නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
General Certificate of Education (Adv. Level) Examination, 2020

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

**65 E I**

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 Vernier caliper shows a reading of 10.10 mm when measuring a true length of 10 mm, because it has a zero error. What would be the reading, when taking a measurement of true length of 20 mm?
   (1) 19.80 mm (2) 19.90 mm (3) 20.00 mm (4) 20.10 mm (5) 20.20 mm

2. What is the abbreviated name representing the standard which is largely used when selecting lubricating oil for motor vehicles?
   (1) BSI (2) CIDA (3) ISO (4) SAE (5) SLSI

3. Consider the following statements about manufacturing of traditional medicinal products locally.
   A - New technology must be used to produce medicinal products.
   B - Traditional medicinal products have to be presented to the market to match the busy life style.
   C - Research must be carried out to improve medicinal value of products.
   Mostly relevant statement/s out of the above for developing an export market for locally manufactured traditional medicinal products is/are
   (1) A only. (2) B only. (3) C only.
   (4) A and B only. (5) B and C only.

4. If the base diameter of a bottomless hollow cone is equal to its inclined height, what is the correct development drawing for it?
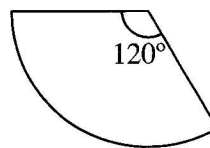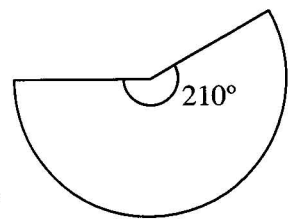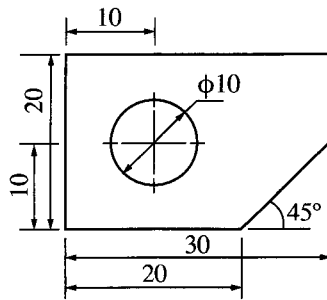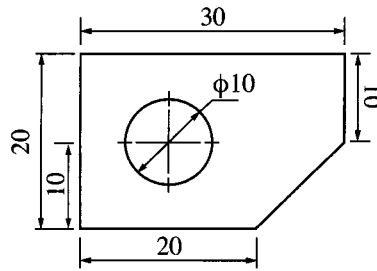

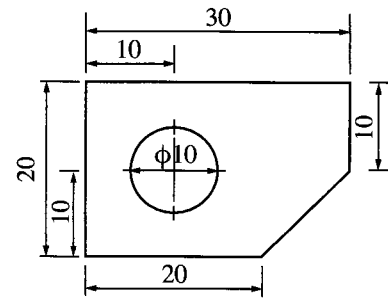(1)　　　(2)　　　(3)　　　(4) 120°　　　(5) 210°
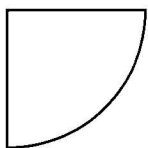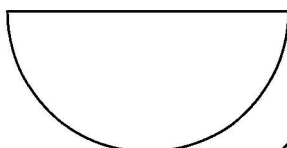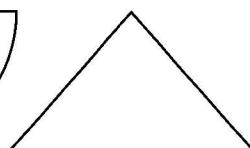
5. Out of the drawings shown below, which drawing has correctly presented the dimensions according to the SLS standards for engineering drawing?
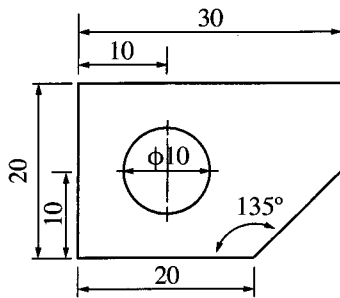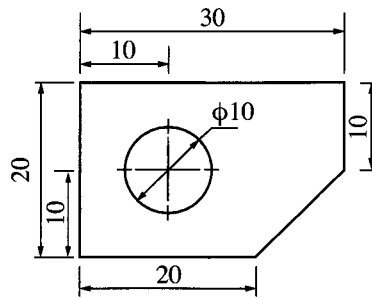

(1)   (2)   (3)

(4)   (5)

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6. What is the most important management skill that an entrepreneur should strive to improve for minimising the risks that a business may face?
   (1) Planning   (2) Organising   (3) Leading
   (4) Communicating   (5) Controlling

7. Consider the following management activities.
   >   A - Accounting
   >   B - Competitive analysis
   >   C - Production planning
   The activity/activities which must be used for preparing a business plan is/are
   (1) A only.   (2) B only.   (3) C only.
   (4) A and B only.   (5) B and C only.

8. Some materials used in fire extinguishing are given below.
   >   A - Water
   >   B - Foam
   >   C - Carbon dioxide (CO_2)
   >   D - Wet chemicals
   Out of the above materials, the materials suitable for putting out a fire caused by liquid fuels are
   (1) A and B.   (2) A and C.   (3) B and C.
   (4) B and D.   (5) C and D.

9. According to the SLS standard, the correct relationship between the length and the other relevant dimensions of an engineering brick is
   (1) length = (2 × width) + mortar joint thickness
   (2) length = (2 × width) + height + mortar joint thickness
   (3) length = (2 × width) + (2 × mortar joint thickness)
   (4) length = width + height + mortar joint thickness
   (5) length = width + (2 × height) + mortar joint thickness

10. A common characteristic of the coarse aggregates which are used as a raw material in the production of concrete is
   (1) having a flat shape.
   (2) being properly graded.
   (3) the water absorption being more than 20% of weight.
   (4) the ability to be broken down into smaller pieces.
   (5) reacting well with cement.

11. According to the building construction regulations, a fact which is **not** relevant to the prevention of accidents to the building users is
   (1) the space between the building and high tension power line.
   (2) the relationship between the window area and the recommended window area in the building.
   (3) the minimum height of a room, which has a slanted roof.
   (4) the vertical height between the beams and the floor level in the building.
   (5) the minimum headroom of a stairway.

12. The property of concrete which makes it very popular in the construction industry, for constructing various shapes is
   (1) hardness.   (2) water tightness.   (3) non-porosity.
   (4) plasticity.   (5) strength.

13. Several statements relevant to concrete technology are given below.
   A - Shear reinforcements of concrete beams must be close to each other at each of the two ends, amounting to an extent of $\frac{1}{3}$ of the beam length.
   B - In extending the length of reinforcement bars, a sufficient additional length should be allowed for joining bars and such additional length is called as lap length.
   C - The test that is done for ensuring the correctness of the ratio between water and cement in a concrete mixture is known as slump test.
   The correct statement/statements of the above statements is/are
   (1) A only.   (2) B only.   (3) C only.
   (4) A and B only.   (5) B and C only.

14. The main purpose of using water traps in sewer-pipe systems is to
   (1) use as a junction for obtaining a suitable slope for the pipe system.
   (2) connect sewer lines to each other conveniently.
   (3) prevent unclean gasses from getting into the building environment.
   (4) prevent blocking of pipe lines.
   (5) retain the debris such as sand that can block the main line.

15. Some steps of purification of river water is given below.
   A - removal of dissolved gases in water.
   B - removal of bacteria in water.
   C - removal of suspended particles in water.
   The most suitable methodologies that are used in above steps A, B and C respectively are
   (1) aeration, disinfection and filtration.
   (2) disinfection, aeration and flocculation followed by sedimentation.
   (3) aeration, disinfection and flocculation followed by sedimentation.
   (4) aeration, flocculation followed by sedimentation and screening.
   (5) flocculation followed by sedimentation, screening and disinfection.

16. Several strategies used at present for waste management are given below.
   A - Placing bins at public places to collect plastic bottles.
   B - Encouraging to bring meals in stainless steel containers.
   C - Separating digestible components from garbage for composting.
   Waste management methods that are planned to implement by the above A, B and C strategies are respectively
   (1) reuse, reduce and recover.
   (2) recover, recycle and reduce.
   (3) recycle, reuse and recover.
   (4) recycle, reuse and reduce.
   (5) reduce, reuse and recycle.

17. Consider the following statements regarding the documents used by a quantity surveyor.
   A - Query sheet is the document for keeping records of delays in the work site.
   B - Abstract sheet is the document for recording the summary of taking off sheet.
   C - The first part of the bill of quantities (BOQ) is the pricing preamble.
   Out of the above statements, the correct statement/s is/are
   (1) A only.   (2) B only.   (3) A and B only.
   (4) A and C only.   (5) B and C only.

18. Consider the following statements regarding the calculation of unit rate used in quantity surveying.
   A - When the discount in purchasing raw material decreases, relevant unit rate increases.
   B - When the wastage during the usage of raw materials increases, unit rate increases.
   C - When the hiring charges for machinery increase, the unit rate increases.
   Out of the above statements the correct statement/s is/are
   (1) A only.   (2) C only.   (3) A and B only.
   (4) B and C only.   (5) A, B and C all.

19. If the distance between points A and B in a map drawn to a scale of 1:10 000 is 10 cm, when the same two points are shown in a map of 1:50 000, the distance between them will be
   (1) 1 cm.   (2) 2 cm.   (3) 3 cm.   (4) 4 cm.   (5) 5 cm.

20. In a levelling process, the levelling staff readings taken from a single instrument station to three points A, B and C are respectively 3.0 m, 1.5 m and 2.5 m. It is required to prepare the land so that the points B and C will be on the same levelling plane represented by point A.
   The actions that have to be taken for this are

	Point B	Point C
(1)	Excavation of 1.5 m	Excavation of 2.5 m.
(2)	Filling of 0.5 m	Filling of 0.5 m.
(3)	Excavation of 0.5 m	Filling of 0.5 m.
(4)	Excavation of 1.5 m	Excavation of 0.5 m.
(5)	Filling of 0.5 m	Excavation of 0.5 m.

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21. The following factors are considered in locating survey stations.
   A - Inter-visibility between any two adjoining stations
   B - Ability to locate triangles in the land as appropriate
   C - Ease of taking offsets to land features
   Among the above factors, the factor/s that should be taken into consideration in selecting a location for a survey station used in a theodolite survey with a traverse is/are
   (1) A only.   (2) A and B only.   (3) A and C only.
   (4) B and C only.   (5) A, B and C only.

22. Consider the following two statements regarding the way triangulation is practically used in chain surveying.

   A - Only well-conditioned triangles should be used.

      B - Only straight line lengths are measured whereas the only geometric shape that could be drawn with only linear measurements is a triangle.

Out of the above two statements

(1) only A is correct.

(2) only B is correct.

(3) both A and B are correct. B clarifies the practical application of A.

(4) both A and B are correct. B does not clarify the practical application of A.

(5) both A and B are incorrect.

23. Which diagram respectively depicts the charging of a capacitor through a resistor to its supply voltage (V_S) and discharging of the charged capacitor through the resistor?
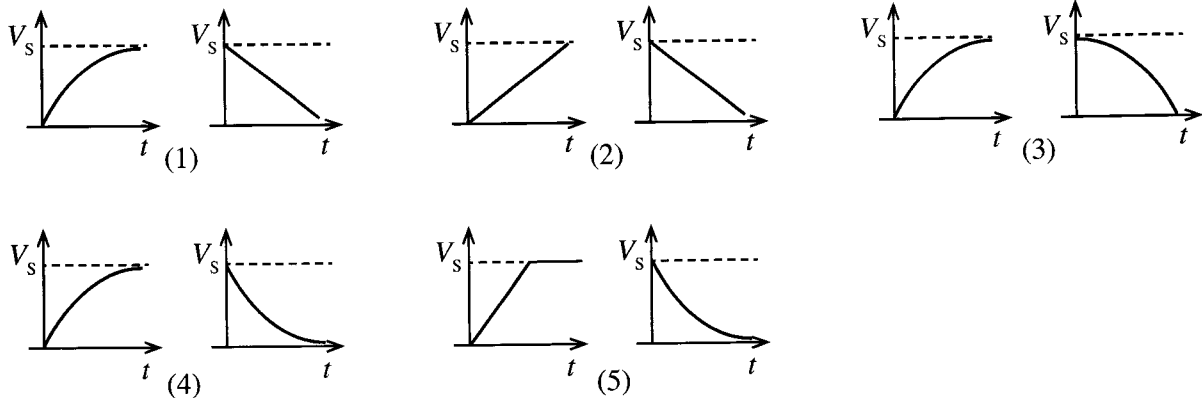
24. A, B, C, D and E denote five resistors with their rated values. The measured potential differences across each resistor and the current in the circuit are indicated in the diagram.
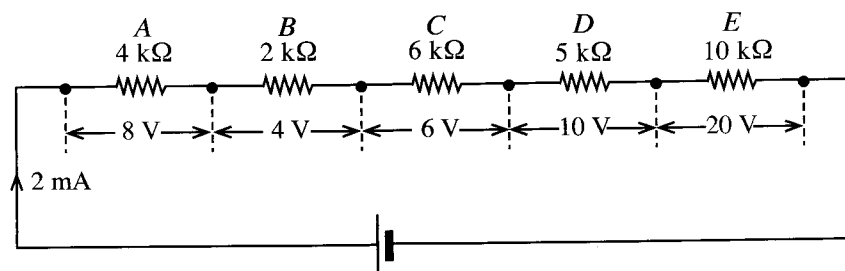
The defective resistor in the above circuit is

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

25. Consider the following statements regarding the use of high voltages in electrical power transmission.

      A - Power transmission efficiency can be increased.
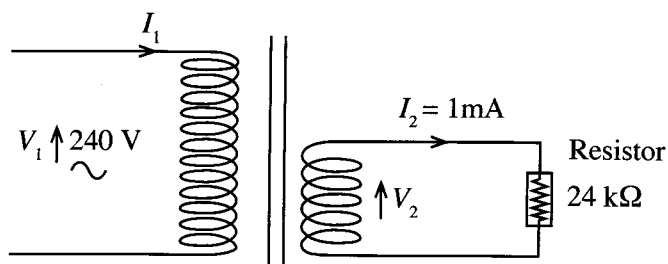
      B - Generation voltage is normally higher than transmission voltage.

      C - Cost for electrical cables can be minimized.

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

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

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

26. Shown in the figure is a loss-free step-down transformer.

Current flowing in the primary winding of this transformer is
(1) 0.001 mA.   (2) 0.01 mA.   (3) 0.1 mA.   (4) 10 mA.   (5) 100 mA.

27. Consider the following statements related to three-phase induction motors.
   A - To reduce starting current, Star-Delta starters are used.
   B - Direction of rotation can be changed by interchanging any two phases of the electric supply.
   C - Starting torque should be provided by capacitors.
   Out of the above statements, the correct statement/s is/are
   (1) A only.   (2) B only.   (3) C only.
   (4) A and B only.   (5) B and C only.

28. Consider the following statements related to direct current series wound motors.
   A - Starting torque is high relative to the other direct current motors.
   B - While the motor is running, load should not be decoupled.
   C - Can also be operated with an alternating current power supply.
   Out of the above statements, the correct statement/s is/are
   (1) A only.   (2) B only.   (3) C only.
   (4) A and B only.   (5) A, B and C all.

29. Consider the following observations regarding the circuit X shown in the figure.
   ● When connected to a direct current power supply, a current of 100 mA flows continuously.
   ● Having connected to an alternating current power supply, when the voltage is increased while maintaining the frequency constant, the current flowing increases.
   ● Having connected to an alternating current power supply, when the frequency is increased while maintaining the voltage constant, the current flowing decreases.
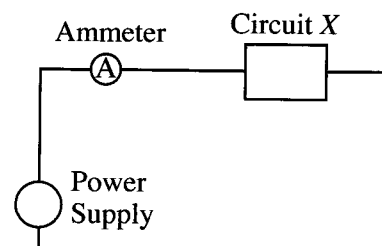
   According to the above observations, the circuit X could be
   (1) only a resistor.
   (2) only a capacitor.
   (3) a capacitor connected in series with a resistor.
   (4) an inductor connected in series with a resistor.
   (5) a resistor, an inductor and a capacitor connected in series.

30. Consider the following statements regarding intrinsic semiconductors.
   A - At the room temperature the number of free electrons and the number of holes are equal.
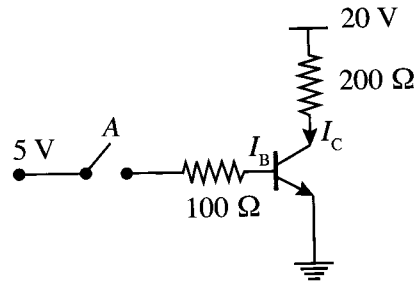   B - Only the free electrons contribute to the current.
   C - N-type semiconductors are formed by doping with third group elements.
   Out of the above statements, correct statement/s is/are
   (1) A only.   (2) B only.   (3) C only.
   (4) A and B only.   (5) A and C only.

31. The circuit shows a transistor used as a switch.

(At the saturation $V_{BE} = 0.7$ V and $V_{CE} = 0$)

When switch A is closed, base current (I_B) and collector current (I_C) of the transistor respectively are

(1) 0.043 A and 0.1 A.   (2) 0.05 A and 0.05 A.
(3) 0.05 A and 0.1 A.   (4) 0.193 A and 0.1 A.
(5) 0.2 A and 0.1 A.

32. The circuit shows a Junction Field Effect Transistor (JFET) used as an amplifier. If the drain current (I_D) is 2 mA, V_{GS} and V_{DS} respectively are

(1) –2.2 V and 0 V.   (2) –2.2 V and 6.2 V.
(3) 0 V and 6.2 V.   (4) 0 V and 15 V.
(5) 2.2 V and 6.2 V.
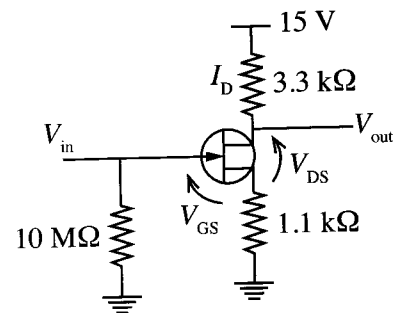
33. Consider direct current circuit shown in the figure.
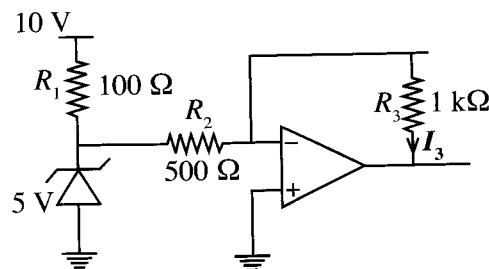
I_3 current in the above circuit is

(1) 0.001 A.   (2) 0.005 A.   (3) 0.01 A.   (4) 0.05 A.   (5) 0.1 A.

34. Consider the following proposed logic circuits for controlling a bulb (Z) in a long corridor using three switches (P, Q and R) in different places.
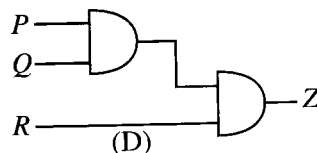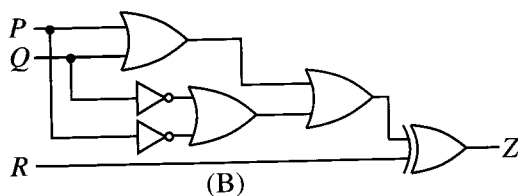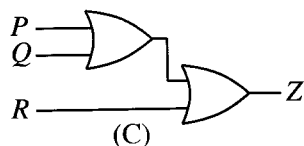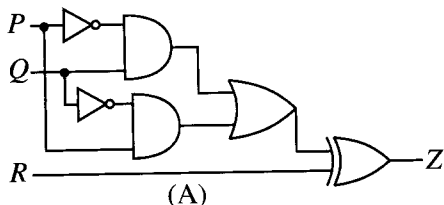
Which circuit/circuits can be used for the above requirement?

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

35. Consider the following statements about analogue and digital signals.

    A - In a given situation, digital signals can have only one value from two constant values while analogue signals can have any value in a certain range.

    B - The effect of noise on digital signals is relatively less than that of analogue signals.

    C - Digital signals can be stored relatively easier than analogue signals.

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

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

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

36. Consider the following statements about modulation.

    A - The frequency of the carrier is greater than the frequency of the signal.

    B - In frequency modulation, frequency of the carrier is varied according to the amplitude of the signal.

    C - In amplitude modulation, amplitude of the carrier is varied according to the frequency of the signal.

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

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

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

37. Some properties of lubricant oils used in automotive engines are given below.

    A - Viscosity

    B - Heat conductivity

    C - Surface wettability

    D - Flash point

Out of the above, the most influential properties for lubrication are

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

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

38. Which of the following gases will be converted into other gases by a two-way catalytic converter?

(1) Unburnt hydrocarbons, nitrogen oxides and carbon monoxide

(2) Unburnt hydrocarbons and nitrogen oxides

(3) Unburnt hydrocarbons and carbon monoxide

(4) Nitrogen oxides and carbon monoxide

(5) Unburnt hydrocarbons

39. In a motor car, it was observed that the inner edge of only the right front wheel has worn out abnormally. The cause for this could be, faulty

(1) Toe in.   (2) Toe out.   (3) Caster angle.

(4) Camber angle.   (5) Turning angle.

40. Consider the following statements regarding a Diesel engine.

    A - Emits black smoke in sudden acceleration.

    B - Emits white smoke in cold start.

    C - Emits blue smoke in driving.

Out of these, the observation/s that can be seen due to worn out piston rings is/are

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

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

41. What is the **incorrect** statement regarding centrifugal pumps?

(1) When the static head increases the liquid flow rate reduces.

(2) The outlet pressure of the liquid increases as a result of the gradually enlarging shape of the housing.

(3) The impeller increases the pressure of the liquid.

(4) Normally a centrifugal pump should be filled with the liquid before first use.

(5) The suction head of the pump should not exceed the atmospheric pressure head.

42. Depicted by the hydraulic symbol shown in the figure is

    (1) a manually operated 3 port 2 position (3/2) directional control valve.

    (2) a manually operated 2 port 3 position (2/3) directional control valve.

    (3) a solenoid operated 2 port 3 position (2/3) directional control valve.

    (4) a solenoid operated 3 port 2 position (3/2) directional control valve.

    (5) a solenoid operated 3 port 3 position (3/3) directional control valve.
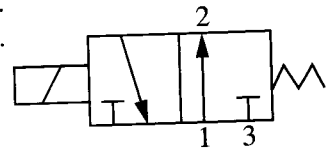
43. The following figure shows a horizontal venturi tube used in fluid machinery.
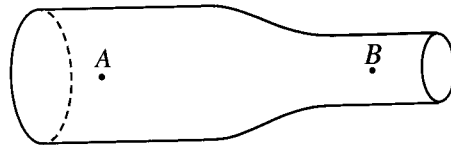
When a non-viscous, incompressible fluid with a density of $1000 \, \text{kg/m}^3$ is flowing steadily from A to B, the pressure at A is $2 \times 10^5 \, \text{Pa}$ and the average speed across A is 10 m/s. If the cross sectional area of A is twice the cross sectional area of B, pressure at B in Pa is

    (1) 0.   (2) 0.5×10^5.   (3) 1×10^5.   (4) 1.5×10^5.   (5) 2×10^5.

44. The special power transmission component included in the free wheel, fixed to the rear wheel of bicycles is the

    (1) bearing.   (2) coupling.   (3) clutch.   (4) ratchet.   (5) flywheel.

45. Consider the following machines.

    A - Piston engine

    B - Electric Drilling machine

    C - Grinding machine

    D - Mechanical Forging machine

    E - Shaping machine

Out of the above machines, the machines with motion conversion mechanisms are

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

    (4) B, D and E.   (5) C, D and E.

46. In the frictionless chain drive shown in the figure, the diameter of driving wheel A is 100 mm and the diameter of driven wheel B is 400 mm. C is a tension wheel.
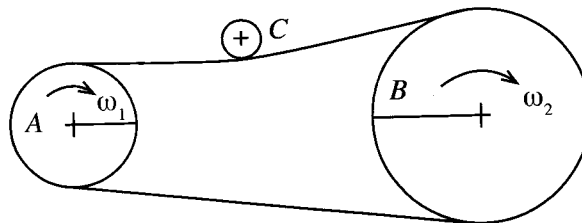
If the torque applied to wheel A is 200 N m, how much is the torque applied to wheel B?

   (1) 50 N m   (2) 100 N m   (3) 200 N m   (4) 400 N m   (5) 800 N m

47. What property of copper is used in the production process of wire drawing?

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

48. Consider the following statements on standards and specifications.

    A - Specifications are enforced processes relevant to a large number of certain institutions.

    B - Parameters such as geometric, mechanical, electrical and chemical of a product produced by a manufacturer are known as specifications.

    C - Standards are parameters which can always be fulfilled but specifications are not like that.

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

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

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

49. The machine part shown in the figure is required to be manufactured from a 63 mm diameter metal rod.

8 holes, M6 thread
Ø6
Ø60
Ø30
65
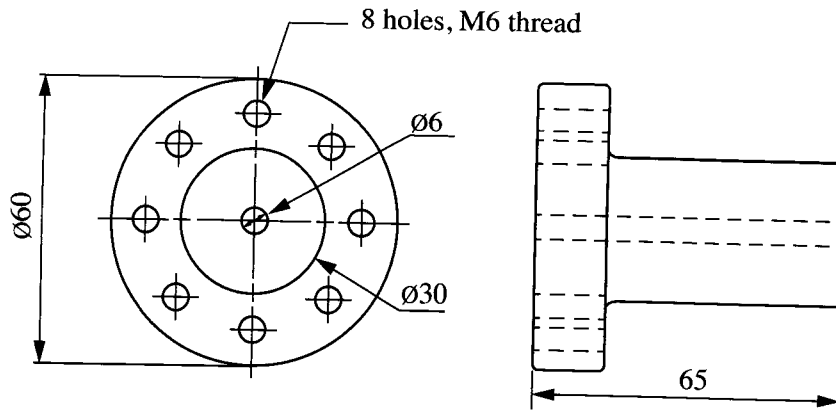
The machines which are required to manufacture the above part are
(1) milling machine and boring machine.
(2) lathe machine and milling machine.
(3) milling machine and drilling machine.
(4) lathe machine and boring machine.
(5) lathe machine and drilling machine.

50. Consider the following manufacturing methods.
      A - Welding
      B - Riveting
      C - Glueing

Out of the above methods, the suitable manufacturing method/s for permanent assembly of metal parts is/are
(1) A only.
(2) B only.
(3) C only.
(4) A and B only.
(5) A and C only.

� ✳ ✳ ✳

නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
General Certificate of Education (Adv. Level) Examination, 2020

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

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

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

Index No. : ....

Important :	**For Examiners' Use Only**		

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	

PART A — Structured Essay

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

1. The front view, side view and plan of a steel machine part drawn using first-angle projection are shown in the figure. This machine part is symmetric about the shown centre line. The drawings given are not to scale. Using free hand, draw the isometric view of the machine part in the dot sheet provided taking the corner shown by *X* as the origin, looking in the direction shown by the arrow *Y*. Mark all the given dimensions 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 and to use isometric scale. When drawing, consider the distance between two adjacent dots on the dot sheet as 10 mm.
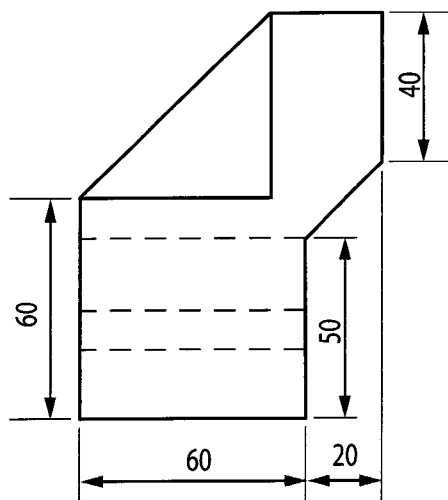
SIDE VIEW
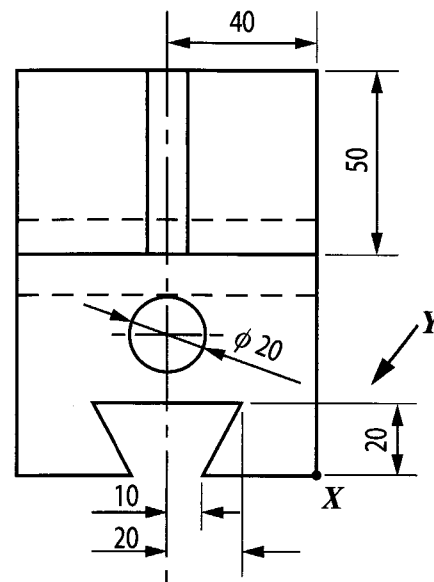
FRONT VIEW

PLAN

(75 marks)

0202

X
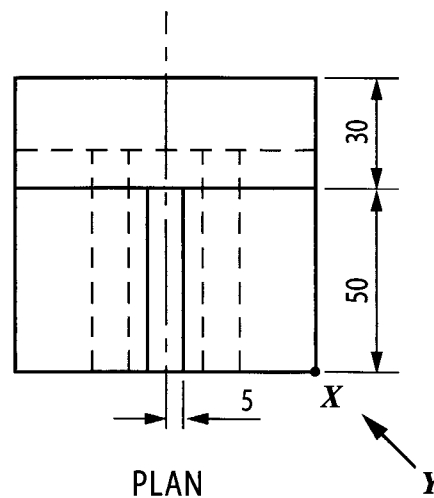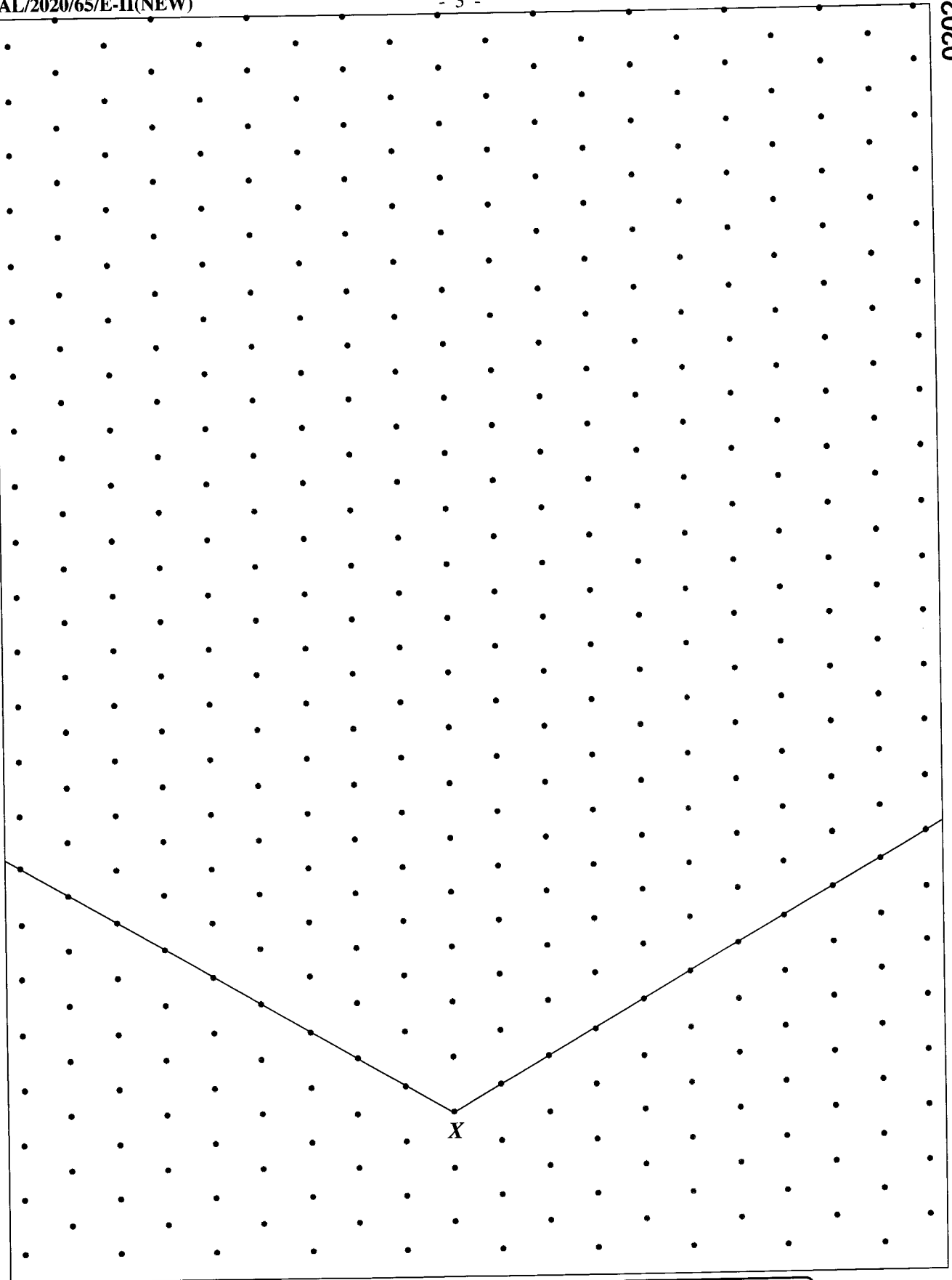
For use of the examiners	Marks
Drawing straight lines (54 Marks)	
Drawing curves and centre lines (04 Marks)	
Marking of straight line dimensions according to the standard (13 Marks)	
Marking dimensions of curves according to the standard (04 Marks)	

Q. 1

75

2. It has been proposed to construct a dam across a water stream at place *A* and construct a hydro-power plant at *B* as shown in the figure. By this project, it is expected to generate hydro electricity to feed the national electricity grid system and supply water for the agricultural needs of the area through the canal shown by *C*.
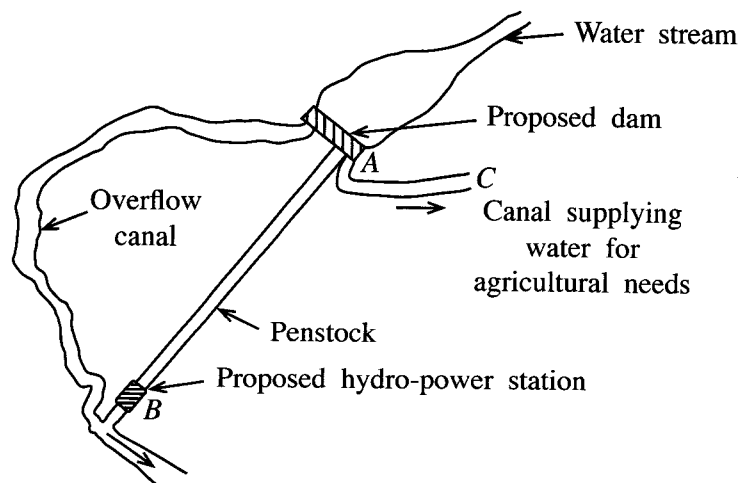
(*a*) (i) For planning the project comprehensively and in full detail, it is required to prepare a plan of the site. What is the type of surveying that should be used for this?

....
(05 *marks*)

(ii) If the scale used for drawing the survey plan is 100 m to 1 cm, indicate this scale as a ratio.

....
(05 *marks*)

(iii) A measuring tape cannot be used to measure the slope distance between the dam and the power station, for calculating the length of the penstock. Name a survey instrument that can be used for this.

....
(05 *marks*)

(*b*) (i) It has been proposed to test the concrete mixtures used for constructing the above dam on site to decide the suitability for use.

(1) What is this test?

....
(05 *marks*)

(2) Which property of concrete is measured here?

....
(05 *marks*)

(ii) What are the machinery used for the following activities in constructing the dam, which is a large scale civil engineering project?

Activity	Machinery
Transporting concrete	....
Pouring concrete mixture to the correct place	....

(10 *marks*)

(iii) The figure shows a cross-section of the above dam *A*. Draw on the *X–Y* plane, the variation of the load, imposed by water on the dam, with the depth.

Depth *Y*
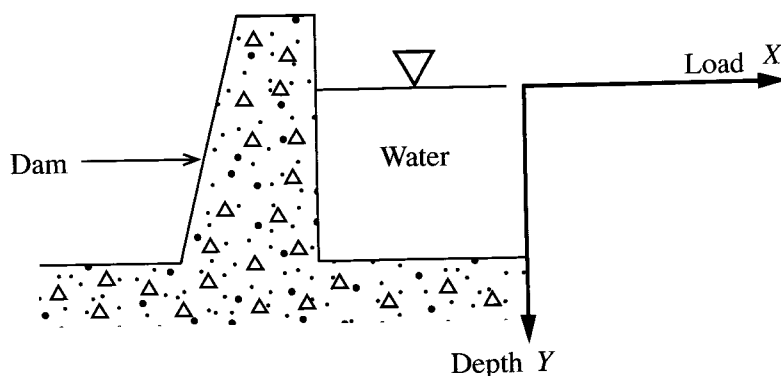
(05 *marks*)

(*c*) The water supplied by the canal *C* is proposed to be supplied as drinking water to a community area. However, this water cannot be supplied directly as drinking water and it is required to subject to a purification process.

(i) Write a property that may **not** be present in water flowing in the canal but relevant for the quality of drinking water.

....

(05 *marks*)

(ii) Name a purification method to obtain the property mentioned in (*c*)(i).

....

(05 *marks*)

(*d*) (i) The water head of the proposed hydro-electric power station is 70 m. What is the type of turbine that is most suitable for the power station?

....

(05 *marks*)

(ii) The voltage generated by the power station is 6.6 kV. In order to connect this to the national electric power transmission system, what is the type of transformer that should be used?

....

(05 *marks*)

(*e*) (i) If the flow rate of water through the penstock of the power station is 0.5 m^3 s^{-1}, water head 70 m and the efficiency of the turbine 85%, how much would be the electricity generating capacity in kW?
(Consider the density of water as 1000 kg m^{-3} and acceleration due to gravity as 10 m s^{-2}.)

....

....

....

(10 *marks*)

Q.2

(ii) The power station runs 10 hours per day for 300 days in a year. How much is the amount of electrical energy generated by the power station in a year in kWh?

....

(05 *marks*)

75

3. It is required to transport raw materials from the ground floor to the second floor of a factory as shown in figure **(1)** below. The finished materials processed on the second floor are again brought down to the ground floor. An elevator that can be used for this purpose has to travel up and down many times during a day to perform such activity. The figure **(2)** shows the schematic arrangement of the mechanism used in the proposed elevator system. A drive system which is operated by an electric motor is proposed to be connected to pulley *Y*.
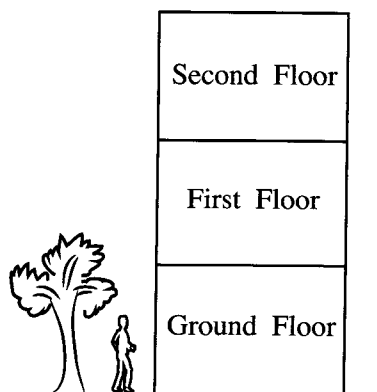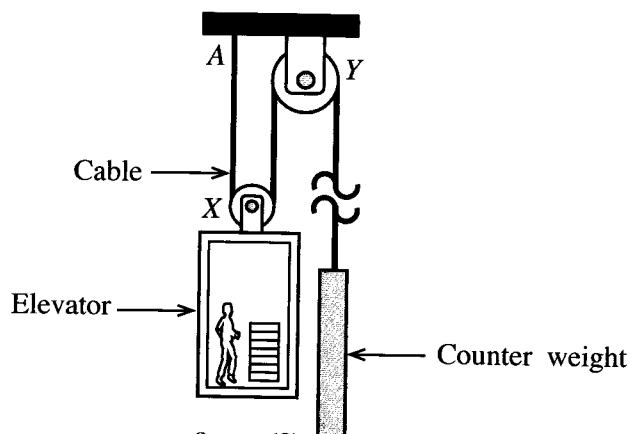
figure **(1)**   figure **(2)**

(Consider the acceleration due to gravity as 10 m s^{-2} for the calculations.)

(*a*) (i) State a benefit of using a counter weight in this elevator.

....

(05 *marks*)

(ii) The cable has been made with a number of wire strands with small cross-sectional area. State **two** reasons for this.

(1) ....

(2) ....

(10 *marks*)

(iii) The mass of the counter weight is 100 kg and the mass of the elevator is 200 kg. When the elevator is moving at a constant velocity while carrying the maximum mass of 500 kg that can be carried, how much will be the tensile force in Newton (N) in cable section *A*? Neglect the mass of the cable and bearing frictional forces.

....

....

(15 *marks*)

(iv) Under the situation referred to in (*a*)(iii) above, when the elevator is moving up at its maximum velocity of 0.4 m s^{-1}, calculate the power delivered by the motor in kW.

....

....

(15 *marks*)

(v) The power of the required motor has been estimated to be 50% more than the calculated power in (*a*)(iv) above. State a reason for this.

....

(05 *marks*)

(b) Three light emitting diodes (D_0, D_1 and D_2) (LED) are used to indicate the floor that is being passed by the elevator. Floors are identified using a sensor system which gives three signals S_0, S_1 and S_2.

When the elevator is in ground floor ($S_0 = 1$, $S_1 = 0$, $S_2 = 0$), only D_0 LED is ON, when in first floor ($S_0 = 0$, $S_1 = 1$, $S_2 = 0$) D_0 and D_1 are ON and when in the second floor all ($S_0 = 0$, $S_1 = 0$, $S_2 = 1$) D_0, D_1 and D_2 are ON and under any other conditions, all the LEDs should be OFF.

(i) Construct the truth table in relation to the above LED operation.

S_0	S_1	S_2	D_0	D_1	D_2

(15 *marks*)

(ii) Derive the Boolean expression in relation to D_0 LED operation.

....
(05 *marks*)

(iii) Design the logic circuit in relation to D_0 LED operation.

Q.3

75

(05 *marks*)

4. Rani who was working as an experienced quality controller in a garment factory, was hoping to have her own manufacturing business someday. Having procured machinery required she started a business for manufacturing and selling face masks used for health and safety according to an international standard and resigned from her usual job. By this time she had only a very small amount of money as her personal savings. Later on several friends also joined to work in her business.
Answer the following questions based on the above case.

(a) (i) State **two** factors leading to identify Rani as an entrepreneur according to the definitions of entrepreneurship.

(1) ....

(2) ....
(05 × 2 = 10 *marks*)

(ii) State **two** aspects that should be considered in performing a competitive analysis for the face masks market.

(1) ....

(2) ....
(05 × 2 = 10 *marks*)

(iii) Name **two** types of institutions which provide financial facilities for small scale entrepreneurs like Rani for starting up businesses.

(1) ....

(2) ....

(05 × 2 = 10 *marks*)

(iv) State a business risk which is likely to be faced by Rani and propose an action that can be taken to control the risk.

Risk   : ....

Action : ....

(05 × 2 = 10 *marks*)

(v) If face masks are manufactured in large quantities mention an organised selling method that can be employed.

....

(05 *marks*)

(b) (i) State a reason for the high demand for face masks that are manufactured according to a standard.

....

(05 *marks*)

(ii) State a method that can be used for checking, in a single setting, whether several dimensions of manufactured face masks are within specified tolerance limits.

....

(05 *marks*)

(iii) Mention a hazard and a risk to the health of the workers, caused by dust producing materials used in apparel factories and state one technological method that can be used to control the hazard when designing factories.

Hazard : ....

Risk   : ....

Action : ....

(05 × 3 = 15 *marks*)

(iv) Write down an aim of the government in initiating apparel factories in Sri Lanka.

....

(05 *marks*)

Q.4

75

* *

නව නිර්දේශය/புதிய பாடத்திட்டம்/*New Syllabus*

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
General Certificate of Education (Adv. Level) Examination, 2020

ඉංජිනේරු තාක්ෂණවේදය	**II**			
பொறியியற் தொழினுட்பவியல்	**II**	**65**	**E**	**II**
Engineering Technology	**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. It is proposed to construct a 40 storied high-rise apartment building in an urban area adjacent to a main road. It is expected to use light-weight construction material as much as possible.

   (a) (i) Name **two** light-weight materials that can be used for the doors and windows in this building instead of wood.   (10 *marks*)

   (ii) Explain how the cost of the structure can be reduced by using light weight materials of this building, stating technological reasons.   (10 *marks*)

   (iii) Name the most important environmental load to be considered in designing the structure of this type of high-rise buildings and explain how that load affects the building structure.   (10 *marks*)

   (b) (i) Draw a figure of a wooden door frame and name the main parts of it.   (10 *marks*)

   (ii) Name the timber joint used in a door frame and draw a three dimensional figure showing its parts clearly.   (10 *marks*)

   (iii) Describe the process of maintaining geometrical accuracy in making the timber joint mentioned in (b)(ii) above, stating the specific tools used for applying the measurements and marking out.   (10 *marks*)

   (c) Approval has been obtained from the Urban Development Authority for constructing this building.
   (i) Explain the reason for constructing this building without obstructing the 'standard light plane'.   (05 *marks*)

   (ii) This building is situated on the same level plane as the main road, and waste water of it has to be connected to the public sewer system using manholes. State **two** instances where manholes should be used related to the disposal system of the building.(10 *marks*)

   (d) Domestic waste of this building is proposed to be managed by collection after separation.
   (i) Explain the importance of not mixing solid and water-borne waste types together, generated in this building using **three** scientific reasons.   (15 *marks*)

   (ii) Explain separately one damage to the environment and one community health problem caused by releasing untreated wastes to the environment.   (10 *marks*)

6. Plan of a simple building is shown in the figure below. (Figure is not to scale)
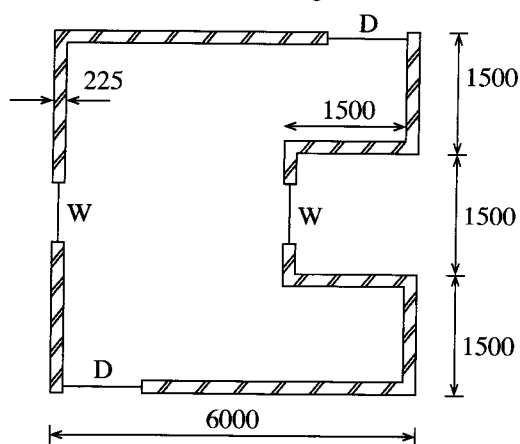
Dimension	Value (mm)
Height of brick walls	3000
D-Door	1000 × 2200
Diameter of circular window-W	800

(a) Answer the following questions according to SLS 573. Prepare measurement sheets, abstract sheets and bill-of-quantity (BOQ) formats when necessary.

(i) Calculate the centreline distance for the 225 mm thick brick walls.   (05 *marks*)

(ii) Take off quantities of the brick wall.   (05 *marks*)

(iii) Take off quantities for the deductions for D and W openings in the brick wall. (10 *marks*)

(iv) Parts of several measurement sheets used to take off quantities by a Quantity Surveyor for the concrete slab of a building is given below. Transfer the quantities in these measurement sheets to an abstract sheet.   (10 *marks*)

(v) Using the abstract sheet prepared in (iv) above, insert the quantities of the concrete slab into the bill-of-quantity.   (05 *marks*)

(b) Using the data given below calculate the net unit rate per square meter for painting a plastered brick wall with one prime coat and two coats of emulsion paint.

● One litre of Prime coat is Rs. 800 and 50 m^2 of wall can be painted with it.
● One litre of Emulsion paint is Rs. 1000 and 25 m^2 of wall can be painted with it.
● A gang with a painter and a helper paints 150 m^2 of the wall per day.
● All wastes are included in the above values.
● It is not needed to add the cost of water, scaffolding and brushes to the unit rate as they are included in the preliminary bill.
● Daily wage of a painter is Rs. 2000.
● Daily wage of a helper is Rs. 1500.   (15 *marks*)

(c) Explain the use of levelling process to take measurements with one instrument station for preparing longitudinal section of a road segment of horizontal length 40 m with a rise. For this, consider the interval between two points for taking measurements as 10 m.
Descriptions about instruments to be used, field process, the method of taking readings, the way of recording readings, calculation process and drawing the longitudinal section should be included in the answer.   (30 *marks*)

(*d*) From a theodolite set up at the foot of a mountain the angle of elevation measured to the top end of the ranging pole kept at the top of the mountain was 40°. The slant distance from the theodolite to the top end of the ranging pole along the line of sight was 20 m. Consider the height of the instrument as 1.5 m, the height of the ranging pole as 1.0 m and the reduced level of the point situated at the foot of the mountain as 800 m (relative to the mean sea level).

Show the given measurements on a sketch and calculate the reduced level of the point where the ranging pole was kept.

Use the following trigonometric values for the calculation.

sin 40° = 0.64   cos 40° = 0.77   tan 40° = 0.84   (20 *marks*)

Part C - Essay (Electrical and Electronic Technology)

7. (*a*)   (i) Explain the difference between renewable and non-renewable sources of energy.
(05 *marks*)

(ii) State **two** renewable energy conversion methods seen in Sri Lanka and explain **two** factors that negatively affect their use.
(20 *marks*)

(*b*)   (i) In relation to an electric motor, show active power, apparent power, reactive power and power factor using a power triangle.
(10 *marks*)

(ii) The circuit shown below was designed to calculate the power factor of a single-phase alternating current motor used in an electric appliance.
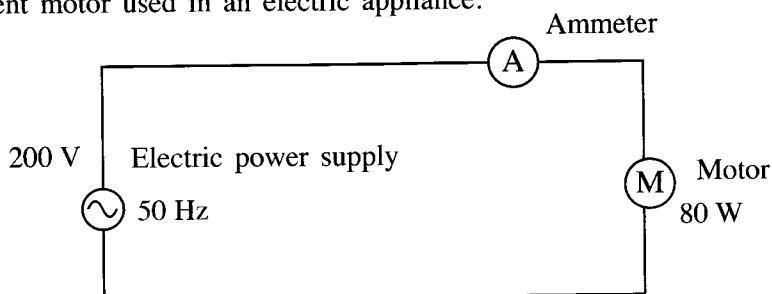

When the electric power supply was 200 V, the ammeter reading was seen as 0.5 A. Assume that the power loss in the ammeter is zero.

(I)   Calculate the apparent power drawn by the motor.   (10 *marks*)

(II) How much is the active power of the motor?   (10 *marks*)

(III) Calculate the power factor of the motor.   (10 *marks*)

(IV) Calculate the reactive power drawn by the motor.   (10 *marks*)

(*c*) In a household electrical installation, it is compulsory to install an earth electrode and to connect the earth wire of the circuits. Explain the way in which personal protection is provided by this arrangement.
(10 *marks*)

(*d*) A consumer purchased a new electric oven rated 2.3 kW, 230 V and 50 Hz. This electric oven did not have a plug installed. Therefore, the consumer connected a 5 A plug to it and plugged to the 5 A socket outlet in the kitchen. After that,

● the consumer turned "ON" the electric oven to bake a cake, and set its timer to 45 minutes.

● having ensured that the oven is in operation, the consumer left the place.

● when returned after 30 minutes, it was observed that the electric oven has ceased to operate.

● when investigated, it was observed that the 6 A miniature circuit breaker at the distribution board related to the socket outlet used for the electric oven has switched to the "OFF" position.

● when further investigated, consumer observed that, even though the miniature circuit breaker was switched to the "ON" position, it did not stay in the "ON" position.

Explain the reasons for above observations.   (15 *marks*)

**8.** (*a*) The figure shows a part of a power supply circuit.
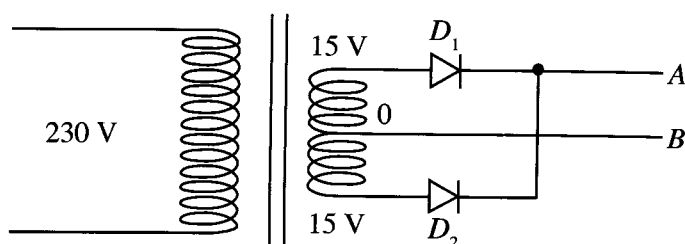
(i) What is the type of rectification shown in the circuit? (05 *marks*)

(ii) Write down the polarities of *A* and *B* separately. (05 *marks*)

(iii) Draw the waveform of *A* when diode D_1 is open circuited. (05 *marks*)

(iv) Draw the circuit again after modifying the above circuit section for obtaining a 12 V stable voltage using a zenner diode, a resistor and a capacitor. (15 *marks*)

(*b*) Consider the transistor amplifier circuit given below.


$V_{BE} = 0.7$ V

$\beta = 100$
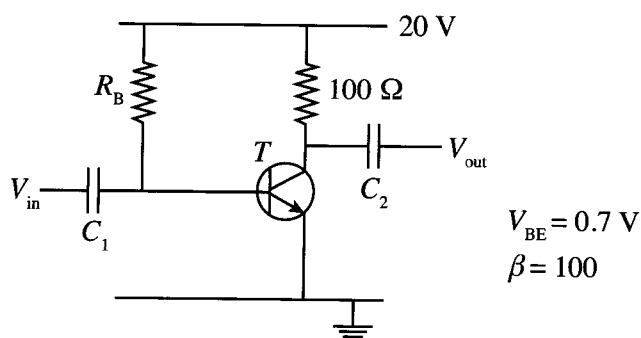
(i) Briefly describe an instance in day-to-day life where a transistor is used as an amplifier. (05 *marks*)

(ii) State the importance of capacitors C_1 and C_2 in the above circuit. (05 *marks*)

(iii) Calculate the following, considering that the collector current (I_{CQ}) at the bias point (*Q*–point) of the transistor *T* is 100 mA.

   (I) Base current (I_{BQ}) (05 *marks*)

   (II) Value of resistor R_B (15 *marks*)

   (III) The voltage difference (V_{CEQ}) between collector and emitter (10 *marks*)

(iv) Draw in the same graph the wave forms of V_{in} and V_{out} when a sinusoidal wave is supplied to the circuit as the main signal. (10 *marks*)

(v) When the above circuit is in operation for a long time the output signal (V_{out}) changed as below.
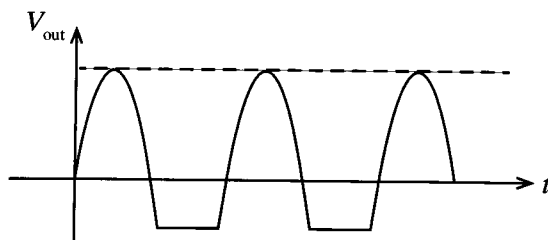
   (I) Explain the reasons for the above observation. (10 *marks*)

   (II) Draw a circuit diagram to show how the circuit should be changed to prevent the above change. (10 *marks*)

Part D - Essay (Mechanical Technology)

9. (*a*) Draw a labelled rough sketch to illustrate the connection of turbo charger and intercooler to the engine.

(10 *marks*)

(*b*) Explain, giving technological reasons, how the drop in lubrication oil pressure of an automobile engine, below its recommended value affects its operation.

(10 *marks*)

(*c*) It was identified, without removing the spark plugs, in a four cylinder four stroke spark ignition piston engine that one of the spark plugs was not operating.

   (i) Write down **two** observations which could have helped to identify that one spark plug is not working.

(10 *marks*)

  (ii) Describe step by step, a simple method without using testing equipment and not removing the spark plugs to correctly identify the defective spark plug out of the four spark plugs.

(30 *marks*)

(*d*) The circuit diagram of a hydraulic power transmission system is shown in the figure below.
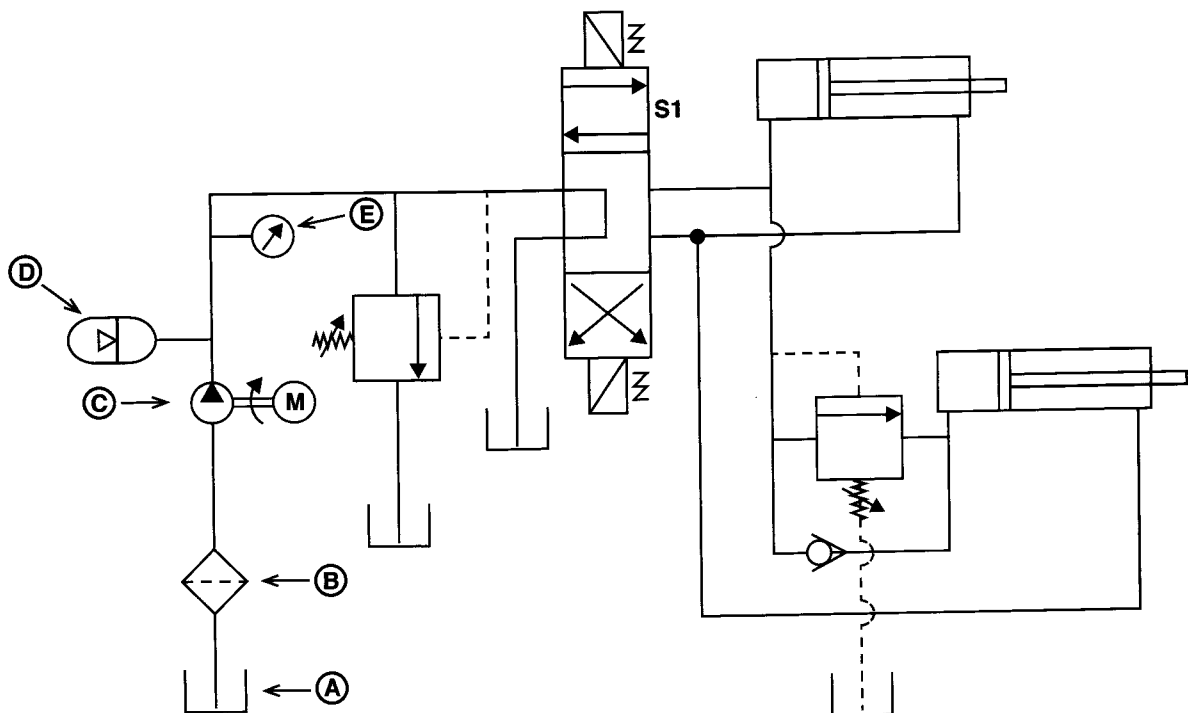
    State the components shown by the above symbols from Ⓐ to Ⓔ and briefly explain the functions performed by each of the component.

(15 *marks*)

(*e*) (i) Sketch the circuit diagram of a vapour compression refrigerator and name the main components and mark the direction of refrigerant flow.

(10 *marks*)

  (ii) State **three** technical methodologies used in refrigerators for increasing the efficiency of heat transfer between refrigerant and the freezing compartment and explain how the efficiency is increased by them.

(15 *marks*)

10. A fixture that can be used for mounting a given workpiece on a machine is shown in the figure. This fixture includes part Ⓟ, four (4) pins that are shown as Ⓠ and four (4) T-bolts that are shown as Ⓡ. Part Ⓡ is purchased from the market.
All dimensions given are in millimetres.

Four symmetric
holes of φ10

φ10

37

20

φ12

Ⓠ

φ12

M12

12

22   26

Ⓡ
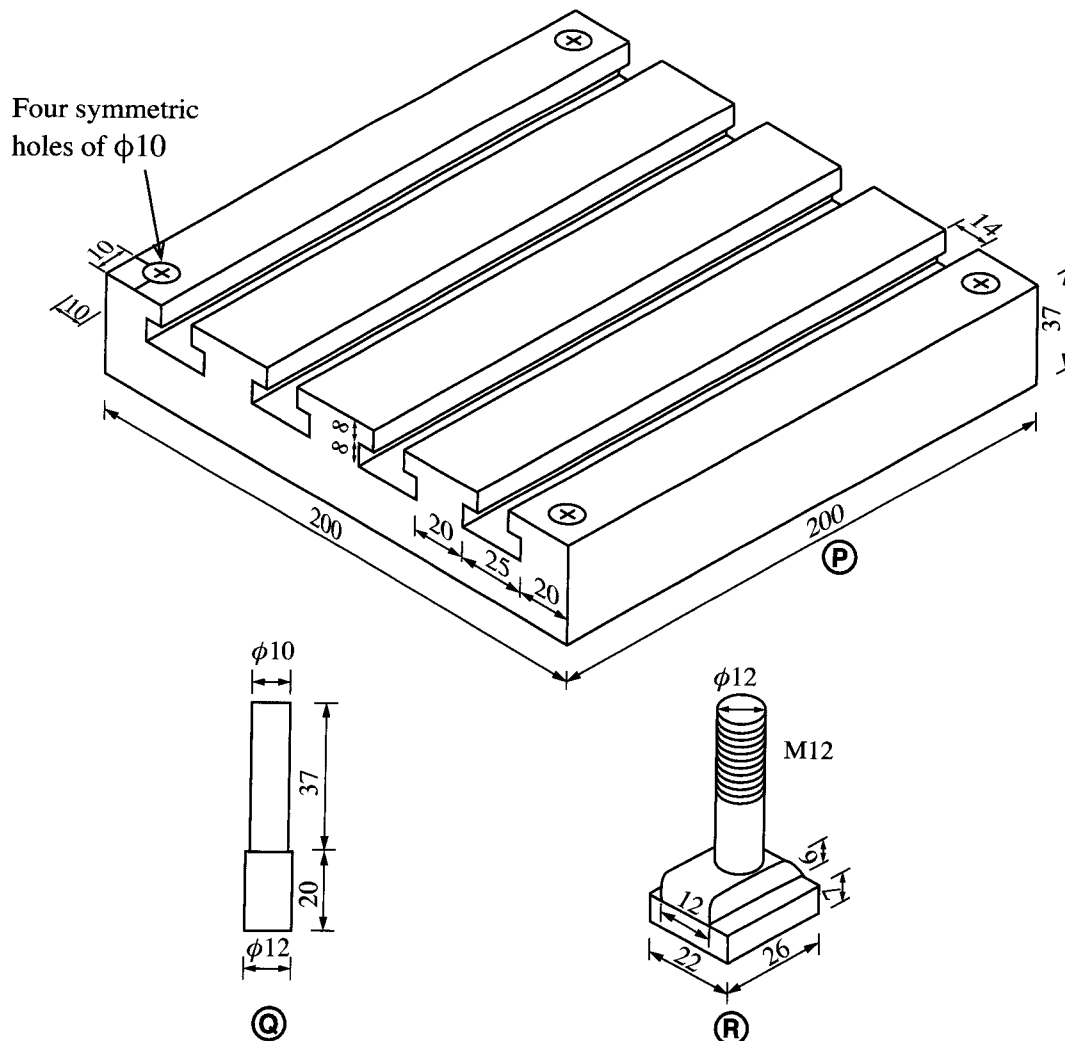
(*a*) A 200 mm × 200 mm × 37 mm finished mild steel part has been supplied for manufacturing part Ⓟ. In order to completely finish Part Ⓟ, T-slots and circular holes parallel to each other have to be produced.

   (i) Describe step by step the method of producing the T-slots in minimum number of passes using only one machine by stating instruments, machines, equipment and tools with their sizes where necessary.
   (25 marks)

   (ii) Describe step by step the method of producing the circular holes by stating the instruments, machine, equipment and tools.
   (25 marks)

(*b*) (i) State the most suitable machine for producing part Ⓠ.
   (05 marks)

   (ii) A 12.5 mm diameter 240 mm length mild steel rod is supplied. When producing four parts of Part Ⓠ, calculate the maximum finishing allowance for a face. Consider the width of parting of tool as 2 mm.
   (10 marks)

   (iii) Describe step by step the method of producing part Ⓠ using the machine mentioned in above (b)(i) by stating instruments, machines, equipment and tools with their sizes where necessary.
   (25 marks)

(*c*) State the **two** methodologies that are used for manufacturing part Ⓡ in mass scale. *(10 marks)*

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