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NEW

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

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

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தொழினுட்பவியலுக்கான விஞ்ஞானம்	II	Essay	67 E II
Science for Technology	II		

Instructions:
* Select minimum of **one** question each from parts **B**, **C** and **D** and answer **four** questions only.
* Each question carries **150** marks.
* Graph sheet required for question number **5** **in part B** is provided with the question paper.
* Use of non-programmable calculators is allowed.

Part B - Essay

5. **Table 1** shows the distribution of the incubation period (time period between the exposure to the virus and the appearance of the first symptom) of randomly selected 200 individuals who were infected by the Corona virus. The third column of the table indicates the **average** age of the infectants for each class interval.

**Table 1**: Grouped frequency distribution for the incubation period and the **average** age of 200 infectants

Incubation period (days)	Number of infectants	Average age (years)
2 - 3	6	88.5
4 - 5	90	72.5
6 - 7	78	78.0
8 - 9	12	68.5
10 - 11	4	54.5
12 - 13	4	50.0
14 - 15	4	24.5
16 - 17	2	20.0
Total	**200**	

(a) (i) Copy the **Table 2** given below to the answer booklet and complete the columns of class boundary, class mark, less than cumulative frequency and less than percentage cumulative frequency.

Table 2: Grouped frequency distribution for the incubation period of 200 infectants

Class limit	Number of infectants (frequency)	Class boundary	Class mark	Less than cumulative frequency	Less than percentage cumulative frequency
2 - 3	6				
4 - 5	90				
6 - 7	78				
8 - 9	12				
10 - 11	4				
12 - 13	4				
14 - 15	4				
16 - 17	2				

(ii) Calculate the **mean** incubation period of the infectants participated in the study.

(b) Draw the less than percentage cumulative frequency curve for the distribution given in **Table 2** on the graph paper provided with the question paper in page 14, and attach it to the answer script.

(c) Based on the less than percentage cumulative frequency curve drawn in part (b), find the following.

   (i) Median of incubation period of the infectants

   (ii) Lower boundary and upper boundary of the middle 90% data of the incubation period of the infectants

(d) Assume that the quarantine period for the infectants is decided based on their incubation periods. Based on the less than percentage cumulative frequency curve drawn in part (b), answer the following questions.

   (i) Find the minimum quarantine period required to identify 99% of the infectants.

   (ii) Suppose that there are 3000 Corona suspects in the quarantine centres and they are kept there up to a maximum period of 14 days. If these suspects are infected by the virus, then how many infectants are expected to show up symptoms during the quarantine period?

(e) Using **Table 1**, find the **average** age of the Corona infectants participated in the study.

6. This question is based on a basic concept of a technology used to make judgments in Cricket. **Figure 1** shows the top view of a cricket ground. A and B are positions of two fielders. The dotted line CD shows the straight path of the ball hit by the batsman. A Cartesian coordinate system is placed on the image, so that its origin coincides with the centre of the circular ground. (This diagram is not drawn to scale.)
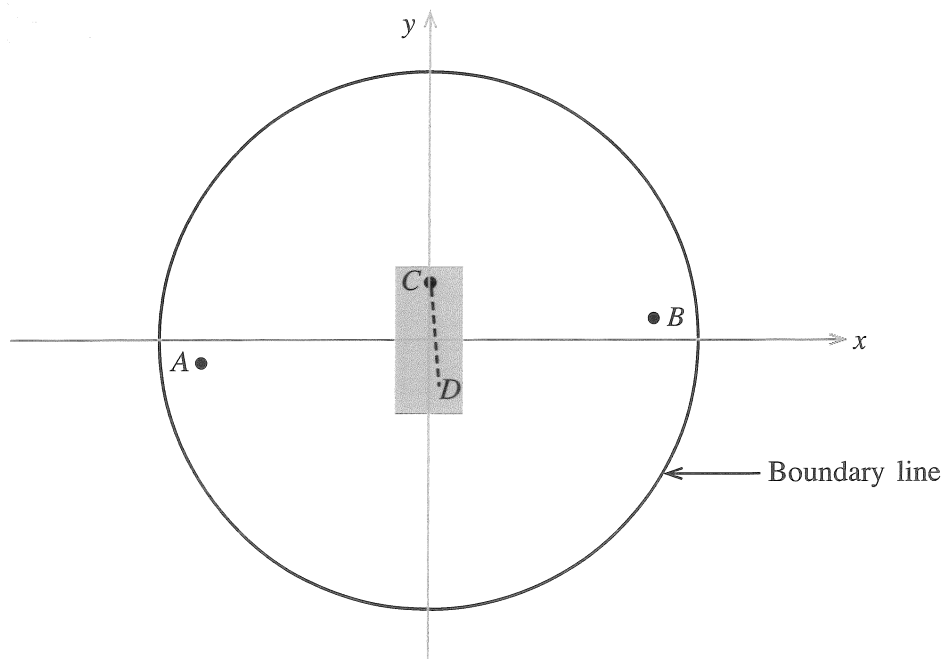
Figure 1

(a) The midpoint of straight line AB is the origin $(0, 0)$. The coordinates of point B are $(30, 0.2)$. Find the following.

   (i) Coordinates of point A
   (ii) Gradient of line AB

(b) The coordinates of point C are $(0, 8)$. Line CD is perpendicular to the line AB. Find the following of the straight line CD.

   (i) Gradient
   (ii) y Intercept
   (iii) Equation

(c) Along the *CD* line, the ball travels towards the opposite wicket. Given that the coordinates of a stump are (0.12, –10), determine whether the ball hits this stump.

(d) The sector *CMN* in **Figure 2** indicates the strongest batting region of a batsman batting at *C*. It is given that the angle $M\hat{C}N$ is 30° and the radius *CM* is 62 m. Calculate the following.

   (i) Angle $M\hat{C}N$ in radians

   (ii) The arc length *MN* (Consider $\pi = 3$)

   (iii) The area of sector *CMN*
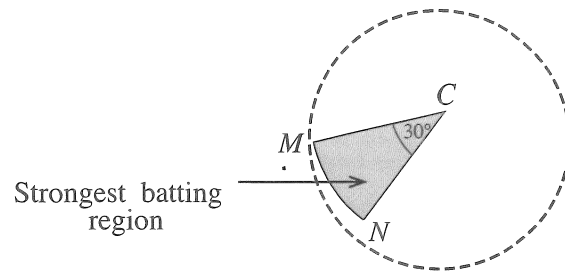   (Consider $\pi = 3$)

Strongest batting region

Figure 2

(e) The play area of the ground is confined by the circular boundary line. Given the coordinates of a point on the boundary line are (16, 63), calculate the following of the playing area. (Consider $\pi = 3$)

   (i) The radius

   (ii) The area

Part C - Essay

7. A group of students in the technology stream started a project to produce reusable face masks.

  (a) (i) What is expected by using a face mask?

     (ii) Why is it not recommended to use a face mask during sports activities?

     (iii) According to the 3R concept, write **two** objectives of producing a reusable face mask?

  (b) School Technology Club is planning to produce the face mask in a large-scale to generate funds.

     (i) What are the **five** main resources required to start a production process?

     (ii) Write **two** factors that must be considered in selecting a natural raw material for a production process.

  (c) It is planned to improve the quality of the face mask by treating (soaking) its outer layer with a diluted extract of cinnamon leaves containing many secondary metabolites. The process used to produce cinnamon extract is shown by the flow chart given below.
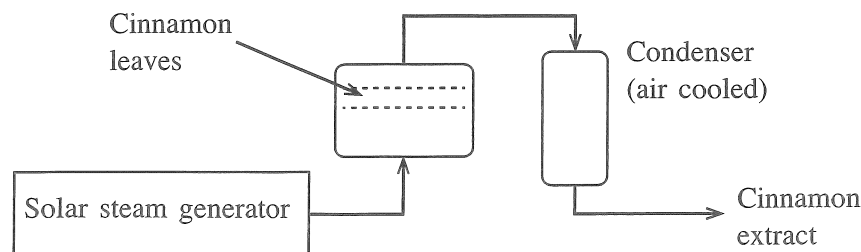
     (i) What is the main secondary metabolite extracted from cinnamon?

     (ii) Write **one** property that can be introduced to the face mask by treating its outer layer with the cinnamon extract.

     (iii) State **two** renewable resources used to produce the cinnamon extract in the above process.

     (iv) Write **one** environmental advantage and **one** economical advantage of using a solar steam generator for the above extraction process.

     (v) State **two** issues arise in producing steam by using solar energy.

(vi) The parabolic surface area which directs solar radiation to the steam generator is 3 m². The energy supply from this surface to the steam generator is 1 kJ m⁻² s⁻¹. Calculate the amount of energy collected in an hour by the steam generator.

(vii) Calculate the time required to produce 1 g of steam after starting the production of steam by receiving energy at the above rate. (The latent heat of vaporization of water is 2.26 MJ kg⁻¹)

8. (a) Sucrose is a disaccharide.

(i) Name the **two** monosaccharides contained in sucrose.

(ii) What is the main biological function of sucrose?

(b) Sucrose is a primary metabolite produced in sugar cane. The extracted sugar cane sap can be converted to ethanol by using microorganisms. The production process of bioethanol by using sugar cane is shown below.
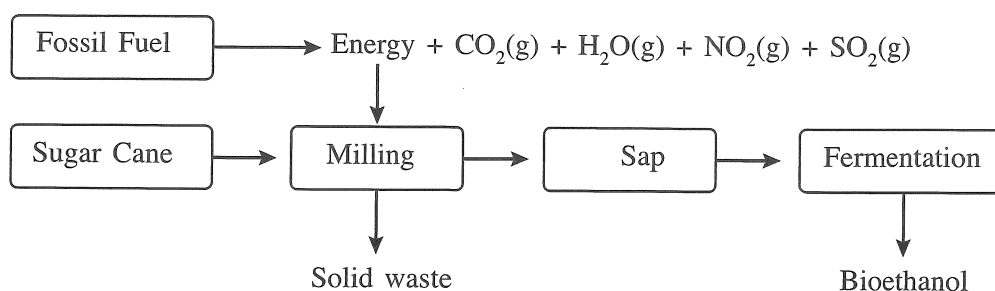

(i) What are the gasses produced in the above process that contribute to acid rain?

(ii) Name the greenhouse gasses produced in this process.

(iii) State **two** advantages and **two** disadvantages of using bioethanol as a fuel.

(iv) Write **two** main advantages of chemical synthesis of ethanol.

(c) Ethanol, hydrogen peroxide, glycerol and distilled water are the main ingredients of a hand sanitizer formula recommended by the World Health Organization (WHO). The reaction chamber used for the production of hand sanitizer is shown below.
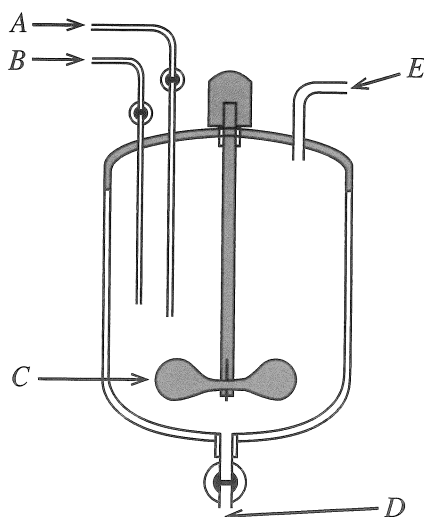
(i) What is the function of each part labelled as *A*, *B*, *C*, *D* and *E* in the diagram?

(ii) It is recommended to perform the above production process at low temperatures. Explain the reason for that.

(iii) What is the main function of hydrogen peroxide in the sanitizer?

Part D - Essay

9. (a) Consider an object executing uniform circular motion in a circular path of radius r. The equation $v = r\omega$ can be used to calculate its angular velocity.

   (i) Name the physical quantities represented by v and ω.

   (ii) An object executing a circular motion is always associated with an acceleration, even though the object moves with a constant speed. Explain the reason for that.

(b) Awaiting clearance for landing at an airport, an aircraft is circling in the sky with the speed of 100 m s^{-1}. If the radius of circular path of the aircraft is 4 km, calculate its,

   (i) angular velocity, in rad s^{-1} and

   (ii) periodic time, in minute.

   (Consider $\pi = 3$)

(c) You are provided with sufficient number of identical resistors, each with the resistance of 80 Ω. Using **minimum number** of given resistors, draw separate circuit diagrams to obtain following equivalent resistance.

   (i) 40 Ω

   (ii) 400 Ω

   (iii) 460 Ω

(d) (i) The figure shows a sketch of a dynamo. What is the direction of each of the following parameters?

   (1) The magnetic field between magnetic poles N and S.

   (2) The current (I) between B and C?
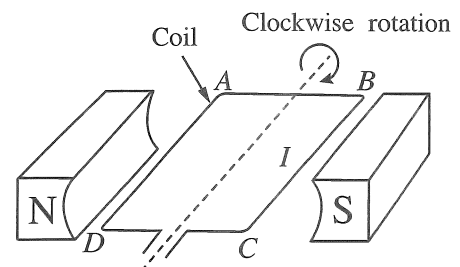
   (ii) Write down the **three** major factors that affect the amount of current generation in the dynamo.

10. Hot water entering at one end of a straight tube PQ which is placed in air, leaves at the other end as cold water. Heat is transfered across the tube material of the tube wall.


Tube   **Cross section of the tube**
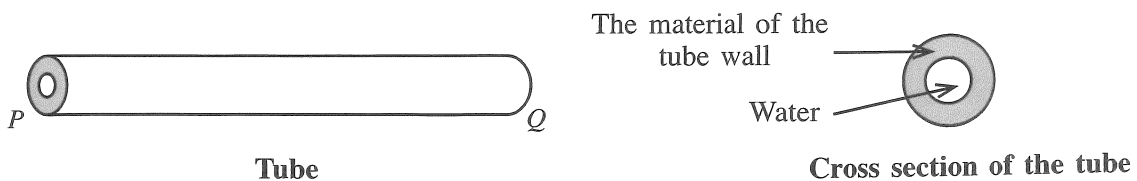
(a) Does the heat transfer in the above tube occur from water to air or air to water?

(b) Which method out of conduction, convection and radiation is the main mode of heat transfer between each of the following pairs?

   (i) Hot water inside the tube and the material of the tube wall

   (ii) Material of the tube wall and surrounding air

(c) The heat transfer between the hot water in the tube and the surrounding air of the tube has to be made more efficient. In order to do so, five factors are to be changed. With regard to the change in each factor, suggestions given by student A and student B are shown below.

	Factors to be changed	Suggestion made by Student A	Suggestion made by Student B
(1)	Material of the tube	Use rubber	Use copper
(2)	Outer surface of the tube	Keep non-insulated	Keep insulated
(3)	Nature of the outer surface of the tube	Make it rough	Make it polished
(4)	Nature of the tube	Keep it short and straight	Keep it lengthy and spiral
(5)	Surrounding air of the tube	Maintain as a fast air flow	Maintain as a slow air flow

   (i) From the above suggestions given by students **A** and **B** for each factor from (1) to (5), write the more suitable suggestions?

   (ii) Give reasons for each of your decision given in (i) above.

(d) When a motor-car-engine runs, as it gets heated continuously, the engine has to be cooled using a cooling system. The block diagram of such a cooling system with basic components A, B, C and D is shown below. Engine and the cooling unit (radiator) are represented by two spiral tubes.
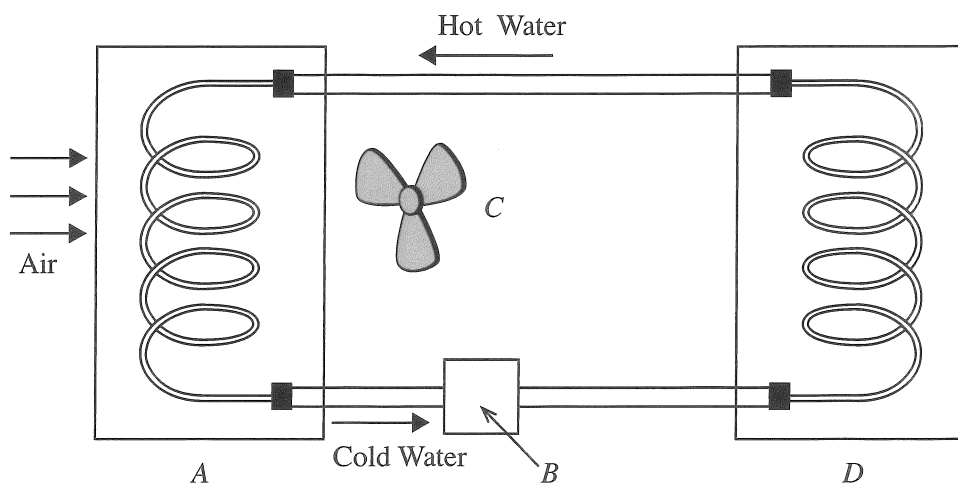
Name the component out of A, B, C and D which contributes to each of the functions given below.

   (i) Heat generation

   (ii) Cooling

   (iii) Circulation of water

   (iv) Circulation of air

(e) Hot water at temperature 90 °C flows into the radiator at the rate of 0.5 kg s^{-1}. If the temperature of the exit water is 40 °C, calculate the rate of heat loss.
(Specific heat capacity of water is 4200 J kg^{-1} °C^{-1}.)

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