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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018**

COURSE NAME : MECHANICAL AND ELECTRICAL SYSTEM

COURSE CODE : BFC32602

PROGRAMME CODE : BFF

EXAMINATION DATE : JUNE / JULY 2018

DURATION : 2 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS.
DO NOT BRING THIS QUESTION PAPER OUT OF THE EXAMINATION HALL.

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THIS QUESTION PAPER CONSISTS OF **SIXTEEN (16) PAGES**

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SECTION A

Answer all questions in an OMR form provided (total marks = 80).

- Q1** What is the main function of the building system?
- A. To shelter the building occupants from rain, wind, snow and sun
 - B. To shelter the building occupants from harsh conditions from outside of the building
 - C. To create consistent and more productive indoor environment for the occupants
 - D. To show the living standards of the occupants and protect them from thief
- Q2** Which of the followings is **TRUE** about the scope of building operation systems?
- A. HVAC, utilities, plumbing system and fire protection system
 - B. Electrical power, lighting and communication systems
 - C. Gas pipelines, fire alarm and special systems
 - D. Building transportations, processing and special systems
- Q3** What is the most important factor that needs to be considered during the design and construction stage before deciding the types of mechanical and electrical system to be installed in a building?
- A. Global environment
 - B. Construction cost
 - C. Architectural design
 - D. Space planning
- Q4** IBMS is the short form for _____.
- A. Integrated Building Maintenance System
 - B. Integrated Building Monitoring System
 - C. Integrated Building Mechanical System
 - D. Integrated Building Management System
- Q5** Ways of heat transfer mechanisms can be grouped into 3 broad categories; conduction, convection and radiation. Heat transfer by convection happens when
- A. the kinetic energy is transferred between particles or groups of particle at the atomic level
 - B. physical movement of the molecules from one place to another in natural way due to temperature gap or density differences
 - C. energy is being transport through electromagnetic waves
 - D. two different materials in touch with each other and the component with higher temperature transferred the heat to the component with lower temperature

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- Q6** Which of the followings is **TRUE** about the temperature?
- A. A measure of rate at which work is done
 - B. The heat energy absorbed or released from a substance during a change of state, with no change of temperature
 - C. The measure of heat energy required to increase the temperature of a unit quantity of a substance by a unit of temperature
 - D. A physical properties that underlies the common nations of hot and cold
- Q7** Once the heat is extracted from a moist air, it will change the water air vapour into liquid. This process is described as _____.
- A. Radiation
 - B. Evaporation
 - C. Convection
 - D. Condensation
- Q8** A new resort will be constructed near to the Tioman beach. As an engineer, you need to advice the resort owner to choose the suitable thermal properties of wall and roofing material in order to ensure the indoor comfort of the resort. R-value is an important parameter for thermal insulation performance of wall and roofing. The comfort of indoor environment can be efficiently achieved by employing _____ insulating materials.
- A. Low R-value
 - B. High R-value
 - C. Fractional R-value
 - D. Restricted R-value
- Q9** If the indoor temperature of a multipurpose hall is increased to 45⁰C, what is the parameter that needs to take into consideration for maintaining the good human comfort inside the hall?
- A. Lowering the humidity
 - B. Limiting the circulating of the air supply
 - C. Lowering the lighting intensity
 - D. Decreasing the ventilation rate
- Q10** Which of the followings refers to the official unit of heat energy.
- A. Watt
 - B. Joule
 - C. Kilowatt
 - D. Gigajoule

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- Q11** Calculate the total thermal resistance of a typical wall of house that consists of 10 cm of brickwork ($k = 0.68 \text{ W/mK}$), 1.5cm thickness of lightweight plastering ($k = 0.18 \text{ W/mK}$) at each internal and external surface.
- A. $0.15 \text{ m}^2 \text{ K/W}$
 - B. $0.08 \text{ m}^2 \text{ K/W}$
 - C. $0.31 \text{ m}^2 \text{ K/W}$
 - D. $0.23 \text{ m}^2 \text{ K/W}$
- Q12** Calculate the U-value for a cavity wall with a 110mm thick brick outer leaf (k -value = 0.77 W/mK), 50mm of clear cavity ($0.18 \text{ m}^2 \text{ K/W}$), 40mm of insulation board (0.025 W/mK), then a 115mm high performance concrete block inner leaf (0.11 W/mK) with a 15mm layer of lightweight plaster (0.18 W/mK). Assume that the thermal resistances for the internal and external surface are $0.12 \text{ m}^2 \text{ K/W}$ and $0.06 \text{ m}^2 \text{ K/W}$.
- A. $0.34 \text{ W/m}^2 \text{ K}$
 - B. $0.32 \text{ W/ m}^2 \text{ K}$
 - C. $0.30 \text{ W/ m}^2 \text{ K}$
 - D. $0.31 \text{ W/ m}^2 \text{ K}$
- Q13** Based on the **FIGURE Q13**, calculate U-value for 250mm thick reinforced concrete beam with 8mm thick glass cladding at outside surface. Given k -value for glass cladding is 1.053 W/mK , air gap is 0.16 W/mK and RC beam is 1.442 W/mK . Assume that the outer surface (o/s) resistances is $0.044 \text{ m}^2 \text{ K/W}$ and the inner surface (i/s) resistances is $0.123 \text{ m}^2 \text{ K/W}$.
- A. $1.960 \text{ W / m}^2 \text{ K}$
 - B. 1.960 m /WK
 - C. $1.969 \text{ W / m}^2 \text{ K}$
 - D. 1.969 W/ m K
- Q14** What is the best orientation for the buildings in Malaysia in maximizing the natural ventilation while minimizing the sun's radiation?
- A. The building longest wall is placed off the cardinal (north-south) direction approximately 30 degrees.
 - B. The building longest wall is placed off the cardinal (east-west) direction approximately 30 degrees.
 - C. The building shortest wall is placed off the cardinal (north-south) direction approximately 30 degrees.
 - D. The building shortest wall is placed off the cardinal (east-west) direction approximately 30 degrees.

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- Q15** Perfect ventilation highly depends on the following factors, **EXCEPT**
- A. Floor area
 - B. Relative humidity
 - C. Air purity
 - D. Air temperature
- Q16** During winter season, the stack effect driven the warmer air inside the building to _____ area and creates the negative indoor pressure at the _____ area which then filled by the colder air from the outside of the building.
- A. upper, upper
 - B. bottom, upper
 - C. upper, bottom
 - D. bottom, bottom
- Q17** Which of the followings are **TRUE** about the types of fire fighting agent required for fires involving combustible metals, such as sodium, magnesium, and potassium?
- I. Water
 - II. Halon
 - III. CO₂
 - IV. Dry Chemical Powder
- A. All of the above
 - B. II and III
 - C. I, III and IV
 - D. IV only
- Q18** All of the followings are examples of passive fire protection, **EXCEPT**
- A. Building utilization
 - B. Compartmentation
 - C. Portable fire extinguisher
 - D. Mean of escape

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Q19 An escape route or an exit route is a continuous and non-obstructed path of exit travel from any point within a workplace to a safety place. What are the factors that influence the design and construction of the exit routes?

- I. Exit routes must be permanent parts of the workplace
- II. Exit discharges must lead directly outside
- III. Exit route doors must be unlocked from the inside
- IV. Side-hinged exit doors must be used to connect rooms to exit routes

- A. All of the above
- B. II and III
- C. I, III and IV
- D. IV only

Q20 Which of the followings are **TRUE** about the requirements of the exit?

- I. Exits must be separated by fire resistant materials
- II. Exits are permitted to have only those openings necessary to allow access to the exit from occupied areas of the workplace
- III. Objects that project into the exit must reduce its width
- IV. Openings must be protected by a self-closing, approved fire door that remains closed or automatically closes in an emergency

- A. All of the above
- B. II and III
- C. I, II and IV
- D. IV only

Q21 Which of the followings are **NOT TRUE** about good building design with fire safety measure?

- I. Provide adequate fire appliances, fire hydrants and other facilities to assist fire and rescue personnel
- II. Designing, constructing the exterior of a building so that the fire likely to spread to it from another burning building
- III. Selecting materials for the construction which will promote the spread of fire or generates hazardous smokes.
- IV. Designing, providing adequate and safe escape route for the occupants of the building

- A. All of the above
- B. II and III
- C. I, II and IV
- D. IV only



Q22 What is the difference between escalator and walkalator?

- I. Escalator is a vertical transport equipment that efficiently moves people or goods between floors of a building, vessel or other structure meanwhile walkalator is a slow moving conveyor mechanism that transports people, across a horizontal or inclined plane, over a short to medium distance.
- II. Escalator is a conveyor transport device for carrying people between floors of a building meanwhile walkalator is a slow moving conveyor mechanism that transports people, across a horizontal or inclined plane, over a short to medium distance.
- III. Escalator is a conveyor transport device for carrying people between floors of a building with maximum angle of inclination of the horizontal floor level is 30 degrees meanwhile walkalator is a slow moving conveyor mechanism that transports people, across a horizontal or inclined plane, over a short to medium distance with the steps lay flat
- IV. Escalator is a slow moving conveyor mechanism that transports people, across a horizontal or inclined plane, over a short to medium distance, meanwhile walkalator is a vertical transport equipment that efficiently moves people or goods between floors of a building, vessel or other structure.

- A. All of the above
- B. II and III
- C. I, II and IV
- D. III and IV

Q23 The followings are the advantages of the hydraulic elevators, **EXCEPT?**

- I. Eliminating rooftop structure
- II. No pulleys of driving sheave
- III. Large machine room and can be located at some distance from the shaft
- IV. Acceleration and travel is very smooth

- A. All of the above
- B. I only
- C. III only
- D. II and IV

Q24 Electricity is a basic part of nature and it is one of the most widely used forms of energy. Which of the followings are classified as renewable energy?

- I. Wind power and solar power
- II. Hydropower and coal power plant
- III. Petroleum and natural gas
- IV. Nuclear power and wind power

- A. None of the above
- B. All of the above
- C. I only
- D. IV only



Q25 All of the followings are **TRUE** about three phase power supply, **EXCEPT**?

- I. The cost of a three-phase distribution network is cheaper
- II. It is used to power large motors and other large loads
- III. Widely used especially in rural areas
- IV. The delay between phases has the effect of giving constant power transfer over each cycle of the current

- A. I only
- B. I, II and III
- C. I and III
- D. II and IV

Q26 In an electric power system, overcurrent or excess current is a situation where a larger intended electric current exists through a conductor, leading to excessive generation of heat, and the risk of fire or damage to equipment. What are the causes of the overcurrent?

- I. Incorrect design
- II. Ground fault
- III. Short circuits
- IV. Excessive load

- A. I only
- B. I, II
- C. I, II and III
- D. All of the above

Q27 All of the followings are examples of commonly used protection mechanisms to control the risks of overcurrent, **EXCEPT**

- I. Temperature sensors
- II. Short circuits
- III. Current limiters
- IV. Circuit breakers

- A. I and IV
- B. I and II
- C. I, III and IV
- D. II, III and IV

Q28 Which of the following personal protective equipment (PPE) should be worn when working with electricity?

- A. Metal hard hat and insulated gloves and clothing
- B. Non-metallic hard hat and insulated gloves and clothing
- C. Non-metallic hard hat and non-insulated gloves and clothing
- D. Metal hard hat and non-insulated gloves and clothing

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Q29 Which of the followings is **NOT TRUE** about the issues of electrical safety in a buildings?

- I. Injury or damage resulting from contact with blunt edges or corners, moving parts, vibration or physical instability
- II. Fire is normally considered as a secondary effect from overload, abnormal operating conditions, or fault in some system component
- III. This is the shock hazard resulting from the passage of electric current through the human body
- IV. Burns can be caused when metallic objects get very hot or melt and splash when they bridge sources with high volt-ampere (VA) potential

- A. I only
- B. I and II
- C. III and IV
- D. IV only

Q30 Based on the **FIGURE Q30**, find the total resistance of the circuit.

- A. 0.071 k Ω
- B. 1.283 k Ω
- C. 3.214 k Ω
- D. 5.033 k Ω

Q31 The treated water supplied by a public water system should meet all the following requirements, **EXCEPT**

- A. Pleasant to taste
- B. Moderately hard
- C. Moderate amount of suspended matter
- D. Free of harmful impurities

Q32 The water supply company is responsible to deliver treated water of proper quantity only as far as the _____.

- A. Entry point of the communication pipe system
- B. End point of the distribution pipe system
- C. Customer's service pipe connection
- D. Consumer's tap inside the house

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Q33 What is the difference between direct and indirect water supply system?

- I. Direct supply system conveys water directly from water mains to water taps without any transit to the water storage while for indirect system the water from water mains directly feeds storage tank and at least one water tap at the kitchen sink.
- II. Supply of potable water for direct system is from the water mains while for indirect system from the water storage
- III. One of the disadvantages of direct system is the risk of contamination directly from the water mains which is not a problem for indirect system
- IV. Indirect system is suitable for high rise building while direct system is suitable for low rise building

- | | |
|------------------|---------------------|
| A. I, II and III | C. II, III and IV |
| B. I, III and IV | D. All of the above |

Q34 Propose which of the following(s) is/are potential building(s) to be fitted with cold water system as shown in **FIGURE Q34**?

- I. Terrace house
- II. 3 storeys bungalow
- III. 9 storeys apartment
- IV. 12 storeys hotel

- | | |
|-------------|---------------|
| A. I only | C. III and IV |
| B. I and II | D. IV only |

Q35 A three-storey bungalow project is under going construction. Arrange the following activities in correct sequence to carryout plumbing system fitting for direct hot water system in the bungalow.

- I. Water from raising main to the distribution pipe
- II. Drinking water to the kitchen
- III. Water from service pipe to the rising main
- IV. Cold feed pipe to the toilet and boiler
- V. Water from communication pipe to the service pipe
- VI. Water from the boiler to the kitchen and bathroom

- | | |
|-------------------------------|-------------------------------|
| A. V → III → I → II → IV → VI | C. III → I → IV → V → II → VI |
| B. I → V → II → III → IV → VI | D. I → II → V → III → IV → VI |

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Q36 to Q38 are based on the diagram below:

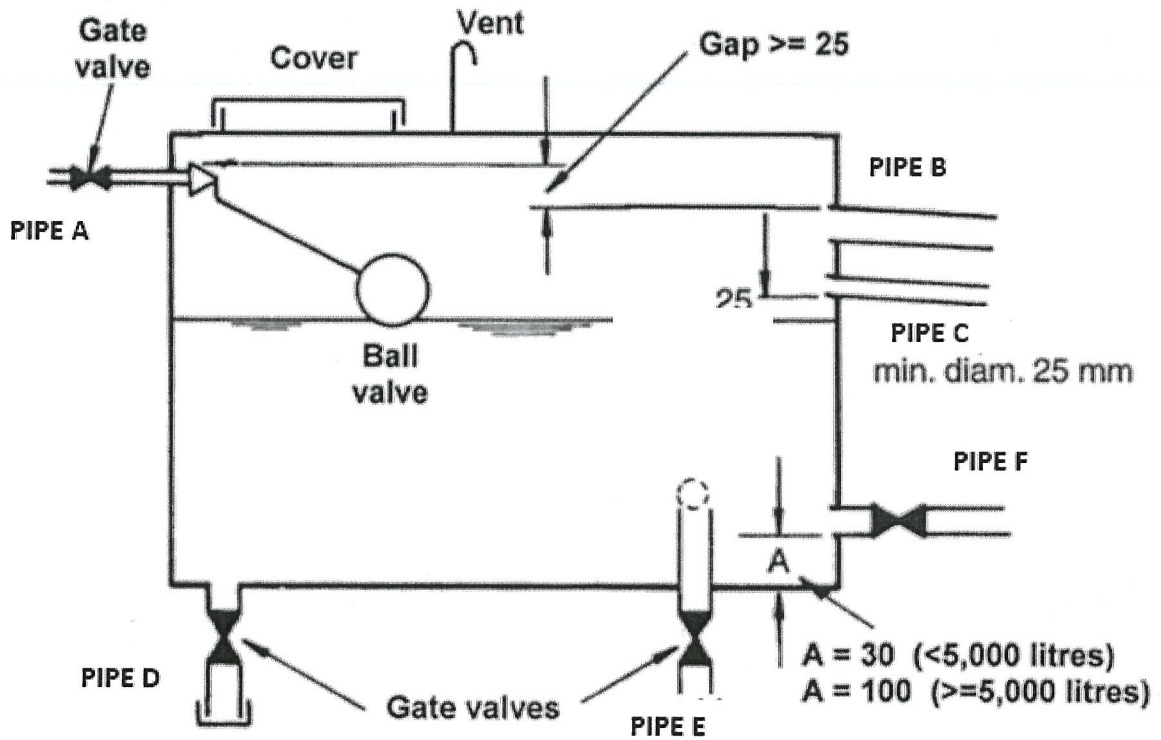


FIGURE Q36 to Q38

FIGURE Q36 to Q48 above is a basic water tank requirement for a gravity supply system.

Q36 Which of the following pipes should be fitted in every water tank as means of warning of an impending excess water in the tank?

- I. PIPE A
- II. PIPE B
- III. PIPE C
- IV. PIPE E

- A. I and II
- B. II and IV

- C. III and IV
- D. II and III

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Q37 What are the combination of pipes in the water tank to be at the opposite side to each other to prevent stagnation of water?

- I. PIPE A
- II. PIPE B
- III. PIPE D
- IV. PIPE F

- C. I and IV
- D. I and II

- C. III and IV
- D. II and III

Q38 What is/are the possible cause(s) of water storage overflow?

- I. PIPE F is leaking
- II. Ball Valve malfunction
- III. Low water pressure in PIPE A
- IV. No maintenance of PIPE B

- A. I only
- B. II only

- C. II and III
- D. I and IV

Q39 All of the followings are examples of water efficiency approaches, **EXCEPT**

- A. Water recycling
- B. Water efficient irrigation
- C. Water pressure detection system
- D. Water efficient fittings

Q40 Which of the followings are benefits of water efficiency program?

- I. Less environmental impact
- II. Sustained water quality
- III. Reduced water demand
- IV. Wastewater treatment saving

- A. I, III and III
- B. II, III and IV

- C. I, III and IV
- D. All of the above

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SECTION B

Answer all questions.

Q41 U-values is referred as heat transfer coefficients and are used to measure how effective elements of a building's fabric as conductors. Identify **TWO (2)** methods for improving the U-values of the structures in a house.

(10 marks)

Q42 **FIGURE Q42** shows a cavity wall of an existing house that has outer and inner brickwork leaves each 112mm with a 50mm air gap between them, finished with a 20mm layer of plaster inside. Based on the information below, calculate the U-value of the existing wall.

- Thermal conductivity (k-value) brickwork : 0.73 W/m K
- Thermal conductivity (k-value) plaster : 0.46 W/m K
- Thermal resistances (R-value) outer surface (R_{so}) : 0.055 m² K/W
- Thermal resistances (R-value) inner surface (R_{si}) : 0.123 m² K/W
- Thermal resistances (R-value) air gap : 0.18 m² K/W

(10 marks)

– END OF QUESTIONS –



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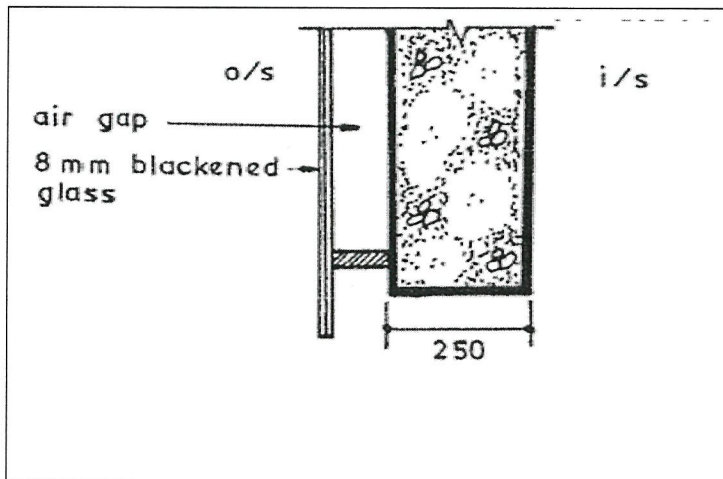


FIGURE Q13

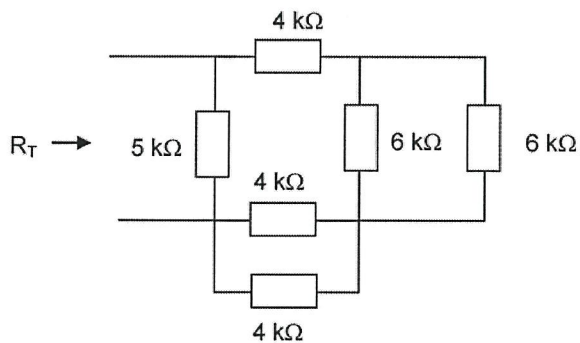


FIGURE Q30

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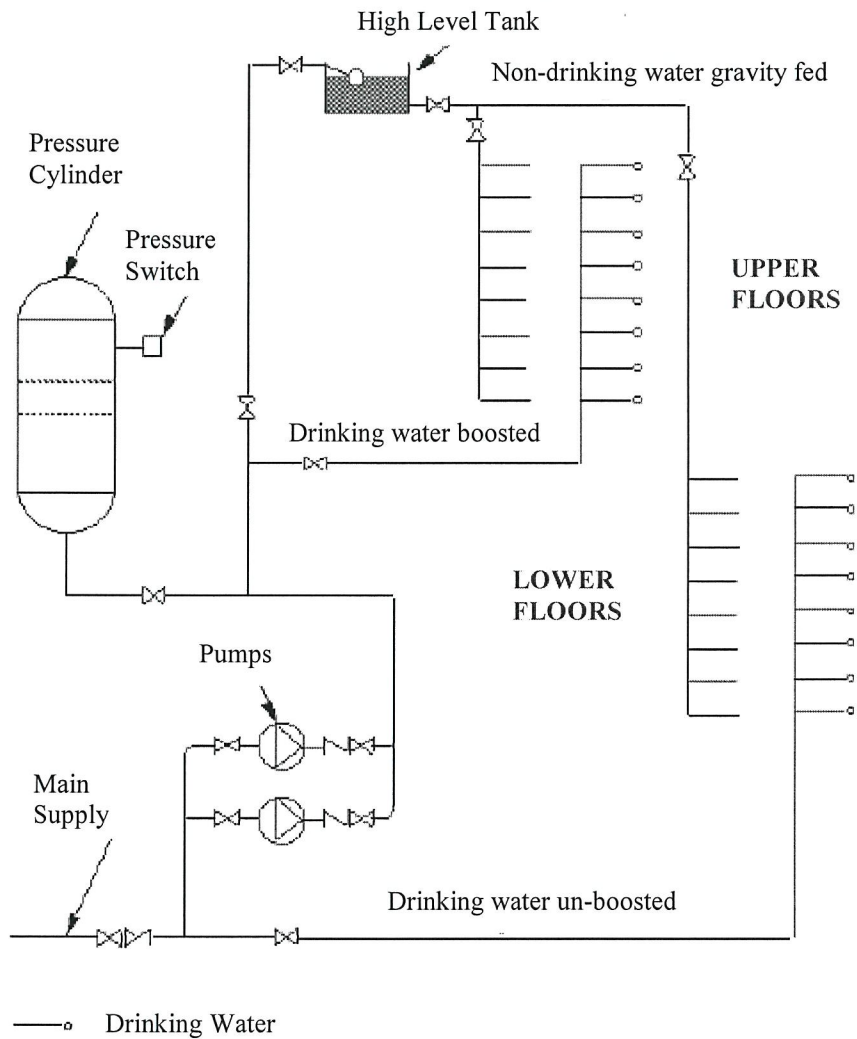


FIGURE Q34

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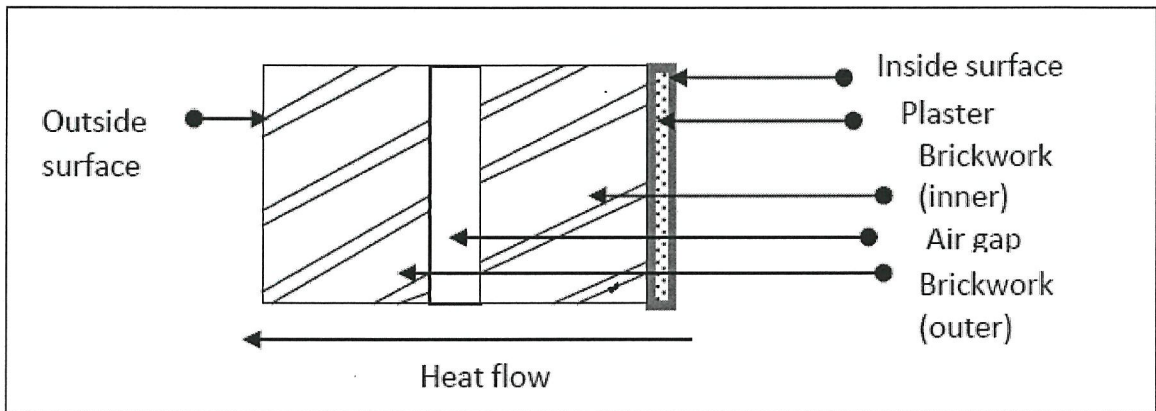


FIGURE Q42

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