

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 කல்පික පත්‍ර (උසස් පෙළ) විභාගය, 2016 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2016 ஓகஸ்ட்
General Certificate of Education (Adv. Level) Examination, August 2016

විදුලිය, ඉලෙක්ට්‍රොනික හා තොරතුරු තාක්ෂණවේදය I
 மின், இலத்திரன், தகவல் தொழினுட்பவியல் I
Electrical, Electronic and Information Technology I

16 E I

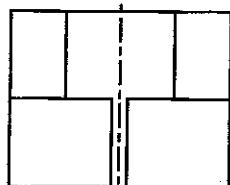
පැය දෙකයි
 இரண்டு மணித்தியாலம்
Two hours

Instructions:

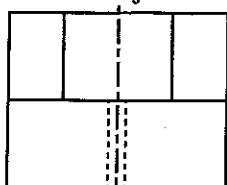
- * Answer **all** the questions.
- * Write your **Index Number** in the space provided in the answer sheet.
- * Use of calculators is not allowed.
- * Instructions are given on the back of the answer sheet. Follow those carefully.
- * In each of the questions 1 to 50, pick one of the alternatives from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

1. The drag force acting on a free falling sphere in a fluid, is expressed as $F = 6\pi\eta aV$, where a is the sphere radius, V is the terminal velocity and η is the absolute viscosity. The SI units of η are
 (1) Pa.s (2) Poise (3) m^2s^{-1} (4) m^2s (5) Nm
2. Density of water at room temperature is found to be $62.4 \text{ lb}_f/\text{ft}^3$. Unit weight of water is given as 9.81 kN/m^3 . 1 psi pressure is equal to
 (1) 1.0 kPa (2) 4.1 kPa (3) 5.8 kPa (4) 6.9 kPa (5) 7.2 kPa
3. Certain safety measures for cyclists are suggested below.
 A - Adjust seat to ensure comfort and efficient pedalling.
 B - Check to ensure uneven wear in brake shoes.
 C - Determine tyre pressure based on the weight of rider.
 D - Use a side mirror to look behind, before changing course.
 As a cyclist, which safety measures you would consider taking in order to prevent injury during riding?
 (1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
 (4) B, C and D only. (5) A, B, C and D all.
4. Alum is a chemical compound used in swimming pools and water purification plants. The specific compound of hydrated Potassium Aluminium Sulphate (ie. Potassium Alum) has the formula $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. Consider the following statements regarding Alum:
 A - It is a crystallized solid at room temperature.
 B - It is used in water purification, in order to cause negatively charged particles to flocculate.
 C - It also acts as a disinfectant that removes bacteria from water.
 D - It is highly soluble in water.
 Which of the above statements are true?
 (1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
 (4) B, C and D only. (5) A, B, C and D all.
5. A person has purchased a three-wheeler on credit obtained from a finance company. He intends to serve his semi-urban community, and a few retail outlets in his neighbourhood. Which of the following decisions demonstrate his entrepreneurship traits?
 A - Serve two regular customers to transport their children to the National school (Destination being 3 km away).
 B - Use mobile phone to network with fellow drivers
 C - Offer a discounted rate to regular customers
 D - Use mobile phone to secure night-time hires
 (1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
 (4) B, C and D only. (5) A, B, C and D all.

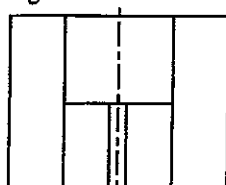
6. Select the correct elevation of the object when looking from direction A.



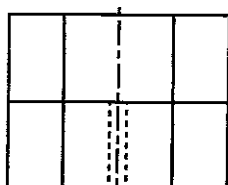
(1)



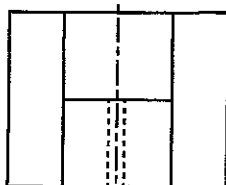
(2)



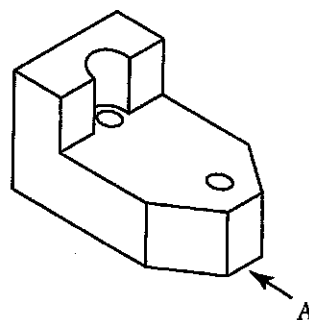
(3)



(4)



(5)



7. Figures 1 and 2 show velocity-time graphs for two projections of a ball. Select the response which gives the most relevant projection. Neglect the air resistance and other relevant resistances.

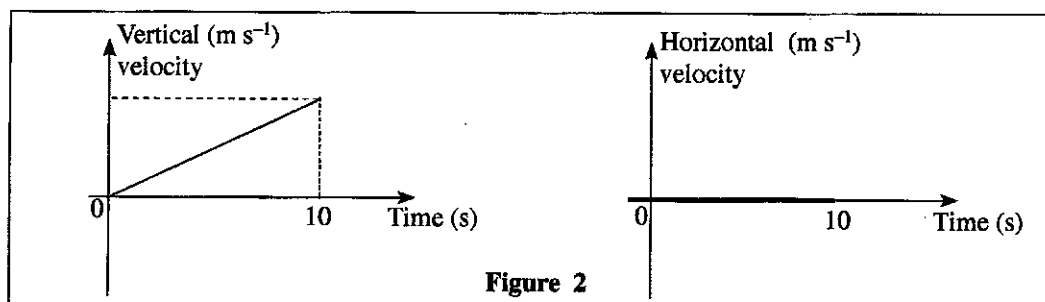
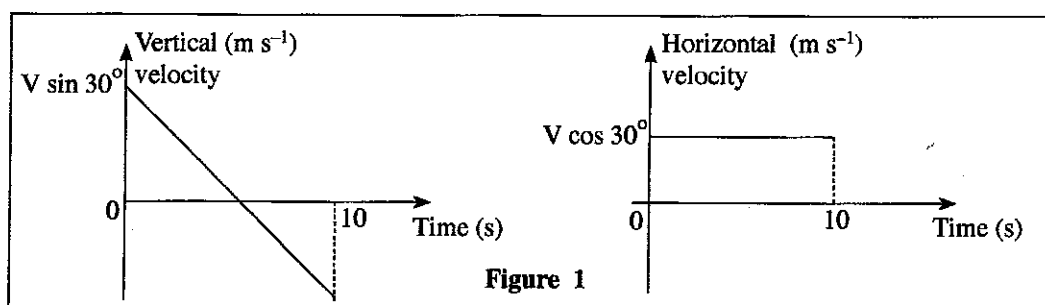
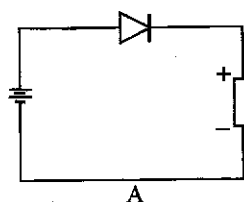
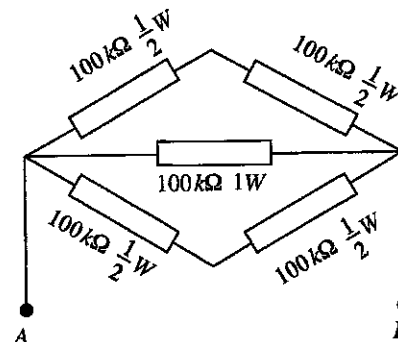


	Figure 1	Figure 2
(1)	Projection of a ball from velocity V at an angle 30° to a horizontal plane	Projection of a ball along a horizontal plane
(2)	Projection of a ball along a vertical plane in upward direction	Projection of a ball from velocity V at an angle 30° to a vertical plane
(3)	Projection of a ball from velocity V at an angle 30° to a horizontal plane	Drop a ball along a vertical plane from a height
(4)	Drop a ball along a vertical plane from a height	Projection of a ball along a horizontal plane
(5)	Projection of a ball from velocity V at an angle 30° to a vertical plane	Drop a ball along a vertical plane from a height

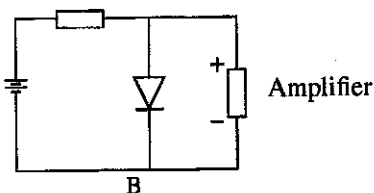
8. Wind and tidal waves are used with turbine and generator sets to convert one form of energy to another. Select the correct energy conversion involved in the process.

- (1) Mechanical energy \rightarrow electrical energy (2) Kinetic energy \rightarrow electrical energy
 (3) Potential energy \rightarrow kinetic energy (4) Potential energy \rightarrow electrical energy
 (5) Chemical energy \rightarrow electrical energy

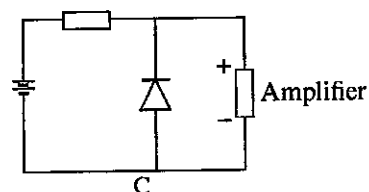
9. Which of the following statements is true about the law of conservation of energy?
- Energy cannot be created nor destroyed, but it can be converted from one form to another.
 - Energy can be created or destroyed, but it cannot be converted from one form to another.
 - Energy cannot be created nor destroyed, nor can it be converted from one form to another.
 - Energy can be created or destroyed, and it can also be converted from one form to another.
 - Energy can be created but cannot be destroyed.
10. Which of the following options given below correctly shows the energy changes involved when a television is on?
- Electrical energy \rightarrow Light and Sound energy \rightarrow Thermal energy
 - Electrical energy \rightarrow Thermal energy \rightarrow Light and Sound energy
 - Light and Sound energy \rightarrow Thermal energy \rightarrow Electrical energy
 - Thermal energy \rightarrow Light and Sound energy \rightarrow Electrical energy
 - Thermal energy \rightarrow Electrical energy \rightarrow Light and Sound energy
11. Select the proper optical arrangement for the reflector of a front head lamp of a car.
- Plane mirror
 - Plane glass
 - Concave mirror
 - Convex mirror
 - Lens arrangement
12. A 75 W incandescent lamp is installed in a house wiring circuit. It is switched on for 2 hours in the morning and for 6 hours at night. Owner decided to replace the 75 W incandescent lamp with a 15 W CFL lamp to reduce power consumption. What is the expected saving in daily power consumption?
- 480 kWh
 - 48 kWh
 - 0.48 kWh
 - 600 kWh
 - 0.6 kWh
13. A bipolar junction transistor is tested to identify whether it is working or faulty. A multimeter is switched to ohm scale and the positive testing probe is connected to the base and the negative testing probe is connected to the emitter. Then a low resistance is displayed. After interchanging the probes, a high resistance is shown. Consider the following conclusions regarding the transistor.
- It is a NPN type transistor
 - It is a PNP type transistor
 - Base-emitter junction is broken
 - Base-emitter junction is in good condition
 - Data are not sufficient to reach any conclusions.
- Select the most accurate statement/s.
- A and C only
 - B and D only
 - A and D only
 - B and C only
 - E only
14. What is the equivalent resistance and standard power values for one equivalent resistor which can be used between A and B, instead of the resistor bank?
- 200 k Ω / 2W
 - 50 k Ω / 1W
 - 50 k Ω / 2W
 - 20 k Ω / 2W
 - 120 k Ω / 2W



- A only
- B and C only

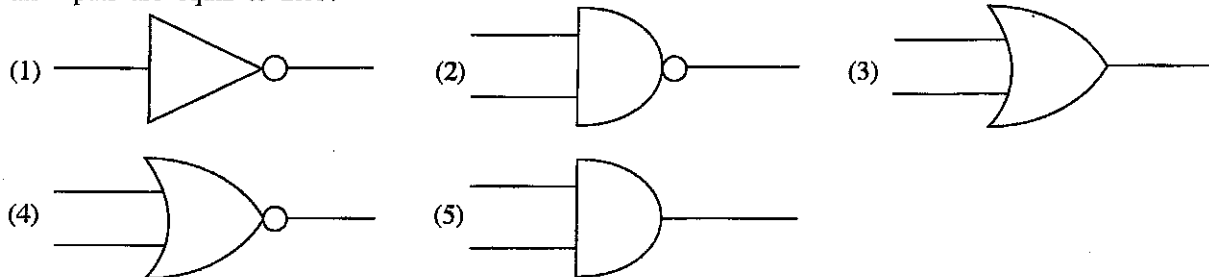


- A and B only
- A, B and C all

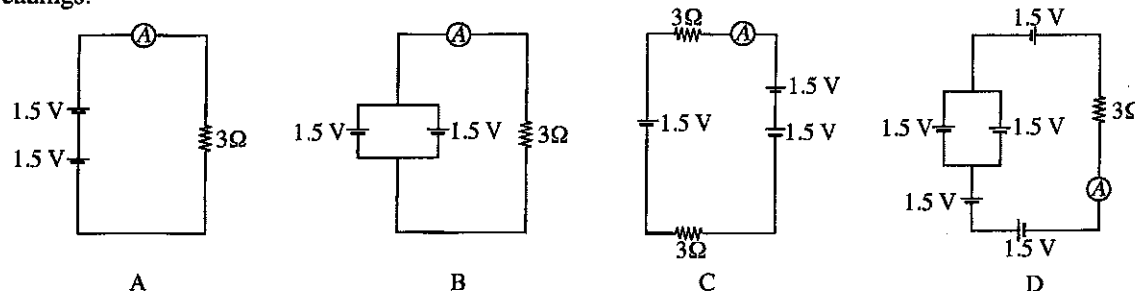


- A and C only

16. What is the symbol used for a logic gate with an output logic state equal to 0, only when logic states of all inputs are equal to zero?



17. Consider the following circuit arrangements. Select the option that gives the ascending order of ammeter readings.



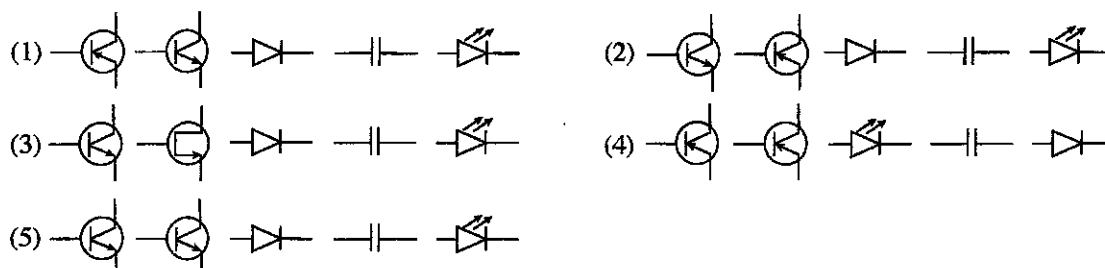
- (1) C, B, A, D (2) A, B, C, D (3) A, B, D, C (4) D, C, B, A (5) C, A, B, D

18. Select the option which gives the correct symbols for electronic components given below, in corresponding order from A to E.

A - NPN transistor
D - Capacitor

B - PNP transistor
E - Light emitting diode

C - Diode



19. Which one of the following best describe the relationship between the buoyancy force of an object submerged in a fluid?

- (1) The buoyancy force is equal to the mass of the object.
(2) The buoyancy force is equal to the weight of the fluid.
(3) The buoyancy force is equal to the mass of the fluid that the object displaces.
(4) The buoyancy force is equal to the weight of the fluid that the object displaces
(5) The buoyancy force is equal to the density of the fluid.

20. When an aeroplane is taking off passengers inside the cabin may feel a pain in their ears. This can be due to

- A - Air pressure reduction with increasing altitude.
B - Sound of the engine of the aeroplane.
C - Temperature increase with increasing altitude.
D - Reduction of the density of air with increasing altitude.

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

• Answer the questions 21 and 22, assuming $g = 10 \text{ ms}^{-2}$.

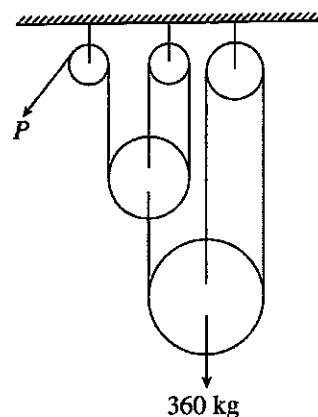
21. A train engine reaches a speed of 36 kmh^{-1} from zero velocity within 5 seconds. It weights 120 tons and the friction coefficient between its wheels and the rail track is 0.4. The generated frictional resistance is

- (1) 12 kN (2) 120 kN (3) 48 kN (4) 480 kN (5) 960 kN

22. The force generated from the engine described in question 21 is

- (1) 480 kN (2) 240 kN (3) 270 kN (4) 232 kN (5) 720 kN

23. 360 kg weight is lifted through a frictionless pulley arrangement as shown in the figure. The force to be applied at P would be



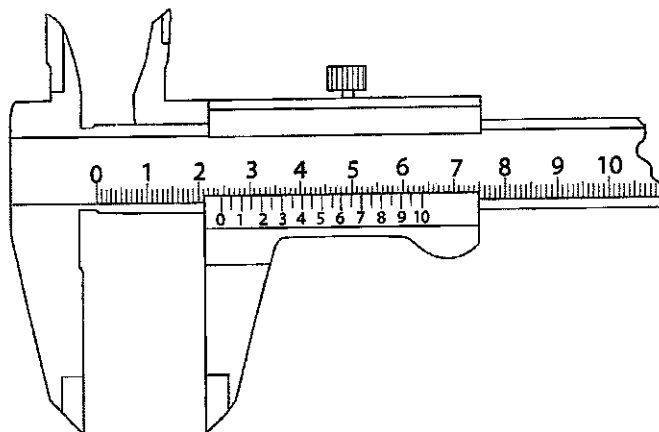
- (1) 60 kg
(2) 120 kg
(3) 40 kg
(4) 80 kg
(5) 150 kg

24. What are the correct statements regarding the friction force?

- A - The friction force between two surfaces can be increased by increasing the surface areas.
B - The friction force between two surfaces can be changed by changing the roughness of each surface.
C - The friction force is used in automobiles to carry out useful tasks.
D - By changing the roughness of two surfaces, coefficient of friction between those surfaces can be changed.

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

25. A measurement obtained from a vernier calliper is shown in the figure. What is its reading?



- (1) 3.16 cm
(2) 2.40 cm
(3) 2.16 cm
(4) 4.80 cm
(5) 2.46 cm

26. What is the component which is **not** required in installing computer networks?

- (1) Server computer
(2) Network cables
(3) Hub
(4) Switch
(5) MS office software package

27. A 5 m long conductor has a cross section of 0.1 mm^2 . The resistivity of the conductor material is $1.7 \times 10^{-8} \Omega \text{ m}$. What is the resistance of the conductor?

- (1) 0.85Ω
(2) 8.5Ω
(3) 85Ω
(4) 1.7Ω
(5) 0.17Ω

28. Consider the following statements regarding the use of information technology.

- A - The internet can be accessed by using web browsing software such as Internet Explorer.
B - Raw data can be converted to information by data processing using information technology.
C - Any web page has a unique address and the details of the web pages can be searched by using search engines such as google.

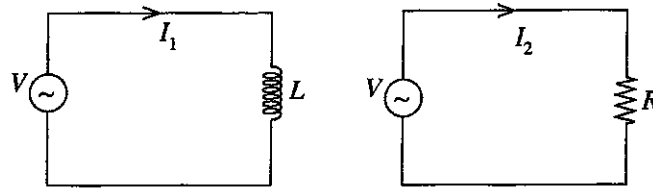
Which statement/s is/are correct?

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

29. An inductive load is connected to an AC supply of V and the load consumes I current at a power factor of $\cos \theta$. Active power consumption of the load is given by

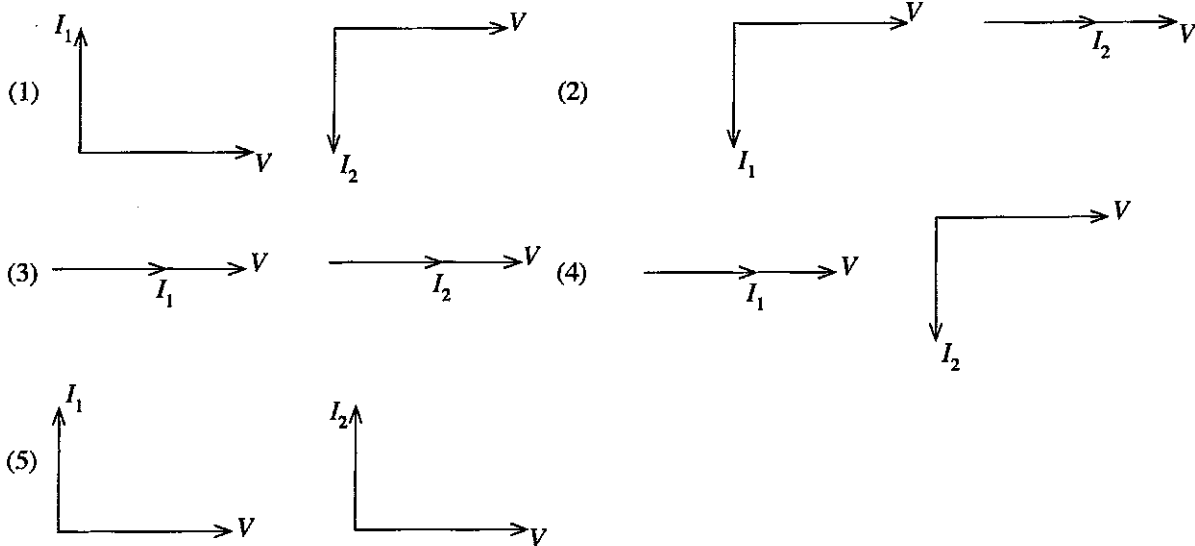
- (1) VI
(2) $VI \sin \theta$
(3) $VI \cos \theta$
(4) $\cos \theta$
(5) $VI \tan \theta$

30. Ideal inductive load and a resistor are connected to two ideal AC sources separately as in Figure.

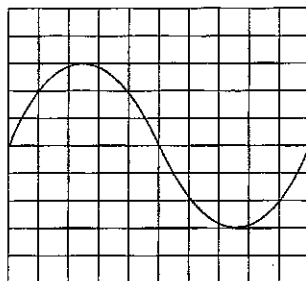


Figure

Select the answer with correct phaser representation.

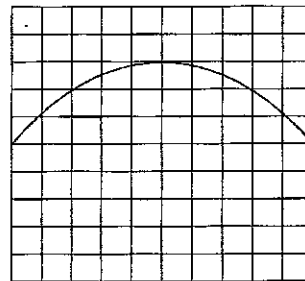


31. Following figures show two sinusoidal signals observed by an oscilloscope. Voltage magnitude scale and relevant time scales are given.



5V/div and 2ms/div

Figure 1



2V/div and 1ms/div

Figure 2

Consider the following statements regarding the measurements.

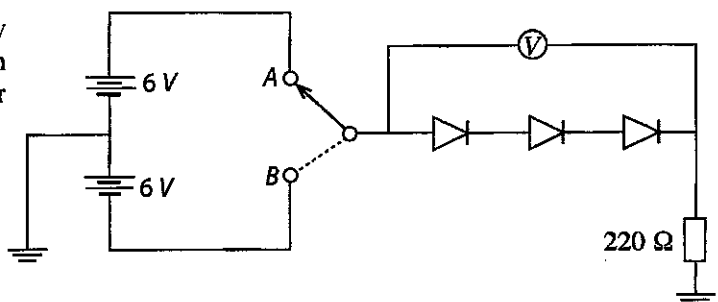
- A - Sinusoidal signals observed in figure 1 and 2 have the same frequency.
- B - Magnitude of the sinusoidal signal in figure 1 is higher than the magnitude of the signal in Figure 2.
- C - Cycle time and frequency of the sinusoidal signal in figure 1 is 20 ms and 50 Hz respectively.

Select the answer with correct statement/s.

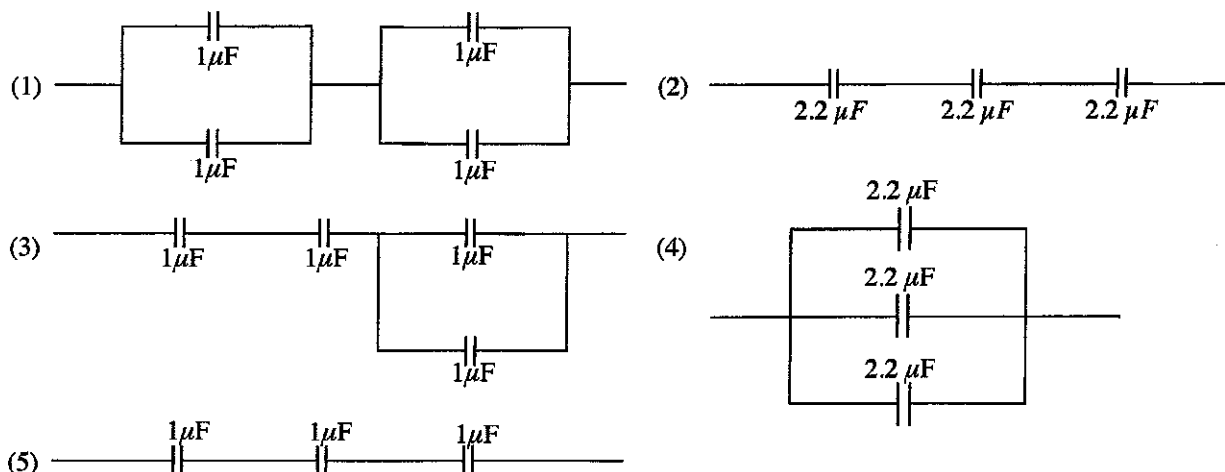
- (1) A only
- (2) B only
- (3) A and C only
- (4) B and C only
- (5) A, B, and C all

32. Consider the following circuit with a two way switch. First switch is move to A and then moved to B. What are approximate voltmeter reading in two states A and B respectively?

- (1) 1.8V, 12V
- (2) 0V, 1.8V
- (3) 6V, 1.8V
- (4) 1.8V, 6V
- (5) 0V, 6V



33. Select the capacitor network which can store highest amount of charge when it is connected to a given supply.



34. Colour code of a resistor is marked as brown, red, brown, silver. The resistance value of the resistor can be between

- (1) $100\ \Omega$ - $120\ \Omega$ (2) $90\ \Omega$ - $120\ \Omega$
 (3) $108\ \Omega$ - $132\ \Omega$ (4) $120\ \Omega$ - $132\ \Omega$
 (5) $108\ \Omega$ - $120\ \Omega$

35. What is the transformer type which is commonly used in measurement equipments as a sensor interface?

- (1) 110V/230V step up transformer
 (2) power transformer
 (3) impedance matching transformer
 (4) current transformer
 (5) 12V/230V step up transformer

36. The following statements are about the use of residual current circuit breaker (RCCB).

- A - protects from high current
 B - protects from high voltage
 C - protects from leakage currents

Select the most accurate statement/s.

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

37. Select a motor type which can be operated by both direct current (DC) and alternating current (AC) supplies.

- (1) Synchronous motor
 (2) Capacitor starter motor
 (3) Universal motor
 (4) Shaded pole motor
 (5) Shunt wound motor



38. Consider an NPN transistor which is connected to a circuit in common-emitter configuration. It is operated in active region and the collector current (I_c) is measured as 50 mA. Current gained at common-emitter configuration is 100. What is the base current (I_B)?

- (1) $50\ \mu\text{A}$ (2) $500\ \mu\text{A}$ (3) $0.5\ \mu\text{A}$ (4) $0.25\ \mu\text{A}$ (5) $250\ \mu\text{A}$

39. Select the option which includes a device/component **not** commonly used in house wiring circuits.

- (1) Residual current circuit breaker (RCCB), miniature circuit breaker (MCB), kilowatt hour (kWh) meter
 (2) Main switch, miniature circuit breaker (MCB), kilo watt hour (kWh) meter
 (3) Earth electrode, kilo watt hour (kWh) meter, 15 A socket outlet
 (4) 5 A socket outlet, residual current circuit breaker (RCCB), capacitor bank
 (5) Miniature circuit breaker (MCB), kilowatt hour (kWh) meter, residual current circuit breaker (RCCB)

40. Following tables show the specifications of two induction motors.

Induction Motor 1		Induction Motor 2	
Phase : 3 ϕ	2 kW	Phase : 3 ϕ	1 kW
Amp : 5 A	RPM : 1430	Amp : 3 A	RPM : 1700
Volt : 400 V		Volt : 400 V	
Hertz : 50 Hz		Hertz : 60 Hz	

Consider the following statements regarding the motors.

A - Both motors should be connected to 3 ϕ phase supply.

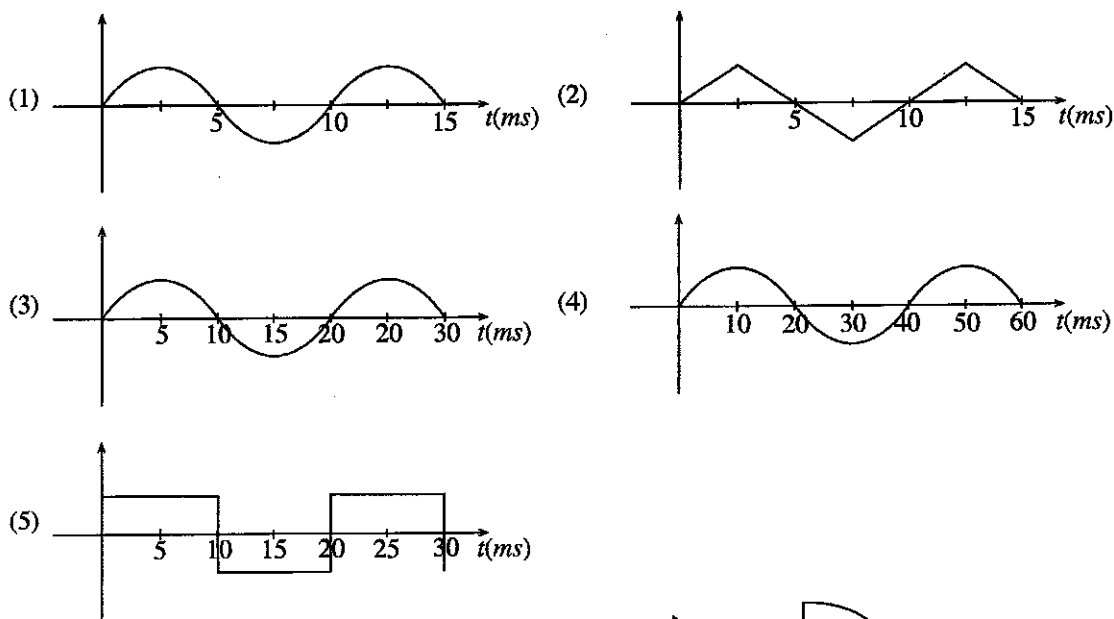
B - Terminal box of both motors should be connected as star connections.

C - Motor 1 can be used in Sri Lanka whereas the motor 2 cannot be used properly in Sri Lanka without any modification.

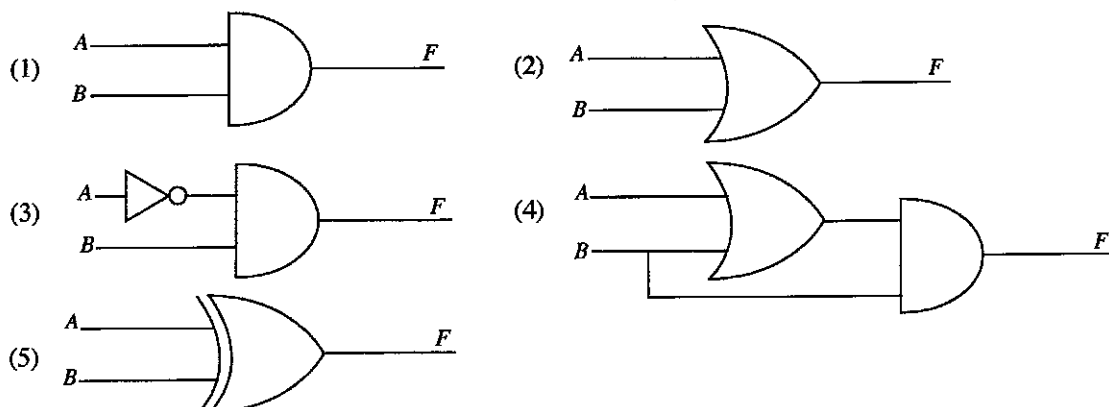
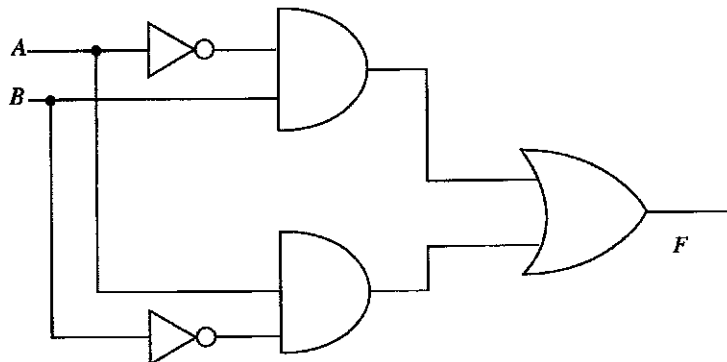
Select the most accurate statement/s regarding the motors.

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

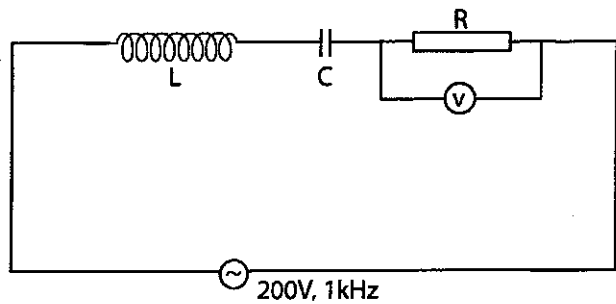
41. Select the 50 Hz sinusoidal wave form.



42. What is the equivalent logic gate circuit for the logic gate circuit shown in figure?



43. Following circuit includes pure inductor (L), Pure capacitor (C) and resistor (R). What is the reading of the voltmeter (V) when the circuit is at resonance with 1 kHz?



- (1) Higher than 200V
- (2) Lower than 200V
- (3) equal to 200V
- (4) Change with the value of R
- (5) Given data are not sufficient to determine answer

44. Minimum power dissipation and zenor voltage of a zenor diode are given as 600 mW and 6V by the manufacturer. What is the approximate volume of the allowable maximum current flow of the zenor diode?

- (1) 36 mA
- (2) 3.6 mA
- (3) 10 mA
- (4) 100 mA
- (5) 10 A

45. Select the answer which gives examples for operating system, application software, input hardware device and output hardware device of computers in the same order.

- (1) Microsoft Windows 10, Linux, mouse, joystick
- (2) Linux, Auto CAD, writing pad with pen, mouse
- (3) Microsoft Windows 10, Microsoft Office, mouse, speaker
- (4) Linux, speaker, mouse, joystick
- (5) Mouse, joystick, multimedia projector, Linux

46. Consider the following types of transmission of electro-magnetic waves.

- A - By using amplitude modulation (AM).
- B - By using frequency modulation (FM).
- C - By using very high frequency (VHF) range.
- D - By using ultra high frequency (UHF) range.

Select the type of transmission used for radio and TV signals.

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

47. Select the option with a type of power plant **not** used in the power system of Sri Lanka.

- (1) Large scale hydro power, diesel-based thermal power, solar power
- (2) Wind power, solar power, nuclear power
- (3) Small scale hydro (mini) power, wind power, coal-based thermal power
- (4) Coal-based thermal power, hydro power, wind power
- (5) Wind power, hydro power, solar power

48. Consider the following statements regarding operational amplifiers.

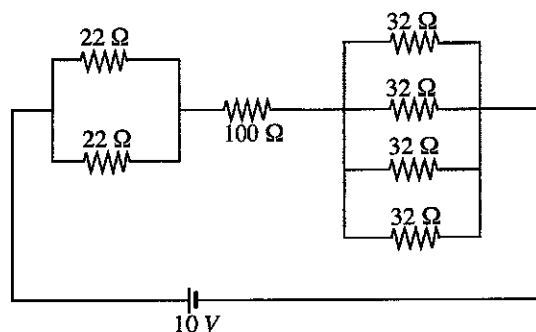
- A - Has very high bandwidth
- B - Has very low output resistance
- C - has very high voltage gain with open loop
- D - Can be used as a switch in open loop

Select the correct statement.

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

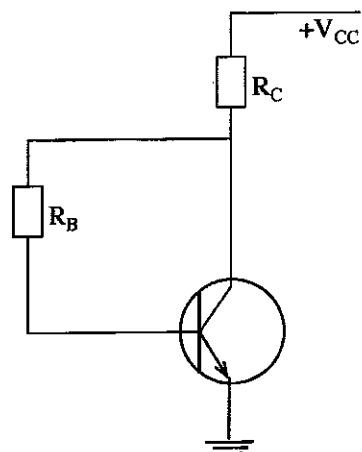
49. Suppose that the 100 Ω resistor has been disconnected due to a fault. Select the most appropriate answer with voltage across the 100 Ω , current through 100 Ω and power dissipation in 100 Ω .

- (1) 0V, 0A, 0W
- (2) 10V, 0A, 0W
- (3) 10V, 10A, 0W
- (4) 0V, 0A, 11W
- (5) 10V, 11A, 33W



50. In the following circuit, transistor is,

- (1) in fixed biased and collector current is controlled.
- (2) in fixed biased and collector current is not controlled.
- (3) self biased and collector current is controlled.
- (4) self biased and collector current is not controlled.
- (5) base resistor biased and collector current is controlled.



* * *

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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2016 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2016 ஓகஸ்ட்
General Certificate of Education (Adv. Level) Examination, August 2016

විදුලිය, ඉලෙක්ට්‍රොනික හා තොරතුරු තාක්ෂණවේදය II
 மின், இலத்திரன் தகவல் தொழினுட்பவியல் II
Electrical, Electronic and Information Technology II

16 E II

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 மூன்று மணித்தியாலம்
Three hours

Index No. :

Important :

- * This question paper consists of 12 pages.
- * This question paper comprises **Parts A, B and C**. The time allotted for **all parts** is **three hours**. (Use of calculators is **not** allowed.)

Part A - Structured Essay (08 pages)

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

Part B and C - Essay (04 pages)

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

For Examiner's Use Only

Part	Q. No.	Marks
A	1	
	2	
	3	
	4	
B	1	
	2	
	3	
C	4	
	5	
	6	
Total		
Percentage		

Final Marks

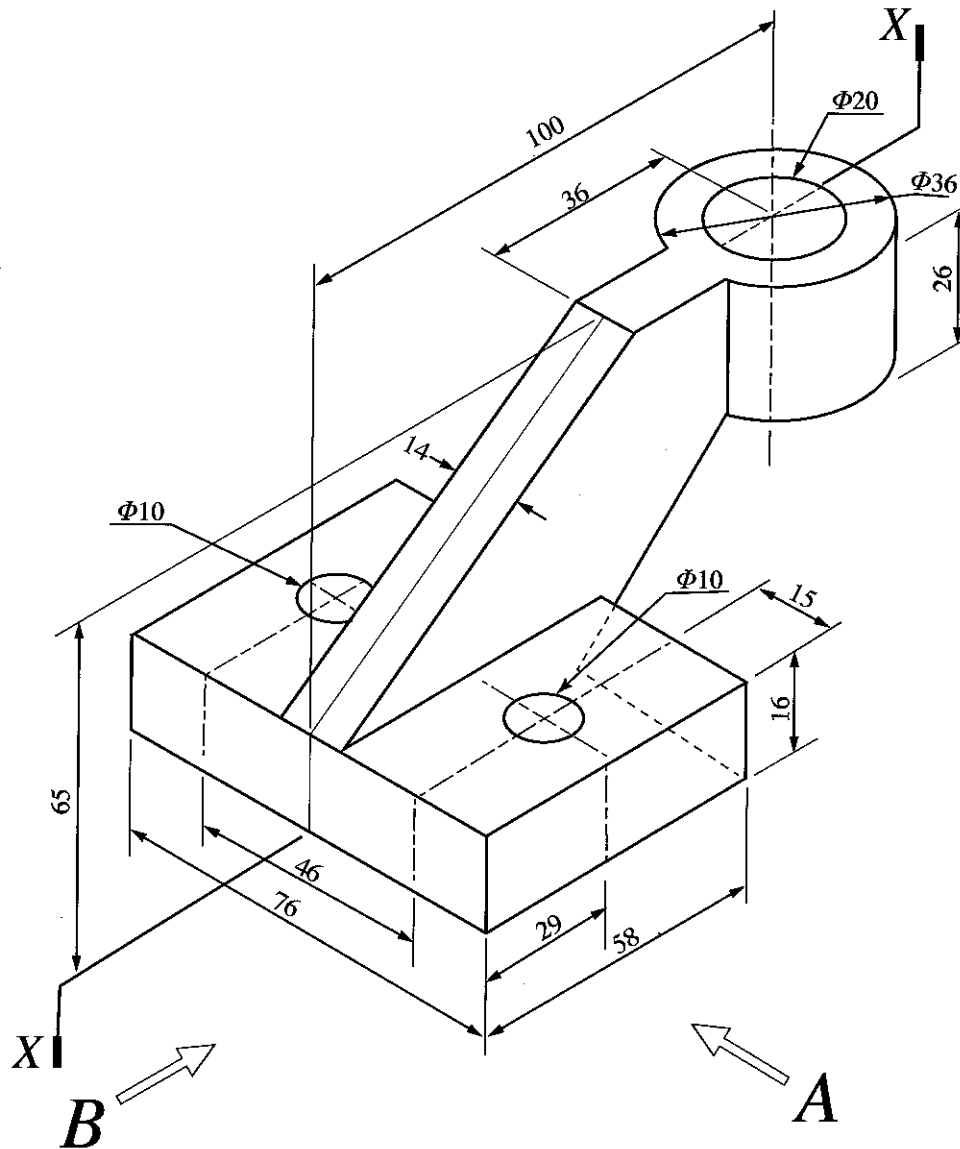
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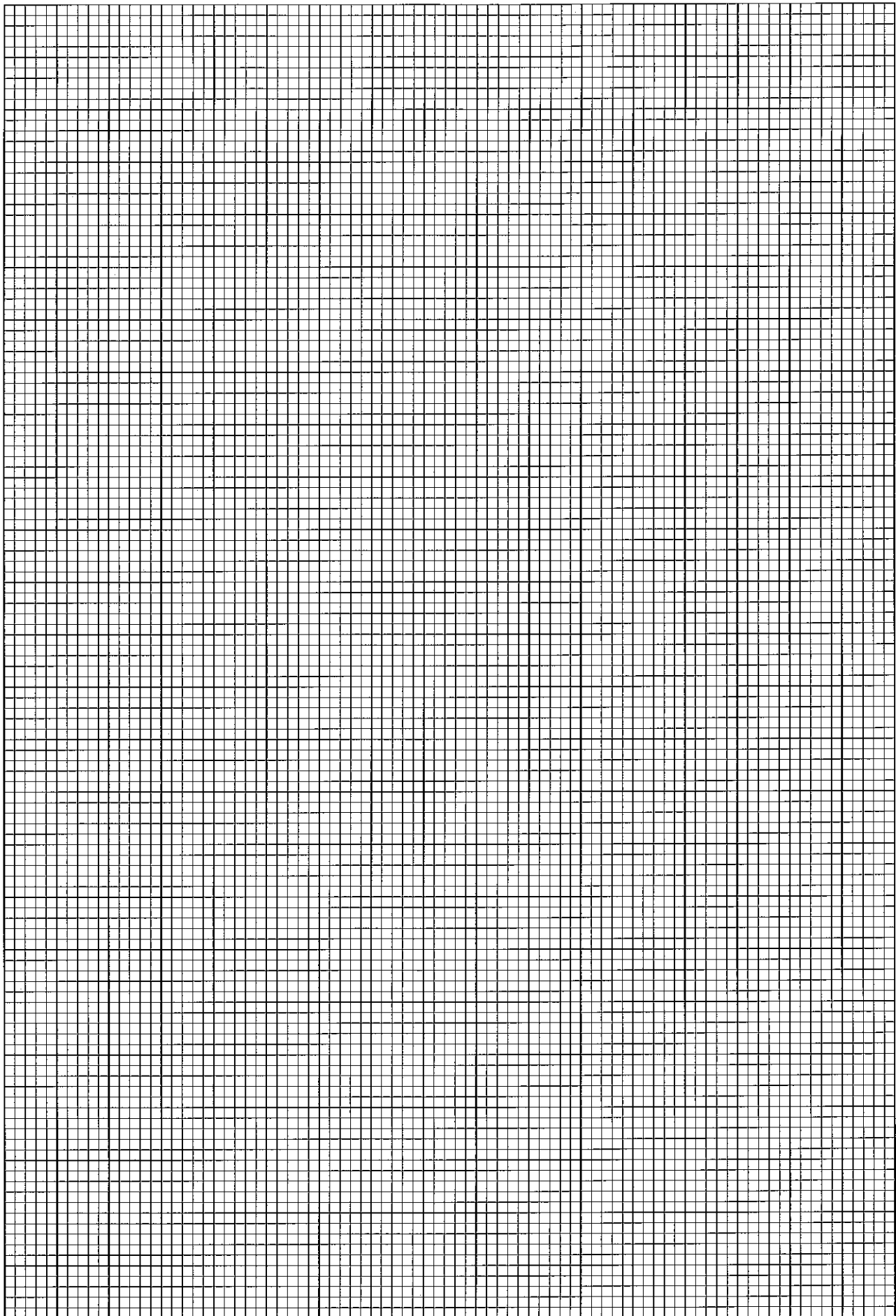
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Marking Examiner 2	
Checked by	
Supervised by	

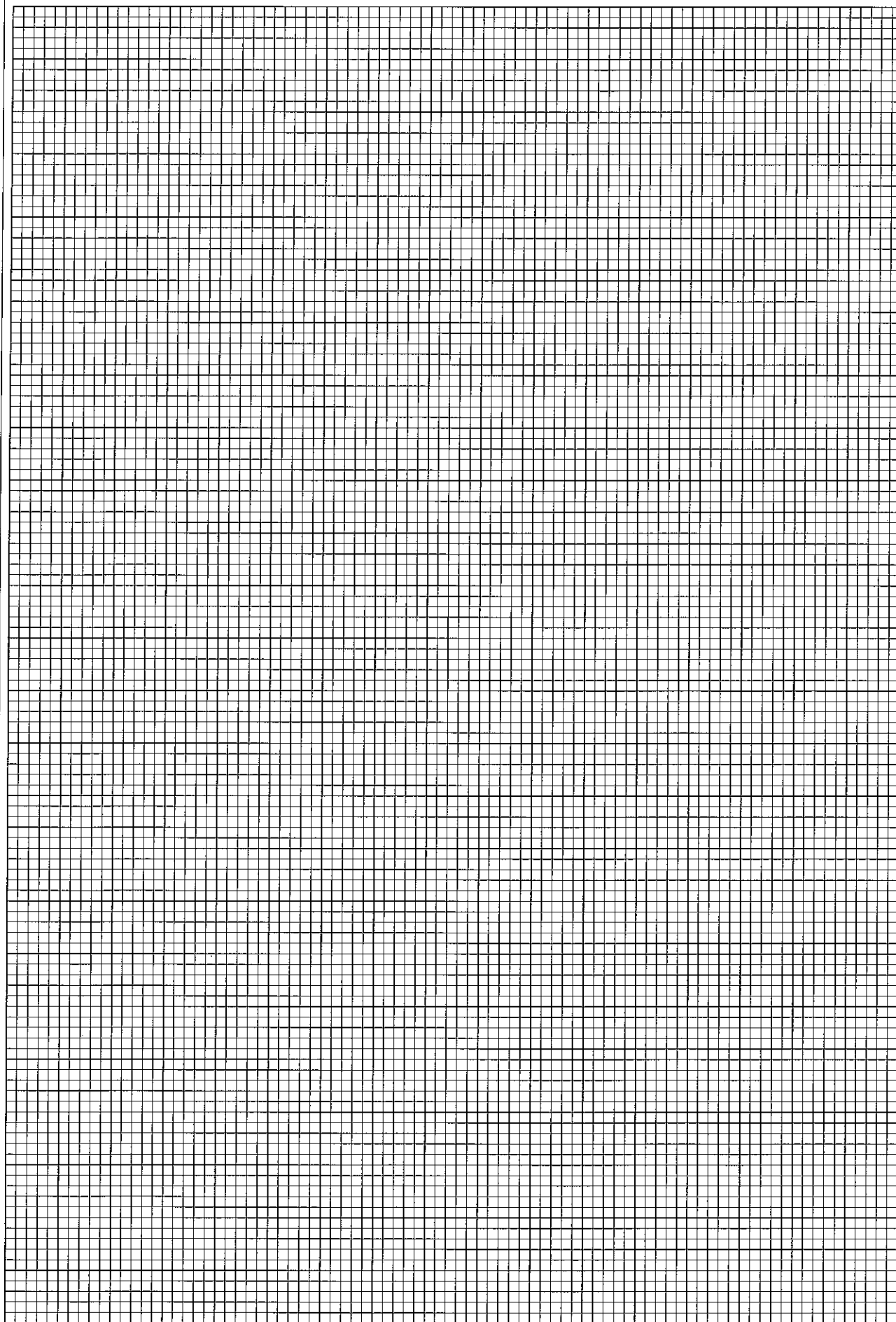
PART A – Structured EssayAnswer **all four** questions on this **paper itself**.(Each question carries **10 marks**)Do not
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1. An isometric view of a machine component is shown in Figure 1. Machine component is symmetric along the vertical plane passing through X-X. Two holes of diameter 10 mm ($\Phi 10$) pass completely through the component. Assuming any missing dimensions, draw the following views to a suitable scale using first angle projection principle. Show all relevant dimensions in the sketches. Use the graph sheets given on page 3 and 4 to answer the questions. (All dimension are in mm.)



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





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2. ABC school has a computer laboratory and a conference room. As the IT technician, you are assigned with the task to upgrade the IT facilities of the ABC school. The computer laboratory has 20 working desktop computers. It is decided to add another 30 computers to the laboratory.

(a) 10 computers will be assembled by using the components in good working conditions from computers removed from the laboratory due to various faults. Consider that the following list of components are in good working condition.

- Mother board 15 units
- Casing of the system unit with
power supply and other accessories 20 units
- RAM card 10 units
- Hard disk 15 units
- LCD monitor 15 units
- Mouse 15 units
- Keyboard 20 units
- DVD player and writer 10 units

Note: Assume that all hardware items are compatible and large stock of cables and connectors are available.

(i) Select **four** items required to assemble a basic system unit from the available list.

- (1)
- (2)
- (3)
- (4)

(ii) List another **three** hardware items required to prepare a fully functional computer in addition to the system units.

- (1)
- (2)
- (3)

(iii) Assume that these ten computer units will be used to prepare documents, presentations, create drawings and to edit pictures. List **four** softwares required to make these ten computers fully functional.

- (1)
- (2)
- (3)
- (4)

(b) Assume that ten computers have been assembled and another twenty computers have been bought. Currently computers are not connected to a computer network and no internet facilities are available.

(i) List **three** hardware items required to create a computer network of fifty computers.

- (1)
- (2)
- (3)

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- (ii) Propose a method to supply the internet facilities for the computer laboratory.

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- (c) The conference room will be renovated with multimedia facilities, facilities for video conferencing, for conducting workshops and seminars by resource persons from distance places using online facilities.

- (i) List **three** input/output hardware devices required for the computer in addition to the basic input/output devices.

(1)

(2)

(3)

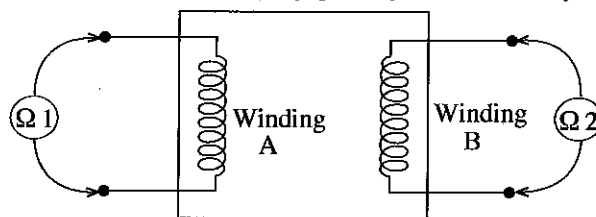
- (ii) Mention **one** specific software required for the conference room in addition to the basic application software.

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3. Following figure shows a test used for identifying primary and secondary windings of a step down transformer.



Here, reading of the Ohm meter ($\Omega 1$) is 10Ω and reading of the Ohm meter ($\Omega 2$) is 100Ω .

- (a) (i) What is the primary winding according to the above readings?

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- (ii) Give reasons for your answer in part (i).

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- (b) In above mentioned transformer, primary winding has 2000 turns and the secondary winding has 200 turns. Calculate the secondary side voltage if the primary is connected to a 230V/ 50Hz supply. Assume the transformer as an ideal transformer.

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- (c) A filament lamp with a filament resistance of 100Ω is connected to the secondary of the above transformer. Calculate the current taken by the lamp.

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- (d) List **two** applications of step down transformer.

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4. Following electrical components are given to a group of students for some experiments. A 230 V AC supply is available in the laboratory.

- Four diodes
- one 230V to 24V step down transformer.
- one 230V to 12V step down transformer.
- one 230V to 6V step down transformer.
- one capacitor of $1000\ \mu\text{F}$.
- one capacitor of $2200\ \mu\text{F}$.
- connectors and wires.

- (a) Students are given some tasks to obtain DC supplies from the available AC supply by using the given components.

- (i) Students are required to obtain approximately 5V DC supply from 230V AC. Select a suitable transformer for this.

.....

.....

- (ii) Draw a suitable circuit arrangement for obtaining DC output from AC by using only one diode, a transformer and a $1000\ \mu\text{F}$ capacitor.

- (iii) Sketch the output waveform of the circuit in part (a)(ii) above.

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column

- (b) (i) Draw the suitable circuit diagram for obtaining DC output of approximately 12V from AC supply by using four diodes, step down transformer and 1000 μF capacitor.

- (ii) Sketch the output waveform of the circuit given in part (b) (i) above.

- (iii) Mention one change that could happen in the output waveform if the capacitor is replaced with a capacitor with higher capacitance value such as 2200 μF .

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* *

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மின், இலத்திரன் தகவல் தொழினுட்பவியல் II

Electrical, Electronic and Information Technology II

16

E

II

පැය තුනයි

மூன்று மணித்தியாலம்

Three hours

Essay

* Select **two** questions from each of the **Parts B and C** and answer **four** questions only.
(Give concise answers. Sketch clear figures and label them where necessary.
(Each question carries **15** marks.)

Part B

1. Sri Lanka's most households are connected to the main electricity supply, which has been improved due to recent rural electrification projects.

(a) Lighting is a main electricity consumption need in urban homes. Now there is a trend in replacing previous CFL and incandescent lamps with LED lights for improving the efficiency and thereby reducing the electricity consumption. Consider the following details of a house.

Lighting item	Number	Power rating	Daily usage (hours)	Units consumed per month (kWh)
1) Indoor CFL lamps	05	15 W	8	
2) Indoor CFL lamps	03	10 W	6	
3) Indoor incandescent lamps	04	40 W	4	
4) Outdoor incandescent lamps	01	75 W	6	
5) Outdoor incandescent lamps	01	100 W	6	

Calculate the monthly power consumption of lighting items mentioned in the table.

(b) Owner is planning to replace existing lights with more efficient LED lamps. Following table gives a comparison of incandescent, CFL and LED lamps based on light output.

Incandescent (W)	With equivalent light output CFL (W)	With equivalent light output LED (W)
40	10	4
60	13	6
75	18	9
100	23	16

Suggest LED options for each lighting item mentioned in (a) based on the details in the table.

(c) (i) Calculate the total monthly electric energy consumption for the items mentioned in (a) in kWh with LED lamps.

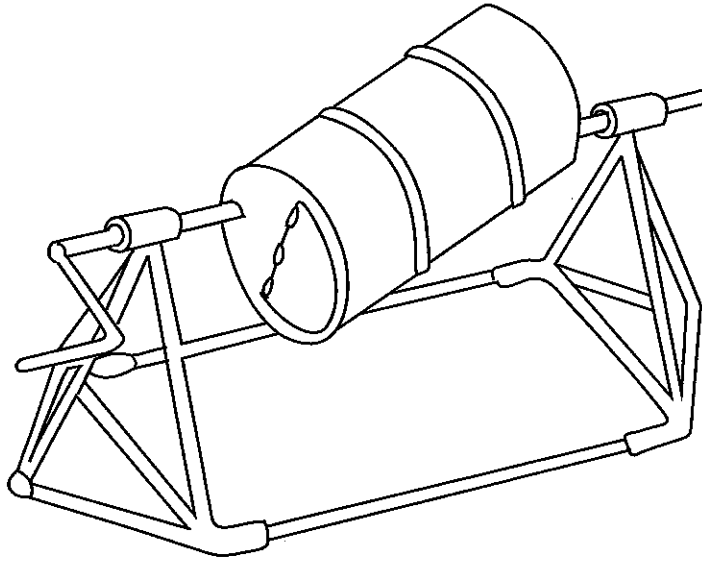
(ii) Calculate the percentage energy saving achieved by replacing the existing lighting.

(d) Initial cost of LED is high compared to CFL and incandescent lamps. However, the lifetime of LED is very much higher than CFL and incandescent lamps.

(i) Explain how you can consider these facts in selecting lamps for household application. Assume that the cost of a CFL is six times the incandescent lamp and cost of LED is 20 times the incandescent lamps. Lifetime of LED is 5 times the CFL and lifetime of CFL is 10 times the incandescent lamps.

(ii) Explain the effect of efficiency improvement if you use CFL instead of LED for selected one in part (b) by considering cost factor and the lifetime. Consider one example and justify your answer.

2. Figure shows a sketch of a home-built concrete mixer made of items that can be purchased from a general hardware store.



Suppose that your team is given the task to design and built the said device for your school building project.

- Sketch the sectional view of the rotating parts to an approximate scale, on a vertical plane passing through its rotating axis. Show details of connection between the drum and its axle, and steps taken to reduce energy loss due to friction.
 - Estimate the volume of concrete you could mix in a single batch. Explain how you have arrived at the estimated value. State any assumptions you have made in this regard.
 - Estimate the amount of torque that one has to give in order to rotate the drum, when it is mixing the quantity of concrete estimated in (b) above. Explain how you have arrived at the estimated value. State any assumptions you have made in this regard.
3. Congenital disorders, diseases, injuries and accidents have caused a considerable number of differently-abled persons living with amputated limbs, weak limbs and loss of vision, hearing or speech. Societies have now accepted the need to make their life comfortable and to facilitate them to contribute to society, to the best of their abilities. In this regard, technological innovations are playing a greater role. Select one type of disability of your choice.
- Discuss how modern technological innovations have made such individuals to be productive individuals.
 - Explain how the innovations discussed in 3(a) above, facilitates such individuals to live with their family and loved ones comfortably, rather than living in a facility dedicated to such individuals.
 - Describe instances where such individuals can contribute to their household and/or society while being differently-abled.

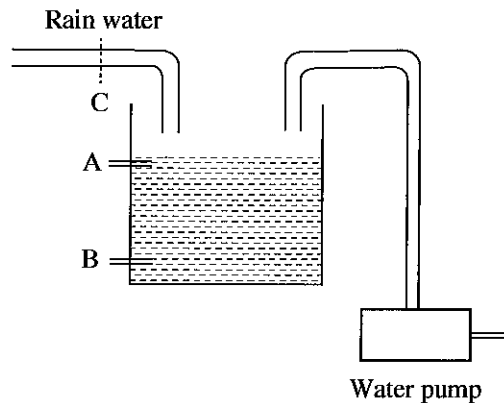
Part C

4. Water tank of a house is given in the following figure. Rainwater is used for filling the tank when the rainwater is available. When rainwater is not available, the water is pumped for filling the tank by using an electric pump. A, B and C sensors are used for following sensory inputs.

A - For detecting higher maximum water level of the tank. Logic output level is 1 when water is available to this level.

B - For detecting lower minimum water level of the tank. Logic output level is 1 when water is available to this level.

C - For detecting rain water supply. Logic output level is 1 when rain water supply is available.



The electric water pump should start pumping water when water is not available for sensor B and the water pump should stop when the water is filled and water is available to sensor A. However, electric water pump should not operate when rain water is available for filling the tank. Consider that you are assigned to design a logic circuit for this filling process.

- Prepare the truth table for the above filling process. Remove states that are **not** related from the truth table.
 - Obtain the relevant Boolean expression for the logic circuit.
 - Simplify the Boolean expression and obtain most simplified boolean expression. (Do **not** remove sensory inputs A, B and C from the expression.)
 - Draw the logic gate diagram for the Boolean expression with minimum number of logic gates.
 - Draw a circuit diagram showing the connection from output of the logic gate circuit to water pump which operates on 230V AC supply.
5. You are requested to prepare following presentation slides by using Microsoft Powerpoint for the opening ceremony of the new science laboratory.

<p style="text-align: center;">Opening of New Science Laboratory</p> <p style="text-align: center;">My School</p> <p style="text-align: center;">01 September 2016</p>

Slide 1

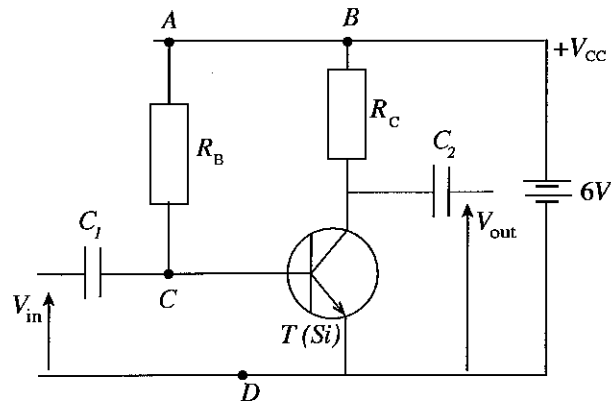
<p style="text-align: center;">New Science Laboratory</p> <p>Details of New Science Laboratory</p> <ul style="list-style-type: none"> • Facilities - <i>in Physics, Chemistry</i> • Experiments - <i>10 basic, 5 advanced</i> • Funding - <i>10 million</i> • Teachers and students support
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Slide 2

- State main steps required for preparing a new blank Powerpoint presentation and saving it as 'myschool-lab.ppt' in a new folder called 'Lab Opening' in My documents. You should create a new folder called 'Lab Opening'.

- (b) State **five** formattings done with Microsoft Powerpoint to obtain above-mentioned two slides.
- (c) Assume that you are requested to create a new slide to show two images of sections of the lab and one video of a laboratory experiment.
- Sketch a rough view of the proposed slide and name the sections.
 - State the main steps required in each formatting of the slide.
- (d) Explain how you can insert the logo of the school for the title of all the slides. Consider the easiest method for this.
- (e) State the steps required to prepare a printed version of the presentation as notes for the occasion.

6. A transistor amplifier with common-emitter configuration is shown in the following circuit.



- Explain the current gain and input of the circuit.
- Base current (I_B) is $20\mu\text{A}$ when there is no signal input through C_1 . Calculate the value of R_B for this.
- Calculate the collector current (I_C) in the situation described in (b) above by considering DC biasing current and current gain of 200.
- Circuit is changed by removing two C_1 and C_2 capacitors and by connecting light emitting diode (LED) to output and light dependant resistor (LDR) to the input so that the LED is ON in dark. Redraw the circuit as a switching circuit.
- Name **one** additional component required for controlling the above circuit with required right level.
- Consider the same circuit is modified to switch off the water pump when water level of the tank is at spill level.
 - Select from A, B, C and D points the point for connecting the wet sensor.
 - What is the additional equipment required to connect the circuit output to the electric water pump?

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