BOARD OF STUDIES
NEW SOUTH WALES

HIGHER SCHOOL CERTIFICATE EXAMINATION

1999

RURAL TECHNOLOGY

2 UNIT

(85 Marks)

Time allowed—Three hours
(Plus 5 minutes reading time)

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right-hand corner of this page.

- Attempt ALL questions.

- The marks allocated to each Section are shown in this paper.

- Write your answers in the spaces provided in this paper.

- Board-approved calculators may be used.
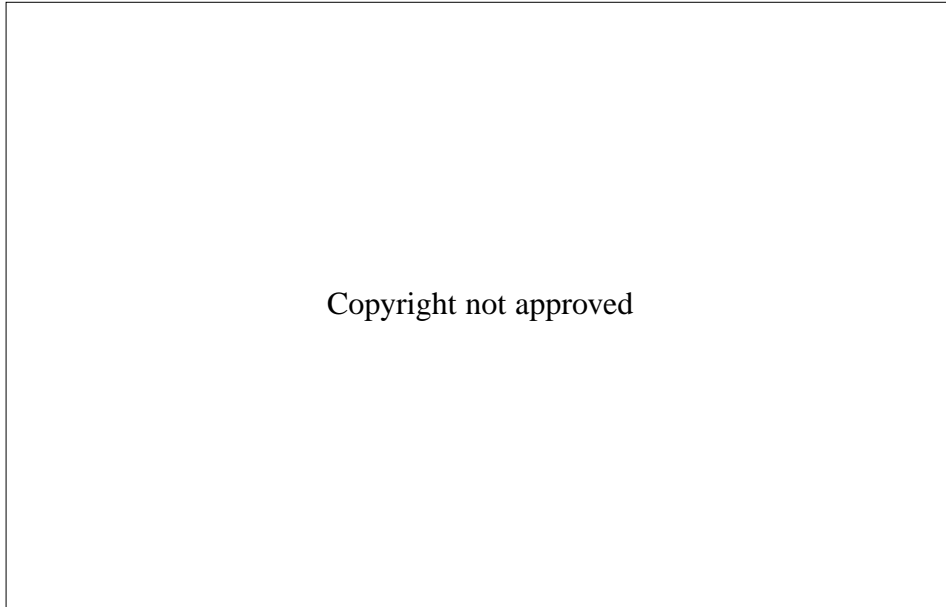
- The Formulae Sheet will not be collected.

400

SECTION I—FARM MACHINERY

(20 Marks)

QUESTION 1

Figure 1 shows two farm implements. Answer the following questions in relation to the diagrams shown below.

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IMPLEMENT *A*

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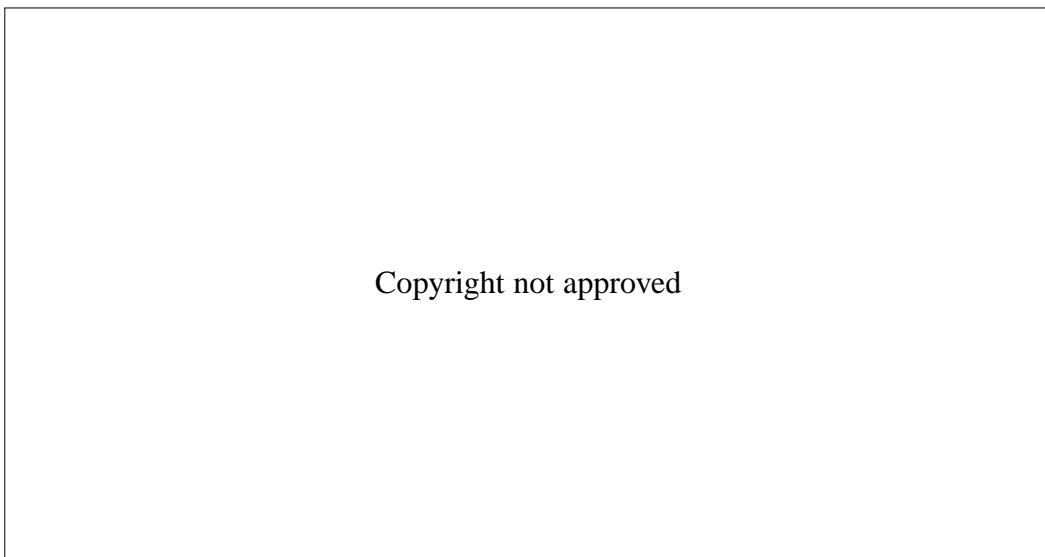
IMPLEMENT *B*

FIG. 1

(a)   Name the implements shown above.

Implement *A*   ....

Implement *B*   ....

QUESTION 1 (Continued)

(b)   Describe TWO advantages of implement *A* over implement *B*.

    (i)   ....

    (ii)   ....

(c)   Explain the main purpose of implement *B*.

    ....

(d)   Describe one essential daily maintenance operation that is required on implement *A* when in use.

    ....

(e)   Implement *B* requires daily inspection for wear when in regular use.

    (i)   Name a part that requires daily inspection.

        ....

    (ii)   Describe how the operator would correct any wear observed on this part.

        ....

(f)   In many cultivation operations in Australia, cultivation implements are too large for the implement to be mounted on the tractor three-point linkage.

Describe how these large implements are attached to the tractor in this situation and how they are raised and lowered.

    ....

    ....

(g)   Describe THREE safe working practices that should be observed when operating tractors with cultivating or other field machines.

    (i)   ....

    (ii)   ....

    (iii) ....

QUESTION 1 (Continued)

(h) Explain why, when using a three-point linkage mounted implement, the tractor may overturn if a lower linkage pin breaks.

....

....

(i) A tractor is operating with a 5 metre wide implement at 5 km/h. Calculate the area covered in four hours if the field efficiency is 70%.

.... hectares

(j) The rate of tyre wear is closely related to soil type. On a heavy clay soil, expected tyre life is 1500 hours. Will the tyres wear more or less than 1500 hours if operated on a sandy soil? Explain your answer.

....

....

....

(k) State TWO safety procedures to be followed prior to servicing a high pressure hydraulic system.

(i) ....

(ii) ....

QUESTION 1 (Continued)

(l) Figure 2 shows a tractor operating with side mounted equipment on sloping ground. Should the equipment be placed on the uphill or downhill side of the tractor? Explain your answer with reference to the centre of gravity.
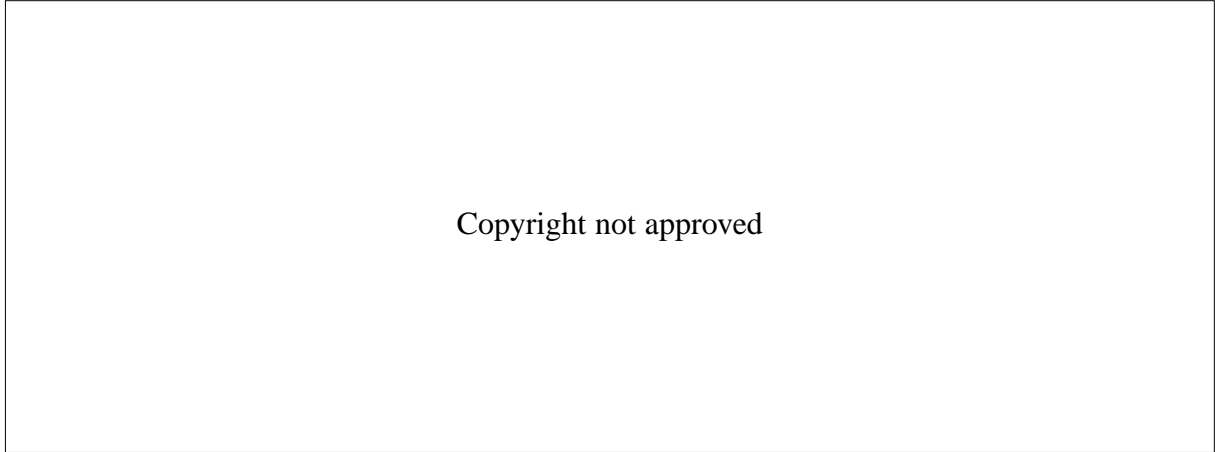
Copyright not approved

FIG. 2

....

....

....

(m) Explain, from the point of view of electrical safety, the difference between fine spray and solid continuous jet water delivery for irrigators operating close to overhead power lines.

....

....

QUESTION 1 (Continued)

(n)   The chart below (Figure 3) is used to determine lengths and angles when using augers to fill grain bins. The vertical discharge height is 6 metres. The horizontal conveying distance between the auger inlet and the filling point is 9 metres. Using the chart, determine the length of auger required and the angle of elevation.
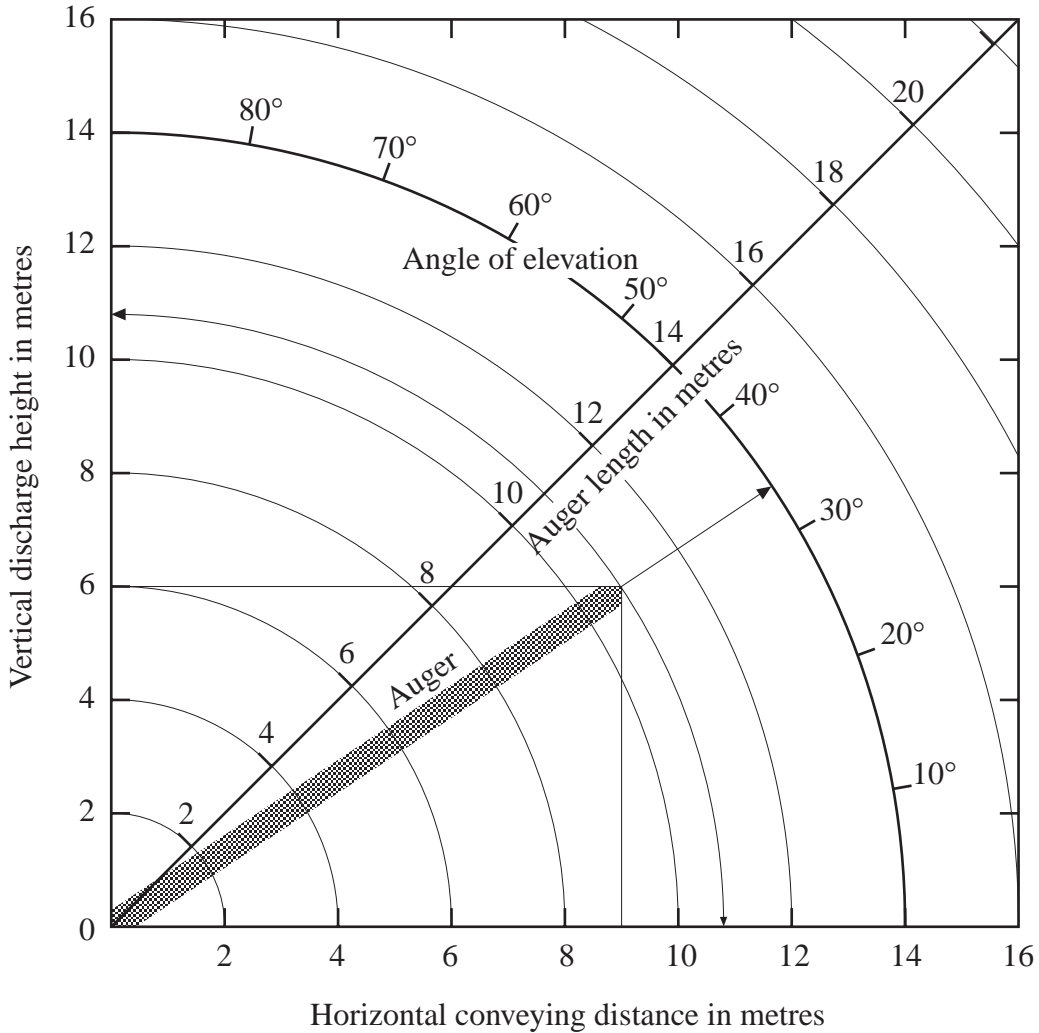

FIG. 3

Length .... metres

Angle .... degrees

QUESTION 1 (Continued)

(o)   Will the auger in Question 1 part (n) be suitable to fill another bin that has a vertical discharge height of 10 metres and a horizontal conveying distance of 3 metres? Give a reason for your answer.

....

....

....

(p)   When moving grain augers, what precautions should be taken with regard to overhead power lines?

....

....

Please turn over

SECTION II—FARM STRUCTURES

(10 Marks)

QUESTION 2

(a) A wire strainer is essential in an efficient fencing operation. Who is credited with the invention of the nineteenth-century wire strainer?

  ....

(b) Using a tractor to tension any wire is unsafe. Describe a safe alternative for tensioning multistrand wire (for example Hinged Joint™ or Ring Lock™ wire).

  ....

  ....

  ....

(c) The cost of 667 steel posts for a fencing project is $2268·00.

  (i) Calculate the cost of one steel post.

    ....

    ....

  (ii) Calculate the cost of the posts required for one kilometre of fence if the spacing of posts is five metres.

    ....

    ....

(d) Define the term *efficiency* when considering knots for fencing wire.

  ....

  ....

QUESTION 2 (Continued)

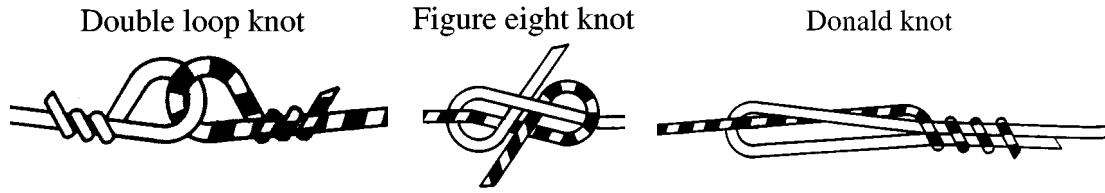(e)   Three types of fencing wire knots are shown in Figure 4. Name the most efficient and least efficient knots.

Double loop knot   Figure eight knot   Donald knot

FIG. 4

Wires & Pliers, Kondinin Group, 1994

Most efficient ....

Least efficient ....

(f)   A reading through the eyepiece of a dumpy level is shown in Figure 5 below. State the reading indicated by the horizontal crosshair.

....

Horizontal cross hair
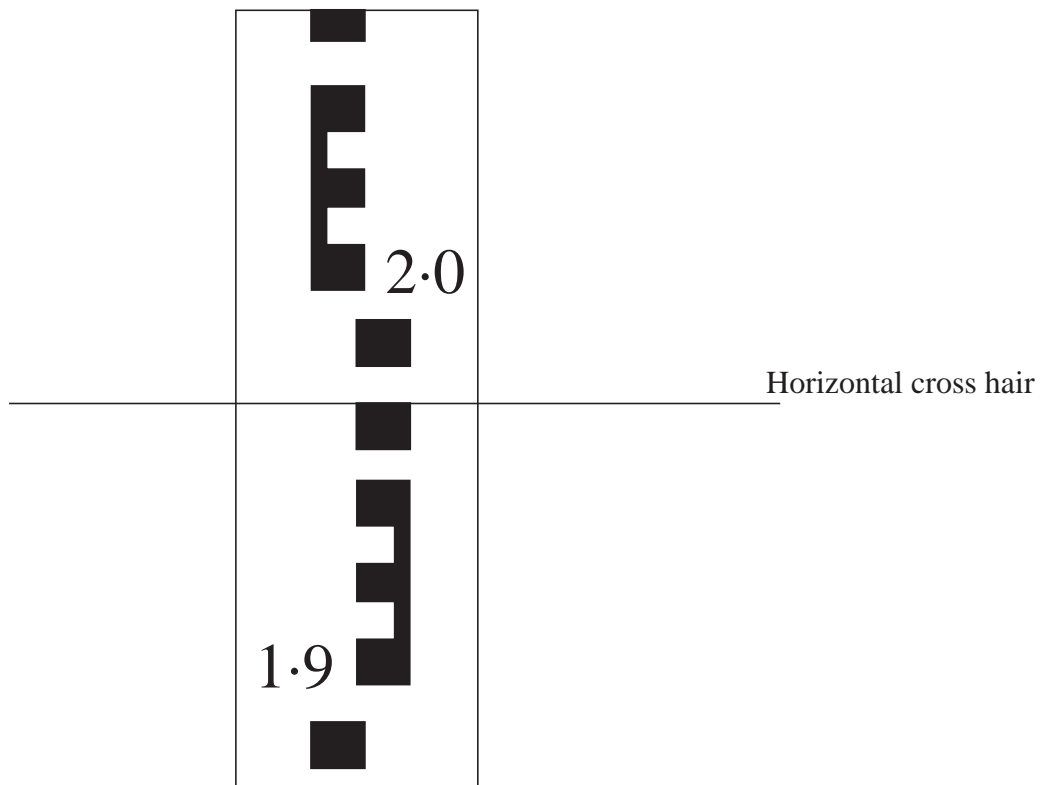
FIG. 5

Question 2 continues on page 10

QUESTION 2 (Continued)

(g)   The contour lines below are taken from a topographic map.

Indicate the drainage line and direction of flow. State the contour interval.

100 m   200 m   300 m

Contour interval ....
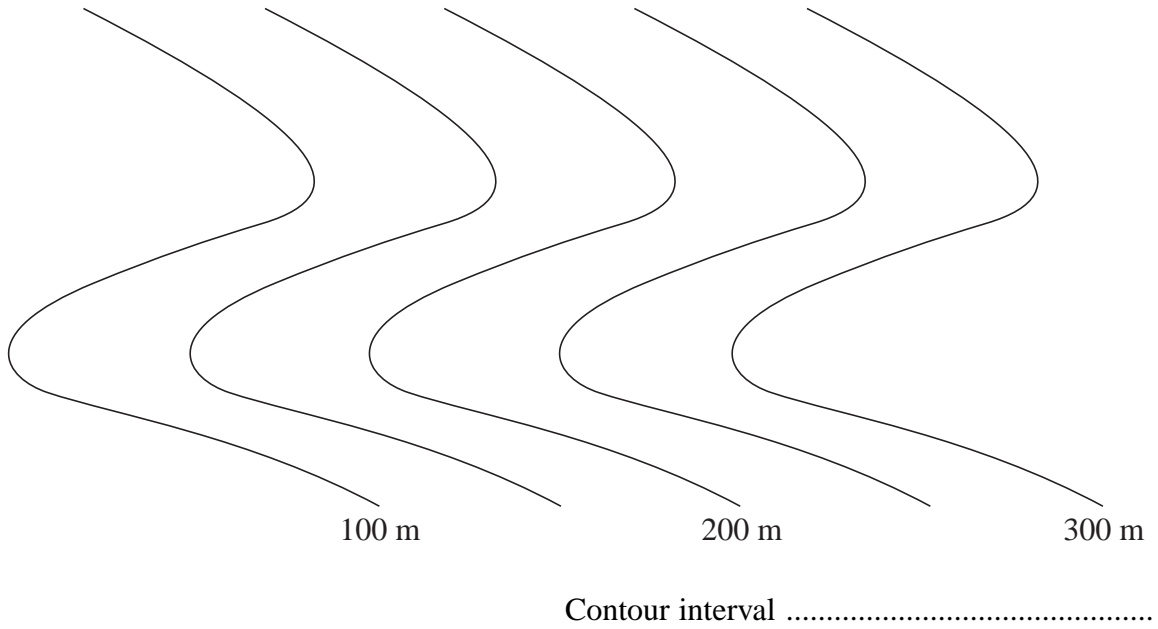
(h)   The rectangle below represents a paddock drawn on a map with a scale of 1 : 25 000.

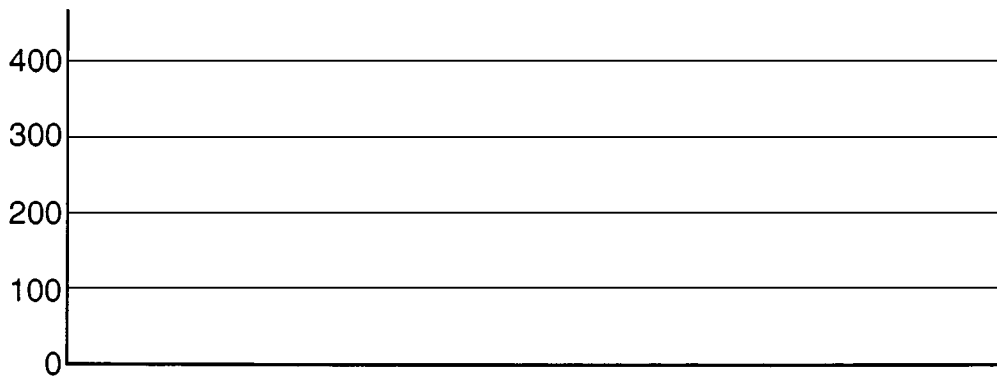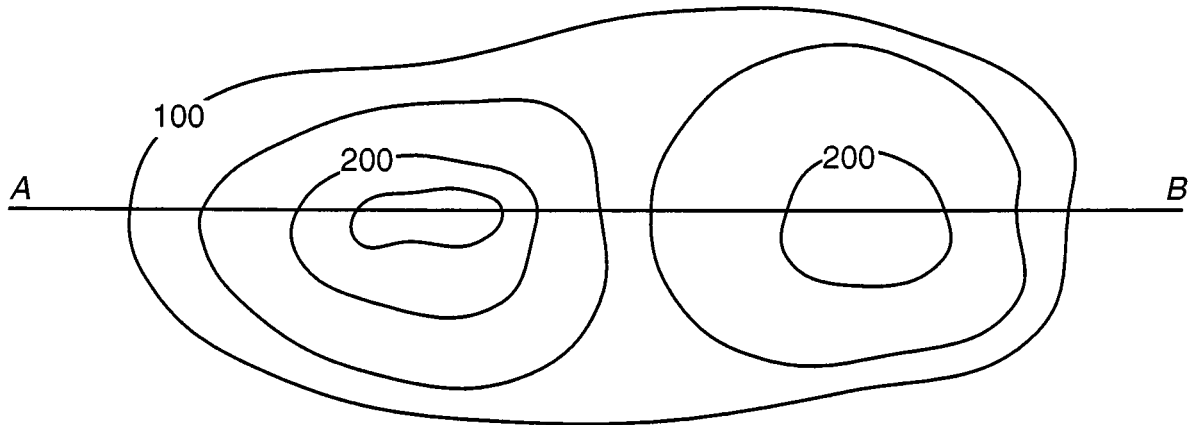Calculate the area of the paddock in hectares and the length of the boundary fence.

Area   ....

Length ....

QUESTION 2 (Continued)

(i) Two landform shapes are indicated by contour lines below. Draw a cross-section of the landform in the space provided. The cross-section is taken at the line *AB*.

Please turn over

SECTION III—FARM GRAPHICS

(20 Marks)

QUESTION 3 (10 marks)

A dimensioned exploded isometric drawing of a transmission drive is given in Figure 6.
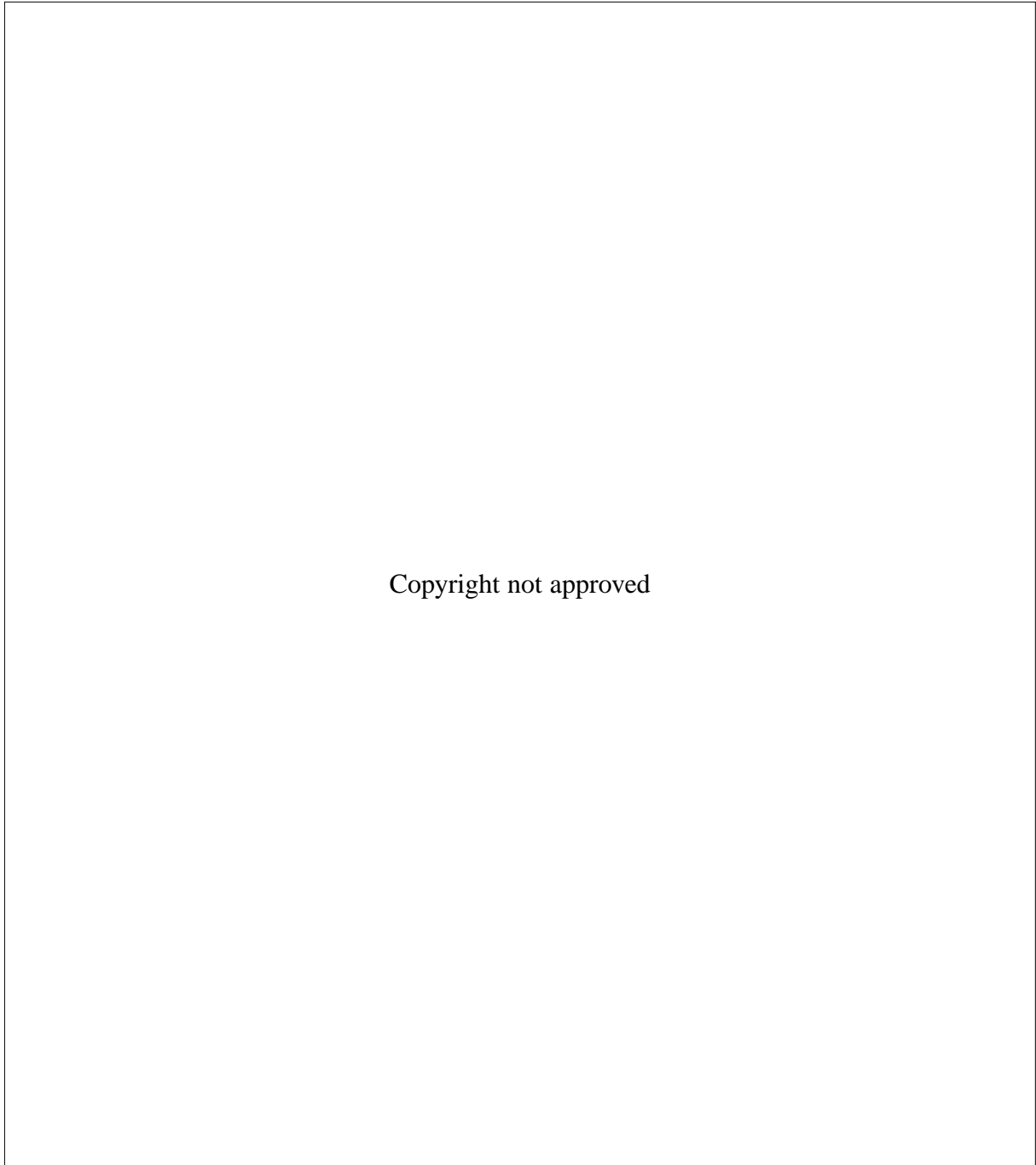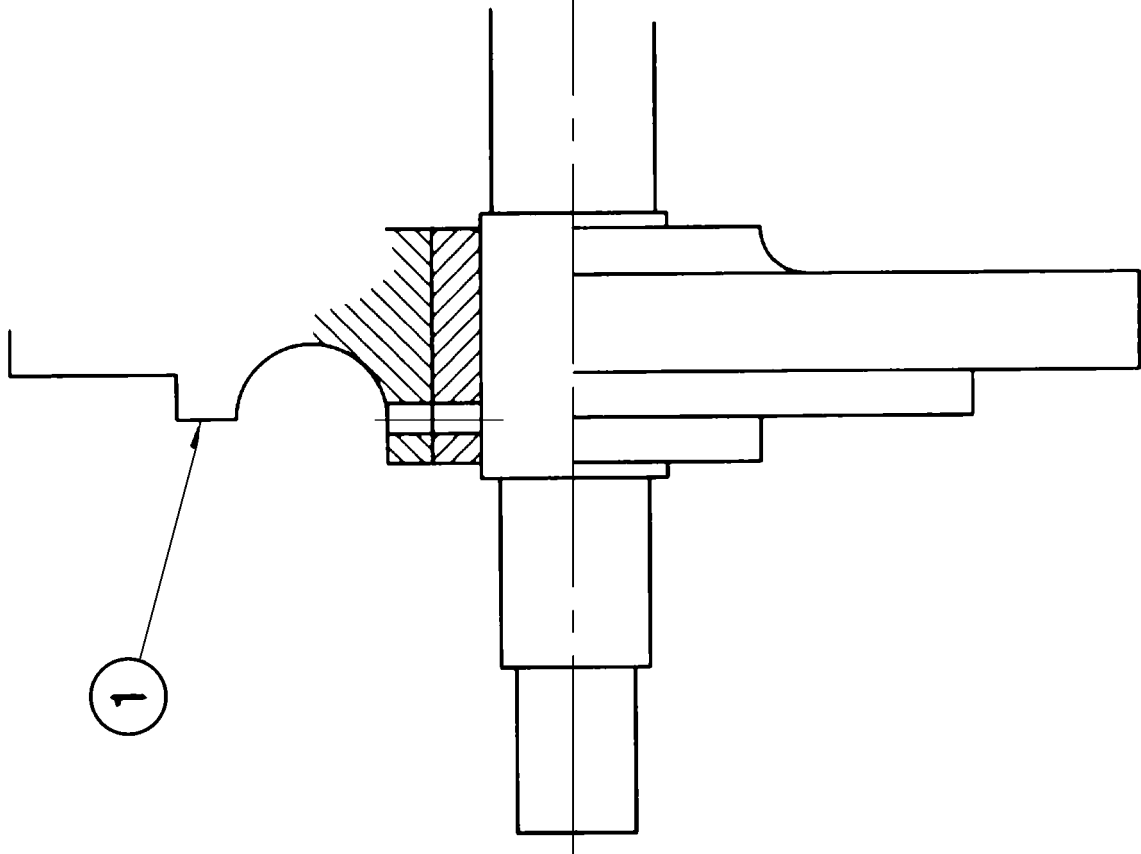
Copyright not approved

FIG. 6

(a) Using the centre line and information provided on the following page, complete a half-sectional front view at a scale of 1 : 1. The object is viewed in the direction of arrow A.

(b) Itemise the drawing and complete the material list given.

QUESTION 3 (Continued)

ITEM	PART NAME	MATERIAL	QUANTITY
1	BODY	C.I.	1

QUESTION 4 (5 marks)

The side view of a conical oil measure is given in Figure 7 below. Draw a half-pattern development of part A of the oil measure. The seam is located under the handle.

Do not add any allowances for seams or edges.

Figure 7 is drawn to scale. Take sizes directly from Figure 7 as appropriate.

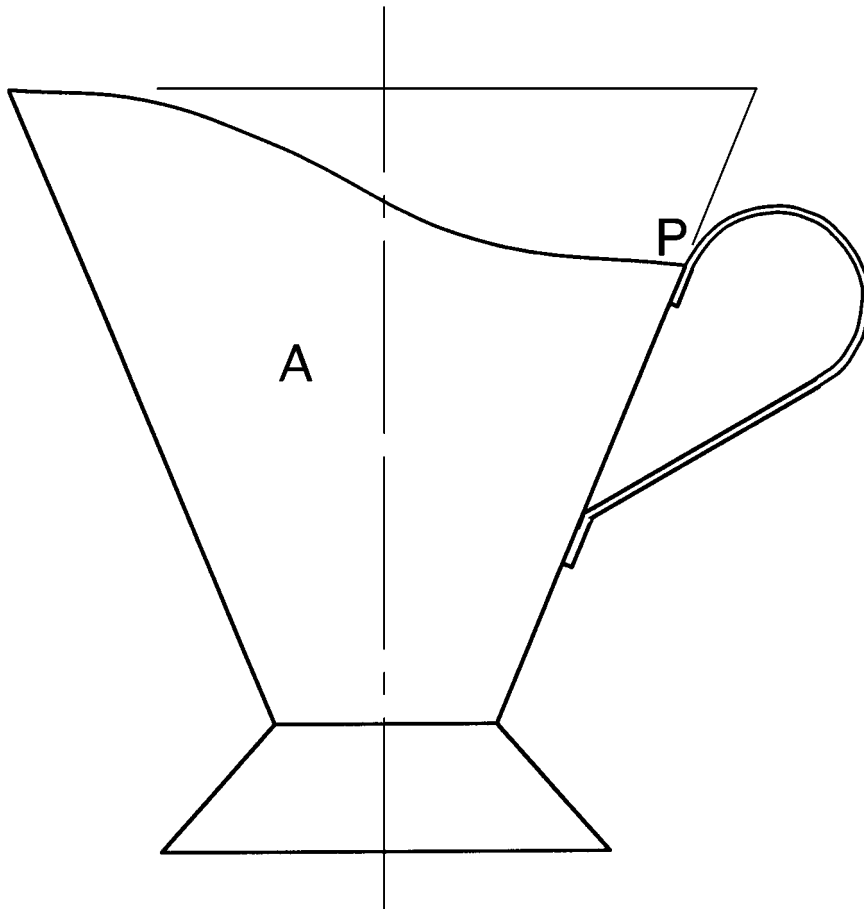A starting point P is given on page 15.

FIG. 7

QUESTION 4 (Continued)

P.

SEAM
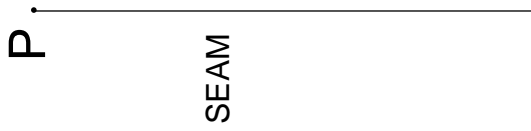
QUESTION 5 (5 marks)

Details of an offset trip link are given in the orthogonal drawing in Figure 8 below.

Make an isometric drawing of the offset link when viewed in the direction indicated by arrow A.

A starting point is given on page 17.
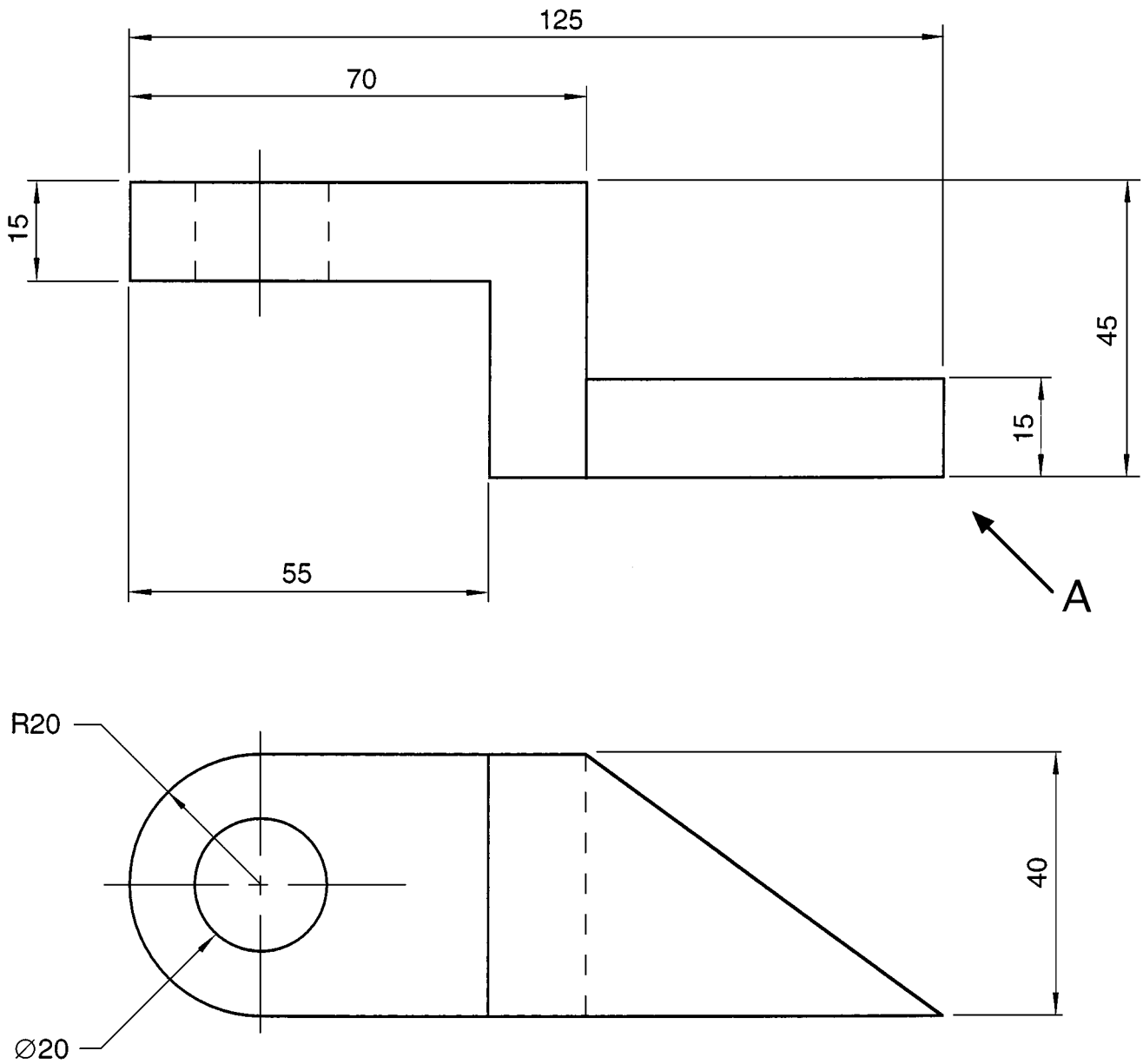
FIG. 8

QUESTION 5 (Continued)

A
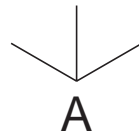
SECTION IV—RELATED MATERIALS SCIENCE

(10 Marks)

QUESTION 6

(a) In moving a bale of hay, 72 kilojoules of work was done by a front-end loader.

   (i) If the distance moved was 30 metres, how much force was exerted by the front-end loader?

.... newtons

   (ii) If the operation required 800 watts of power, how long did the operation take to complete?

.... seconds

(b) Prior to the introduction of digital readings on weighing machines, steelyards were used to weigh carcasses. Determine the weight and mass of the carcass if the movable weight has a mass of 5 kg and is 1·1 metres from the fulcrum. Disregard the weight of the steelyard. The carcass is 150 mm from the fulcrum.
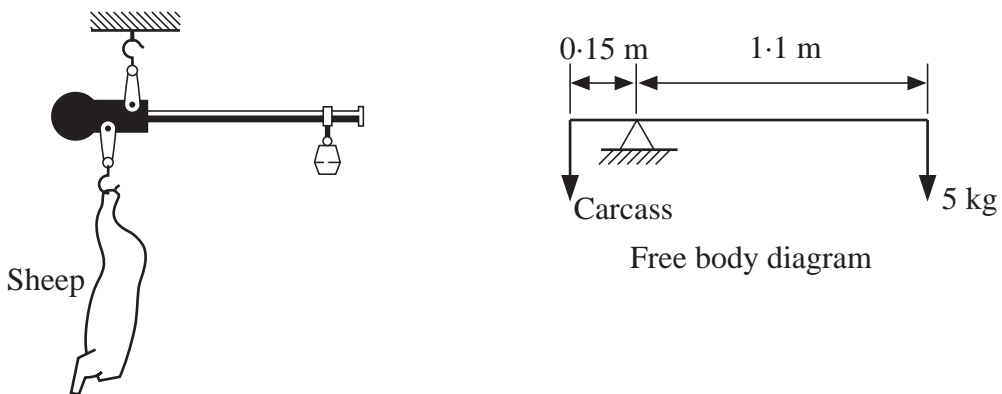
FIG. 9
Introduction to Engineering Mechanics, B R Schlenker, Reproduced with permission of Jacaranda Wiley Ltd

Mass .... kg

Weight .... newtons

QUESTION 6 (Continued)

(c) A truck, mass 3·7 tonnes, passes over a weighbridge at a winery and a reading of 12·2 tonnes is shown. If the grower receives a cheque for $14 450·00 for the load of grapes, how much was the payment per kilogram?

$ ....

(d) A vehicle is travelling at 80 km/h when the driver sees a 60 km/h sign ahead and immediately starts to slow down. It takes 20 seconds before the vehicle reaches the sign. How far was the vehicle from the sign when the driver started to slow down, and what was the rate of deceleration?

.... metres

.... m/s^2

(e) (i) A farm worker has lost the drawbar pin from a tractor but has found three pieces of metal that could be turned on the lathe to produce a pin. The metals are cast iron, mild steel and hardened steel. Indicate the most suitable metal and give a reason for your choice.

Suitable metal ....

Reason for selection ....

(ii) Give ONE reason why each of the other metals would not be selected.

Metal ....

Reason ....

Metal ....

Reason ....

QUESTION 6 (Continued)

(f) There are four types of force that can cause a material to fail. Indicate these types of force and give an example where a failure of each type may occur on the farm.

	Type of force	*Failure*
(i)		
(ii)		
(iii)		
(iv)		

(g) List THREE types of fungus that can cause timber to decay.

(i) ....

(ii) ....

(iii) ....

(h) Timber may have a number of defects present that make it unsuitable for use. State TWO groups into which timber defects may be classified.

(i) ....

(ii) ....

QUESTION 6 (Continued)

(i)   Figure 10 represents a timber board and a cross-section of a log.

Sketch the following timber defects on the most appropriate diagram and indicate them with an arrow and a label.

Knot, waney edge, cup shake, star shake and gum vein.
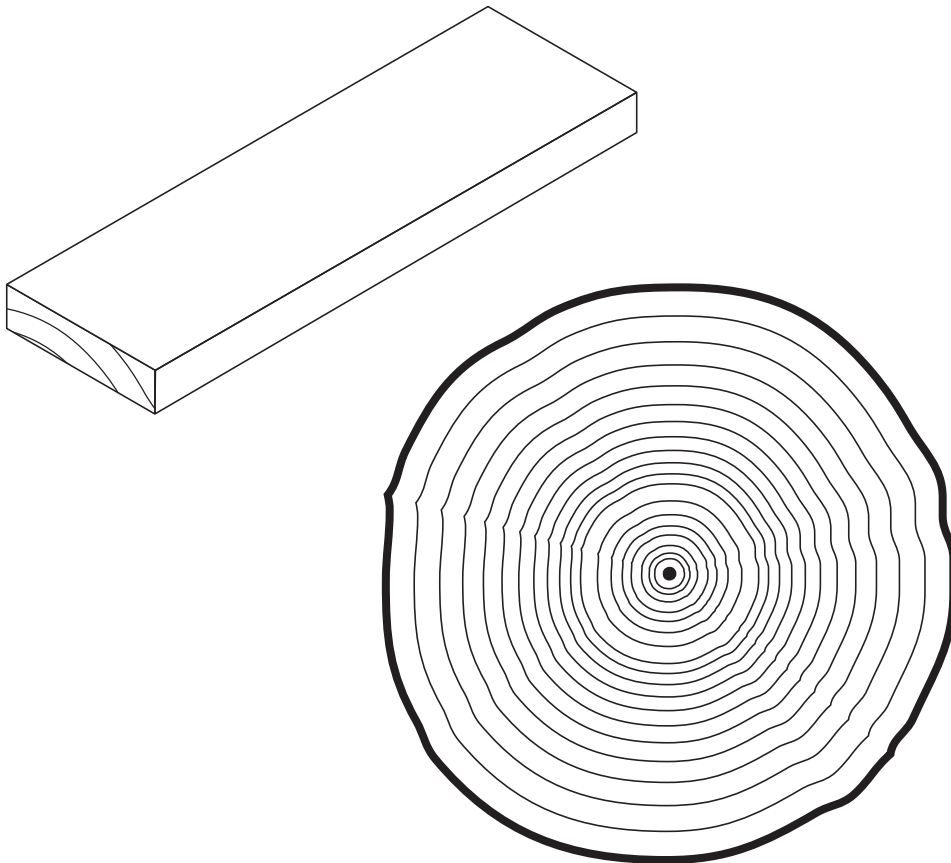
FIG. 10

(j)   State how you would determine if a piece of timber has been treated with copper naphthenate or zinc naphthenate.

....

....

SECTION V—FARM WATER SUPPLIES

(15 Marks)

QUESTION 7

(a) A range of undesirable conditions can occur in farm and domestic water supplies. Explain the cause of each water condition listed below.

    (i) Algal growths ....

    (ii) Hardness ....

    (iii) Turbidity ....

(b) For one of the above conditions, describe an appropriate treatment to improve water quality.

Name of condition ....

Description of treatment ....

....

(c) Polythene or *poly pipe* is often used for farm water supplies. Name TWO other materials that are used for farm water supplies.

    (i) ....

    (ii) ....

(d) List FOUR characteristics that give *poly pipe* advantages over pipes made of other materials.

    (i) ....

    (ii) ....

    (iii) ....

    (iv) ....

QUESTION 7 (Continued)

(e)   The efficiency of a pump is affected by friction in the system. Answer the following question with reference to Figure 11 below.

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FIG. 11

   (i)   For a total head of 20 metres and a pump operating at a speed of 1900 r.p.m., what are the maximum and minimum efficiencies possible?

Maximum ....

Minimum ....

  (ii)   For a total head of 30 metres and a pump operating at 2300 r.p.m., what is the efficiency?

....

 (iii)   For a total head of 25 metres, and an r.p.m. of 2100, the flow rate is 3·9 litres per second. What will be the increase in flow rate if the r.p.m. is increased to 2300 to maintain the same total head?

....

QUESTION 7 (Continued)

(f)   The illustrations below show three different types of pumps.
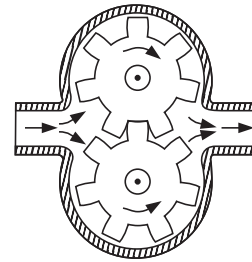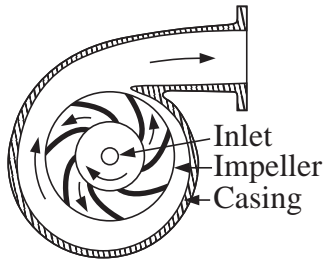
(i)   ....   (ii)   ....
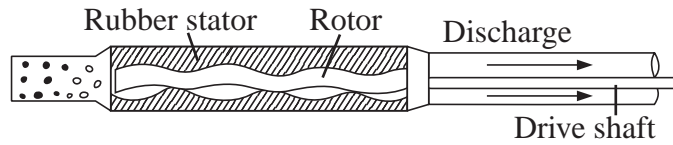
(iii)   ....

FIG. 12

Write the name of each of the pumps on the line below the appropriate illustration.

(g)   Air chambers are often used in pumping systems in household and farm water supplies. Explain the purpose of these air chambers.

....

....

(h)   Cavitation is a problem that occurs in some pumping systems.

(i)   Explain the term cavitation.

....

(ii)   Describe ONE method that can be used to avoid cavitation.

....

....

(iii)   In which of the pumps shown in part (f) above is cavitation likely to occur?

....

SECTION VI—TOPICAL STUDY

WINDMILLS AND SOLAR POWER AS FARM POWER SOURCES

(10 Marks)

QUESTION 8

(a)   Figure 13 shows a common windmill. In the spaces provided, name and describe the function of the parts indicated.
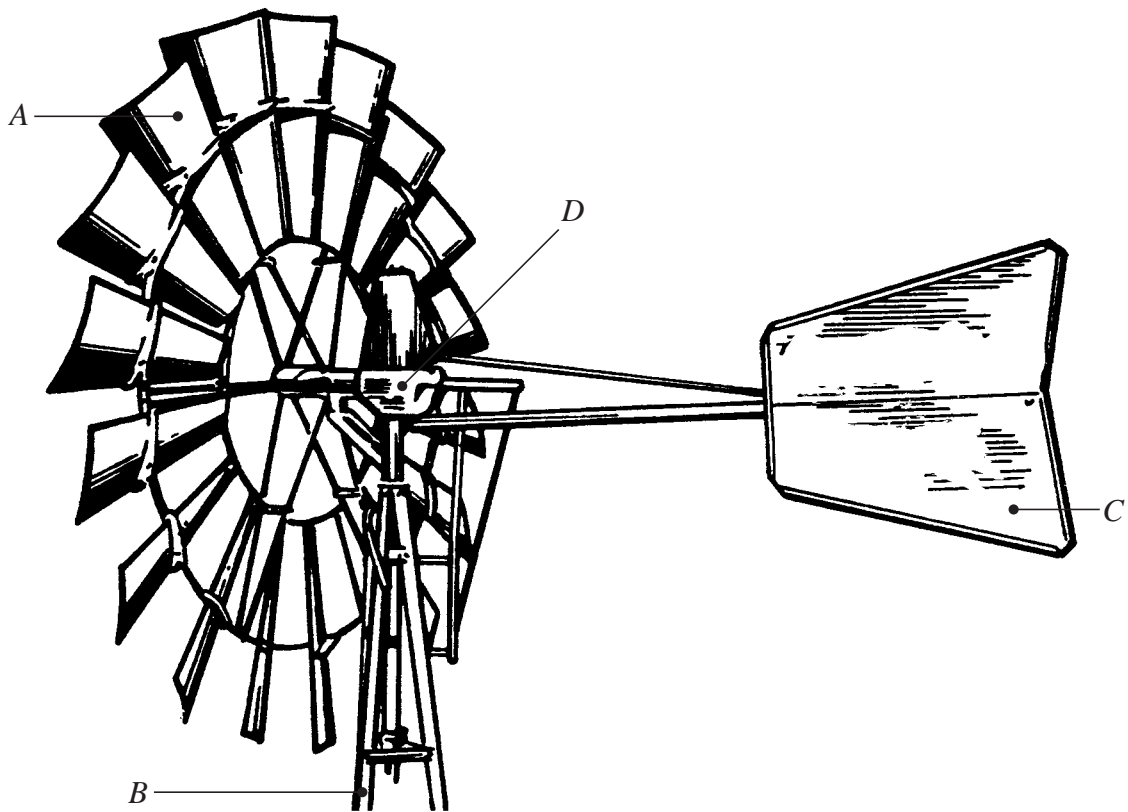
FIG. 13

A   ....

B   ....

C   ....

D   ....

QUESTION 8 (Continued)

(b)   Accurate wind velocity data are essential to proper windmill system design. Name the
        wind velocity measuring device shown in Figure 14 below.
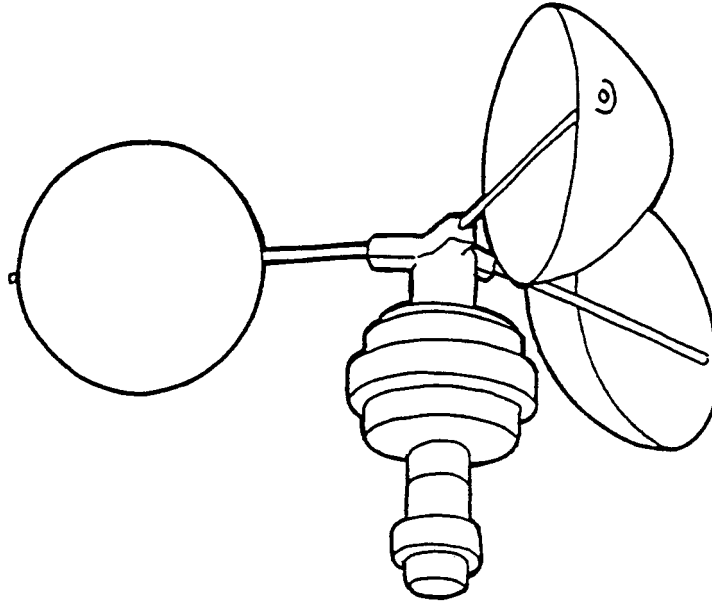
FIG. 14

....

(c)   Wind power is often used on farms to operate pumps. Describe one other use for wind
        power on the farm.

        ....

(d)   Explain, with the aid of a sketch, how circular motion is converted to reciprocal motion
        in the operation of a windmill.

        ....

        ....

QUESTION 8 (Continued)

(e) Explain, with the aid of a sketch, the operation of a cylinder pump.

....

....

....

(f) State THREE factors that will affect the rotational speed of a windmill.

(i) ....

(ii) ....

(iii) ....

QUESTION 8 (Continued)

(g)   Governing refers to limiting the speed at which a windmill may rotate. Describe, with the aid of a sketch, how the mounting of the mill engine on the tower governs the destructive action of sudden high velocity wind gusts.

....

....

....

(h)   (i)   List THREE applications of solar power on the farm.

1   ....

2   ....

3   ....

(ii)   For one of these applications describe TWO advantages, other than cost, of solar energy when compared to conventional power.

1   ....

2   ....

(i)   Explain the relationship between set-up cost and long-term operating cost savings when comparing diesel powered and solar powered pumps.

....

....

....

QUESTION 8 (Continued)

(j)   The use of solar power is more likely in western NSW than on the coast. State TWO reasons for this.

   (i)   ....

   (ii) ....

(k)   Indicate THREE conditions to be considered when siting a solar power unit on the farm. (Tilt angle is not a part of siting.)

   (i)   ....

   (ii) ....

   (iii) ....

(l)   Explain, with the aid of a sketch, the significance of the tilt angle of a solar panel.

   ....

   ....

   ....

(m)   Electricity may flow as either alternating current (ac) or direct current (dc). Which current is produced by solar cells?

   ....

Question 8 continues page 30

QUESTION 8 (Continued)

(n)   Explain, with reference to alternating and direct current, the role of an inverter in a solar electrical system.

....

....

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RURAL TECHNOLOGY
2 UNIT

Not to be collected at the conclusion of the examination

FORMULAE

Dynamics

$$v = u + at$$

$$s = ut + \tfrac{1}{2}at^2$$

$$s = \left(\frac{u + v}{2}\right)t$$

$$v^2 = u^2 + 2as$$

$$F = ma$$

$$P = \frac{W}{t}$$

$$W = Fs$$

Statics

If a body is in equilibrium, then :

$$\sum F_x = 0; \quad \sum F_y = 0; \quad \sum M = 0$$

$$M = Fd$$

Machines

$$RPM_1 \times Dia_1 = RPM_2 \times Dia_2$$

Area of circle

$$A = \frac{\pi}{4}d^2$$

Circumference of circle

$$C = \pi d$$

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