AL/2021(2022)/14/E-I

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)

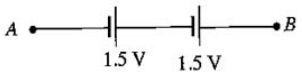
සිවිල් තාක්ෂණවේදය I குடிசார்த் தொழினுட்பவியல் I **Civil Technology I**	**14 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

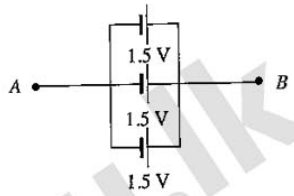
Instructions:

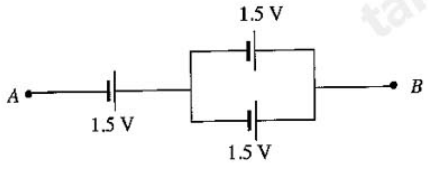
- ✻ *Answer* ***all*** *the questions.*
- ✻ *Write your* ***Index Number*** *in the space provided in the answer sheet.*
- ✻ *Instructions are given on the back of the answer sheet. Follow them carefully.*
- ✻ *In each of the questions* **1** *to* **50**, *pick one of the alternatives from* (1), (2), (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 in the back of the answer sheet.*
- ✻ *Use of calculators is not allowed.*

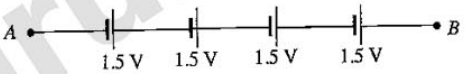
1. What is the units of force in base units?
(1) $kg\ m\ s^{-1}$ (2) $kg\ m\ s^{-2}$ (3) $kg^{-1}\ m^{-1}\ s^{-2}$ (4) $kg^{-1}\ m^{-1}\ s^{2}$ (5) $m\ s^{-2}$

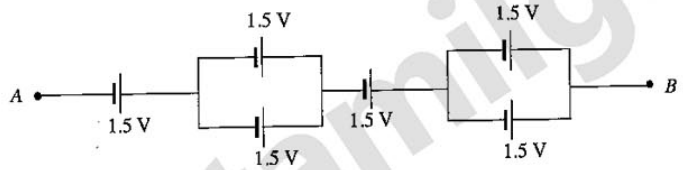
2. Following voltage sources are prepared by a student group. What is the circuit with lowest voltage between terminals *A* and *B*?

(1) 

(2) 

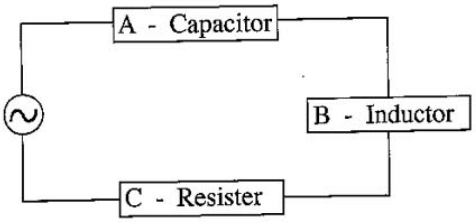
(3) 

(4) 

(5) 

3. A student group has selected, a capacitor (A), an inductor (B) and a resistor (C) for the following circuit. Select the correct option for A, B and C.

(1) A - 10 kΩ B - 1 mH C - 1000 μF
(2) A - 1 μF B - 1 mH C - 1 kΩ
(3) A - 1 kΩ B - 1 μF C - 1 mH
(4) A - 1 kΩ B - 1 mH C - 1 mH
(5) A - 1000 μF B - 1 kΩ C - 1 mH



4. What is the component that is **not** normally used in the domestic electric circuits?
(1) Main switch
(2) Residual current circuit breaker (RCCB)
(3) Miniature circuit breaker (MCB)
(4) Socket outlet
(5) Oscilloscope

[*See page two*

5. Two items with static electrical charges, positive or negative are placed near by. Select the answer with correct directions of forces exerted on them.

(1) ⊖ ⊕

(2) ⊕→ ←⊕

(3) ⊖→ ←⊖

(4) ⊕→ ←⊖

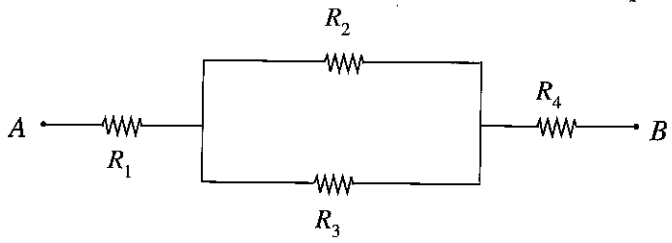
(5) ←⊕ ⊖

6. What is the correct option for the units of voltage, current, frequency and electric power respectively?

(1) A, V, Hz and W (2) V, A, Hz and W (3) W, A, Hz and V

(4) A, W, Hz and V (5) V, W, Hz and A

7. R_1, R_2, R_3 and R_4 resistors are connected in parallel and series combinations as shown in the figure, where $R_1 < R_2$ and $R_3 < R_4$. If a potential difference is applied to this circuit across A and B points. What is/are the resistor/resistors with the highest power dissipation?



(1) R_1 (2) R_2 (3) R_3 (4) R_4 (5) R_2 and R_3

8. The discrepancy between the 'measured value' and 'actual value' is called,

(1) Constant error. (2) True error. (3) Random error.

(4) Systematic error. (5) Mistakes.

9. What is the correct statement regarding the error due to the thermal contraction of steel measuring tapes?

(1) The error is positive. (2) The error is negligible.

(3) The error is negative. (4) The error only depends on the temperature.

(5) No error to be considered.

10. Diagram shows a truss arrangement carrying three forces. If the roller B can sustain a maximum load of 18 kN, what is the maximum value of force F that can be supported by the truss?

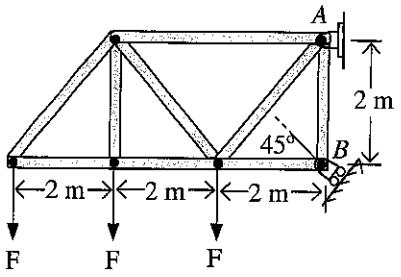
(1) $\sqrt{2}$ kN

(2) $1.5\sqrt{2}$ kN

(3) $6\sqrt{2}$ kN

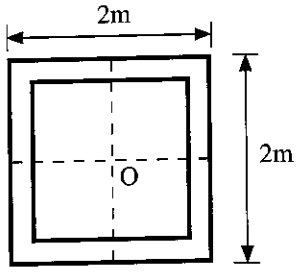
(4) $9\sqrt{2}$ kN

(5) $12\sqrt{2}$ kN



[See page three

11. A hollow square cross sectioned steel element shown in the figure is subjected to an axial compressive load of 100 kN along 'O' axis. Wall thickness is 0.25 m. Following gives some statements regarding stresses and strains in the steel element.



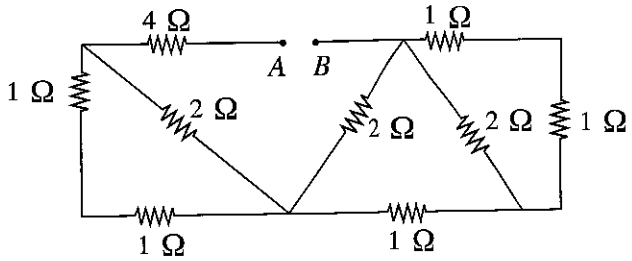
A - Element is subjected to an axial compressive stress of 57 kPa.
B - Element is subjected to an axial compressive stress of 25 kPa.
C - By increasing the wall thickness, axial stress can be reduced.
D - There is an axial compressive strain in the element.
E - If the compressive stress is increased, corresponding axial strain is proportionally decreased.

Which of the above statements are correct?

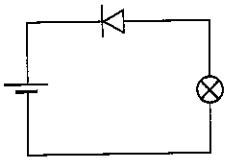
(1) A, C and D only (2) A, D and E only (3) B, C and D only
(4) B, D and E only (5) C, D and E only

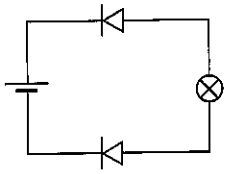
12. The equivalent resistance between terminals *A* and *B* for the network shown below is,

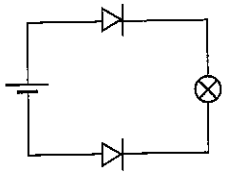
(1) 2 Ω.
(2) 4 Ω.
(3) 6 Ω.
(4) 8 Ω.
(5) 10 Ω.

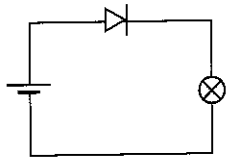


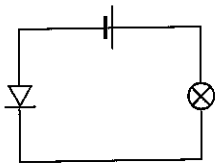
13. DC power sources, diodes and bulbs are connected in following circuits. What is the circuit which the bulb is light up?


(1)


(2)

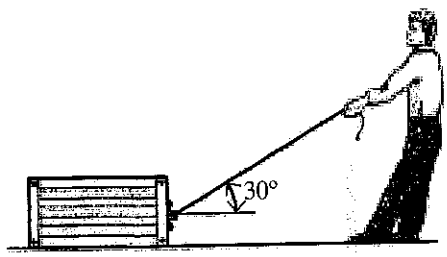

(3)


(4)


(5)

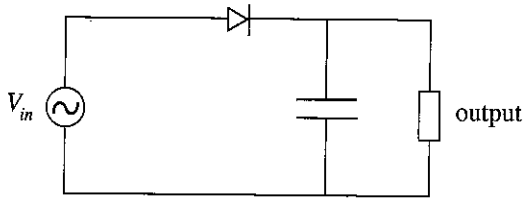
14. Diagram shows a man attempting to pull a 150 kg crate. The weight of the man is 80 kg and the coefficient of static friction between the ground and the crate is 0.3. The coefficient of static friction between this man's shoe and the ground is,

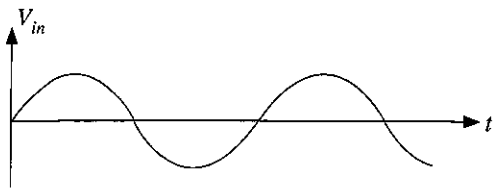
(1) 0.28
(2) 0.3
(3) 0.4
(4) 0.56
(5) 0.6

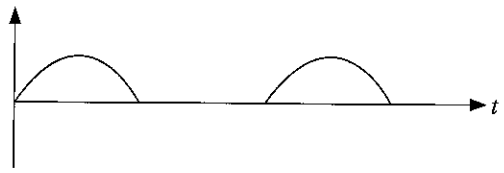


[See page four

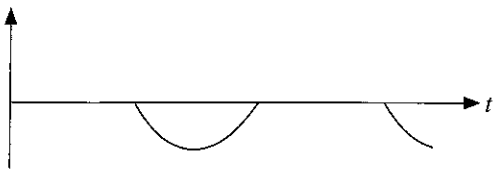
15. Following circuit is connected to an AC supply. Select the answer with correct output.



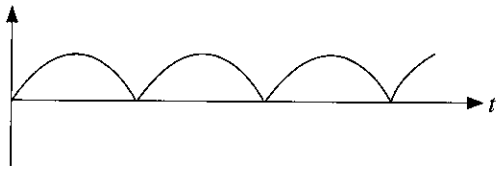




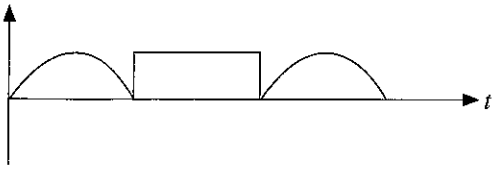
(1)



(2)



(3)



(4)

(5)

16. Consider the following statements.

A - Water can be used to stop any type of fire.

B - Blue coloured fire extinguishers are suitable to stop fires involving flammable liquids and flammable gasses.

C - Black coloured fire extinguishers contain CO_2 and they are suitable to stop electrical fires.

D - The colour of 'Foam fire extinguisher' is green.

Which of the above statements are correct about the fire extinguishers?

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

17. Consider following statements.

A - Bakelite is the first synthetic plastic which is made of phenol-formaldehyde.

B - Chlorine can be manufactured by the electrolysis of calcium chloride.

C - Calcium Carbonate is a main component found in Ordinary Portland Cement.

D - Crude Oil is used in the manufacturing process of polyvinyl chloride.

Which of above statements are correct regarding chemicals used in industries?

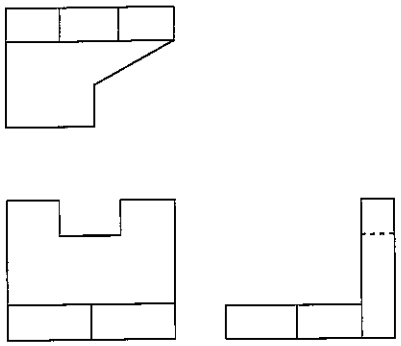
(1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
(4) B, C and D only. (5) A, B, C and D all.

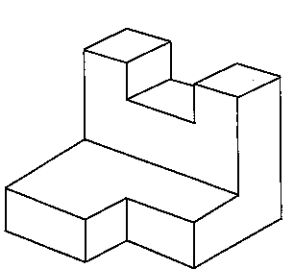
18. Rate of change of momentum is defined as,

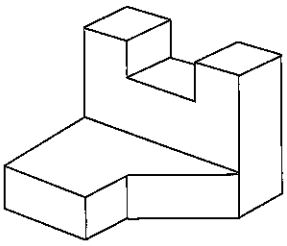
(1) acceleration. (2) force. (3) impulse. (4) inertia. (5) work.

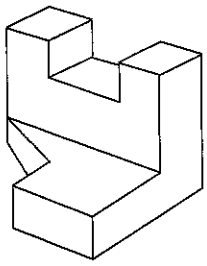
[*See page five*

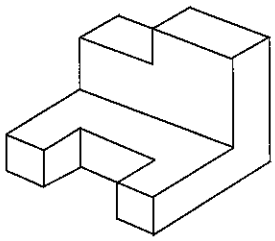
19. What is the correct isometric view for the orthogonal projections?

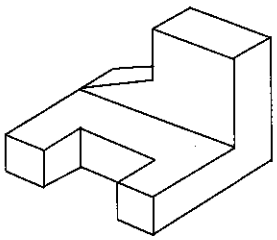



(1)


(2)


(3)


(4)


(5)

20. Consider the following statements.

A - Higher worker motivation will lead to a higher productivity.
B - Senior management support is not necessary to achieve higher productivity levels.
C - Overnight shifts and longer working hours will improve the productivity.
D - Maintaining clean and organized workspace will improve the productivity levels.

Which of the following statements are correct about improving construction productivity at site?

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

21. Consider the following statements.

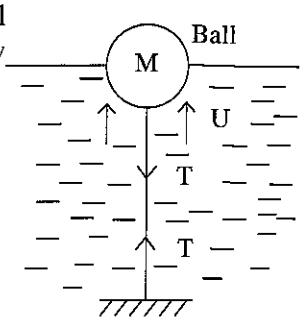
A - All objects dropped freely are subjected to a same acceleration.
B - Objects with different masses take different times to reach ground.
C - All objects dropped freely are subjected to the air friction.
D - The velocity of an object on the air is gt. (t - time, g - acceleration)

What are the correct statements regarding movement of objects dropped freely from a height?

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

[*See page six*

22. A ball is partly submerged in the water as shown in the figure. The ball is attached to the bottom of the tank using a rope. Out of the below statements, what is the correct statement?



(1) U - Upward thrust, U = Mg+T
(2) U - Surface tension, U = Mg–T
(3) U - Surface tension, U = Mg+T
(4) U - Water pressure, U = Mg+T
(5) U - Upward thrust, U = Mg–T

23. Propane and Butane are the main gases available in domestic LPG cylinders. The main reason for mixing Propane with Butane is to
(1) increase mixture vapor pressure.
(2) reduce the liquefying pressure.
(3) reduce the liquefying temperature.
(4) reduce the cost.
(5) maintain a stable flame during combustion.

24. Consider the following statements on ergonomics.
A - An ergonomic chair can assist to reduce lower back pain of a person with work related musculoskeletal disorders.
B - Location of light bulb switches is also an important ergonomic consideration.
C - Ergonomics helps to develop products that can be used easily.
D - Production cost of a product can always be reduced by using ergonomics.

Which of the above statements are correct?

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

25. Which of the following particle sizes are considered as nanoparticles under nanotechnology?
(1) 10^{-8} m - 10^{-9} m
(2) 0.01 m - 0.001 m
(3) 1 μm - 100 μm
(4) 1×10^{-9} m - 100×10^{-7} m
(5) 10^{-6} m - 10^{-9} m

26. Consider the following statements.
A - Cement is produced by burning lime stones and clay.
B - Steel bars are added to increase the tensile strength of concrete.
C - The compressive strength of 1:2:4 concrete mixture is greater than that of 1:1½:3 concrete mixture.
D - Tensile strength of concrete is usually low.

Which of the above statements are correct regarding cement and concrete?

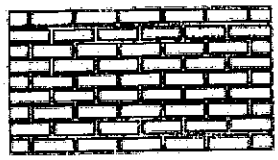
(1) A, B and C only (2) A, B and D only (3) A, C and D only
(4) B, C and D only (5) A, B, C and D all

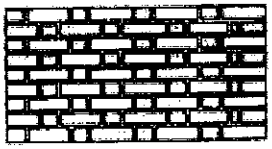
27. According to the Sri Lankan specifications, if the bottom cover for a land fill is made out of clay, what would be its thickness?

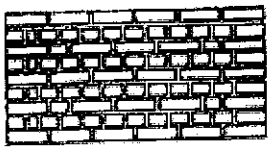
(1) 50 mm (2) 150 mm (3) 500 mm (4) 1000 mm (5) 1500 mm

[*See page seven*

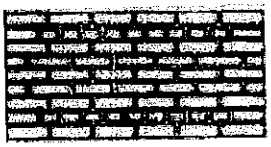
28. Which one of the following images shows the Flemish bond for a masonary wall?


(1)


(2)


(3)


(4)


(5)

29. Following gives four statements regarding steel reinforcements used in the construction industry.

A - Tensile strength of tor steel is higher than that of mild steel.
B - Steel bars are available in different lengths.
C - Density of tor steel bars and mild steel bars are almost equal.
D - Tor steel bars are used more than mild steel bars in structural elements.

Which of the above statements are correct regarding steel bars?

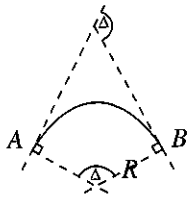
(1) A, B and C only (2) A, B and D only (3) A, C and D only
(4) B, C and D only (5) A, B, C and D all

30. The figure shows a simple curve connecting point A to point B. If the chainage at point A is X, the chainage at point B is;

(1) $X+\frac{\pi R\Delta}{180}$ (2) $X+\frac{\pi R}{180}$

(3) $X+\frac{R\Delta}{180}$ (4) $X+\frac{\pi R\Delta}{90}$

(5) $X+\frac{\pi R}{90}$



31. Consider the following statements.

A - Increase of temperature in water
B - Increase of salinity in water
C - Spread of waterborne diseases
D - Threat to the existence of mangrove forests

Among which of the above can be resulted due to industrial wastewater being added to the surface water?

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

32. Consider the following statements.

A - Energy is added to water while passing through the vanes of the impeller.
B - Water leaves the volute of the pump through the axis of the impeller.
C - Volute is constructed with a path of increasing diameter to increase the velocity of water.
D - Pressure of water increases while flowing through the volute of the pump.

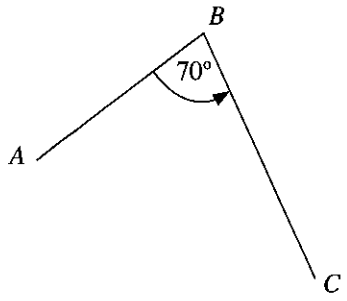
Which of the above statements are correct about domestic centrifugal pumps?

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

[See page eight

33. The figure shows an open traverse which ends at point *C*. The inclusive angle *ABC* is 70°. The bearing of the arm $AB(\phi_{AB})$ is 45°. Then the bearing of the arm CB (ϕ_{CB}).

(1) 45°
(2) 155°
(3) 225°
(4) 335°
(5) 355°



34. Following gives a few statements regarding bricks used in construction industry.

A - Compressive strength of burn clay bricks are almost same as that of unburnt bricks.
B - Bricks must be soaked in water before using in the construction.
C - At the construction site, the quality of burnt bricks can be examined.
D - Brick bats should not be used in the load bearing wall constructions.

Which of above statements are correct?

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

35. A hotel is to be constructed in a land bordering a river. The owner is required to submit initially his survey plan to get approval from

(1) The Survey Department.
(2) The Urban Development Authority.
(3) Local Governments Authority.
(4) The Sri Lanka Land Reclamation and Development Corporation (SLLR&DC).
(5) The Central Environment Authority.

36. There are different types of roads in Sri Lanka. What is the road type/types that is **not** present in Sri Lanka?

(1) Class E roads (2) Class A roads (3) Class F roads
(4) Class AC roads (5) Class E and AC roads

37. Consider the following characteristics.

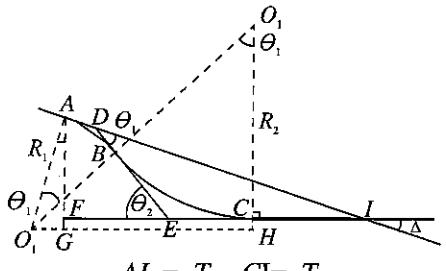
A - Workability
B - Consistency
C - Mobility
D - Durability

Which of the above characteristics are correct regarding fresh concrete?

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

38. The figure shows a reverse circular curve connecting two divergent straights *AI* and *CI*. If tangent length *AI* is T_1, the tangent length $CI(T_2)$ is represented by,

(1) $T_2 = T_1 \cos \Delta - (R_1 - R_2) \sin \Delta + R_1 \sin \Delta$
(2) $T_2 = T_1 \cos \Delta - (R_1 + R_2) \sin \Delta + R_1 \sin \Delta$
(3) $T_2 = T_1 \cos \Delta + (R_1 + R_2) \sin \Delta - R_1 \sin \Delta$
(4) $T_2 = T_1 \cos \Delta - (R_1 + R_2) \sin \Delta - R_1 \sin \Delta$
(5) $T_2 = T_1 \cos \Delta + (R_1 + R_2) \sin \Delta + R_1 \sin \Delta$



$AI = T_1$, $CI = T_2$

[See page nine

39. Steel rod with 2.0 m long rod is subjected to a tensile stress of 100MPa. Young's Modules of steel is 200GPa and the Poisson's ratio of steel is 0.3. Then the lateral strain value of steel rod is
(1) a compressive strain of 1.5×10^{-4}.
(2) a tensile strain of 1.5×10^{-4}.
(3) a tensile strain of 3.0×10^{-4}.
(4) a compressive strain of 3.0×10^{-4}.
(5) a compressive strain of 1.5×10^{-3}.

40. Bearing capacity of a soil profile is an important consideration in building design and construction. Following gives a few statements regarding bearing capacity of a soil profile.
A - Allowable bearing capacity should be used in foundation design.
B - Bearing capacity may reduce with the rise of water table during raining seasons.
C - By compacting with suitable soil filing materials, bearing capacity can be upgraded.
D - The purpose of lean concrete below the foundation is to improve the bearing capacity of a soil mass.

Which of the above statements are correct regarding bearing capacity of a soil profile?
(1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
(4) B, C and D only. (5) A, B, C and D all.

41. What is the incorrect statement about a domestic waste water disposal system?
(1) The waste line is connected to the septic tank prior to the soakage pit.
(2) Purpose of the soakage pit is to allow wastewater to soak into the soil.
(3) Suitable gradient for waste pipes increases with the pipe diameter.
(4) Sewerage and grey water should never be sent to a same pit.
(5) T-socket should be used as inlet pipe to a septic tank.

42. A catchment area of two hectares receives a 100 mm of rainfall over 6 hours. If the infiltration rate of the area is 15 mm/hour, what is the runoff volume out of the catchment? (Loss due to interception can be neglected)
(1) 200 m^3 (2) 1400 m^3 (3) 1800 m^3 (4) 2000 m^3 (5) 2200 m^3

43. Consider the following statements.
A - It should be free of disease-causing bacteria and viruses.
B - It should be colourless and tasteless.
C - It should be free from minerals which cause hardness.
D - It should contain liquid oxygen and carbon dioxide.
Which of the above should be essentially fulfilled about the quality of drinking water?
(1) A and B only. (2) A and C only. (3) A, B and C only.
(4) B, C and D only. (5) A, B, C and D all.

44. Which of the following cement type is **not** recommended for medium strength concrete (greater than grade 30 and up to 40)?
(1) Masonry Cement (MC)
(2) Ordinary Portland Cement (OPC)
(3) Portland Limestone Cement (PLC)
(4) Blended Hydraulic Cement (BHC)
(5) Portland-composite Cement (PCC)

45. Road camber is an important part of road design and construction. Which of the following statement is correct regarding road camber?
(1) It is used to mark the road lanes.
(2) It is used to cross drainage of rain water.
(3) It is used to as an improved meaning of road safety.
(4) It is not seen in modern roads.
(5) It is used in road curves only.

[*See page ten*

46. Which of the following statement is correct regarding timber materials?

(1) All timber species can be used for engineering constructions.
(2) Timber can be replaced with concrete when used for long beams.
(3) Timber defects are not going to affect for its strength.
(4) Durability of timber can be improved by timber seasoning.
(5) Timber elements can be connected through nails and screws only.

47. Consider the following statements.

A - It is a form of digital currency.
B - It is allowed to do any transaction in Sri Lanka.
C - It has a centralized structure controlled by a world-wide banking system.
D - It operates beyond control of the governments.

Which of the above statements are correct about cripto currency?

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

48. What is the unit can correctly be used for measurements of 'Bearing Capacity of Soil'?

(1) kN (2) kPa (3) MPa (4) MN (5) N

49. Consider the following statements.

A - Planning for safety
B - Organizing for safety
C - Assuring for safety
D - Controlling for safety

Which of the above statements correct regarding safety?

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

50. During the batching of concrete, a nominal mix of cement, sand and coarse aggregate by weight was maintained in the ratio of 1 : 1.25 : 2.86. It was decided to maintain a water-cement ratio of 0.5. If sand contains 2% of water by weight and coarse aggregate contains 0.5% of water by weights. The amount of water required to mix 50 kg of cement,

(1) 23 kg. (2) 25 kg. (3) 26 kg. (4) 27 kg. (5) 28 kg.

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கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

සිවිල් තාක්ෂණවේදය	II
குடிசார்த் தொழினுட்பவியல்	II
Civil Technology	**II**

14 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 consists of **14** pages.*
- *This question paper comprises **Parts** **A**, **B** and **C**. The time allotted for **all parts** is **three hours**. (Use of calculators is **not** allowed.)*

Part A - Structured Essay (09 pages)

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

Part B and C - Essay (05 pages)

- *Select **two** questions from each of the parts **B** and **C** and answer **four** questions only. Use the papers supplied for this purpose. At the end of the time allotted for this paper, tie the **three parts** together so that **Part** **A** is on the top of **Part** **B** **and** **C** before handing over to the supervisor.*
- *You are permitted to remove only **Parts** **B** **and** **C** of the question paper from the Examination Hall.*

For Examiner's Use Only

Part	Q. No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		

Total	
In Numbers	
In Words	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

[see page two

PART A – Structured Essay

*Answer **all four** questions on this **paper itself**.*
*(Each question carries **10** marks)*

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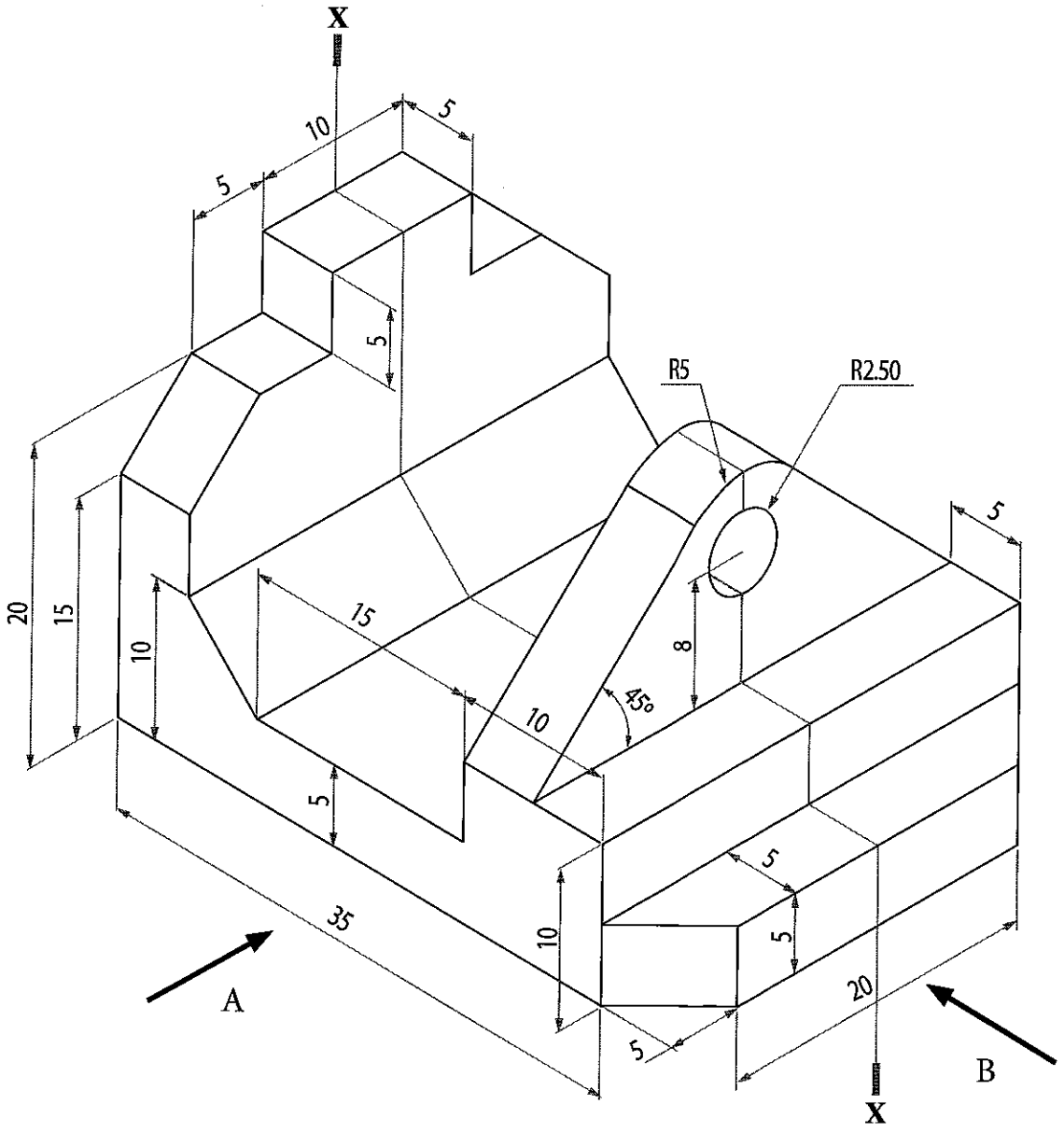
1. An isomeric view of a machine component is shown in the figure. The machine component is symmetric along the vertical plane passing through **X-X**. Assuming any missing dimensions draw the following views to a suitable scale using first angle projection principle. Show all relevant dimensions in the sketches. Use the graph papers provided in pages 3 and 4 to answer the question. (All dimensions are in millimeters.)



(i) Front elevation seen through direction A
(ii) End elevation seen through direction B
(iii) Plan

[see page three

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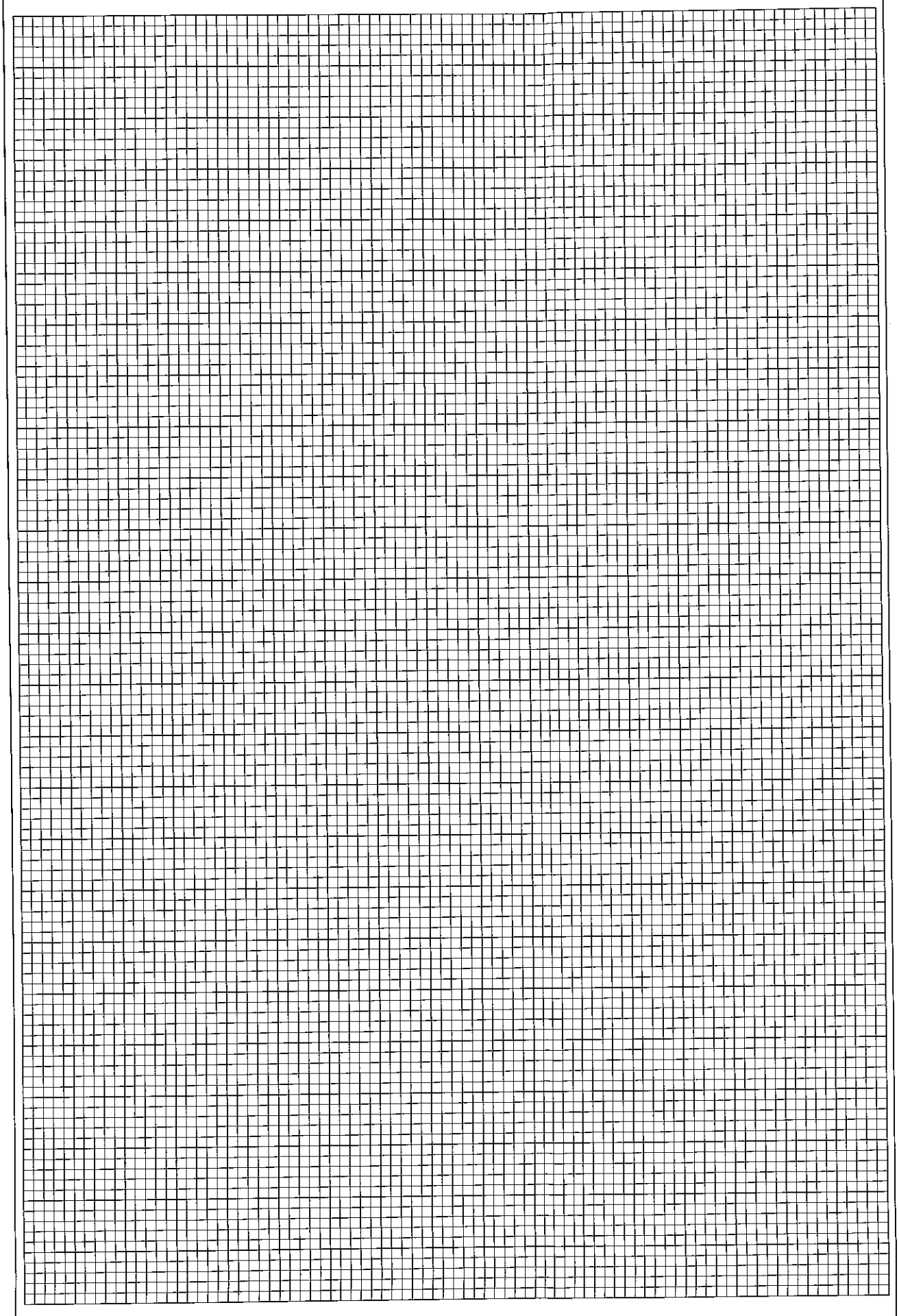

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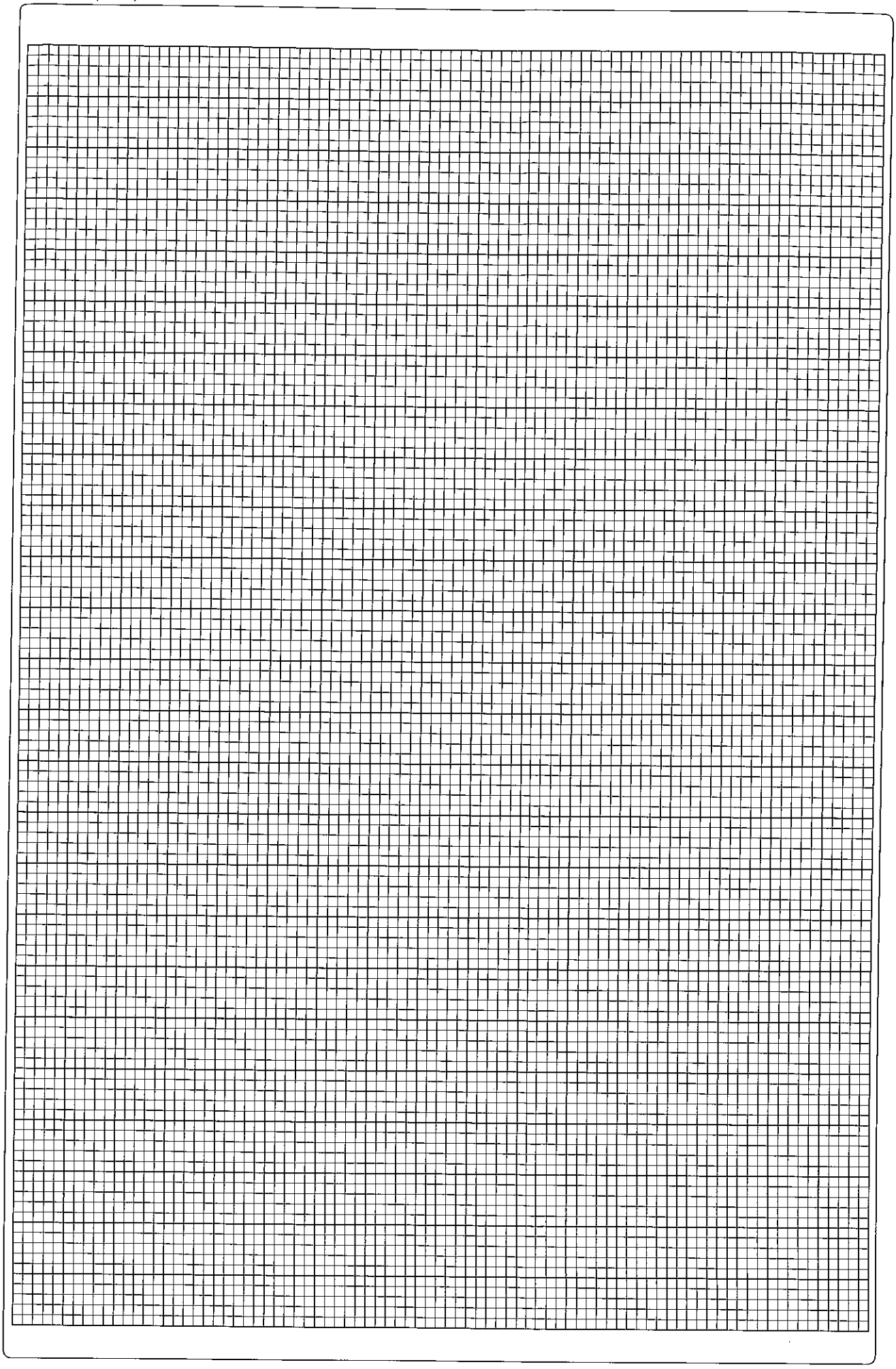

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2. Many nations world wide struggle to handle rising number of infections due to Covid - 19. It is essential to detect infections and release PCR results in a timely manner. A software development company has proposed a computer-based system to reduce the time taken to release the results of PCR tests by using computer software and hardware.

Public Health Inspectors or relevant health officials are expected to take the sample which is sent to the testing laboratory. A sticker will be pasted on the sample and a part of the sticker is given to the patient.

(a) State **three** information that may be entered to the computer system by the sample collecting officer regarding the person who is going to be tested.

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(b) Mention additional hardware needed at the sample collecting center.

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(c) Mention additional hardware needed at the testing lab.

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(d) Briefly explain how the data is stored and results should be given to the patient.

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(e) State the advantages of using internet for this task.

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(f) Mention the security threats and the possible mitigation actions that can be taken when implementing this system.

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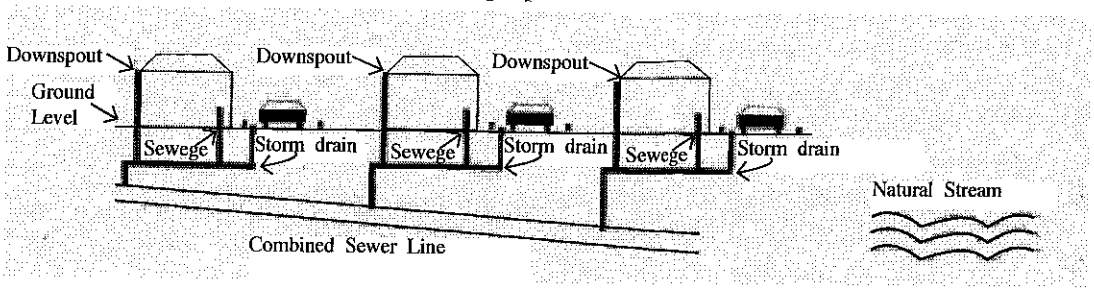
3. A new combined sewer system has been proposed for a developing city with only domestic housing units as shown in the following figure. A natural stream flows near the city and treated wastewater can be discharged to it only after reaching to relevant standards. A wastewater treatment plant has been proposed for it.



(a) State **four** parameters of treated wastewater which should be checked before releasing to the natural stream from the wastewater treatment plant.

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(b) The proposed treatment plant can handle the whole load of the city during dry weather. But in wet weather, a suitable mechanism is required to dispose the storm drainage directly to the stream due to the limit of its capacity. Draw a sketch of such suitable method for the same combined sewer line.

[see page seven

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(c) It is proposed to adopt a simple filtration method to clean storm drainage before sending to the combined sewer line. Draw a sketch of such method using suitable materials which can be introduced to household storm drainage systems.

(d) The households located away from the proposed network are required to go with the same old septic tank + soakage pit system. Describe **three** important details needed to be considered in constructing a septic tank.

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(e) Mention the steps of simple Percolation Test which should be carried out to decide the capacity of a soakage pit.

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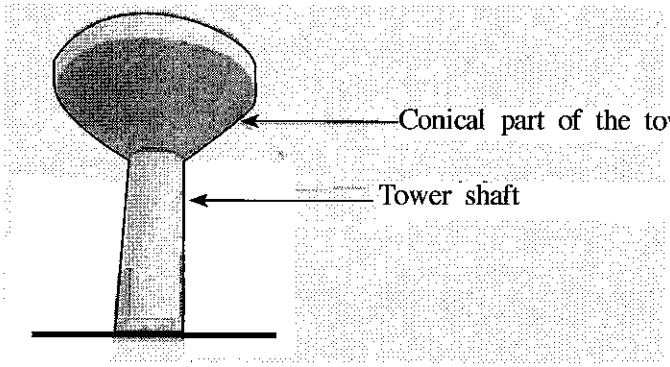
4. A water tank is to be constructed in a certain part of the dry zone in Sri Lanka to alleviate the drinking water problem. The raft foundation is to be supported on the bed rock of the site when building the tower. The following figure shows the sections of the tower.



(a) Mention a suitable concrete mix proportion for the concrete works of the tower shaft and explain why you have selected this concrete mixture.

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[see page nine

(b) Draw a possible false work arrangement to support the concrete works of the conical part of the water tower.

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(c) Mention the purpose of concrete compaction.

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(d) After a certain concrete work is finished, explain briefly the curing works of the concrete.

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கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
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සිවිල් තාක්ෂණවේදය	II
குடிசார்த் தொழினுட்பவியல்	II
Civil Technology	**II**

14 E II

Essay

* *Select* ***two*** *questions from each of the* ***Parts*** **B** *and* **C** *and answer* ***four*** *questions only.*
(Each question carries ***15*** *marks.)*

Part B

5. Liquid Petroleum Gas (LPG) is one of the main fuel sources used for cooking. Leakages of LPG can cause different accidents.

(a) (i) State **two** other applications of LPG.

(ii) State **two** accidents caused due to LPG leakages.

(b) Briefly describe how to identify a LPG leakage at a household.

(c) Explain how new technology can be applied to identify the gas leaks and minimize the accidents.

6. Electricity supply is considered as one of the essential services in modern society. Ceylon Electricity Board (CEB) is supplying electricity in following tariff rates.

Table 1 - Tariff for monthly total usage between monthly consumption 0 - 60 kWh

Monthly consumption (kWh)	**Unit charge (Rs. /kWh)**	**Fixed charge (Rs. /kWh)**
0 - 30	2.50	30.00
31 - 60	4.85	60.00

Table 2 - Tariff for monthly total usage higher than monthly consumption 60 kWh

Monthly consumption (kWh)	**Unit charge (Rs. /kWh)**	**Fixed charge (Rs. /kWh)**
0 - 60	7.85	0
61 - 90	10.00	90.00
91 - 120	27.75	480.00
121 - 180	32.00	480.00
more than 180	45.00	540.00

(Ref. www.ceb.lk)

(a) Identify **four** essential activities that require electricity for comfortable daily life in domestic context.

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(b) (i) The following table shows selected items used in a modern house and their power ratings. Use reasonable assumptions to calculate monthly energy consumption.

Calculate monthly electricity consumption for each item completing following table. (Copy this table in the answer scripts and complete it.)

Item	Number of items	Power rating (W)	Usage per month (hours)	Units consumed per month (kWh)
Refrigerator with inverter	02	500		
Electric iron	02	1500		
Rice cooker	01	500		
Ceiling fans	08	80		
Bulbs	10	40		
	4	60		
	1	100		

(ii) Briefly describe how did you consider on/off cycles, daily activities, and relevant assumptions in calculating the units consumed per month in the table in part (i) for each item.

(c) (i) Monthly electricity consumption of a modern house with higher electricity consumption is 350 kWh. Calculate the cost of lighting load (bulbs) for the modern house considering the lighting loads as in the part (b) (i).

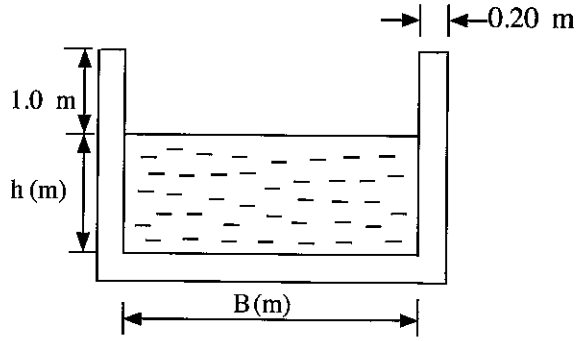
(ii) Briefly describe how to reduce the monthly usage for lighting by using energy efficient LED bulbs.

(iii) Refer to the following chart and calculate the reduction in the cost for lighting in the modern house mentioned in above (i).

Normal incandescent bulb (W)	Equivalent LED (W)
40	4
60	6
100	16

(d) Mention the other ways in which electricity consumption can be reduced.

7. A Mini Hydro Power Plant (MHPP) is to be designed in a certain location in the Central province of Sri Lanka. The water stream that is to be harnessed for the power generation, has an average water flow of 20 m^3/s. The environmental authority allows only 40% of the average flow to be used for power generation. The height difference between water diversion point to the turbine inlet (H) is 150 m. Water is carried through a concrete channel up to the forebay tank and then through the penstock (a steel pipe) up to the turbine. The width of concrete channel section (B) is twice the water height (h) in the channel. Following figure shows the sectional view of the concrete channel.



(a) Determine the available water flow for power generation.

(b) If the free board (channel height above water level) is 1.0 m and the concrete wall thickness is 0.2 m, calculate the overall channel width and overall channel height. (Velocity of water in the channel is $1 ms^{-1}$)

[see page twelve

(c) Calculate the potential energy available for power generation. (Consider gravitational acceleration as 10 m s^{-2} and density of water is 1000 kg m^{-3})

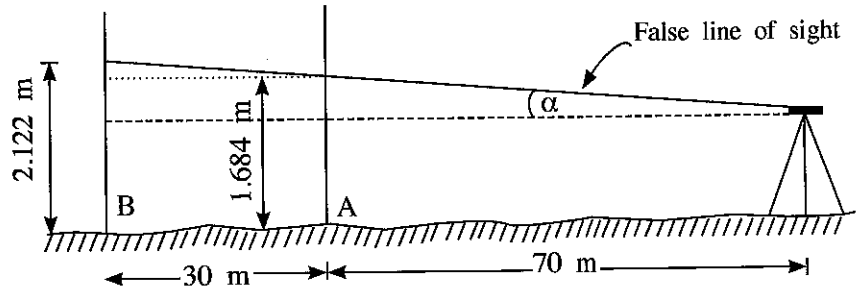
(d) The plant factor is efficiency of the turbine and generator works. In this case, plant factor is assumed to be 0.95 from the electrical and mechanical machinery of the power plant. Determine the power output from the generator in kWs.

(e) State **two** reasons why environmental authority does not allow to divert full water flow of the stream.

Part C

8. (a) Mention the main differences between the following levels.
   (i) Dumpy level
   (ii) Wye level
   (iii) Tilting level

   (b) A level was set up along an extended line BA in a position, 70 m from A and 100 m from B. It reads 1.684 m on a staff held at A and 2.122 m on a staff held at B. The bubble was carefully brought to the centre of its run before each reading. It was known that the reduced levels of the tops of the pegs A and B are 89.620 m and 89.222 m respectively.
   (i) Find the Collimation error.
   (ii) Find the readings that would have been obtained had there been no collimation error.



   (c) The following consecutive readings were taken with a level and a 5 m levelling staff on a continuously sloping ground at a common interval of 20 m.

   0.385 m ;1.030 m ; 1.925 m ; 2.825 m ; 3.73 m ; 4.685 m ; 0.625 m ; 2.005 m ; 3.110 m ; 4.485 m.

   The reduced level of the first point was 208.125 m.
   (i) Rule out a page of a level field book and enter the above readings.
   (ii) Calculate the reduced levels of the points by rise and fall method and find the gradient of the line joining the first and the last point.

9. Surface water pollution is a huge environmental issue faced by the whole world today. Majority of the issues are caused by human activities and many efforts have been taken to mitigate these impacts.
   (a) In May 2021, due to the X-Press Pearl container ship accident near the Sri Lankan coast, a huge marine disaster was caused around Sri Lanka due to tons of nitric acid, Low Density Polyethylene (LDPE) and other chemicals being added to the sea. Write a short essay explaining the environmental impacts of it.
   (b) Salinity intrusion is another natural environmental issue which impacts the quality of surface water. Discuss the possible reasons and the negative impacts of it towards the natural environment including the humans.
   (c) In water distribution networks, natural surface water is subjected to a water treatment process prior to distribution. Describe **four** main stages of water treatment with relevant sketches.

[see page thirteen

10. Calculate the following for both illustrations given in figure 1 and figure 2 respectively. All the dimensions are given in metres.

(a) Calculate the centre line dimensions.
(b) Take-off the quantities of excavation work in foundations.
(c) Take-off the quantities of concrete work in foundations.

(Hint : Volume of a right square pyramid is given by $\frac{a^2h}{3}$ where "a" is the length of base edge and "h" is the height.)

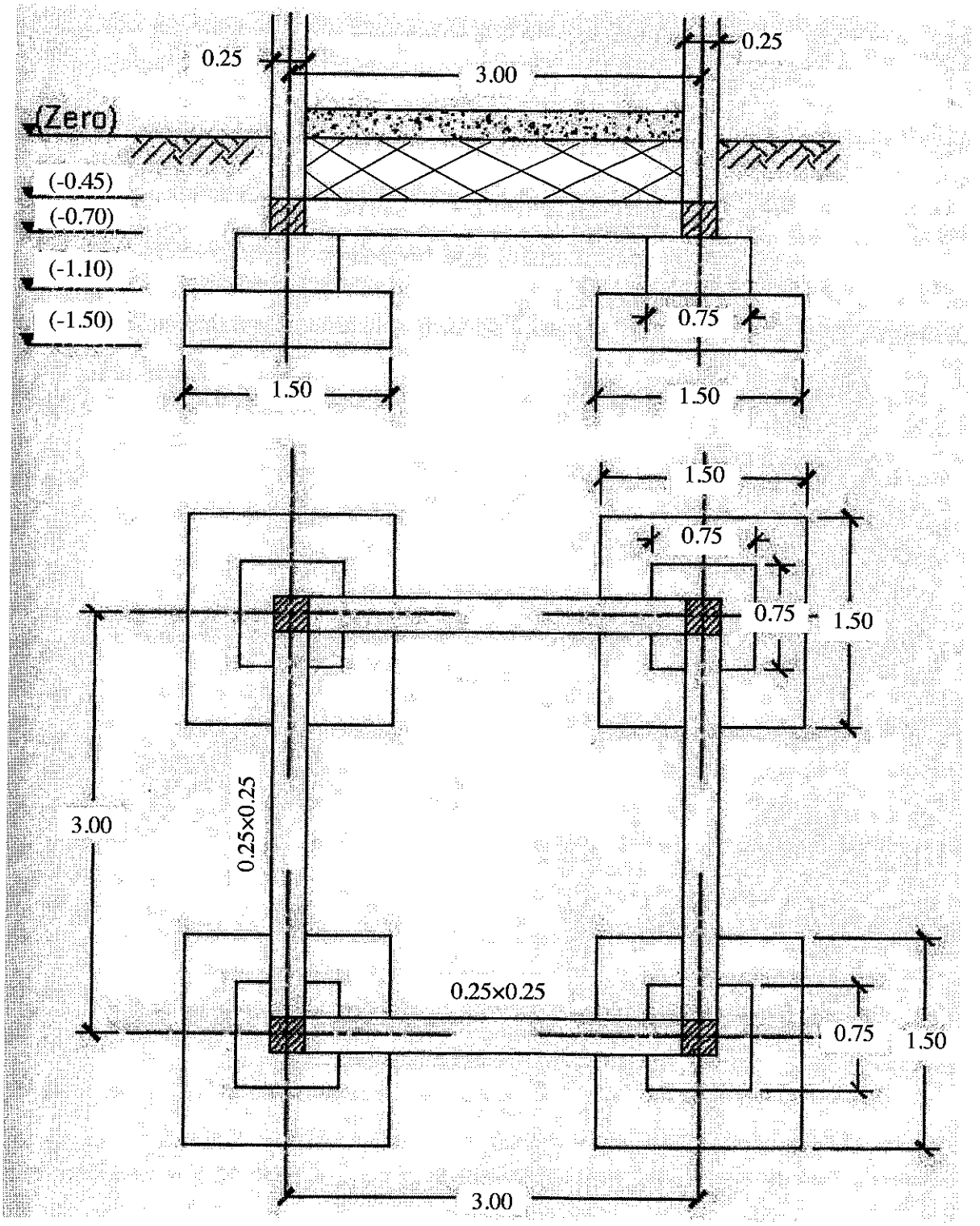
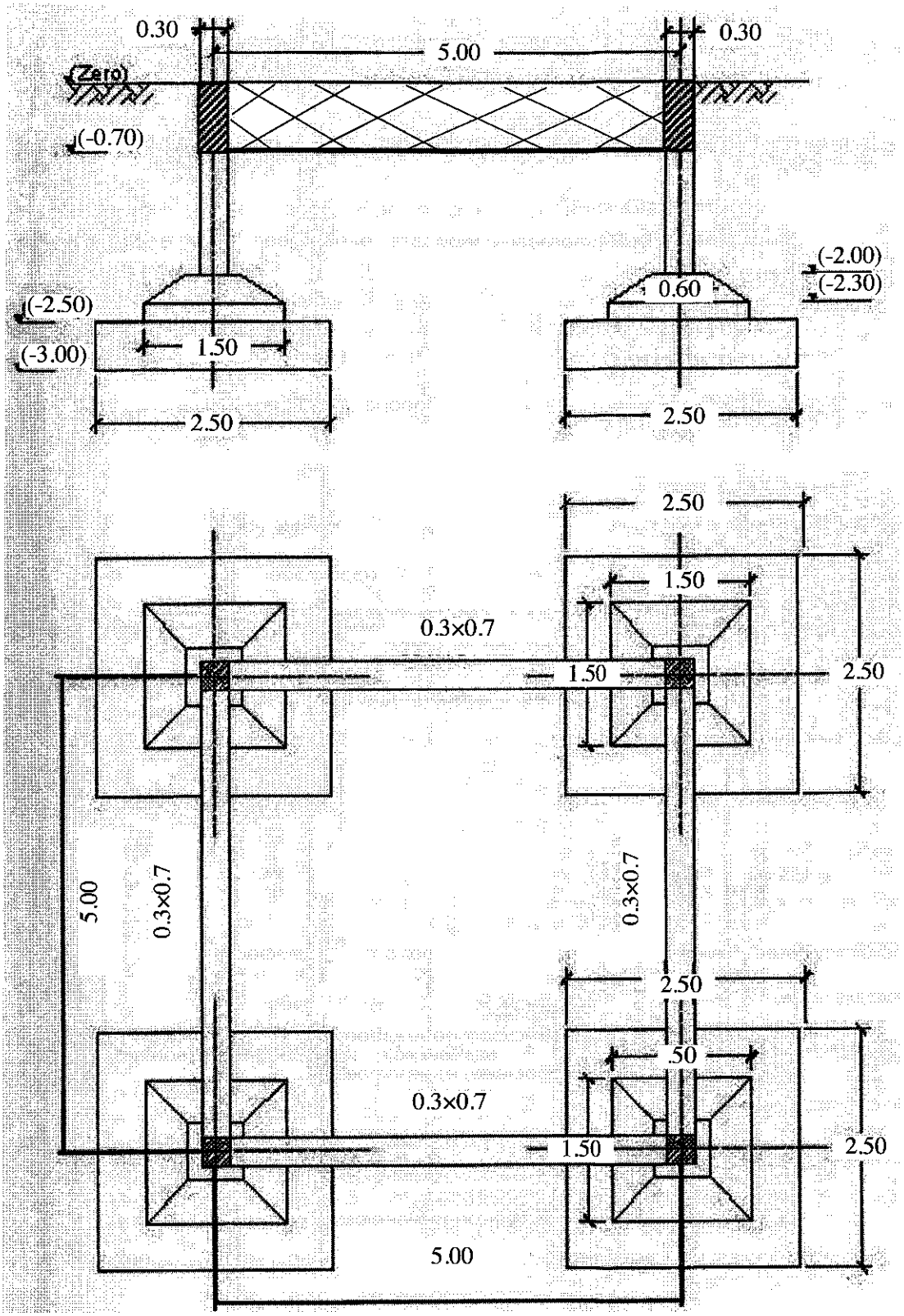


figure 1

[see page fourteen


0.30
5.00
0.30
(Zero)
(-0.70)
(-2.00)
(-2.30)
0.60
(-2.50)
(-3.00)
1.50
2.50
2.50
2.50
1.50
0.3×0.7
1.50
2.50
5.00
0.3×0.7
0.3×0.7
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0.3×0.7
1.50
2.50
5.00

figure 2

* * *