Written Examination for Technical Officers (Civil) (Mechanical) in Public Service and Provincial Public Service - From 2005 to 2009 (1st Exam) - 2010

**(01) Mathematics** (Lower Paper) ⟨ *Three hours* ⟩

Answer question **one** and **five** others. Take $\pi = \frac{22}{7}$ where necessary.

1. (i) A man bought a certain item for Rs. 1200 and marked its selling price at a profit of 20%. When the item is sold for spot cash, he gives a discount of 5%. At what price can the item be bought for spot cash?

    (ii) Solve : $2x + 3y = 13$
    $5x - 2y = 4$

    (iii) What is the volume of a solid cone whose radius is 9 cm and length is 14 cm.

    (iv) *PQRS* is a rectangle.

 $S\hat{R}T = 65°$ and $SR = ST$.

    Find the magnitude of $T\hat{S}P$.
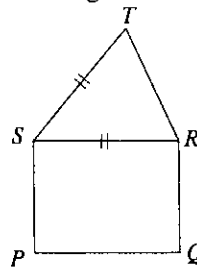
    (v) Five men can complete a certain job in 8 days. After working on the first two days, two of them fell ill and were absent. How many work days will the remaining three men take to complete the job?
    (20 marks)

2. (i) The ratio between the price of a kilogram of rice and that of a kilogram of sugar is 2 : 3. The total price of 2 kilograms of rice and 2 kilograms of sugar is Rs. 300.
    (a) Find separately the price of a kilogram of rice and that of a kilogram of sugar.
    (b) The price of a kilogram of rice and that of a kilogram of sugar were increased by Rs. 10 each. Express in the simplest form, the ratio between the new prices of rice and sugar.

    (ii) A child goes round a circular ground turning a wheel with radius r. Going round in this manner, the wheel revolves 100 times. How many times of the radius of the wheel is the radius of the ground?
    (16 marks)

3. (i) The solid piece of metal shown in the figure is made up of a cylindrical portion and a conical portion placed on it. The radius of the bottom of the cylinder and that of the cone are the same and it is 7 cm. The height of the cylindrical portion is 12 cm while that of the conical portion is 12 cm. Calculate the volume of the entire piece of metal.
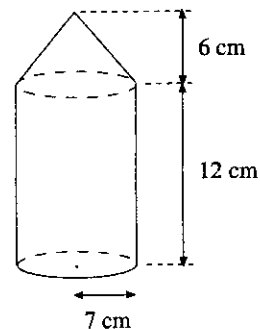
    (ii) By heating the same solid piece of metal, a solid cylinder with the bottom radius 14 cm can be made. Considering that there is no wastage of metal, find the height of the cylinder.
    (16 marks)

4. Given below is an incomplete table containing the values of x and y, suitable to draw the graph of the function $y = x^2 - 4x + 2$.

x	−1	0	1	2	3	4	5
y	7	...	−1	...	−1	2	7

    (i) Copy down the table on to your answerscript and complete the blanks in it.
    (ii) Draw the graph of the above function. (To draw the graph, obtain a graph paper from Supervisor/Invigilator)
    (iii) Is the turning point of the graph a maximum or a minimum? Write its co-ordinates.
    (iv) Write the equation of the symmetric axis of the graph of the function.
    (16 marks)

[See page two

5. $S\hat{P}Q$ is a right angle in the quadrilateral *PQRS*. The perpendicular bisector of *PS* cuts *PS* at *A* and *SQ* at *B*. The mid point of *SRT is C*. Show this information in a rough sketch and prove that,

    (i)   *B* is the mid-point of *SQ*.

    (ii) *BC* and *QR* are parallel.

    (iii) the ratio between the area of the quadrilateral *ABCS* and that of the quadrilateral *PQRS* is 1:4.

    (16 marks)

6. Using a straight edge with cm/mm scale and a pair of compass only,

    (i)   construct the triangle *ABC* with dimensions *AB* = 6 cm, *BC* = 8 cm, *CA* = 7 cm.

    (ii) plot the point *D* on *BC* so that *BD* = 4.2 cm and draw a line parallel to *AD* through *B*.

    (iii) construct the triangle *ABE* so that its area is equal to the area of the triangle *ABD* and *DE* = *AB*.

    (iv) Name a quadrilateral equal in area to triangle *ABC*.

    (16 marks)

7. (i)   Of the Arithmetic Progression 7, 12, 17, ...

        (a) write the next **two** terms.

        (b) find the 20th term.

        (c) find the sum of the first 20 terms.

    (ii) A man who digs a well charges for the job in such a way that for every subsequent metre the charge is twice as much as the charge for the metre immediately preceding, yielding a charge of Rs. 100 for the first metre, Rs. 200 for the second metre, Rs. 400 for the third metre and so on.

        (a) Write as a progression, the amounts be charged for each metre respectively.

            What type of a progression is it?

        (b) Find the amount he charges to dig the fifth metre.

    (16 marks)

8. *PQ* in the diagram depicts a right vertical tree. When looking from a point *R* on the same level of the foot of the tree, the angle of elevation at the top of the tree is 32°. Walking towards the tree along the same horizontal line *RQ* a distance of 20 metres, the angle of elevation at the top of the tree from point *S* is 59°.
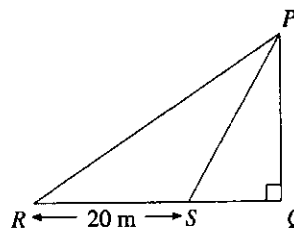
    (i)   Copy down the diagram on to your answer script and indicate the above information in it.

    (ii) Using Trignomatic tables, find to the nearest metre, the height of the tree and the distance to *S* from the foot of the tree.

    (16 marks)

9. (i)   Show that: $\dfrac{1}{(1+\cos\theta)} + \dfrac{1}{(1-\cos\theta)} = 2\,\mathrm{cosec}^2\theta$

    (ii) (a) Write the *sine rule* in the usual notation for any triangle *ABC*.

         (b) In the triangle *PQR*, $P\hat{Q}R = 37°$, $P\hat{R}Q = 62°$ and *QR* = 15 cm. Using Trignomatic tables, find the lengths of *PQ* and *PR* separately.
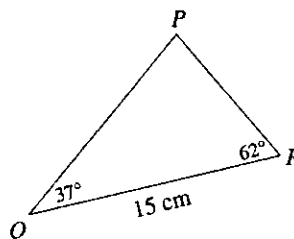
    (16 marks)

* * *

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Written Examinations for Technical Officers (Civil/ Mechanical) in Public Service and
Provincial Public Service – From 2005 to 2009 (1ˢᵗ Exam) - 2010

(02) Taking out Quantities (Lower Paper)

Three hours

Answer **all** questions. The plan TOL/2010/Exam is attached with this question paper. Please read the notes carefully, before answering the question paper.

Notes :

 *   For answering the question no 2,3 and no. 4, candidate may use either standard method of measurements prepared by Buildings Department or standard measurements method approved by SLS. The printed guidelines issued by any of these institutions can be used.

 *   Prepare taking off sheets to answer question no 2,3 and 4 yourself.

 *   Prepare a quarry sheet including all assumptions and attach it to the answer script.

 *   It is not necessary to do multiplications. But deductions and additions to be done.

 *   All waste calculations and back-up sheets must be suitably referred and attached with your answer script.

 *   The candidate's ability will be assessed on the aspect of taking accurate measurements, making suitable assumptions, usage of appropriate abbreviation and neatness.

1. Drawing attached herewith TOL/2010/Exam is a type plan used for government quarters. You were assigned to prepare the B.O.Q. for this work. Prepare the first page of the quantity sheets listing all the work items. (You may assume the technical matters‾ normally use in building construction for this purpose)*(10 marks)*

2. Take out quantities for all the work items below the DPC level.

 Basic relevant information is as follows;

 (i)   The site is a shrub jungle (without large trees) should be cleared. Total land area is 300 m².

 (ii) It is needed to remove 150 mm thick top soil layer and hauled to 0.5 km distance.

 (iii) Prior to laying the foundation screed concrete be 1:2.5:5 (25 mm) mix

 (iv) The foundation be rubble masonary.

 (v)   Foundation main concrete be 1:3:6

 (vi) Suggest a suitable material for DPC and use same in quantity sheet.

 (vii) Floor-tiled floor on concrete base. *(60 marks)*

3. Propose a suitable roof for this building and give a sketch of same. Take out the quantities for roofing material. *(20 marks)*
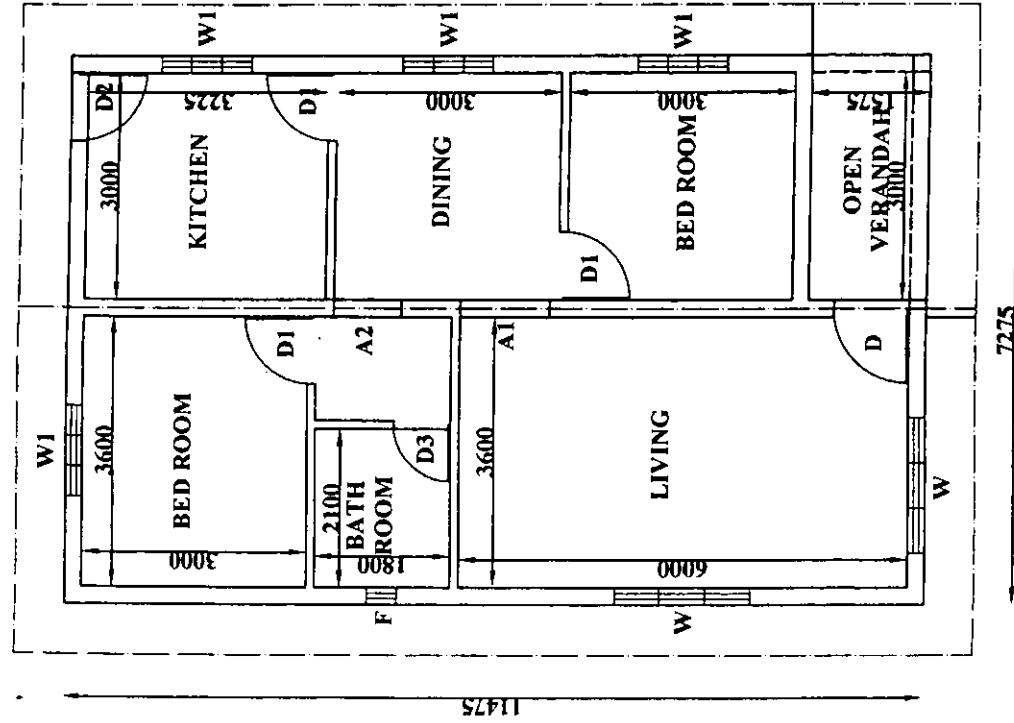
4. Prepare quantity sheets for doors, windows and all the openings.

 Specification

 Doors   : Flush panelled and painted with two coats of enamel paint.

 Windows   : Fully glazed window with 225 mm high louvers above and painted with two coats of weather shield paint. *(10 marks)*
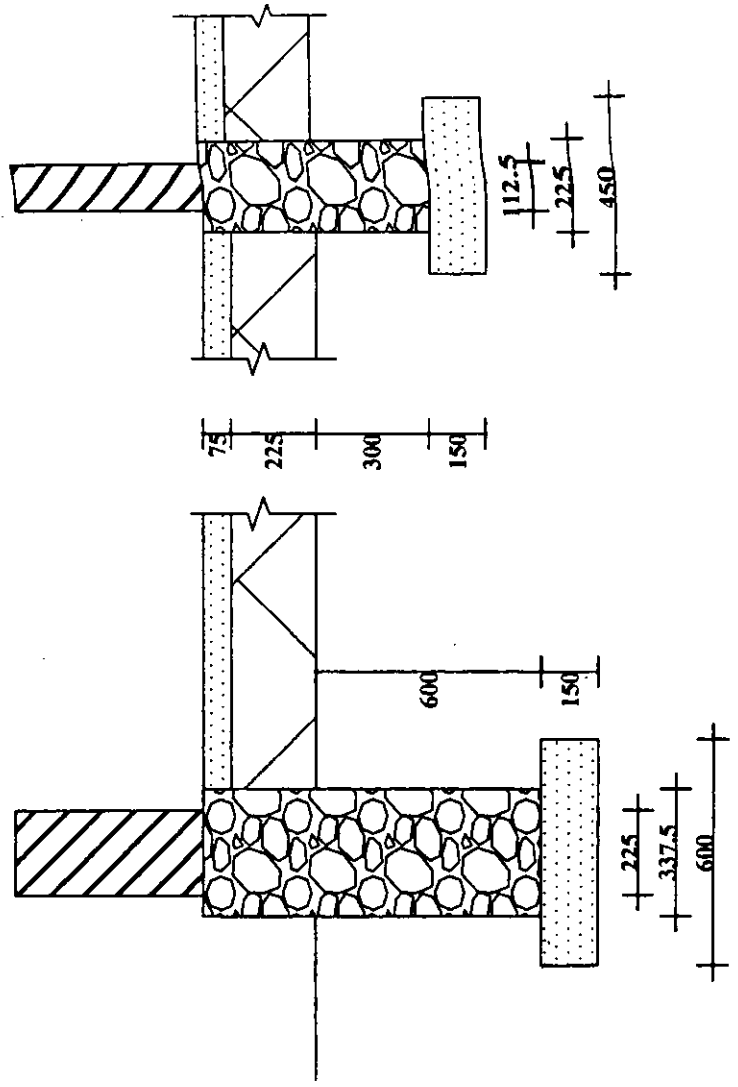
* * *

SCHEDULE OF OPENNINGS

TYPE	SIZE
D	1000 X 2400
D1	900 X 2400
D2	900 X 2100
D3	750 X 2100
W	1800 X 1500
W1	1200 X 1500
A1	1200 X 2100
A2	900 X 2100
F	400 X 600

FOUNDATION DETAILS 1:20

112.5
225
450

75
225
300
150

600
150

225
337.5
600

PLAN 1:100

KITCHEN
DINING
BED ROOM
OPEN VERANDAH
BED ROOM
BATH ROOM
LIVING

W1
D2
D1
D3
A2
A1
D
W
F

3225
3000
3000
3000
3600
3600
2100
1800
6000
7275
11475

TYPE PLAN FOR
GRADE B Government Quarters
Department of Examinations

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Written Examination for Technical Officers (Civil/ Mechanical) in Public Service and Provincial Public Service - From 2005 to 2009 (1ˢᵗ Exam) - (2010)

(03) Surveying and Levelling (Lower Paper)

Three hours

Answer only **five** questions.

1. (i) A chain line 5 metres in length represents 20 millimetres on plan. What is the scale of the plan?
   (ii) What is the length of that line on the plan drawn to 1 : 2000 scale?
   (iii) Construct a plain scale for a plan showing 10 millimetres equal to 3 metres and show on it the length of 25 metres.

2. (i) Explain the principle of chain survey with the aid of a neat diagram.
   (ii) Mention the points that should be borne in mind when selecting stations in chain survey
   (iii) What is well conditioned triangle?

3. (i) How do you level,Dumpy level and Tilting level?
   (ii) What is collimation error of a level?
   (iii) Mention the permanent adjustments of a dumpy level and give the objective of each adjustment.

4. (i) A field book page showing the observations taken with a level is given below. Prepare a level sheet. Apply usual checks. Show the error of the level line.
   (ii) Calculate the gradient of the ground from point 4 to point 5.

Distance metres	Back sight	Inter sight	Fore sight	reduced level	Remarks
0	0.50			51.25	Bench mark P
100		1.25			Point 1
200		2.17			Point 2
300		3.25			Point 3
400		3.15			Point 4
-	0.90		3.10		Change Point
500		1.65			Point 5
600		2.62			Point 6
700		3.45			Point 7
-	1.50		3.05		Change Point
800		1.40			Point 8
			3.18	44.85	Bench Mark Q

5. (i) The following offsets were taken at distances of 25 metres to a wire fence.
   6.0, 10.0, 10.3, 5.3, 5.8, 7.3, and 7.5 metres. Calculate the area included between the chain line, the wire fence, first and last offsets using both *Trapezoidal Rule* and *Simpson's Rule.*
   (ii) How do you use the planimeter to obtain the area of an allotment of land?

6. Explain the following.
   (i) Compensating errors and cumulative errors.
   (ii) Reciprocal levelling and trigonometrical levelling
   (iii) Direct contouring and Indirect contouring.

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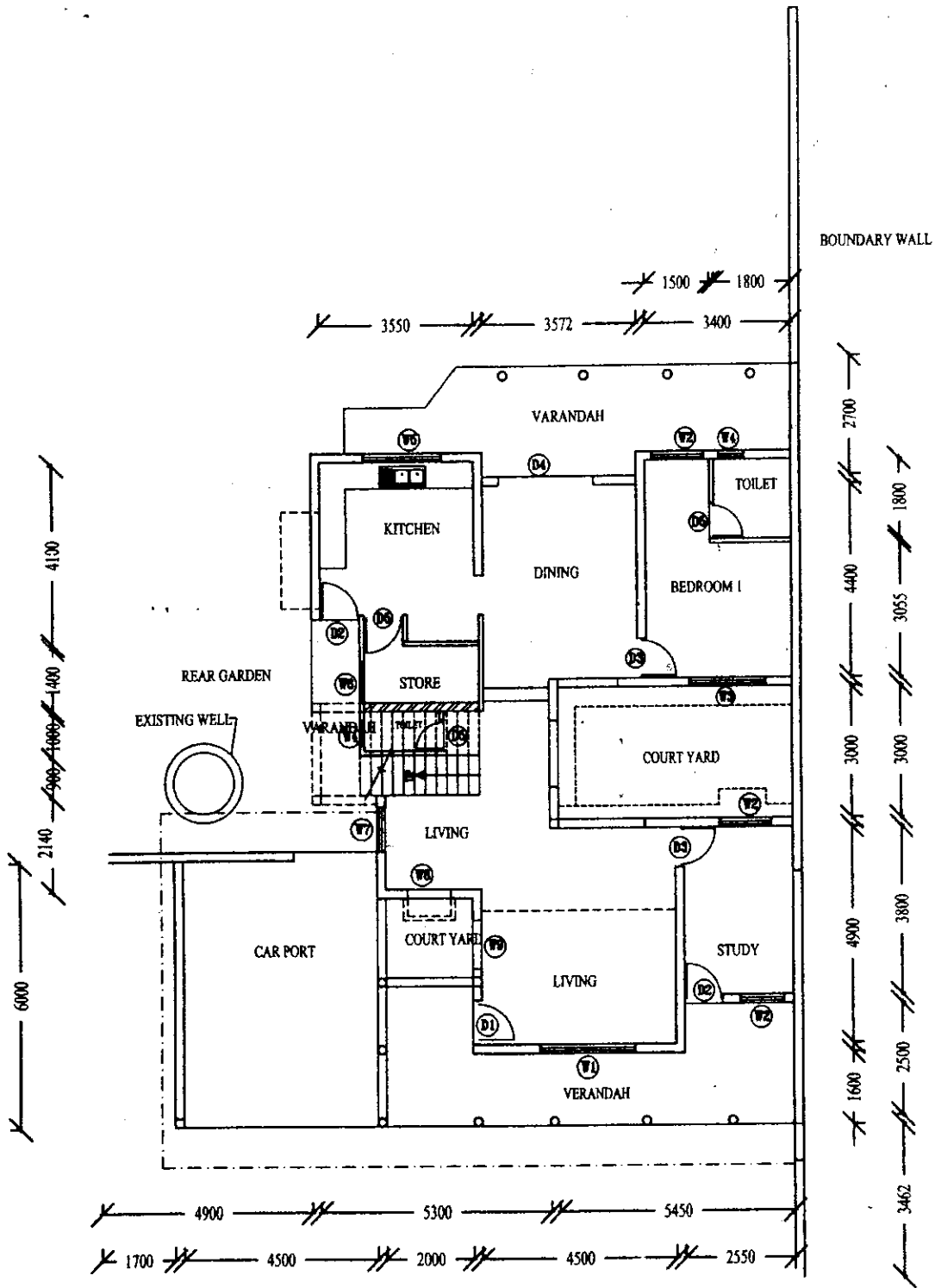ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව / இலங்கைப் பரீட்சைத் திணைக்களம் / Department of Examinations, Sri Lanka

Written Examination for Technical Officers (Civil/ Mechanical) in Public Service and
Provincial Public Service - from 2005 to 2009 (1st Exam) - 2010

(04) Plan Drawing and Tracing
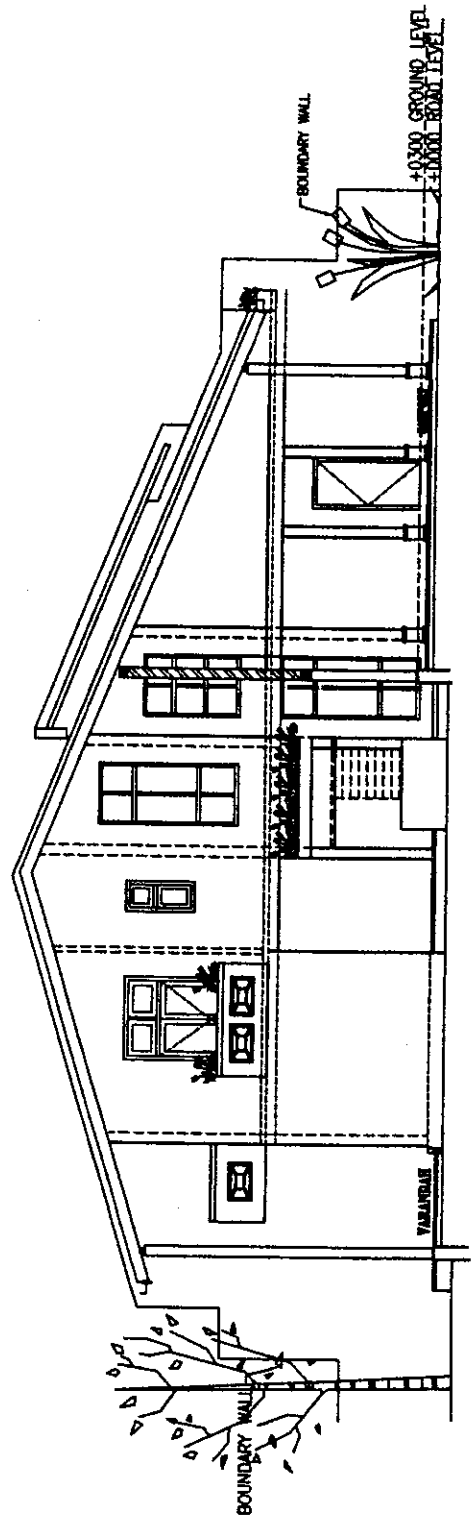
Three hours

Answer **all** questions.

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1. Attached diagrams show scaled ground floor plan and side elevation of a two storey house and a non scaled cross section of a foundation.

   (i) Trace the given plan and side elevation neatly and accurately using pencil.

   (ii) Draw the Cross Section of the foundation on the same tracing paper using 1:20 scale.

   (iii) Draw a 100 mm × 40 mm cage on right-hand bottom on the paper and write **"PROPOSED TWO STOREY HOUSE"** and your **index number** below it in the cage.   *(100 Marks)*
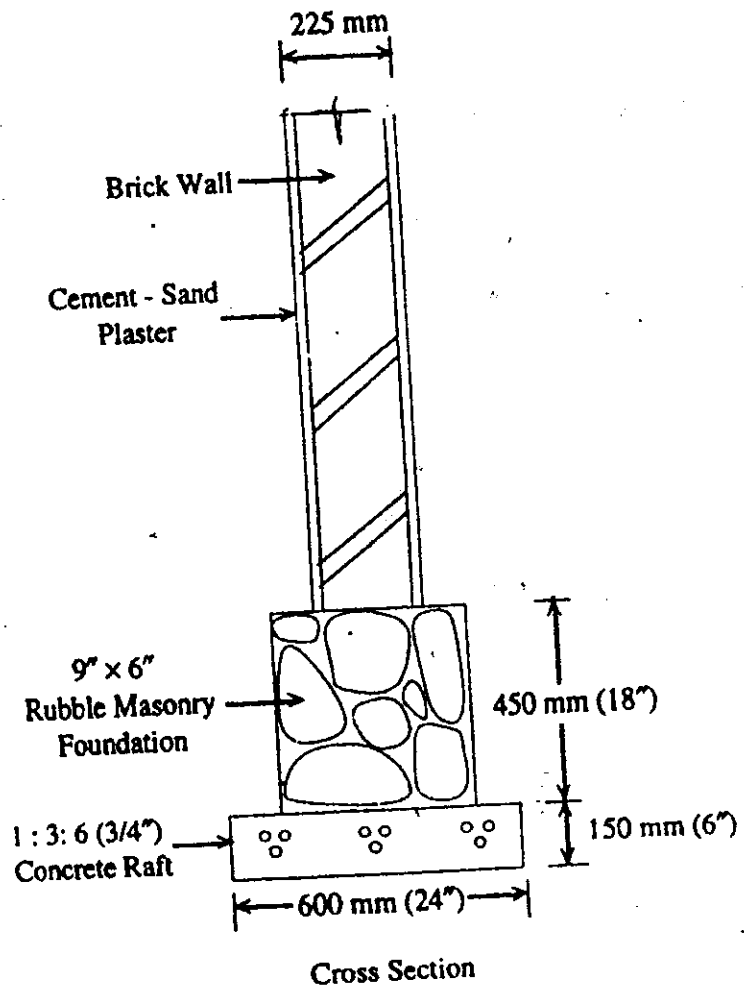
BOUNDARY WALL

VARANDAH

KITCHEN

TOILET

DINING

BEDROOM 1

REAR GARDEN

STORE

EXISTING WELL

VARANDAH

TOILET

COURT YARD

LIVING

CAR PORT

COURT YARD

LIVING

STUDY

VERANDAH

PLAN OF GROUND FLOOR

(fig -01)

SIDE ELEVATION

(Fig - 02)

225 mm

Brick Wall →

Cement - Sand
Plaster →

9" × 6"
Rubble Masonry →
Foundation

450 mm (18")

1 : 3: 6 (3/4") →
Concrete Raft

150 mm (6")

├──── 600 mm (24") ────┤

Cross Section

❋ ❋ ❋

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Written Examination for Technical Officers (Civil/ Mechanical) in Public Service and Provincial Public Service - From 2005 to 2009 (1ˢᵗ Exam) - 2010

(05) Basic Building Construction and Maintenance $\boxed{Three\ hours}$

Answer **five** questions including question 1. The relevant diagrams for questions are given in annexes 1, 2, and 3 attached.

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1. Figure 1 in Annex 01 gives a cross-section of building made of bricks. Answer the following questions with reference to figure 1.

   (i) Name the parts denoted by the parts 01 to 36 in the figure (write the number and name of the relevant part) *(18 marks)*

   (ii) Indicate the minimum and maximum values of $\theta°$. *(02 marks)*

   (iii) Write the foundation here, and name them. *(04 marks)*

   (iv) Briefly describe the function of the foundation. *(04 marks)*

   (v) What are the technological measures used to prevent dampness in the building. *(06 marks)*

   (vi) Mention the ratio of materials used to build item No 01, and state in order the stages of its construction to achieve its maximum strength. *(06 marks)*

2. Figure 2.1 in Annex 01 shows the site plan of building proposed to be constructed on a land with gravel earth. Figure 2.2 shows a cross section of its foundation trench. Bench mark levels of A,B,C and D are 2.5 m, 1.75 m, 1.5 m and 1.25 m respectively. The **dimentions** of the boundaries of the land and the perpendicular heights of the triangles are indicated in the figure. Based on this figure, answer the following questions.

   (i) What is / are the building line / lines *(02 marks)*

   (ii) According to the building regulation can this building be constructed on that land? Explain your answer. *(04 marks)*

   (iii) Draw the sketches 2.1 and 2.2 and answer the following questions.

   (a) The minimum distance or distances from the road to the building line or lines. *(03 marks)*

   (b) The minimum distances to the boundaries of the land from external walls of the building.*(02 marks)*

   (c) From which point out of A,B,C and D are the values of Y_1 and Y_2 of figure 2.2 determined? *(02 marks)*

   (d) If this land is situated in an area which does not get flooded, mention the minimum values of Y_1 and Y_2. *(02 marks)*

3. (i) Taking 750 mm as the depth of the foundation trench in figure 2.2, draw a longitudinal section of the trench to show how it is to be dung, and give the following details.
   * Sight line
   * Sight rails
   * Sight rod and Bearing rod
   * The bottom line of the trench at 'A'
   * The depth of the trench at 'A'
   * The lines of the ground between A and B.

   (10 marks)

(ii) Figure 3 of the Annexe 2 shows some of the symbols used in the Civil Engineering drawings. Mention what these symbols means. Write the relevant letter and the answer against it. *(05 marks)*

4. Figure 4 of Annexe 4 shows the front elevation of a window opening of a 225 mm thick brick wall in a building.

   (i) Name the parts of the opening denoted by *AB*, *BC* and *AD* *(03 marks)*

   (ii) Show all the details and dimentions of the front elevation of a wooden window with two slashes with single glass panels proposed to be used on the *ABCD* opening. *(06 marks)*

   (iii) Draw the vertical section of window drawn under (ii) above according to a suitable scale and indicate the following items in it.

       (a) Reinforced concrete lintel.

       (b) Concrete window sill, its throat and its weathering surface.

       (c) Name the worden window frame and all the part of the frame.

       (d) Name the two window sashes will single glass panels and all their parts. *(06 marks)*

5. At present cement blocks are widely used in construction of buildings.

   (i) There are several types of such cement blocks. One such type in cement hollow blocks. Draw a three dimentional picture of one such block and indicate its dimensions and details. *(02 marks)*

   Answer the following questions based on figure 5.

   (ii) Using cement hollow blocks and showing the thickness of joints draw the following, so as to exceed the size of *x* to be over these blocks indicating all the details.

       (a) The plan of the alternative courses of the right-angled corner. *(04 marks)*

       (b) Front elevation of above (a) at least **five** courses. *(03 marks)*

   (iii) Draw the plans to indicate how blocks are laid on the alternative courses at the right angle corner in figure 5, at a thickness of $1\frac{1}{2}$ bricks. Use a system of boud that ensures the maximum strength for walls. The value of *x* should be more than 4 bricks. *(06 marks)*

6. Answer the following questions based on figure 6 in the Annexe 3.

   The figure gives a rough sketch of a building proposed to be built with bricks with a Tiled roof and a flat ceiling. It is proposed to built with bricks with a tiled roof and a flat ceiling. It is proposed to build a brick column at *"x"*.

   (i) One of the walls shown in the figure indicate the following items.

       (a) Load bearing walls.

       (b) Non-load bearing walls

       (c) Gable walls *(07 marks)*

   (ii) Briefly state the function of the attached pier built at *"x"*. *(04 marks)*

   (iii) Draw a line drawing of the front elevation shown in the section *Y-Y*, of the most suitable roof for this building, and name its parts. *(04 marks)*

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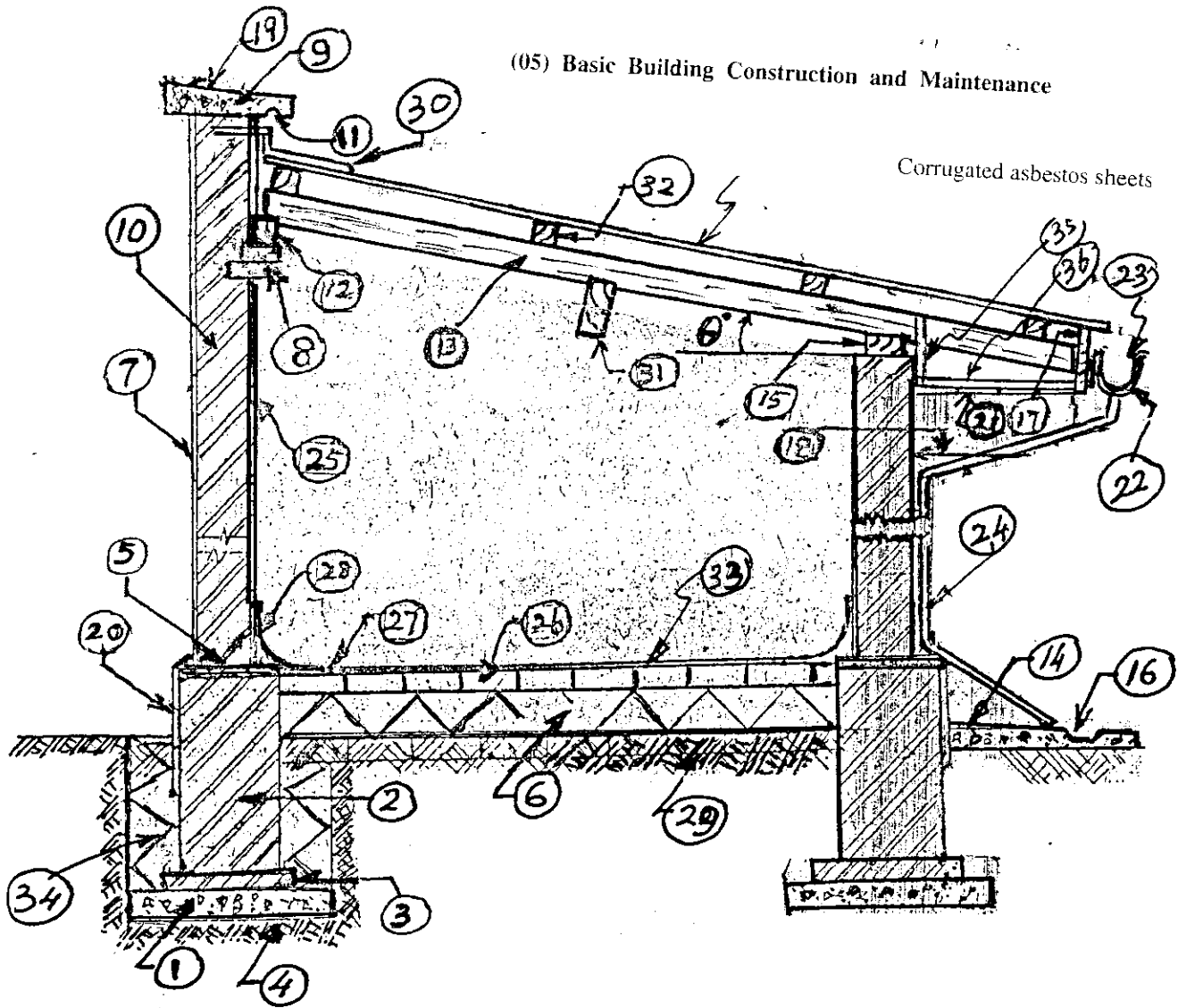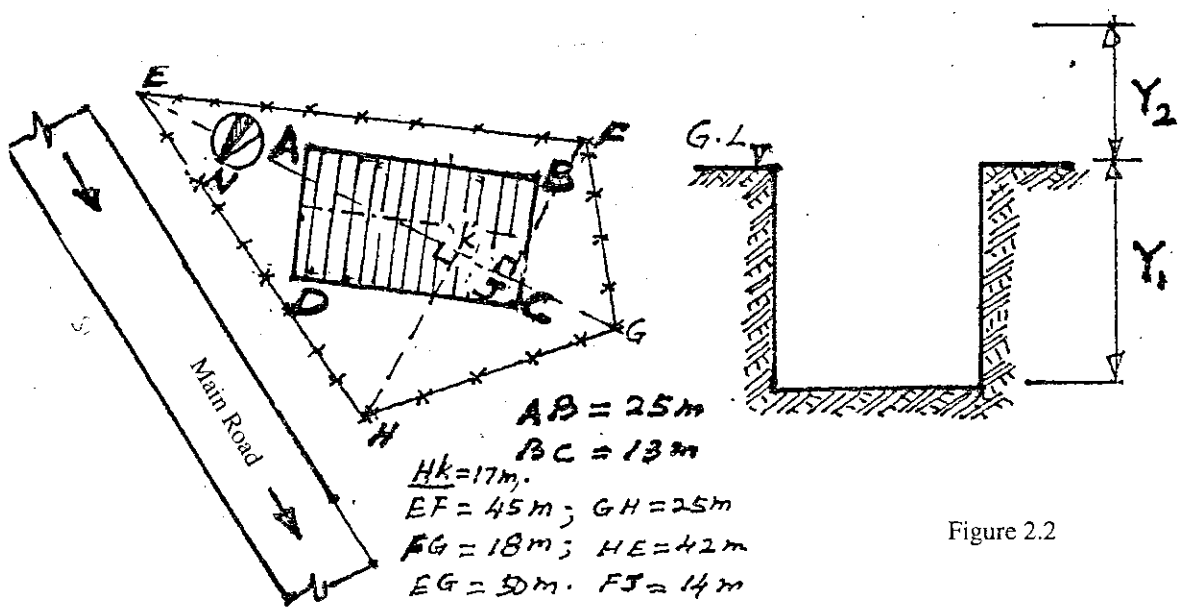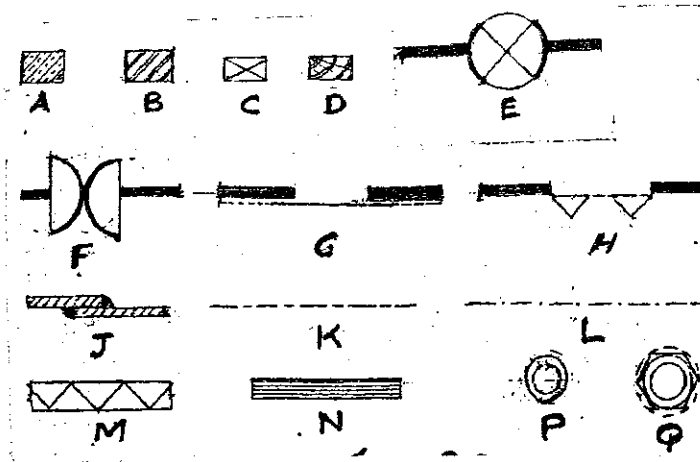## (05) Basic Building Construction and Maintenance

Corrugated asbestos sheets

Figure 1

Figure 2.1

Figure 2.2

$AB = 25m$

$BC = 13m$

$Hk = 17m.$

$EF = 45m; \quad GH = 25m$

$FG = 18m; \quad HE = 42m$

$EG = 50m. \quad FJ = 14m$
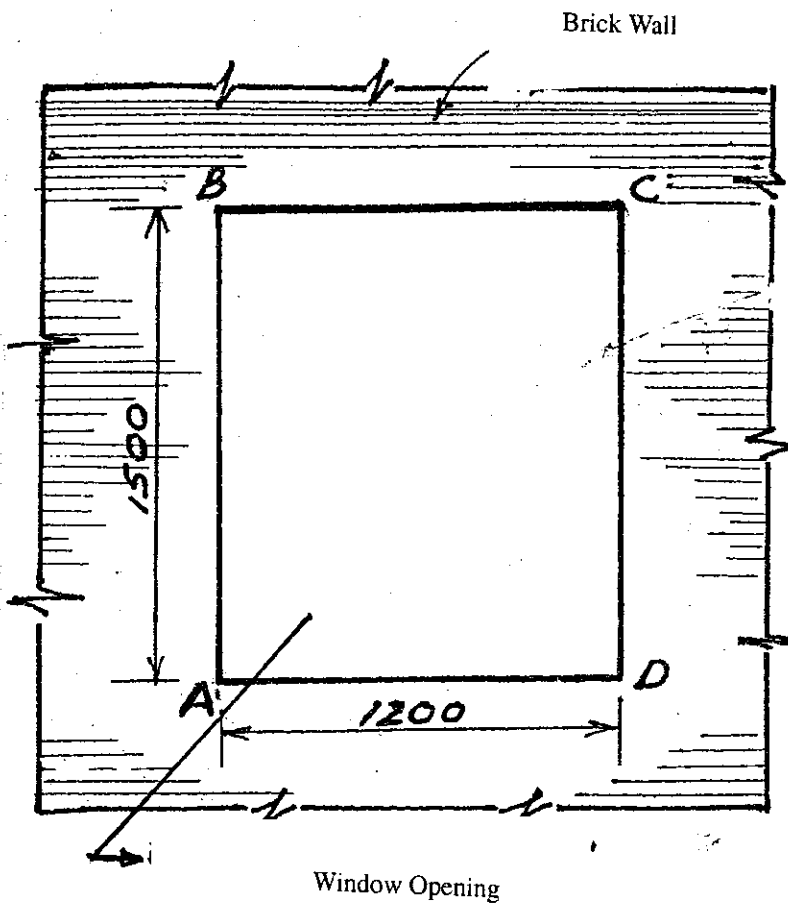
Main Road

G.L

Y_2

Y_1

Figure 2

Figure 3

Brick Wall

Window Opening

FRONT ELEVATION

Figure 4

Figure 5

Plan

Figure 6

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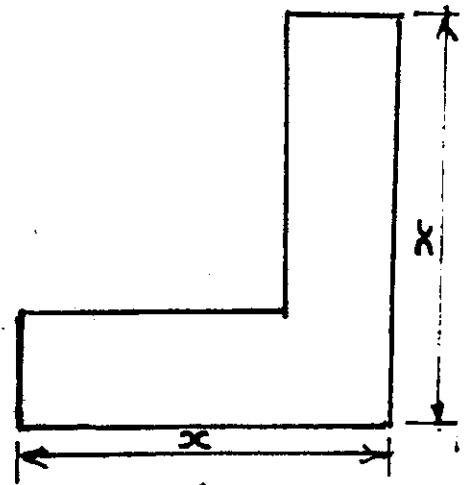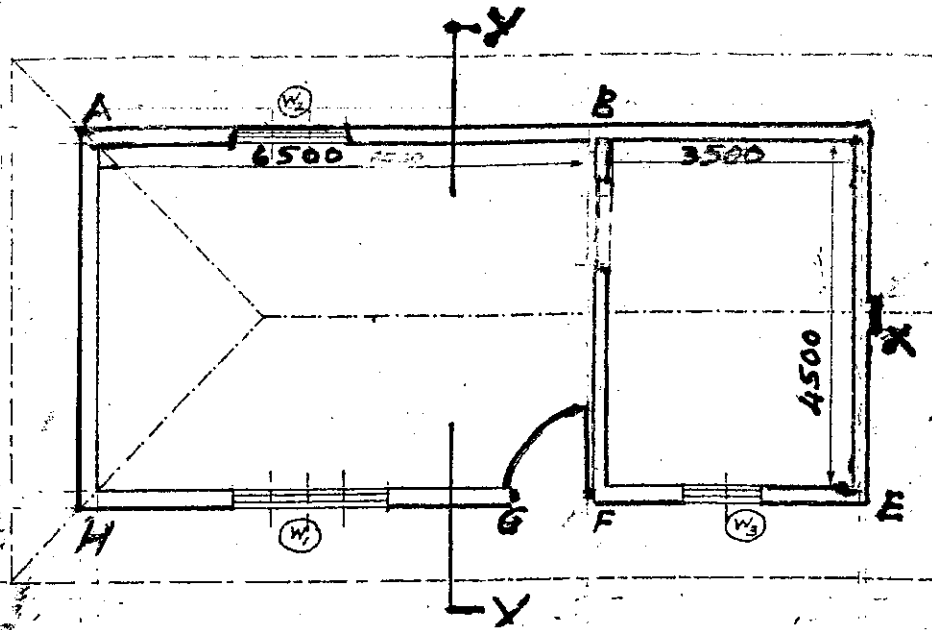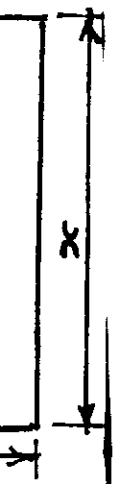
Written Examination for Technical Officers (Civil / Mechanical) in Public Service
and Provincial Public Service - 2009 (2010)

(06) **Water Supply and Drainage** (*Three hours*)

Answer **all** questions.

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1. Define the following terms and state their measurements and units using sketches where necessary.
   (i) Force
   (ii) Pressure
   (iii) Water Head
   (iv) Rate of flow of water

   (20 marks)

2. (i) Explain the Hydrological Cycle with the aid of a sketch. *(10 marks)*
   (ii) State the **three** main sources of water and explain briefly how each source is used to obtain water for water supplies. *(10 marks)*

3. (i) Describe how water sources are polluted due to natural environmental causes and due to human activities.
   (10 marks)
   (ii) Describe briefly the various processes used in water treatment. *(10 marks)*

4. Water flows under gravity through a 100 mm diameter D.I. Pipe from a surface reservoir on top of a hill to a ground sump at the foot of the hill. Estimate the rate of flow of water through the pipe in cubic meters per hour (m^3/hr) using the data given below.

   Top Water Level (TWL) of reservoir on top of hill = 155.75 MSL
   Top Water Level (TWL) of the ground sump = 115.75 MSL
   Diameter of pipe = 100 mm
   Total length of pipe line = 2 000 metres

   Use $H_f = \dfrac{flv^2}{2gd}$ - where

   H_f = Head loss due to friction
   f = 0.01
   l = length of the pipe in metres
   v = Velocity of water in meters per second (m/s)
   g = 9.81
   d = Diameter of pipe in meters

   $Q = AV$ where
   Q = Cubic metre per second
   A = Cross sectional area of pipe (m^2)
   V = Velocity (Metre per second)

   (20 marks)

5. (i) Name **three** types of pipes used for water supply schemes and state their advantages and disadvantages.
   (12 marks)

   (ii) Write short notes on the following valves.
      (a) Air Valves
      (b) Washout Valves

   (08 marks)

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Written Examinations for Technical Officers (Civil/ Mechanical) in Public Service and Provincial Public Service - From 2005 to 2009 (1ˢᵗ Exam) - 2010

(07) Site Management

Three hours

Answer **all** questions.

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1. (i) Describe "Preliminary Works" in a Construction Project. *(10 marks)*

    (ii) Draw a typical organization structure for a small scale building project and briefly explain the role of each person. *(15 marks)*

2. (i) Distinguish a Brick from a Block according to the British Standards. *(04 marks)*

    (ii) Brifly describe the main types of clay bricks used in Sri Lanka. *(09 marks)*

    (iii) Explain the qualities of a good brick. *(12 marks)*

3. (i) Consider a construction of a two story building complex in a urban area. Identify the break of the construction activities of the project into manageable components those can be used as the basis for the planning of the project implementation. *(10 marks)*

    (ii) What are the main types of resources required for the implementation of the above project? Explain with suitable examples. *(06 marks)*

    (iii) Briefly explain the steps of preparing a bar chart. *(09 marks)*

4. Write short notes on the followings:

    (i) Concrete compaction *(05 marks)*

    (ii) Setting time of cement *(05 marks)*

    (iii) Workability of concrete *(05 marks)*

    (iv) Pre-stressed concrete *(05 marks)*

    (v) Timber preservatives *(05 marks)*

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Written Examinations for Technical Officers (Civil/ Mechanical) in Public Service and Provincial Public Service - From 2005 to 2009 (1ˢᵗ Exam) - 2010

**(08) Road Construction and Maintenance (Lower Paper)** | *Three hours*

Answer **five** questions. Support your answer with clear diagram when necessary.

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1. (i) Cement - concrete platform is one, out of the five types of road platforms used in Sri lanka. What are the other platform types? *(04 marks)*

   (ii) What is the purpose of road platform? *(03 marks)*

   (iii) Construction of road is made up of two stages. State them and describe them seperataly. *(13 marks)*

2. (i) Draw the diagrams of a road with earth cutting and filling and a road with double earth cutting constructed in a hilly location, indicating all the details. *(15 marks)*

   (ii) Draw cross section of a road that is being constructed by only filling earth in an area with weak subsoil. *(05 marks)*

3. Cement concrete roads are built abundantly in Sri lanka now a days.

   (i) Draw a cross section of such a road indicating all its details. *(04 marks)*

   (ii) Mention four (4) important factors to be considered when such roads are built? *(04 marks)*

   (iii) State the steps follow in constructing such roads. *(12 marks)*

4. The following diagram indicates how the cutting and filling of earth should be done up to the proposed formation level in constructed a road.
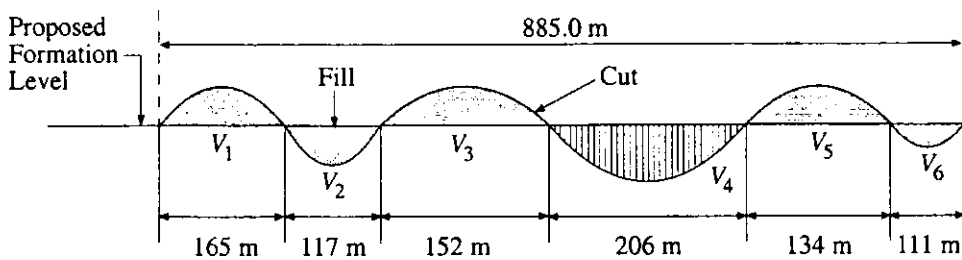
The letter V in this diagram indicates the volumes of cutting and filling earth. Five volumes mentioned V_1, V_2, V_3, V_4, V_5 are as follows.

$V_1 = 10326 \, m^3$, $V_2 = 6831 \, m^3$, $V_3 = 9013 \, m^3$, $V_4 = 14937 \, m^3$, $V_5 = 7618 \, m^3$ and $V_6 = 5747 \, m^3$

Using above diagram and other details.

   (i) Draw Mass Haul Diagram. Mention all the relevant values. *(15 marks)*

   (ii) According to the data indicated in the digram drawn above (i), Calculate the borrow earth quantity. *(05 marks)*

5. (i)   State the materials used for the Water-Bound Macadam used for the base in constructing roads with flexible platforms or flexible pavements, indicating their properties.   *(03 marks)*

    (ii) Describe with the help of diagrams how the Water-Bound Macadam base is constructed. *(06 marks)*

    (iii) Explain what is Bituman.   *(02 marks)*

    (iv) Describe what are bituman cut-backs.   *(03 marks)*

    (v)   What is the purpose of bituman layer applied on the base constructed under (ii) above? *(03 marks)*

    (vi) Briefly describe the test performed to measure the penetration of bituman.   *(03 marks)*

6. (i)   What are the two main functions of the formation of a subgrade with a flexible platform clarify?

                                                                                               (03 marks)

    (ii) What is the damage caused to the road when the subgrade does not function well?   *(02 marks)*

    (iii) State the damages caused to the road by the following items that come across maintaining roads, and describe with help of diagrams how they are repaired.

          (a) Hair Cracks

          (b) Pot holes

          (c) Edge failure

                                                                                               (09 marks)

    (iv) Describe "Turfing" with the help of diagrams.   *(06 marks)*

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