

නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்த்
General Certificate of Education (Adv. Level) Examination, August 2019

ඉංජිනේරු තාක්ෂණවේදය I
 பொறியியற் தொழினுட்பவியல் I
Engineering Technology I

65 E I

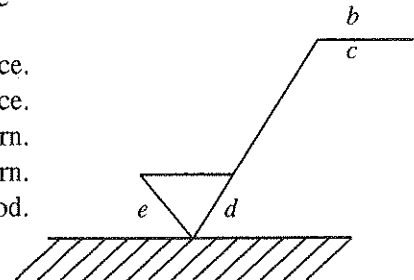
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පැය දෙකයි
 இரண்டு மணித்தியாலம்
Two hours

Instructions:

- * Answer all questions.
- * Write your **Index Number** in the space provided in the answer sheet.
- * Instructions are given on the back of the answer sheet. Follow them carefully.
- * In each of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct or most appropriate** and mark your response on the answer sheet with a cross (×) in accordance with the instructions given at the back of the answer sheet.
- * Each question carries **01 mark** totalling to **50**.
- * Use of calculators is not allowed.

1. A basic factor that contributed towards the rapid industrial development during the industrial revolution is
 - (1) abundance of human labour.
 - (2) use of the water wheel in industries.
 - (3) improvement of metal casting technology.
 - (4) start of commercialisation of goods and services.
 - (5) new inventions that took place in the field of energy.
2. Consider the following tasks in relation to ensuring occupational safety and healthy working environment.
 - A - Inspection
 - B - Working according to safety procedures
 - C - Providing quality equipment
 Out of the above tasks, what is/are the obligation/obligations of the employers in particular?
 - (1) A only.
 - (2) A and B only.
 - (3) A and C only.
 - (4) B and C only.
 - (5) All A, B and C.
3. What is the unit used to measure the illuminance at the table surface, when illuminating a worktable?
 - (1) Lux
 - (2) Candela
 - (3) Tesla
 - (4) Watt
 - (5) Lumen
4. Figure shows a symbol used in production drawings to provide data required for finishing flat surfaces. In this, the data given by the letters *b*, *d* and *e* respectively are
 - (1) surface pattern, finishing method and machining allowance.
 - (2) finishing method, surface pattern and machining allowance.
 - (3) finishing method, machining allowance and surface pattern.
 - (4) machining allowance, finishing method and surface pattern.
 - (5) surface pattern, machining allowance and finishing method.



5. What is the pair of figures that shows the correct first angle orthogonal view of the symmetric object shown in the figure, when looked from the directions of the arrows, *A* and *B*?

	(1)	(2)	(3)	(4)	(5)
View from direction <i>A</i>					
View from direction <i>B</i>					

6. In relation to ordinary Portland cement, SLS 107(2015) means a
 (1) treaty. (2) regulation. (3) parameter. (4) specification. (5) standard.

7. A few decisions taken by managers of a business are shown below.
 A - Allocating employees to most suitable sections according to their qualifications.
 B - Identifying workers who work inefficiently and providing them with further training.
 C - Deciding on a new approach to encourage employees.

The managerial skills pertaining to the above decisions respectively are

- (1) planning, directing and organising.
- (2) organising, controlling and planning.
- (3) planning, controlling and organising.
- (4) organising, directing and planning.
- (5) directing, controlling and planning.

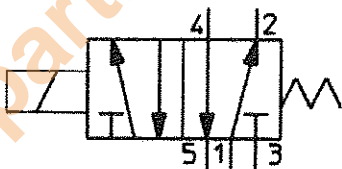
8. The following are several statements which are relevant to offering micro-finance loans to small businesses by the government institutions.

- A - The risk associated with small businesses is low.
- B - Private banks are reluctant to offer loans to small-scale entrepreneurs.
- C - Small-scale business entrepreneurs find it difficult to provide collaterals.
- D - It is sufficient to offer small loan amounts to small businesses.

Out of the above statements, what are the essential factors that the government institutions need to consider when offering micro-finance loans?

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

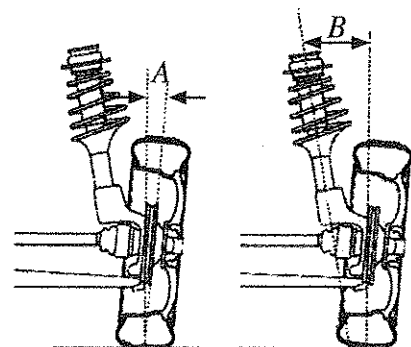
9. The symbol shown in the figure represents a



- (1) 5/2 hydraulic directional control valve.
- (2) 5/2 pneumatic directional control valve.
- (3) 3/2 hydraulic directional control valve.
- (4) 3/2 pneumatic directional control valve.
- (5) 4/3 hydraulic directional control valve.

10. In the figure, the angles *A* and *B* respectively are the

- (1) camber angle and caster angle.
- (2) camber angle and toe in.
- (3) camber angle and king pin angle.
- (4) king pin angle and toe out.
- (5) king pin angle and camber angle.



11. The motion transformation that occurs in a shaping machine is from
 (1) oscillating \rightarrow rotary. (2) reciprocating \rightarrow rotary.
 (3) rotary \rightarrow reciprocating. (4) rotary \rightarrow oscillating.
 (5) oscillating \rightarrow reciprocating.
12. The most suitable method to transfer power with a fixed speed ratio between two parallel axes located widely apart is to use
 (1) spur gears. (2) helical gears. (3) a flat belt drive.
 (4) a v-belt drive. (5) a chain and sprocket drive.
13. In a single cylinder engine with a flat piston head, the compression ratio is indicated as 10 by the manufacturer. Upon being overhauled after the engine was used for a time period, it was identified that the clearance volume has risen by 21% and the bore diameter has risen by 10%. What is the new compression ratio of the engine?
 (1) 8 (2) 10 (3) 12 (4) 14 (5) 16

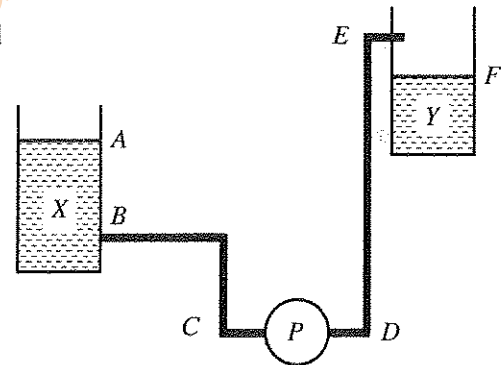
14. Three constituents of a reciprocating air compressor are given below.

A - Cooling fins
 B - Lubrication system
 C - Air filter

Out of the above constituents, the constituent(s) that is/are instrumental in increasing the rate of the discharge air mass (kg/s) by the compressor is/are

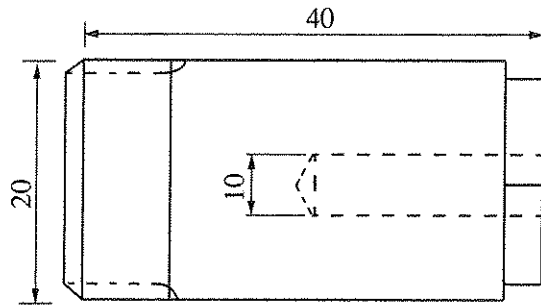
- (1) A only. (2) B only. (3) C only.
 (4) A and B only. (5) A and C only.
15. As indicated in the figure, the pump (P) pumps water from tank X to tank Y. In this instance, the static head that the pump should overcome is

- (1) the vertical height between A and E.
 (2) the vertical height between A and F.
 (3) the vertical height between B and E.
 (4) the vertical height between B and F.
 (5) the vertical height between D and E.

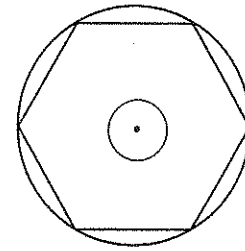


16. Which one of the following vehicle components is **not** contained in starter motor?
 (1) Armature (2) Voltage regulator (3) Commutator
 (4) Brushes (5) Solenoid switch
17. Consider the following statements in relation to braking systems used in motor cars.
 A - Antilock braking system prevents locking of the wheels when brakes are applied.
 B - Tandem master cylinder prevents complete failure of brakes in case of leakage in a brake hose.
 C - The brake booster uses the vacuum force created by the suction manifold.
 The correct one(s) out of the above is/are
 (1) A only. (2) A and B only. (3) A and C only.
 (4) B and C only. (5) All A, B and C.

18. The machines essential to completely manufacture the machine component shown in the figure with a rod of 25 mm in diameter are

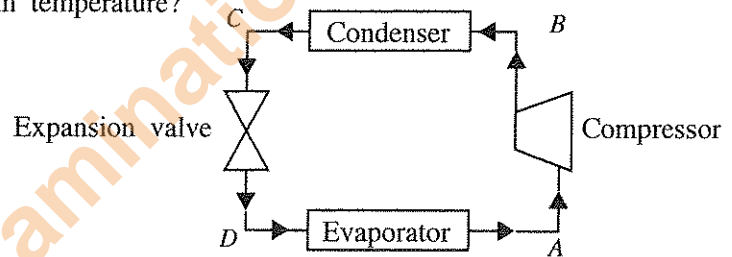


Front view



Side view

- (1) lathe machine and boring machine.
 (2) milling machine and boring machine.
 (3) milling machine and drilling machine.
 (4) lathe machine and drilling machine.
 (5) lathe machine and milling machine.
19. An essential mechanical property that a metal should possess in order to enable forming is
 (1) plasticity. (2) elasticity. (3) strength. (4) brittleness. (5) hardness.
20. Out of the points A, B, C and D of the refrigerant circuit shown in the figure, at which point does the refrigerant reach its maximum temperature?
 (1) A
 (2) B
 (3) C
 (4) D
 (5) Between A and D

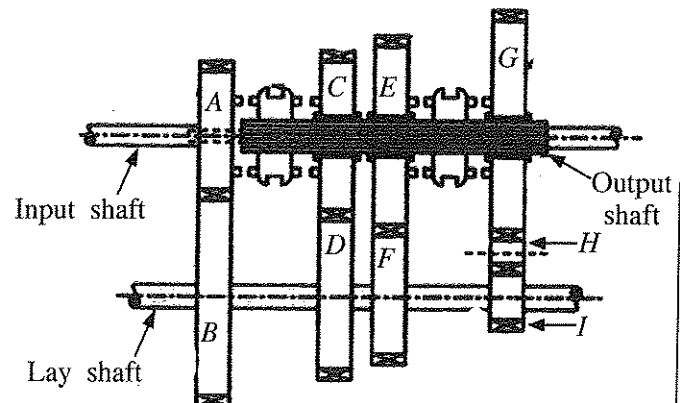


21. Figure shows a schematic diagram of a constant mesh gearbox. The table shows the number of teeth in the gear wheels A to I.

Gear wheel	A	B	C	D	E	F	G	H	I
No. of teeth	20	80	60	60	70	40	80	15	20

If the rotating speed of the input shaft is 2000 rpm, what is the speed of the output shaft in rpm when the gear box is operating in the second gear?

- (1) 125
 (2) 285.7
 (3) 500
 (4) 666.6
 (5) 2000



22. When the crown wheel rotates at 800 rpm in the final drive of a car, it was observed that the left wheel connected to the differential also rotates at 800 rpm. The rotating speed of the right side wheel in rpm is
 (1) 0. (2) 400. (3) 800. (4) 1200. (5) 1600.

23. Consider the following in relation to a conductor connected in a circuit.

- A - Material of the conductor
- B - Voltage difference across the conductor
- C - Density of the material of the conductor
- D - Cross-sectional area of the conductor

When the temperature remains constant the factors that affect the resistance of the conductor are

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

24. The method that makes a self-starting in a single phase induction motor (when connected to an electricity supply) is

- (1) making an artificial phase difference in the stator.
- (2) increasing the supply current.
- (3) interchanging the supply terminals.
- (4) increasing the supply voltage.
- (5) using a star-delta starter.

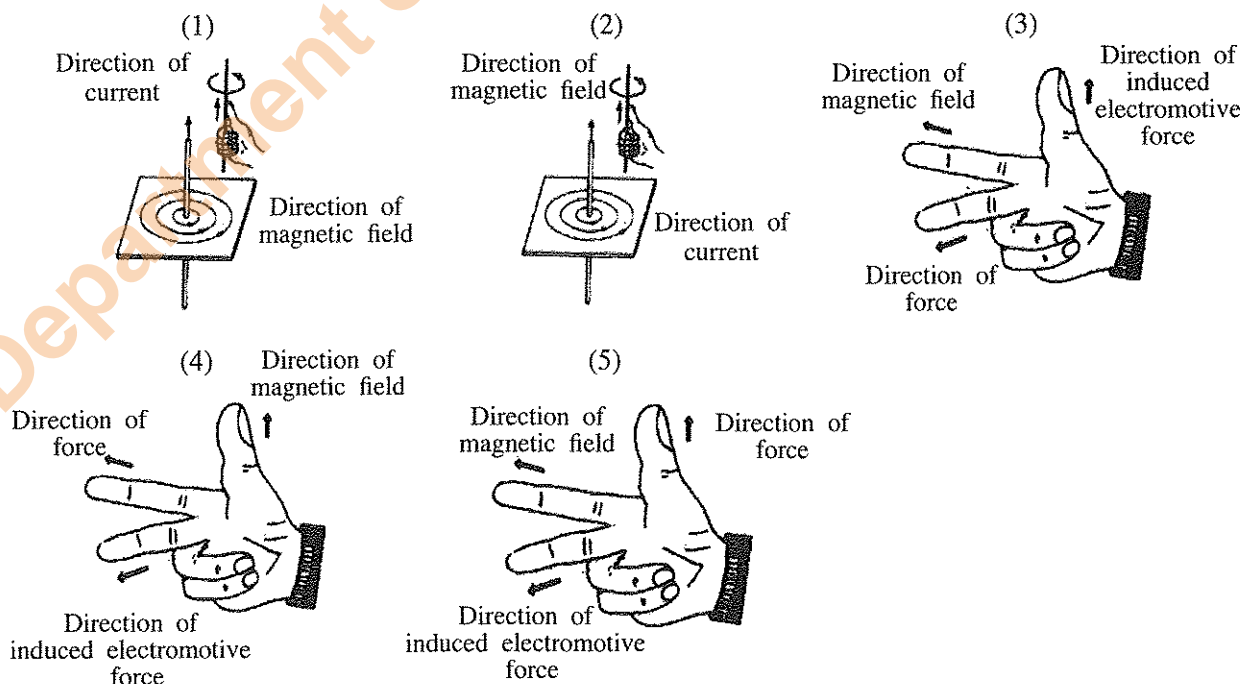
25. A 110 V rated electric bulb has a resistance of 55Ω . If it is required to operate this electric bulb at its rated power using a 220 V supply, an additional resistor is needed to be connected with the bulb. The value of the additional resistor and the way of connecting it is

- (1) 27.5Ω in parallel.
- (2) 27.5Ω in series.
- (3) 55Ω in parallel.
- (4) 55Ω in serial.
- (5) 110Ω in series.

26. The use of miniature circuit breaker as a protective device in domestic electrical circuits is

- (1) to isolate the entire domestic electrical circuit automatically from the supply in a short circuit.
- (2) to isolate only the corresponding section of the circuit automatically from the supply in a short circuit.
- (3) to isolate only the corresponding section automatically from the supply in an earth fault.
- (4) to isolate the entire domestic electrical circuit automatically from the supply in an earth leakage.
- (5) to isolate only the corresponding section of the circuit automatically from the supply in an earth leakage.

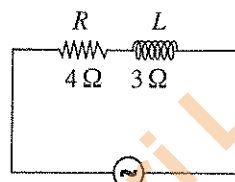
27. Which figure shows the Fleming's Right Hand Rule correctly?



28. What is the **incorrect** statement about step-down transformers?
- (1) Used to reduce voltage.
 - (2) Number of turns in the secondary winding is less than the number of turns in the primary winding.
 - (3) Used to change the voltage when transmitting electricity from power stations.
 - (4) Used at the grid substations.
 - (5) used at the primary substations.

29. A circuit connected to an alternating current supply connected in series with a resistor having a resistance (R) of $4\ \Omega$ and an inductor (L) having an inductive reactance of $3\ \Omega$ is shown in the figure. What is the equivalent impedance of the circuit?

- (1) $1\ \Omega$
- (2) $2.65\ \Omega$
- (3) $5\ \Omega$
- (4) $7\ \Omega$
- (5) $25\ \Omega$



30. Consider the following statements about a rectifier diode and a Zener diode.
- A - Rectifier diode can conduct current only in one direction whereas Zener diode can be used in a way that can conduct current in both directions.
 - B - Rectifier diode is damaged in a normal reverse bias current whereas Zener diode is not generally damaged in a normal reverse bias current.
 - C - Rectifier diode is normally used for rectification whereas Zener diode is normally used for voltage regulation.
 - D - In manufacturing a rectifier diode and a Zener diode, different dopings of P and N semiconductors are used.

Of the above, correct statements are

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

31. Consider the following mathematical expressions for transistors.

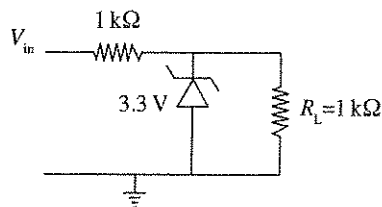
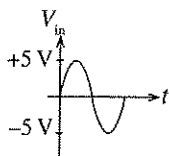
$$A - V_{CE} < 0.2\text{ V} \quad B - V_{CE} > 0.2\text{ V} \quad C - V_{BE} = 0\text{ V}$$

$$D - I_C > \beta I_B \quad E - I_C < \beta I_B$$

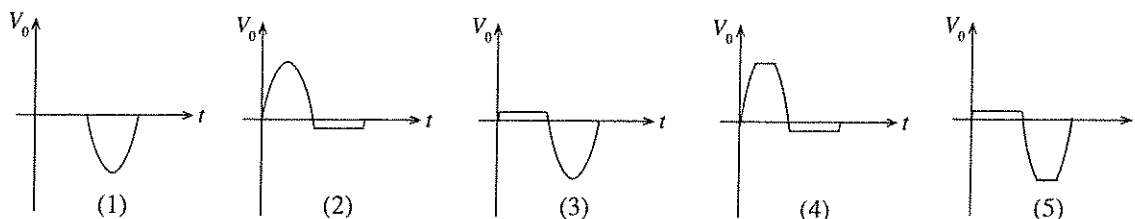
Of the above mathematical expressions, correct statements regarding a transistor which is biased to the state of saturation are

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

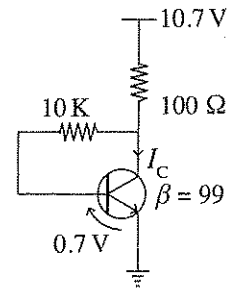
32. Following is a circuit segment which can be used to protect a circuit from input voltage greater than a rated voltage.



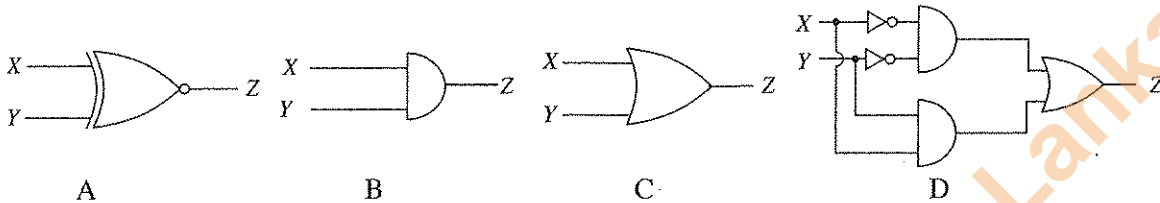
What is the output waveform V_0 across R_L if the input waveform is as given by V_{in} ?



33. In the transistor circuit given in the figure, the current I_c is
- (1) 10 mA.
 - (2) 10.7 mA.
 - (3) 49.5 mA.
 - (4) 53.5 mA.
 - (5) 70 mA.

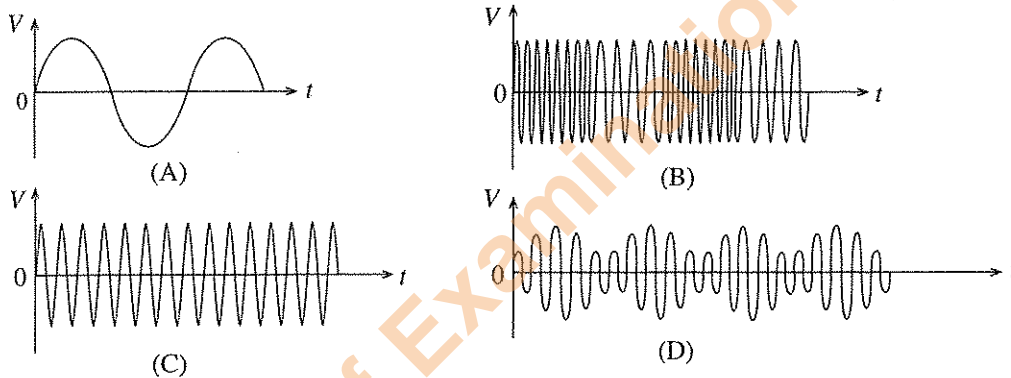


34. In the figures, four logical circuits are shown.



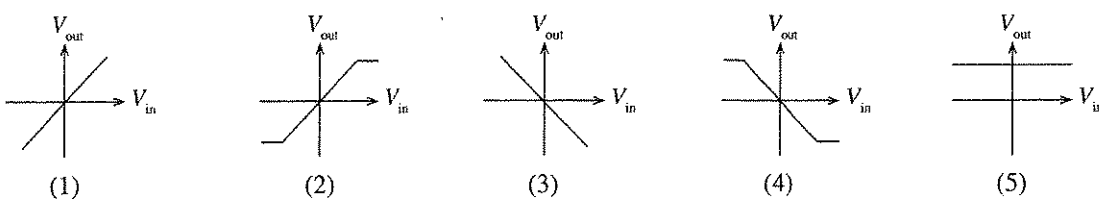
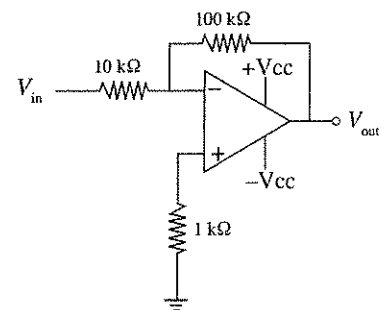
- A bulb controlled by two switches should turn on when both switches are either switch-on or switch-off and otherwise turns-off. The Boolean circuit(s) that can be used is/are
- (1) A only.
 - (2) B only.
 - (3) C only.
 - (4) A and D only.
 - (5) C and D only.

35. Electrical signals in relation to radio transmission are shown below.



- Of the above, the frequency modulated wave is
- (1) A.
 - (2) B.
 - (3) C.
 - (4) D.
 - (5) None of the above.

36. Figure shows the circuit of an operational amplifier. Which graph shows the best relationship between input voltage and the output voltage?



37. Consider the following statements regarding waste water disposal systems.

A - During a heavy rainfall combined sewerage system will direct some sewage to flow into surface water bodies.

B - Septic tanks and soakage pit systems are the most suitable for urban areas with small land parcels.

C - Gullies in a sewerage system are placed so that persons can enter and clean the system.

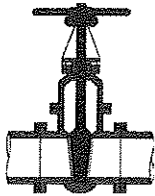
Of the above, correct statement/s is/are

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

38. The main purpose of adding chlorine during water treatment process is to

- (1) remove hardness of water.
 (2) precipitate suspended particles.
 (3) add mineral to water.
 (4) precipitate Ferrous and Manganese ions.
 (5) destroy harmful microorganisms.

39. Three components used in water supply and waste water disposal are shown below.



A



B



C

The figures A, B and C respectively depict

- (1) gate valve, Q water trap and elbow bend.
 (2) stop valve, U water trap and elbow bend.
 (3) ball valve, U water trap and bend.
 (4) gate valve, Q water trap and bend.
 (5) stop valve, Q water trap and bend.

40. Some of the items included, when calculating overhead cost of a building project are

- (1) masons' salaries, stationery and cranes.
 (2) engineer's salaries, site security and cranes.
 (3) site security, concrete mixer and small tools.
 (4) advertisements, mason's salaries and site office rent.
 (5) head office rent, advertisements and unskilled labours' salaries.

41. What is the correct method to take measurements for the volume of five cylindrical columns with a radius of 2 m and 1 m height for quantity bills?

(1)

T	D	S
5/	2.00	
	1.00	

(2)

T	D	S
5/ 22 /	2.00	
7	1.00	

(3)

T	D	S
22 /	2.00	
7	2.00	
	5.00	

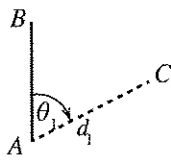
(4)

T	D	S
5/	2.00	
	2.00	
	1.00	

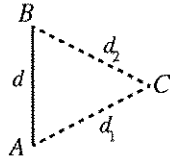
(5)

T	D	S
5/ 22 /	2.00	
7	2.00	
	1.00	

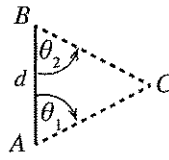
42. The main purpose of land surveying is to
- (1) draw the plan of a land parcel.
 - (2) calculate the area of a land parcel.
 - (3) determine the boundaries of a land parcel.
 - (4) set out the construction plan on the ground.
 - (5) determine the difference in reduced levels in two points.
43. What is the figure that shows a method which **cannot** be used in taking measurements of θ_1 , θ_2 , θ_3 , d , d_1 , d_2 , d_3 and d_4 to determine the position of a point (C) relative to survey line (AB)?



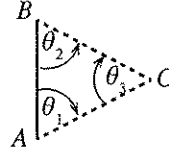
(1)



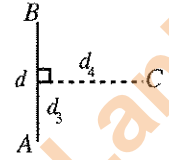
(2)



(3)



(4)



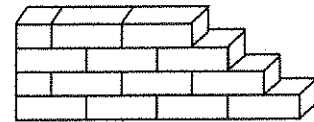
(5)

44. Table shows some of the readings taken in a levelling process.

Level station	Back sight reading	Intermediate sight reading	Fore sight reading	Rise	Fall	Reduced level	Remarks
1	X					100.00	
2		1.5			1.0	99.00	
3			Y	1.0		100.00	

Readings X and Y respectively are

- (1) 0.0 m and 1.0 m.
 - (2) 0.5 m and 0.0 m.
 - (3) 0.5 m and 0.5 m.
 - (4) 1.0 m and 0.5 m.
 - (5) 1.0 m and 1.0 m.
45. A, B and C are statements regarding theodolite traverses.
- A - The error of the survey can be determined, if open traverses are used.
- B - A traverse between two control points is a closed traverse.
- C - The shape of the traverse is same as the shape of the land.
- Of the above, the correct statement/s is/are
- (1) A only.
 - (2) B only.
 - (3) C only.
 - (4) B and C only.
 - (5) All A, B and C.
46. Figure shows the three dimensional view of a brick wall with four rows. Several statements about the wall are given from A to F.



- A - This is an English bond.
- B - Lap length can be seen here.
- C - Both stretcher and header courses can be seen.
- D - One end is a racking back end.
- E - Only stretcher course can be seen.
- F - Queen closer has been used here.

Of the above, correct statements are

- (1) A, B and F only.
 - (2) A, C and F only.
 - (3) B, C and D only.
 - (4) B, D and E only.
 - (5) B, D and F only.
47. Binding material used in preparing a concrete mixture is
- (1) 20 mm aggregates.
 - (2) sieved sand.
 - (3) binding wires.
 - (4) mason's cement.
 - (5) portland cement.

48. Type of foundation adequate for concrete columns of a two-storeyed building which is to be built on a ground with firm soil using concrete frames is a
- (1) narrow strip foundation.
 - (2) wide strip foundation.
 - (3) pad foundation.
 - (4) raft foundation.
 - (5) pile foundation.
49. The essential action that should be taken to ensure the health and safety of occupants, neighbours and the environment from a building is
- (1) using sufficient amounts of concrete structures in constructing the building.
 - (2) keeping the number of fan lights and ventilation openings equal in the building.
 - (3) drawing a building plan with a central courtyard.
 - (4) following the regulations enacted in relation to constructing buildings.
 - (5) taking into consideration the street line regulations imposed by the local authorities.
50. Since it is difficult to use only manual labour when constructing a building for a large factory, it is necessary to use machinery for activities such as
- A - foundation digging
 - B - mixing concrete
 - C - compacting concrete
- Machinery that can be used for the activities denoted by A, B and C respectively are,
- (1) excavator, backhoe loader and dumper.
 - (2) backhoe loader, concrete mixer and dumper.
 - (3) excavator, pump car and vibrator.
 - (4) dumper, pump car and vibrator.
 - (5) excavator, concrete mixer and vibrator.

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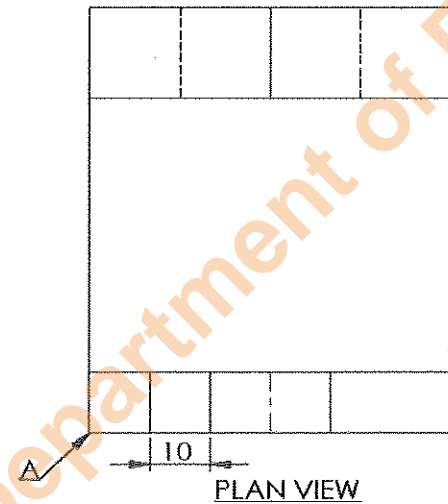
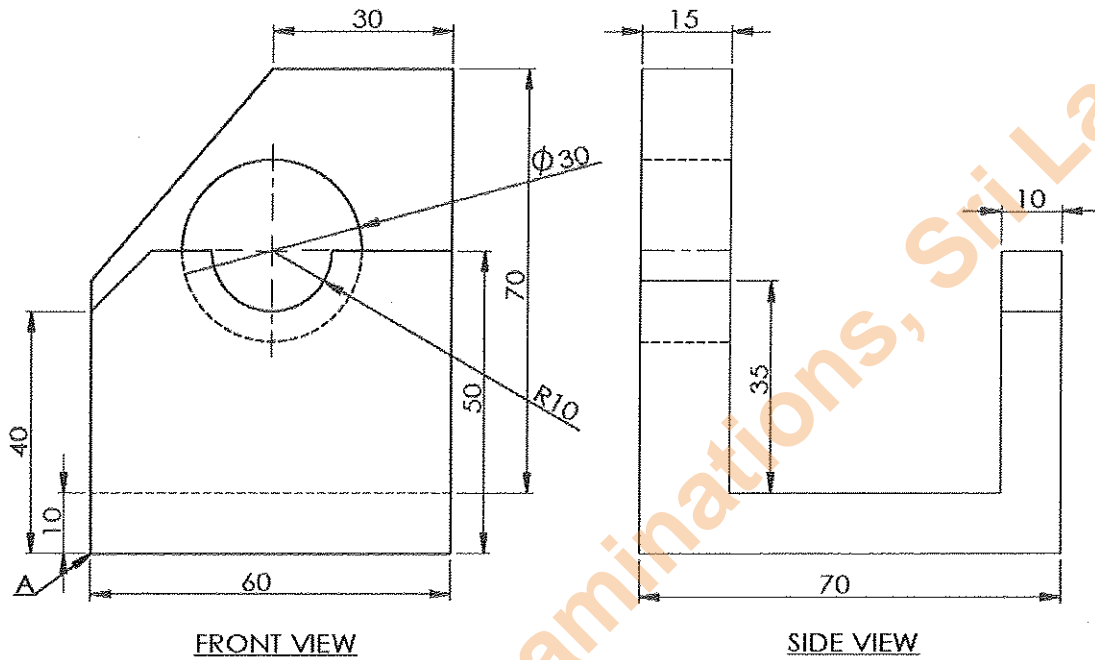
PART A – Structured Essay

Answer all four questions on this question paper itself.

(Marks allocated for each question is 75.)

1. The figure shows the front view, side view and plan view of a mild steel machine part drawn to a scale of 1:1 according to the method of first angle orthographic projection. Draw the Isometric view in free hand on the provided grid paper, taking the point shown by arrow A as the origin and mark all the given dimensions in the Isometric view. It is not required to show hidden lines and also not required to use Isometric scale, but consider the distance between adjoining two dots in grid paper as 10 mm when drawing the figure.

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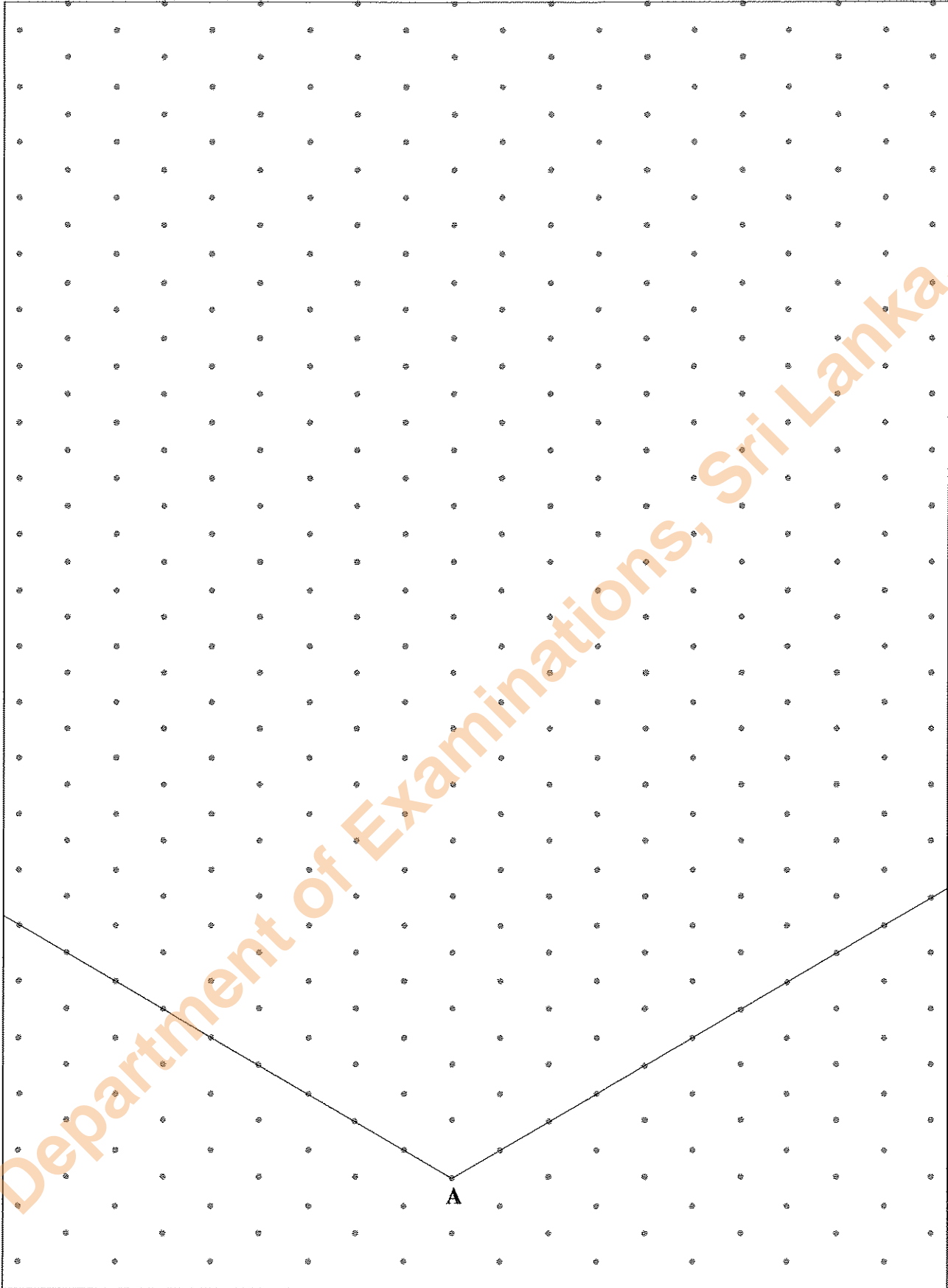
For use by the examiners	Marks
Drawing straight lines	
Drawing curves	
Marking of straight line dimensions according to the standard	
Marking dimensions of curves according to the standard	

Q. 1

(75 marks)

75

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MATERIAL: MILD STEEL	DRAWN BY:	08.08.2019	NAME	LANKA MACHINE PRODUCERS
	CHECKED BY:	09.08.2019	SURESH SAMANTHI	
SCALE: 1 : 1	MILD STEEL MACHINE COMPONENT			DRWG NO. ET/65/05

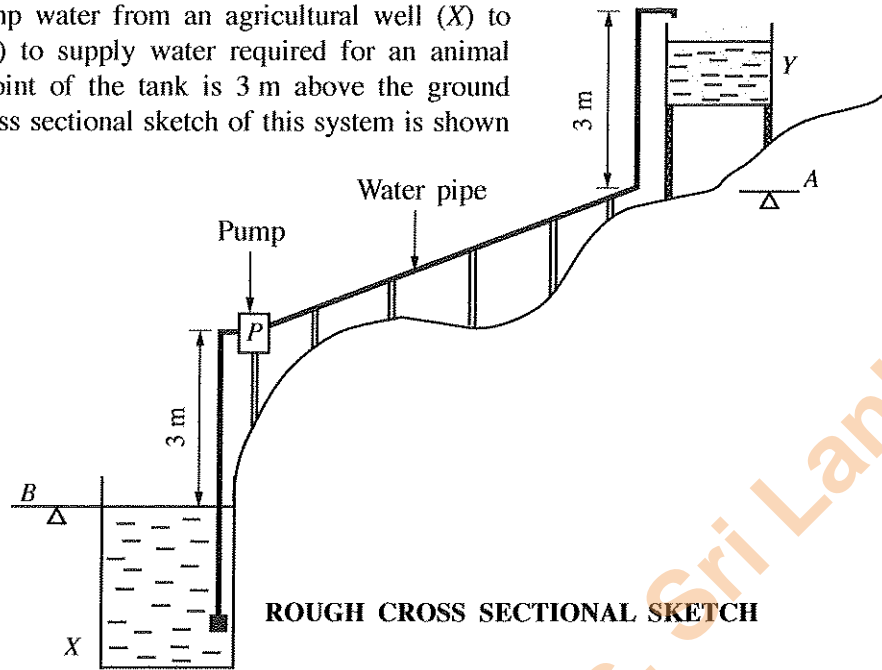
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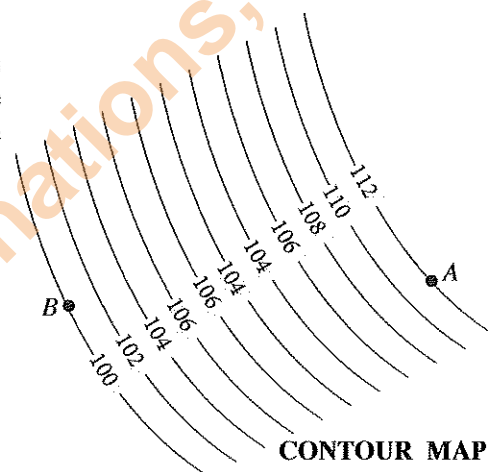
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2. It is required to pump water from an agricultural well (X) to an overhead tank (Y) to supply water required for an animal farm. The highest point of the tank is 3 m above the ground level A. A rough cross sectional sketch of this system is shown in the figure.



(a) Figure shows a section of the contour map drawn for the land between the ground level B at the agricultural well and the ground level A at the overhead tank. (Data is shown in meters)



(i) State another method to illustrate the above levels on a map.

.....
(05 marks)

(ii) Calculate the maximum static head that the water has to be pumped according to the rough cross sectional sketch and the contour map. Assume that the water level in the well remains unchanged while pumping.

.....
(10 marks)

(b) (i) In the water level control system of the overhead tank, an analogue sensor has been fixed. This sensor gives a voltage of 2.5 V when the water level of the tank reaches its maximum limit. Draw an amplifier circuit that uses an operational amplifier to amplify the 2.5 V voltage to 5 V.

(05 marks)

Do not write in this column

(ii) If the value of one of the resistors used in the circuit drawn in (b)(i) above is $1\text{ k}\Omega$, calculate the value of the other resistor.

.....

(05 marks)

(c) (i) The mechanical energy required to pump water for 12 hours in a day is 16.8 kWh. If the electric motor used in the water pump is 70% efficient, what should be the minimum rated power of the motor?

.....

(05 marks)

(ii) Since the electric motor was faulty, it was repaired by rewinding. However, when the pump was operated, it was observed that although the motor was rotating at the correct speed, the water pump was not pumping water and it was definitely caused by an error in rewinding the electric motor. What is the error that has occurred?

.....

(05 marks)

(d) It has been decided to operate a reciprocating water pump using a windmill instead of the electric motor driven water pump.

(i) Propose a method to convert the rotary motion of the windmill to reciprocating motion.

.....

(05 marks)

(ii) Draw the cross section of a reciprocating pump showing the valve arrangement suitable for this purpose and name the main parts.

(10 marks)

(e) (i) It is proposed to use a pre-cast concrete structure for the overhead tank. State an advantage of using pre-cast concrete when compared with in-situ concrete for this.

.....

(05 marks)

(ii) Name **two** types of solid waste disposed from the animal farm and state for each of them a different method to recycle within the farm itself.

	Solid waste	Recycling method
(1)
(2)

Q 2

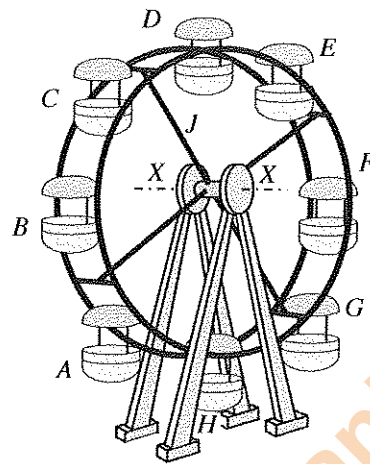
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(05 × 4 = 20 marks)

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3. It is required to design a ferris wheel shown in the figure with 8 seating units *A* to *H*, with two passengers in each seating unit to accommodate 16 passengers.

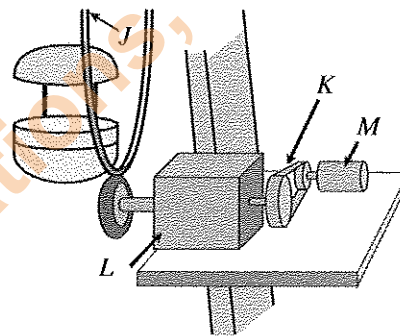


- (a) (i) The mass of a seating unit is 10 kg. The mass of the rest of the rotating parts shown by *J* is 600 kg. There are two bearings symmetrically placed in the axis *X-X*. Assuming that the gravitational acceleration is 10 m s^{-2} and that the mass of a passenger is 60 kg, when the ferris wheel is fully loaded with passengers, calculate the total vertical force on one bearing (Neglect the rest of the loads).

.....

(10 marks)

- (ii) To rotate the ferris wheel, a power transmission system with an electric motor is used. The connection between the motor (*M*), belt drive (*K*), gear drive (*L*) and the ferris wheel (*J*) is shown in the figure (not to scale). The rated rotating speed of this motor is 1500 rpm. Here, the rotating speed reduction ratio of the belt drive (*K*) is 2:1. The rotational speed reduction ratio of the gear drive (*L*) is 50:1.



- (I) Calculate the rotational speed of the ferris wheel.

.....
 (05 marks)

- (II) State **two** reasons for using the belt drive (*K*), for transmitting power here.

- (1)
 (2)

(10 marks)

- (III) If, only one pair of gear wheels is used in the gear drive (*L*), state the type of gear suitable for this?

.....
 (05 marks)

- (IV) It is important to ensure the safety of its passengers when using the ferris wheel. State **two** safety procedures that are needed to be implemented by the management for this.

- (1)
 (2)

(10 marks)

- (b) (i) State **two** unbalanced forces that may act upon the ferris wheel during its operation.

- (1)
 (2)

(10 marks)

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write
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column

- (ii) When constructing the ferris wheel, it is essential for the four bases to be in the same horizontal plane on the earth. State an instrument that can be used to check this.

(05 marks)

- (c) (i) It is required to supply electricity from the main supply to light the rotating part of the ferris wheel using electric bulbs. State the basic technique that can be used to maintain the electric connection to the rotating part.

(05 marks)

- (ii) It is detrimental to the motor, if the electricity to the motor is disconnected and suddenly connected again while the ferris wheel is operating with a load. State a basic electrical protective measure that can be used as a solution to this problem.

(05 marks)

- (d) An electro-mechanical brake named S is used in the rotating part of the ferris wheel. In order to release the brake ($S=1$) the following states need to be fulfilled.

- The overload switch P needs to be open ($P=0$).
- The seat belt warning lamp Q needs to be off ($Q=0$).
- The starting switch R needs to be close ($R=1$).

- (i) In order to operate the brake, it is required to design a logic circuit. Develop the truth table for this.

(05 marks)

- (ii) Design the logic circuit relevant to the above (d)(i) truth table.

(05 marks)

Q 3

75

4. Mr. Suresh has made a name for himself in Sri Lanka as an innovator. In a background where there are impending issues related to access to quality drinking water, he has produced a domestic water purification machine using a novel environment friendly technology and obtained a patent. This machine is currently being produced in small-scale and sold regionally. He wants to further expand this business to a medium-scale enterprise. It is required to invest a large amount of money for this and a large-scale local company has agreed to act as a partner in this investment.

- (a) (i) Based on the passage, state **two** opportunities to expand the market of this business to the national level.

(1)

(2)

(05 × 2 = 10 marks)

[see page eight]

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(ii) Based on the passage, state **two** entrepreneurial qualities possessed by Mr. Suresh.

- (1)
- (2)
(05 × 2 = 10 marks)

(iii) State **two** management skills that Mr. Suresh needs to use when expanding the business.

- (1)
- (2)
(05 × 2 = 10 marks)

(iv) Based on the passage, state **two** strengths already possessed by the business that can be used for the success of the business.

- (1)
- (2)
(05 × 2 = 10 marks)

(v) State a type of institution from which assistance can be obtained to minimise possible future risks in Suresh's business.

-
(05 marks)

(b) (i) Name a psychological hazard that may be present and an action to control the risks arising from the hazard while fixing the rafters of the roof of the factory for the business.

- (1) Hazard :
- (2) Action to control :
(05 × 2 = 10 marks)

(ii) It is proposed to build the roof with a large span. State a technological turning point which made it possible to design such roofs.

-
(05 marks)

(iii) There is a 50 mm diameter hole to fix a filter to this water purification machine. How can a vernier calliper be used to check the circularity of this hole?

-
(05 marks)

(iv) Name a national institution that provides standards for the quality of drinking water and state a benefit that the business can obtain by using such standards.

- (1) Institution :
- (2) Benefit :
(05 × 2 = 10 marks)

Q 4


75

* *

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සියලු ම හිමිකම් ඇවිරිලි / முழுப் பதிப்புரிமையுடையது / All Rights Reserved

නව නිර්දේශය / புதிய பாடத்திட்டம் / New Syllabus


 Sri Lanka Department of Examinations, Sri Lanka
 இலங்கைப் பரீட்சைத் திணைக்களம், Sri Lanka Department of Examinations, Sri Lanka
 இலங்கைப் பரீட்சைத் திணைக்களம், இலங்கைப் பரීட்சைத் திணைக்களம், இலங்கைப் பரීட்சைத் திணைக்களம்

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ட்
 General Certificate of Education (Adv. Level) Examination, August 2019

ඉංජිනේරු තාක්ෂණවේදය II
 பொறியியற் தொழினுட்பவியல் II
 Engineering Technology II

65 E II

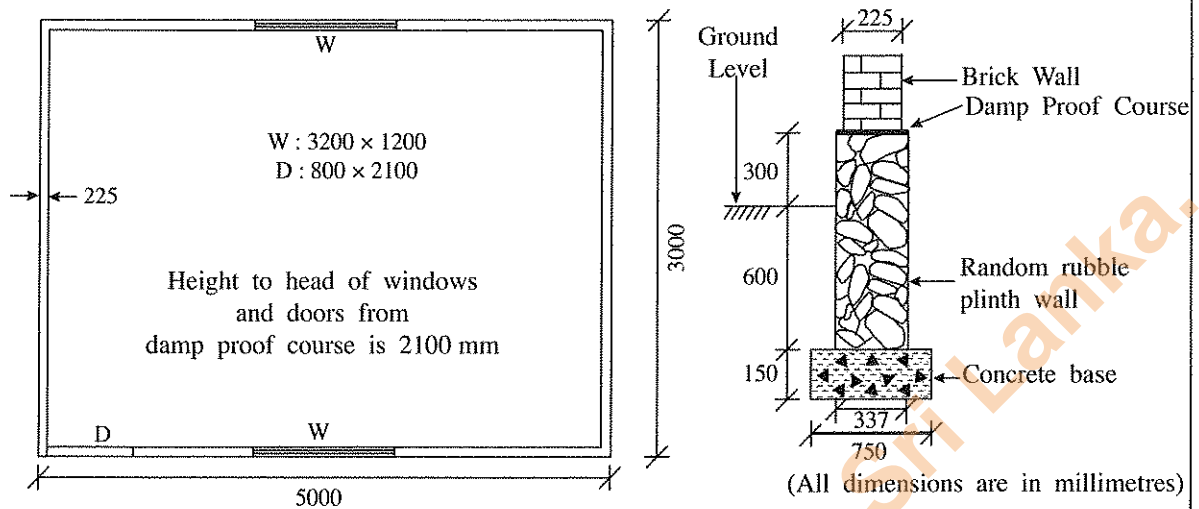
Instructions:

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

Part B - Essay (Civil Technology)

5. Based on a plan prepared by the owner, a shop with a store room was constructed on a marshy land which was prepared by filling soil. For this, a strip foundation was laid and three days later, brick walls were built to the roof level.
- (a) (i) If it is intended to have a couple roof using sawn timber for this building, draw a cross section of the roof and name **five** timber parts. (10 marks)
- (ii) Draw **two** types of timber joints used in this roof and name those two types and name the places where they are used in the roof. (16 marks)
- (iii) It is needed to finish the building after construction of the wall and the roof. Explain **two** aims of finishing. (08 marks)
- (iv) State main steps, materials, tools and equipment needed in plastering walls. (16 marks)
- (b) (i) State **two** factors to be considered in selecting bricks, in order to ensure their quality. (10 marks)
- (ii) Describe the procedure to be followed including the material, tools and equipment for constructing a quality stretcher bond. (10 marks)
- (iii) After the finishing work of the building had been completed, it was observed that the wall had cracked in several places and subsided on one side. Briefly explain **two** possible fundamental factors for this condition to occur. (10 marks)
- (iv) If columns on pad foundations with ground beams were used in constructing the above building, explain how it would help in preventing the conditions mentioned in (b)(iii). (10 marks)
- (v) Draw a vertical cross section of a pad foundation showing the reinforcements. (10 marks)

6. (a) Using the house plan and the cross section of the foundation shown in the drawing, answer the questions on the TDS sheets provided. (taking-off quantities should be according to SLS 573)



- Calculate the centre line girth of brick walls of the building. (10 marks)
 - Take-off quantities for the excavation of 750 mm wide foundations trench. (05 marks)
 - Take-off quantities for the concrete base. (05 marks)
 - Take-off quantities for 337 mm wide random rubble plinth wall. (05 marks)
 - Take-off quantities for brick walls having 3000 mm height from the damp proof course (DPC), with deductions for openings. (10 marks)
- (b) Using the given data, calculate the **net unit rate** for placing **1 meter cube** of concrete for foundation base.
- All in rate for labour

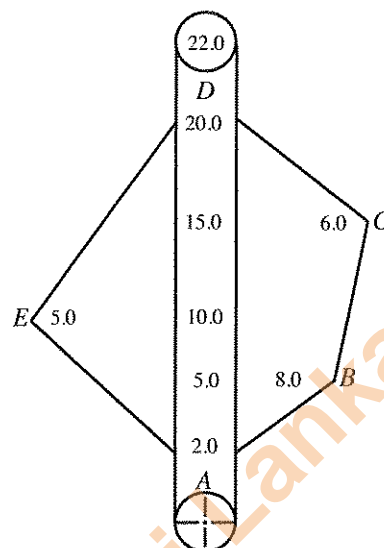
Skilled labour per hour	Rs. 400.00
Unskilled labour per hour	Rs. 200.00
 - Cost of one meter cube of ready mix concrete including transportation to site

	Rs. 24,000.00
--	---------------
 - All in rate for machinery

Pump car per hour	Rs. 2,000.00
Vibrator per hour	Rs. 500.00
 - To place 1 meter cube of concrete base the following items are needed:

Skilled labour	03 hrs
Unskilled labour	09 hrs
Pump car	01 hrs
Vibrator	01 hrs
 - There is no need to calculate formwork and reinforcement cost. (15 marks)
- (c) It is required to prepare a plan for a small land plot with a small house.
- Describe how the above land is surveyed using chain surveying with only one triangle. (20 marks)
 - Describe **two** advantages if the theodolite surveying method is used instead of the chain surveying method for the survey of (c)(i). (10 marks)

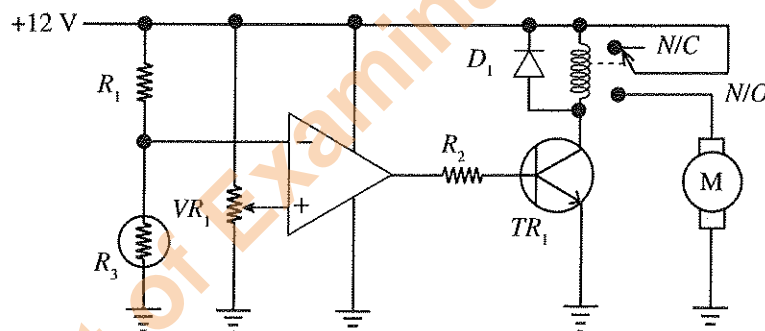
- (d) Figure shows a field record of a survey carried out to determine the area of a polygonal-shaped land. In this survey, measurements have been taken to boundary points A , B , C , D and E of the land. Only one survey line has been used for this survey. Sketch a diagram of the land and calculate the area of it. (20 marks)



Part C - Essay (Electrical and Electronic Technology)

7. (a) (i) Draw a labelled diagram to illustrate how the field and armature coils are connected in a direct-current series motor. (10 marks)
- (ii) Using characteristic curves, explain why direct-current series motors are **not** used in applications where there is a possibility for the loads to get disconnected. (10 marks)
- (b) A commercially used washing machine has rated values indicated as 400 V, 50 Hz. When the machine is operating at its maximum power, a current of 5 A flows in each of the windings of its motor.
- (i) What is the type of motor that could be used in this washing machine? (10 marks)
- (ii) The motor of the washing machine has to be operated at different speeds. What is the speed control method that could be used in the motor you suggested in (b)(i)? (10 marks)
- (iii) If the motor has six poles and connected to a supply having the rated frequency, what is the synchronous speed developed in the stator? (10 marks)
- (iv) If the resistance of one phase winding of the motor used in the washing machine is 0.3Ω , calculate the total power loss in the windings when the motor is operating at its maximum power. (20 marks)
- (v) If the motor operated for 30 minutes at its maximum power, calculate how many units of electricity are wasted due to power loss in the windings of the motor. (20 marks)
- (c) On a rainy day, the power supply of a house got disconnected due to operation of the Residual Current Circuit Breaker (RCCB) of the house. The house owner did the following tests to identify the fault and observed the following:
- When all miniature circuit breakers (MCB) were switched to “OFF” position and RCCB turned to “ON” position, it remained at “ON” position.
 - When RCCB was kept at “ON” position and as soon as any MCBs was turned to “ON” position, the RCCB comes to “OFF” position.
- Based on the above observations, state the fault of the electric circuit of the house and explain the reasons for your conclusions. (10 marks)

8. (a) (i) Draw the diode characteristic curve for a rectifier diode and mark and label the important voltages on it. (05 marks)
- (ii) Draw the diode arrangement in a bridge rectifier circuit. (02 marks)
- (iii) For making a direct current power supply, you are given a 230 V/12 V transformer, a bridge rectifier and a capacitor.
- (I) Draw a circuit diagram to show how a rectifier circuit is made using the given transformer and the bridge rectifier. (05 marks)
- (II) Draw the input and output voltage waveforms of the bridge rectifier circuit, when (a)(iii)(I) circuit is connected to a domestic power supply. (06 marks)
- (III) **Redraw** the above circuit to show how the given capacitor is connected with the circuit of part (a)(iii)(I) for smoothing output voltage wave of the circuit. (05 marks)
- (IV) After connecting the capacitor, draw the voltage waveform of the output power supply. (06 marks)
- (V) A load was connected to the direct current power supply made above. Assuming that the value of the given capacitor is small, draw how the output waveform is changed from the waveform given in (a)(iii)(IV), after the load connected to the supply is increased. (06 marks)
- (b) The circuit shows a heat sensitive switch which is used to control a cooling fan for controlling temperature. R_3 is a thermistor. It is a temperature sensitive resistor where resistance decreases when temperature increases (Negative temperature coefficient-NTC).



- (i) Describe the functions of following components in the circuit.
- (I) VR_1 variable resistor (05 marks)
- (II) Series combination of R_1 resistor and R_3 thermistor (05 marks)
- (III) Operational amplifier (05 marks)
- (IV) D_1 diode (05 marks)
- (V) R_2 resistor (05 marks)
- (ii) Explain the operating regions of the transistor with respect to temperature sensed by the thermistor. (20 marks)
- (iii) Assuming that the output voltage of the operational amplifier can go up to supply voltage and the transistor is silicon, calculate the R_2 resistance to limit the maximum base current to $100\mu\text{A}$. (20 marks)

Part D - Essay (Mechanical Technology)

9.(a) In order to maintain a high efficiency in an engine, intake and exhaust valves should be actuated at the correct moments.

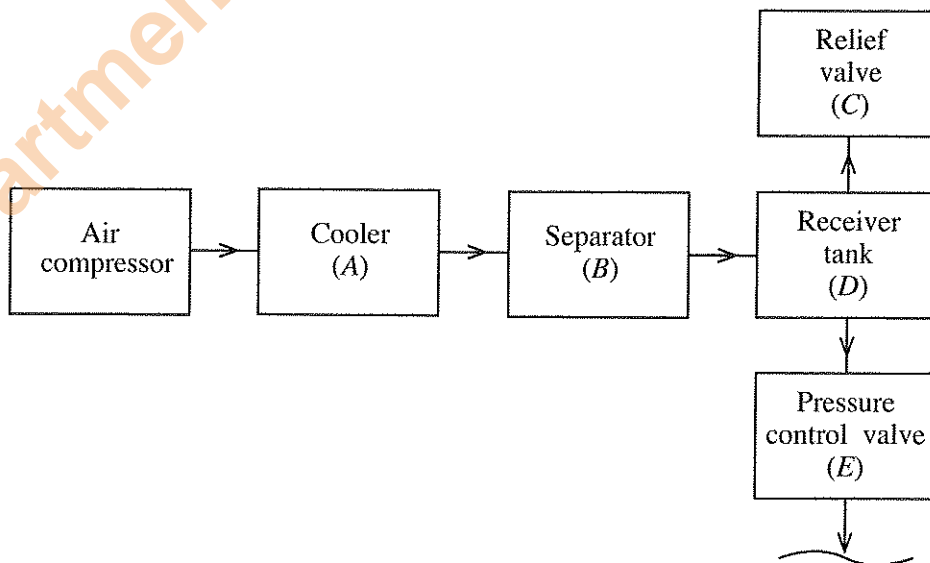
- (i) Sketch **three** valve actuating mechanisms found in motor car engines and label the major components. (15 marks)
- (ii) Draw a valve timing diagram for a four-stroke spark-ignition engine and mark the following:
 - Top Dead Center (TDC)
 - Bottom Dead Center (BDC)
 - Intake Valve Opening (IVO)
 - Intake Valve Closing (IVC)
 - Exhaust Valve Opening (EVO)
 - Valve Overlap Period (VOP)
 - Intake Valve Open Period (IVOP)
 - Exhaust Valve Open Period (EVOP)
 - Spark Release Position (SR)
 - Fuel Injection Start (FIS)

(20 marks)

(b) Radiator and intercooler are used as components of heat exchangers in motor vehicles.

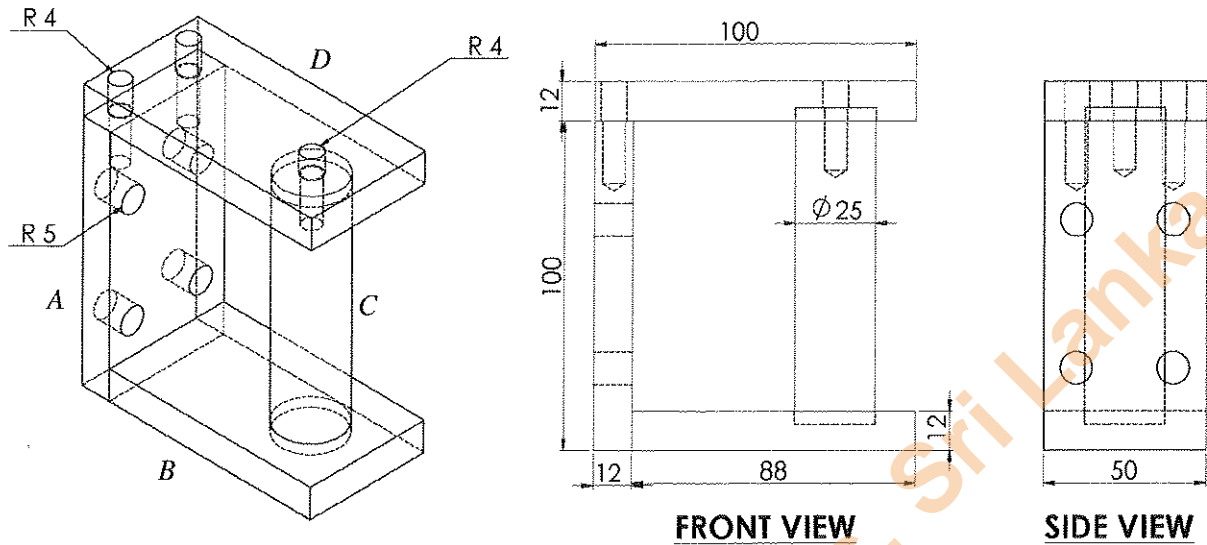
- (i) It was observed that gas bubbles were coming out through the coolant in a radiator of a motor vehicle and the coolant temperature was also observed to be unusually high. State a possible engine fault leading to each of these observations and explain how observed phenomena are caused by the fault mentioned above. (20 marks)
- (ii) Intercoolers are often used with turbo chargers in motor vehicles. Explain giving technological reasons, why an intercooler is required and describe how it affects the engine performance. (20 marks)

(c) Compressed air is often used for various purposes. The block diagram in the figure shows a part of a compressed air system with equipment labelled as A, B, C, D and E. Briefly explain with technological reasons, why each of these equipment from A to E is needed in the particular location of the system.



(25 marks)

10. Figure shows a bracket which is produced by assembling four parts *A*, *B*, *C* and *D* made of steel bars of square section 100 mm × 100 mm, for fixing a gate to concrete posts.



- (i) If a large steel sheet of thickness 12 mm is supplied, list the instruments used for marking out a section to be cut off for producing the part *A*.
Assuming that Oxy-Acetylene cutting flame is used for cutting the section, write down suitable dimensions of the rectangular section to be marked out. (15 marks)
- (ii) Name **three** machines that can be used for producing part *A* with the correct final length and width and state **one** advantage and **one** disadvantage relevant to the quality of the part when finished by each machine. (15 marks)
- (iii) Describe how to mark out and produce the four holes of 10 mm diameter in part *A* stating the instruments, machines, equipment and tools. Name **two** other types of machines that can be used for producing these holes. (15 marks)
- (iv) State step by step, the process of producing the screw bolt holes of diameter 8 mm in the top surface of part *A* mentioning the instruments, machines, equipment and tools. (15 marks)
- (v) State step by step, the production process of cylindrical part *C* using a rod of steel with diameter 26 mm and length 200 mm stating the instruments, machines, equipment and tools. (25 marks)
- (vi) State a method for permanently assembling parts *B* and *C* and write the main steps of the process of assembly using the stated method. (15 marks)

Question No. : 6 (a)

Index No. :

T	D	S	Description

T	D	S	Description

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