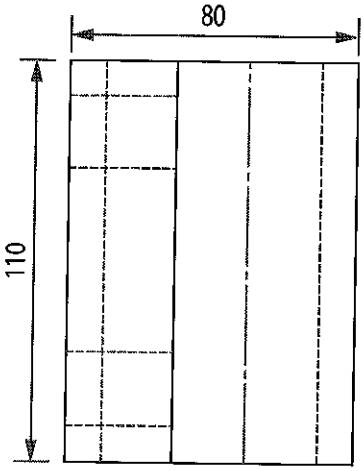
*Answer **all four** questions on **this question paper itself**.*
*(Marks allocated for each question is **75**.)*

Do not write in this column

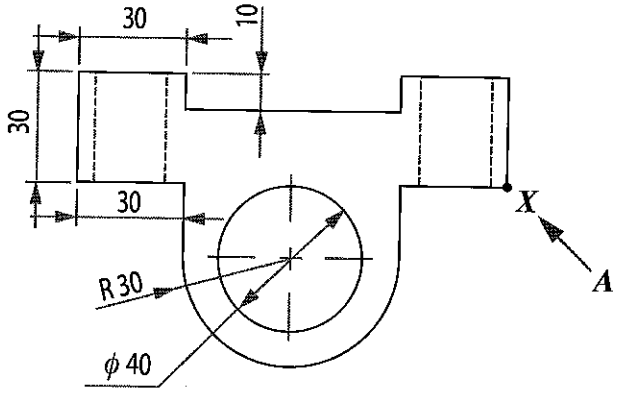
1. The following figure shows the front view, the side view, and the plan of a mild steel machine part drawn using first-angle projection. Draw the isometric view of the machine part in the dot sheet provided by taking the corner shown by ***X*** as the origin, looking in the direction shown by the arrow ***A***. Use the foot-ruler for drawing straight lines and use free hand for drawing curves. Mark all the dimensions given, in the isometric drawing. Make the origin ***X*** of the drawing coincide with the origin ***X*** shown in the dot sheet. It is not necessary to show hidden lines in the isometric drawing. Take the distance between two adjacent dots on the dot sheet as 10 mm. The drawings given are not to scale.



FRONT VIEW



SIDE VIEW



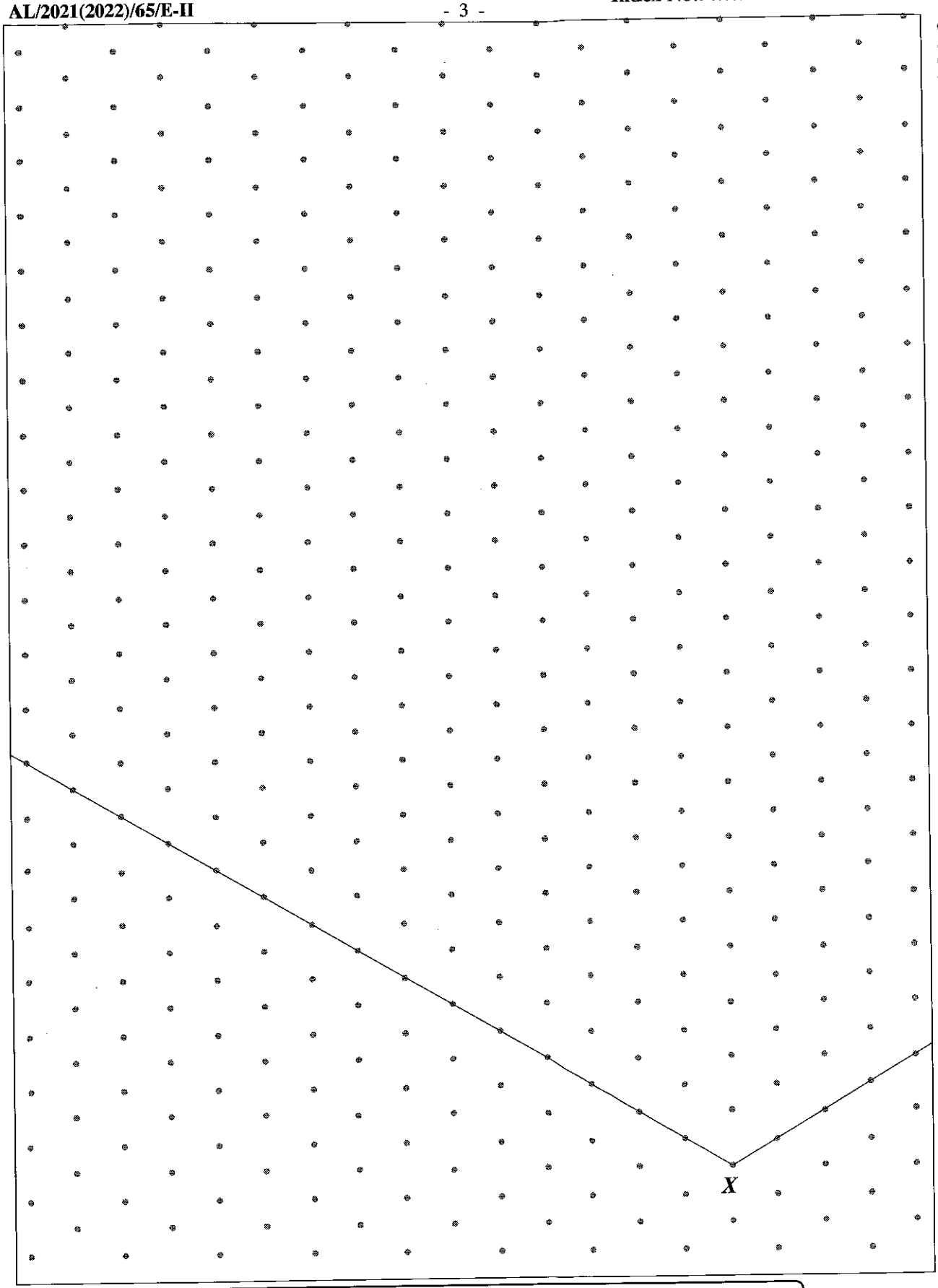
PLAN

(75 *marks*)

[*see page three*

Index No.: .....

0439



For use of the examiners	Marks
Drawing straight lines (38 *marks*)	
Drawing curves and centre lines (22 *marks*)	
Marking of straight line dimensions according to the standard (09 *marks*)	
Marking dimensions of curves according to the standard (03 *marks*)	
Correct positioning of *X* origin (03 *marks*)	

Q. 1

75

[see page four

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2. (*a*) The general procedure of managing household solid waste in Sri Lanka is first to collect all the generated solid waste within a relevant area by the respective local authority and then dump at a particular location.

(i) Write down **two** possible ways of soil pollution due to the above solid waste management procedure.

(1) .....

(2) .....

(05 × 2 = 10 *marks*)

(ii) In categorising household solid waste, state an example for each of the following waste categories.

(1) Hazardous waste : .....

(2) Organic waste : .....

(3) Recyclable waste : ..... (05 × 3 = 15 *marks*)

(iii) State a solid waste management method which can be practiced at home and a relevant example which reduces the generation of 'plastic waste' among generated household solid waste.

Waste management method : .....

Example : .....

(05 × 2 = 10 *marks*)

(*b*) It is required to draw a contour map to represent height measurements of an area where a waste management plant is proposed to be constructed.

(i) Name a survey instrument which can be used to take height measurements for this task.

.....

(05 *marks*)

(ii) State a possible error which can occur in the surveying process carried out by using the above instrument and a precaution to be taken to minimise the impact of this error.

Error : .....

Precaution : .....

.....

(05 × 2 = 10 *marks*)

(*c*) A resident of this area purchased an electrical machine which converts household kitchen waste to compost. The rated values of this machine were stated as 230 V/50 Hz/3 A. In order to convert the waste collected in the house to compost, the resident has to operate the machine once in two days. When it is operated once, it needs to work for 04 hours in full capacity continuously to produce compost completely. (Assume that the number of days per month is 30.)

(i) By assuming that the power factor is 0.9, calculate the power of the machine in kW.

.....

(05 *marks*)

(ii) How many units of electricity will be consumed to operate the machine according to the electricity bill of a month?

.....

(15 *marks*)

[*see page five*

Do not write in this column

(iii) Even before using this machine, the consumption of electricity of this house was over 200 units. Calculate the additional expenditure for the resident due to the use of this machine? For this, use the following tariff structure.

Monthly consumption (kWh)	Unit charge (Rs/kWh)	Fixed charge (Rs/month)
0 – 60	7.85	–
61 – 90	10.00	90.00
91 – 120	27.75	480.00
121 – 180	32.00	480.00
Over 180	45.00	540.00

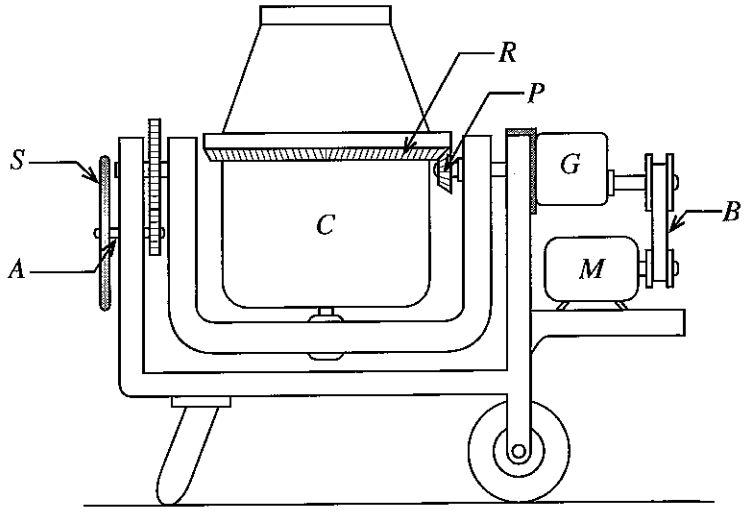
.....

(05 *marks*)

Q.2

75

3. (*a*) A labelled figure of a small-scale concrete mixer operated by an electric motor is shown below. The gearbox *G* is connected to the motor *M* by the belt drive *B*. The container *C* with the concrete mixture must rotate at 50 rpm. In the gearbox *G* of this machine, the number of teeth in the gear wheels connected to the input and output shafts are respectively 25 and 75. In the mixing machine, the nominal diameter of ring gear *R* is 60 cm and the nominal diameter of pinion *P* is 12 cm.



M – Motor
B – Belt drive
G – Gearbox
R – Ring gear
P – Pinion
C – Concrete mixer container

(i) In order to rotate the mixer container at the desired speed, what should be the rotation speed of the output shaft of gearbox *G* in revolutions per minute?

.....

(10 *marks*)

(ii) If the gearbox *G* contains only one gear pair, what should be the rotation speed of its input shaft in revolutions per minute?

.....

(10 *marks*)

[*see page six*

Do not write in this column

(iii) If the motor used in this machine rotates at 1500 rpm, calculate the speed ratio that needs to be maintained in the belt drive.

.....

.....

(10 *marks*)

(iv) Here, protection of the motor is assured using a belt drive. Briefly describe how this happens.

.....

.....

(10 *marks*)

(v) In this mixing machine, the mixed concrete needs to be taken out by rotating steering wheel *S*. When this is done, mention the main power transmission mechanism acting on shaft *A* and the main mechanical property that must be present in the material used to make this shaft.

Power Transmission Mechanism : .....

Mechanical property : .....

(10 *marks*)

(*b*) It is required to design a digital circuit to protect the electric motor being used. Its operation is to, automatically switch off the motor when both temperature of the motor and the current through the motor are higher than a safety limit. Two sensors T and I are used for respectively temperature and current in this process and two sensor outputs give respectively logic '1' when temperature > T_1 and logic '1' when current > I_1. T_1 and I_1 are the safety limit values in the motor operation.

(i) Complete the truth table for the above safety circuit.

T	I	M
0	0	
0	1	
1	0	
1	1	

(05 *marks*)

(ii) Derive the Boolean expression for the above circuit.

(10 *marks*)

(iii) Draw the digital circuit for the above circuit.

(10 *marks*)

Q.3

75

[*see page seven*

Do not write in this column

4. (*a*) Ananda is an engineering technology graduate. He got an opportunity to work as a helper in a biogas digester installation site while he was a university student. Afterwards, he developed a strong interest on biogas production. After graduation he developed a biogas digester at his house with his first salary and conducted relevant researches. As a result, he became an expert in the biogas production industry in a short period of time. He could also develop a biogas digester using modern methods for domestic use and has received a patent and many national and international awards for it. Simultaneously, he started a small-scale business and a set of workers are employed in this business. These digester units are produced by cutting and welding barrels disposed from large-scale factories and making them rust proof.

(i) State **two** benefits that Mr. Ananda can have by developing a business plan.

(1) .....

(2) .....

(05 × 2 = 10 *marks*)

(ii) State **two** major information to be included when preparing a financial plan for Mr. Ananda's business.

(1) .....

(2) .....

(05 × 2 = 10 *marks*)

(iii) Mr. Ananda has started a 'biogas digester production' industry. To ensure the health and safety in it, what is the ordinance that includes regulations pertinent to Sri Lanka?

.....

(05 *marks*)

(iv) State **two** hazards, which can occur due to the machines used for biogas digester production.

(1) .....

(2) .....

(05 × 2 = 10 *marks*)

(v) The aperture of the burner should be manufactured precisely when using biogas in the cooker. Using CNC technology is suitable for this. State a strategy that can help to popularise CNC technology in Sri Lanka.

.....

(05 *marks*)

(*b*) (i) State a benefit received by Mr. Ananda due to manufacturing biogas digesters according to a standard.

.....

(05 *marks*)

(ii) In order to know the pressure inside the digester, a 'U' tube is employed. Name a factor affecting the measurement accuracy when measuring pressure using a U tube.

.....

(05 *marks*)

[*see page eight*

Do not write in this column

(c) Consider the following information in relation to the production of a biogas digester unit.

Production cost of a digester unit	: Rs. 30 000.00
Selling price of a unit	: Rs. 60 000.00
Number of units sold in a year	: 30
Received discounts on raw materials during the same year	: Rs. 30 000.00
Telephone, water and electricity cost	: Rs. 90 000.00
Publicity charges	: Rs. 120 000.00
Interest for loans obtained	: Rs. 100 000.00

Insert the given data pertaining to this business in the appropriate locations in the given profit/loss account format.

Sales income			
Sales expenditures			
Gross profit/loss			
Other income			
Administrative expenditure			
Distribution expenditure			
Financial expenditure			
Other expenditure			
Net profit/loss			

(25 *marks*)

Q.4

75

* *

[*see page nine*

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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. (*a*) Rapid depletion of natural construction materials due to large scale extraction of them from the environment for large scale concrete constructions has presently created a problematic environmental situation.

(i) State **two** thermal properties of concrete related to the functioning stage of a building, and describe how **one** of those properties relate to building functioning. (10 *marks*)

(ii) State the main solid constituents of concrete, and provide an alternative construction material for each of the constituents. (15 *marks*)

(iii) Name a raw-material used in cement production, and describe **one** environmental problem which can arise due to extraction of it from the natural environment. (15 *marks*)

(*b*) Finishing is the last stage in building construction and it provides an aesthetic look and a protection to a building.

(i) State the **two** main categories of building finishing types and explain the two types separately giving **two** examples for each type. (20 *marks*)

(ii) Briefly describe the wall plastering process step by step. (20 *marks*)

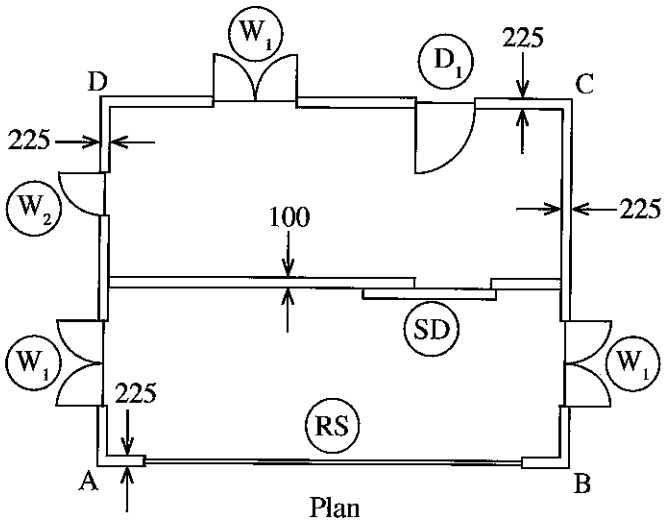
(*c*) In a building, doors and windows are considered as 'Openings'.

(i) Briefly describe **two** reasons for locating doors and windows in a building. (10 *marks*)

(ii) Name **two** ironmongery used for fixing windows and briefly describe their uses and fixing methods. (10 *marks*)

[*see page ten*

6. The plan and the cross sectional details of a single-storey shop, proposed to be constructed from bricks, are given in the figure and the table respectively. (Plan is not to scale)



Plan

Cross sectional details:		
Walls	Height	3.5 m
External	AB length	20.0 m
External	BC length	12.0 m
Windows	W_1	1.0×1.50 m^2
	W_2	0.5×1.50 m^2
Doors	D_1	2.0×1.25 m^2
	SD	2.0×1.25 m^2
	RS	15.0×3.00 m^2

(*a*) Answer the given questions following the SLS 573 and on the measurement sheets prepared by you.

(i) Calculate the centre lengths of the 225 mm thick brick walls.

(ii) Take off the quantities for the 225 mm thick brick walls.

(iii) Take off the reduction of the brick wall stated in (ii) above for the door and windows.

(25 *marks*)

(*b*) (i) List **three** cost items each in the following work items.

(I) Soil filling for the floors.

(II) Cutting and removing a tree

(III) Plastering the soffit concrete.

(ii) The resources and market prices related producing concrete in the site are given below. Calculate the net unit rate for 1 m^3 of concrete using the following data.

Required Resources

Work Item : Preparing 1 m^3 concrete insitu

- 2 unskilled labour days
- 0.5 skilled labour days
- 0.5 days of concrete mixer truck
- 0.2 m^3 of cement
- 0.4 m^3 of sand
- 0.8 m^3 of 19 mm crushed stones (metal)

Market Prices

50 kg (0.035 m^3) cement	–	Rs. 1 375.00
1 cube (2.83 m^3) sand	–	Rs. 16 000.00
1 cube (2.83 m^3) 19 mm crushed stone	–	Rs. 8 000.00
Concrete mixer truck 1 hr	–	Rs. 650.00
Unskilled labour	–	Rs. 2 000.00/day
Skilled labour	–	Rs. 3 500.00/day

(25 *marks*)

[*see page eleven*

(*c*) It is proposed to survey the land where the above proposed building is to be constructed, using chain surveying method.

(i) State **two** difficulties faced when using the chain surveying method to survey a land. (10 *marks*)

(ii) Describe the above process of surveying using only one triangle. (30 *marks*)

(iii) Describe the way of setting-out the building on the above land. (10 *marks*)

Part C - Essay (Electrical and Electronic Technology)

7. (*a*) An electric cooker is to be made using two identical heating coils made out of Nichrome each having a resistance of 52.9 Ω. This cooker is to be connected to the 230 V/50 Hz electric mains supply.

(i) With the aid of separately drawn circuit diagrams, explain that these heating coils can be connected to obtain three different levels of heat generation. (15 *marks*)

(ii) Calculate the heating power of the cooker in kW for each situation. (15 *marks*)

(iii) If the cooker is operated at the maximum heating power for 1 hour per day for 30 days, calculate the amount of electrical energy it consumes during the period in kWh. (10 *marks*)

(*b*) (i) Illustrate how armature and field windings are interconnected in direct current series, shunt and compound wound motors using named circuit diagrams. (15 *marks*)

(ii) Show graphically, how speed and torque varies with the armature current in direct current series and shunt wound motors. (10 *marks*)

(iii) Describe how the windings of a direct current compound wound motor can be designed so that its characteristics are similar to the characteristics of a direct current series wound motor. (20 *marks*)

(*c*) A switch of the electric bell of a house is installed on the parapet wall near the gate. Cables from the house to the switch have been passed through an underground conduit. During rainy days, when someone presses the bell switch, the Residual Current Circuit Breaker (RCCB) of the house shuts off power to the entire house. When the RCCB is switched on again, it stays switched on. If the bell switch is pressed again, the RCCB shuts off power again.
Explain the reason for the above situation giving the operation of the RCCB. (15 *marks*)

[*see page twelve*

8. (*a*) Assume that you are an electronic technician works in an automation company who supports for designing electronic circuits. Your first assignment is to design an unregulated power supply using your acquired knowledge to improve it as a regulated power supply after experimentally validating it.

- Primary and Secondary voltages (RMS) of the transformer are 230 V and 15 V respectively.
- The output should give minimal variation in the rectification.

(i) Design a suitable circuit for rectification and mark the polarities of the terminals. (05 *marks*)

(ii) When a 100 Ω resistor is connected as a load across the rectification circuit, calculate the peak current through the load. (Assume that the voltages across the forward bias diodes are 0 V.) (10 *marks*)

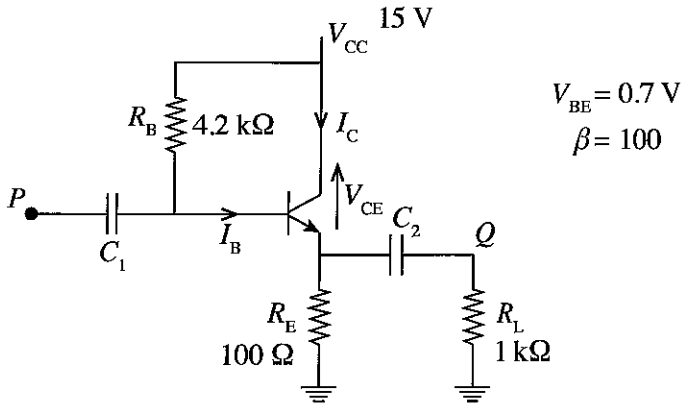
(iii) Illustrate by drawing a circuit diagram how the circuit in above (i) should be changed for smoothing. (05 *marks*)

(iv) After smoothing, it was observed that the output voltage is higher compared to the voltage before smoothing when it was measured using a multimeter. Explain the reason for this. (10 *marks*)

(v) Draw the characteristic curve of a Zenner diode and mark the important parameters on it. (05 *marks*)

(vi) Finally, it was decided to regulate the output of the supply using a 12 V Zenner diode. If the maximum Zenner current is 100 mA, calculate the minimum resistance of the resistor that should be connected with the Zenner diode. (10 *marks*)

(*b*) The following is an amplifier circuit diagram.



(i) State the importance of the C_1 and C_2 capacitors. (05 *marks*)

(ii) Calculate the base current (I_B). (15 *marks*)

(iii) Calculate the collector current (I_C). (10 *marks*)

(iv) Calculate the voltage difference between the collector and the emitter (V_{CE}). (10 *marks*)

(v) A sinusoidal signal was given as the input to point *P*. Plot the output signal at point *Q* and the input signal in the same graph. (10 *marks*)

(vi) Explain using the graph drawn in (v) above, whether the above amplifier is a voltage amplifier or a current amplifier giving reason. (05 *marks*)

[*see page thirteen*

Part D - Essay (Mechanical Technology)

9. (*a*) One of the key ill effects of using fossil fuel in motor vehicles is air pollution.

(i) State **three** emission constituents that may contain in exhaust gas of a petrol engine. (15 *marks*)

(ii) Certain faults in fuel supply system of a spark ignition engine cause excessive emission generation. State one such fault and explain with reasons, how it affect emission generation. State the reason for the fault and types of emissions as well in answering. (20 *marks*)

(*b*) Briefly explain the operation of coil spring, shock absorber and stabilizer bar of a suspension system in a motor car. (15 *marks*)

(*c*) Piston type compressors are used in vapour compression refrigerators.

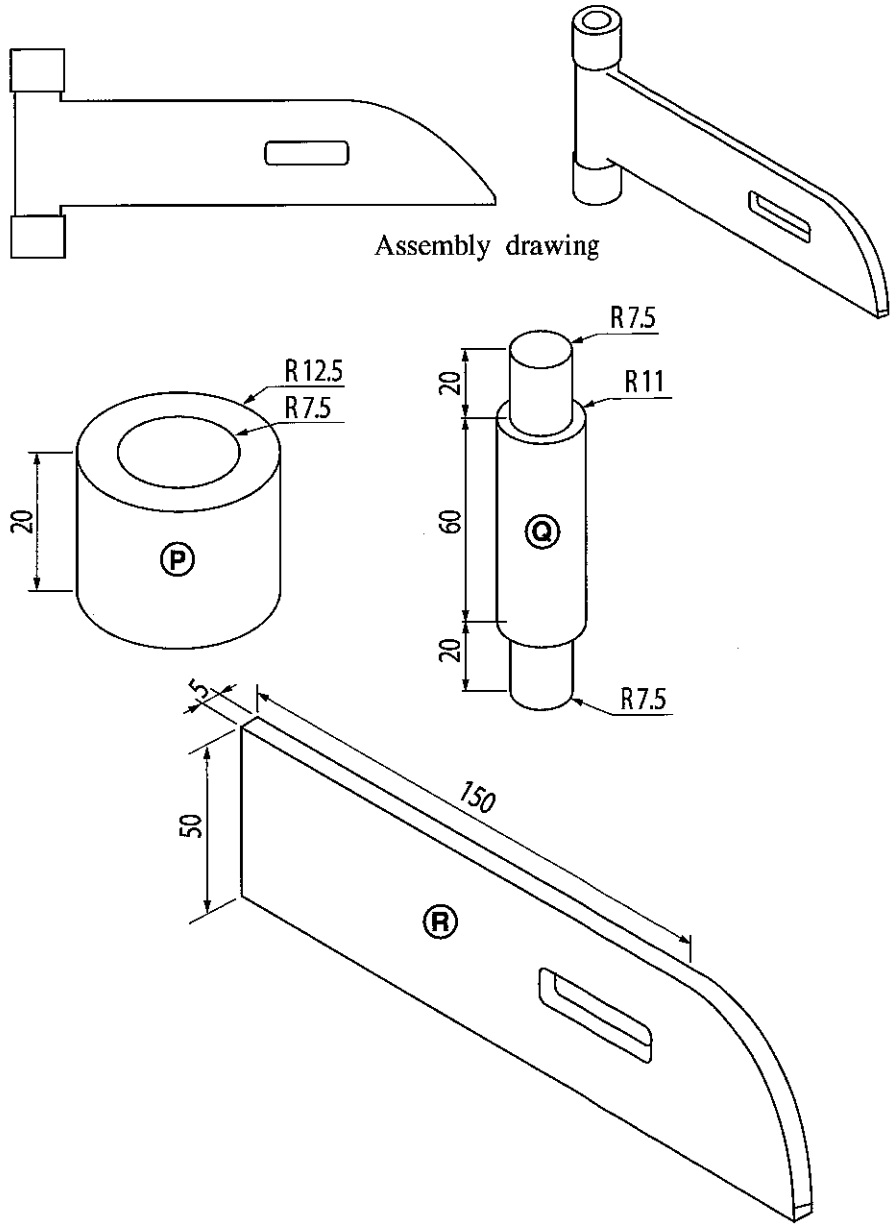
(i) State **two** other types of compressors that can be used instead of piston type compressors as refrigeration compressors. (10 *marks*)

(ii) Condensor is a key component of a domestic vapour compression refrigeration circuit. Explain the operation of a condensor, showing the changes of the temperature, pressure, and physical state of the refrigerant within it. (20 *marks*)

(iii) There are a few vapour compression refrigerators working in an air-conditioned super market. Explain, with reasons, how the operation of these refrigerators can affect the electricity consumption of the air conditioning system. (20 *marks*)

[*see page fourteen*

10. A part manufactured using mild steel for fixing to a gate is shown in the figure. This part was manufactured by assembling two parts of Ⓟ, one part of Ⓠ and one part of Ⓡ.



(*a*) In order to fabricate components Ⓟ and Ⓠ, if a mild steel rod of 25 mm diameter and 160 mm length has been supplied.

(i) Name the most suitable machine to manufacture parts Ⓟ and Ⓠ. (06 *marks*)

(ii) Describe step by step the method of producing the two units of part Ⓟ in a short period of time using the machine specified in (*a*)(i) above by stating instruments, equipment and tools, mentioning their sizes where necessary. (54 *marks*)

(*b*) (i) State **three** methods that can be used to permanently assemble metal parts in a workshop that does not have high technology instruments but has an electrical supply. (18 *marks*)

(ii) Mention the most suitable method among the methods specified in (*b*)(i) above to assemble the parts Ⓠ and Ⓡ in the workshop mentioned above. (06 *marks*)

(iii) Describe step by step the method specified in above (*b*)(ii) to assemble the parts Ⓠ and Ⓡ by mentioning instruments, equipment and tools. (16 *marks*)

* * *