BOARD OF STUDIES
NEW SOUTH WALES

HIGHER SCHOOL CERTIFICATE EXAMINATION

1998
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.

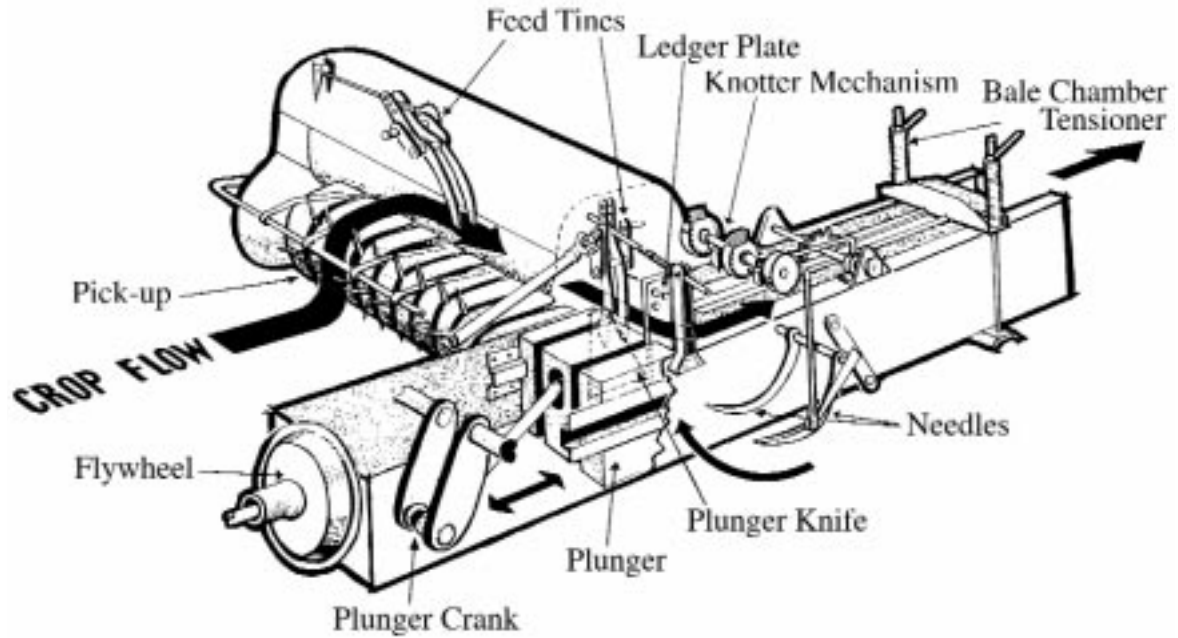- The Formulae Sheet will not be collected.

SECTION I—FARM MACHINERY

(20 marks)

QUESTION 1

British Crown copyright

FIG. 1. HAY BALER

Figure 1 shows a baler. Answer the following questions in relation to the diagram and this type of farm machinery.

(a)   Describe the shape and size of the bales made by this machine.

....

....

QUESTION 1. (Continued)

(b)   Describe the function of the following parts of the baler.

    (i)   Flywheel

....

....

    (ii)   Bale chamber tensioner

....

....

    (iii)   Plunger

....

....

(c)   List, in the order of operation, FOUR types of machinery used to harvest hay for baling.

    (i)   ....

    (ii)   ....

    (iii)   ....

    (iv)   ....

(d)   The baler in Figure 1 is power take-off (PTO) driven. Modern large machines are designed to operate at an optimum PTO shaft speed of 1000 r.p.m.

    (i)   State the other optimum shaft speed for older or smaller balers.

....

    (ii)   Describe a safety precaution you would take before dismounting from the tractor to unblock the baler.

....

....

(e)   Name a PTO-driven machine or implement that is used in the following operations.

    (i)   Cultivating

....

    (ii)   Fencing

....

Question 1 continues on page 4

QUESTION 1. (Continued)

(f)   Hitch sizes for linkage implements have four categories based on the power (kW) of the tractor used. What is the reason for this classification?

    ....

    ....

(g)   A tractor is operating with a 5 m wide implement at a speed of 5 km/h.

    (i)   If the tractor is operating in a 20 ha paddock, calculate the time required to complete the work.

                            Time required .... hours

    (ii)   Owing to certain conditions, the field efficiency of this tractor and implement may be reduced. State THREE factors that may be responsible for lowering the field efficiency.

        1.   ....

        2.   ....

        3.   ....

QUESTION 1. (Continued)

(h)   The graph in Figure 2 shows the relationship between tractor PTO power, engine speed, and fuel consumption. Two identical tractors, *A* and *B*, are operating at different engine speeds, but both are producing 40 kW of power at the PTO shaft.
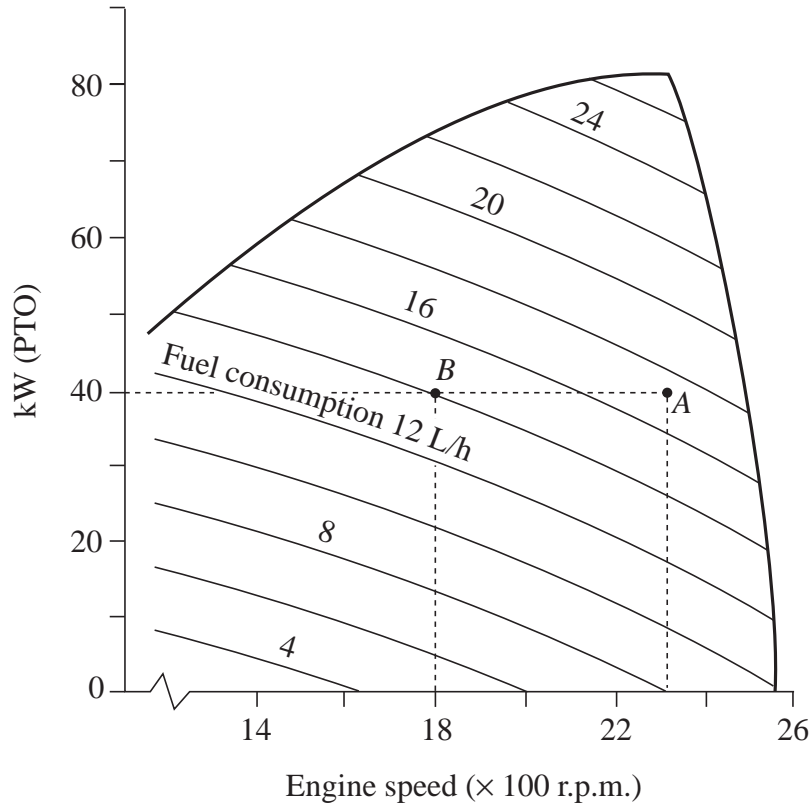
FIG. 2

(i)   Which tractor is operating most efficiently with regard to fuel consumption?

....

(ii)   Which tractor is operating in the higher gear?

....

(i)   A wool press is essential in an efficient shearing and wool-handling operation.

(i)   Who is credited with the invention of the nineteenth century mechanical wool press?

....

(ii)   Modern wool presses have improved on the original design. State TWO modern innovations in wool press design.

1.   ....

2.   ....

Question 1 continues on page 6

QUESTION 1. (Continued)

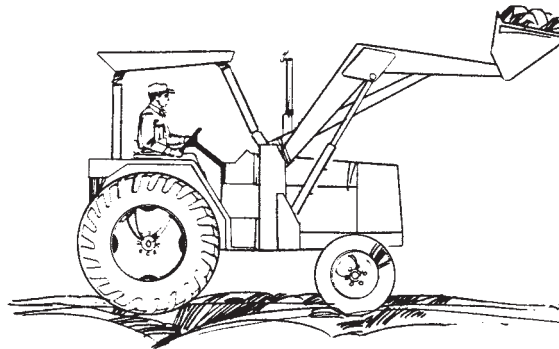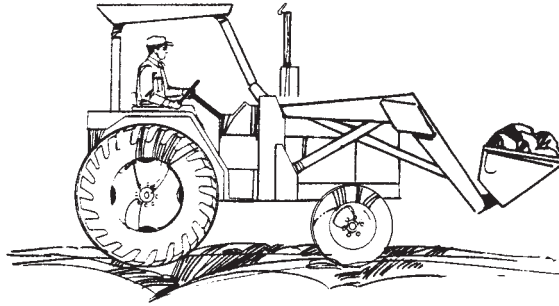(j)   Figure 3 shows a front-end loader transporting a load in a low-bucket position and a high-bucket position.

FIG. 3

(i)   Which position is the safest for the operator?

High/Low ....

(ii)   Give a reason for your choice.

....

....

QUESTION 1. (Continued)

(k)   Figure 4 shows an electricity meter.

100

1000

10 000

10

1
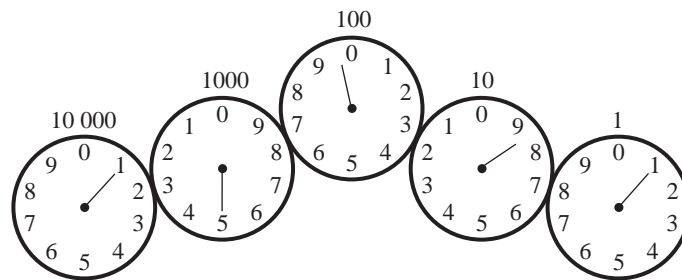
Integral Energy
Promotional brochure

FIG. 4

What is the meter reading and what are the units measured?

....

....

(l)   Portable electric power tools have a symbol printed on them if they are double insulated. In the space below, draw this symbol.

SECTION II—FARM STRUCTURES

(10 marks)

QUESTION 2

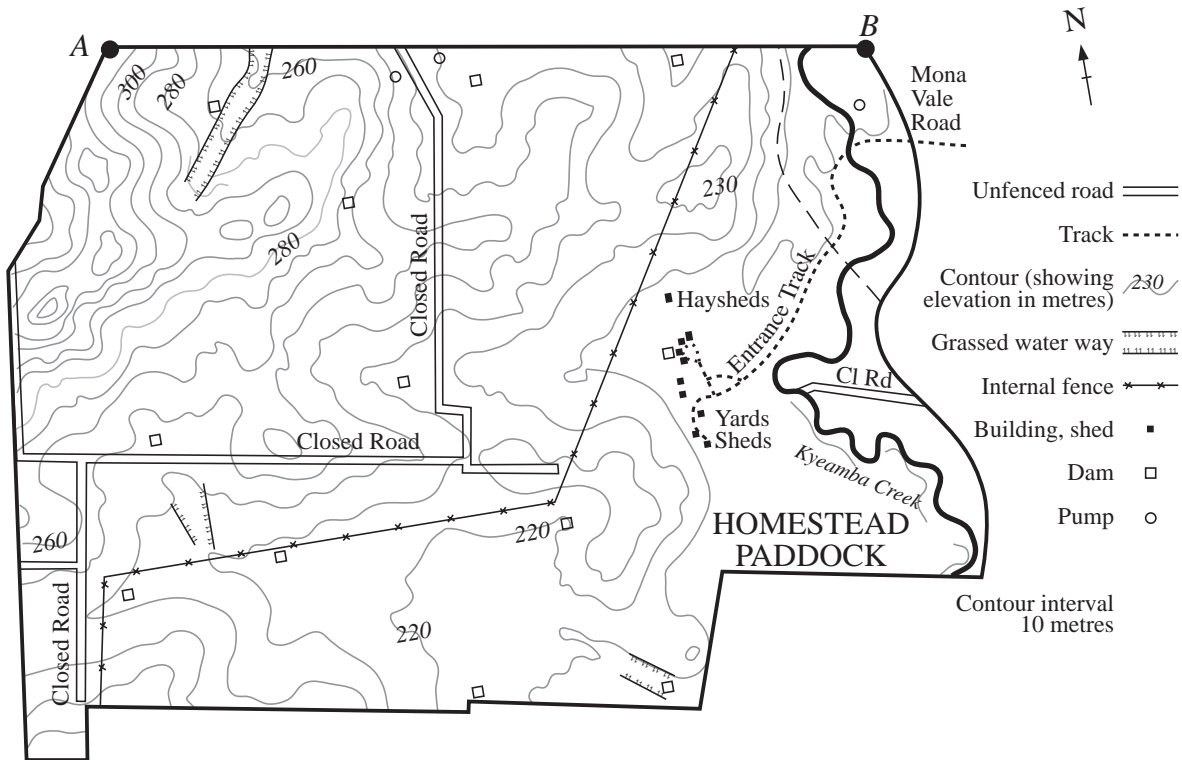(a) Use the topographic map in Figure 5 to answer the following questions.

FIG. 5

(i) The northern boundary shown by the line *AB* is 2·5 km. Calculate the scale and express the scale as a ratio.

....

....

(ii) Show, with an arrow drawn on the map, the direction of the flow of the surface water in the grassed waterway in the north-western corner of the property.

(iii) Explain the purpose of the grassed waterways.

....

....

(iv) Mark, with a large ✗, the highest point on the property.

QUESTION 2. (Continued)

    (v)   Cattle yards are to be constructed in the western paddock.

        1.   Mark the map with a 'Y' where you would put the yards.

        2.   State TWO reasons for your site selection.

           Reason 1 ....

           Reason 2 ....

    (vi) Property planners have identified two classes of land on this property and have divided the property as shown on the map. The western paddock is classified as being suitable for grazing, while the homestead paddock has been classified as suitable for cultivation.

        1.   State TWO factors that are considered when deciding the Land Capability Classification.

           Factor 1 ....

           Factor 2 ....

        2.   Explain why aerial photographs can be useful in farm plan development.

           ....

           ....

Question 2 continues on page 10

QUESTION 2. (Continued)

(b)   Figure 6 shows a permanent fence suitable (when electrified) for cattle and sheep.

Insulated dropper

25 cm

20 cm

15 cm

100 cm

15 cm

15 cm

10 cm

50 cm

Posts @ 20 m spacings, droppers @ 6·6 m spacings
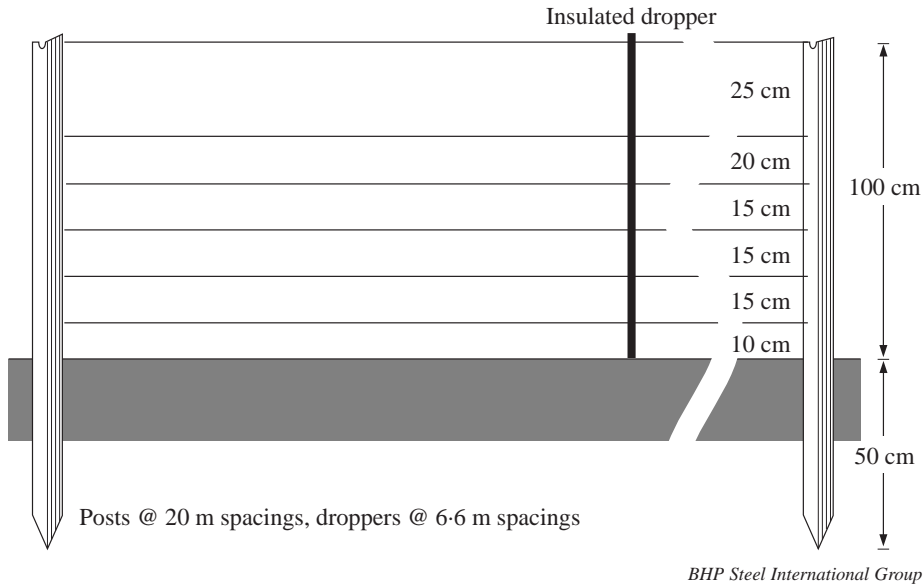
BHP Steel International Group

FIG. 6

(i)   Indicate, by writing the words 'live' and 'earth' above the wires, how you would electrify the fence.

(ii)   State which wires you would insulate at the 150 cm steel posts.

....

(iii)   Explain why the earthing system is critical to the efficient functioning of an electric fence.

....

....

(iv)   The recommended tension for this 2·5 mm high tensile wire is 1·5 kN. Describe how you would ensure your wire is strained to this tension.

....

....

(v)   Describe ONE use for a turnbuckle in fencing.

....

(vi)   Explain, giving THREE reasons, why it is necessary to clear a fence line as the first step in fence construction.

1.   ....

2.   ....

3.   ....

QUESTION 2. (Continued)

(c)   When straining fencing wire, knots will often slip when the strainer is removed. The Gripple^{TM} , shown in Figure 7, has overcome this problem.

FIG. 7

State TWO other advantages of the Gripple^{TM} over conventional knot tying.

   (i)   ....

   (ii)   ....

Please turn over

SECTION III—FARM GRAPHICS

(20 marks)

QUESTION 3. (10 marks)

A dimensioned exploded isometric drawing of an anti-vibration mount is given in Figure 8.
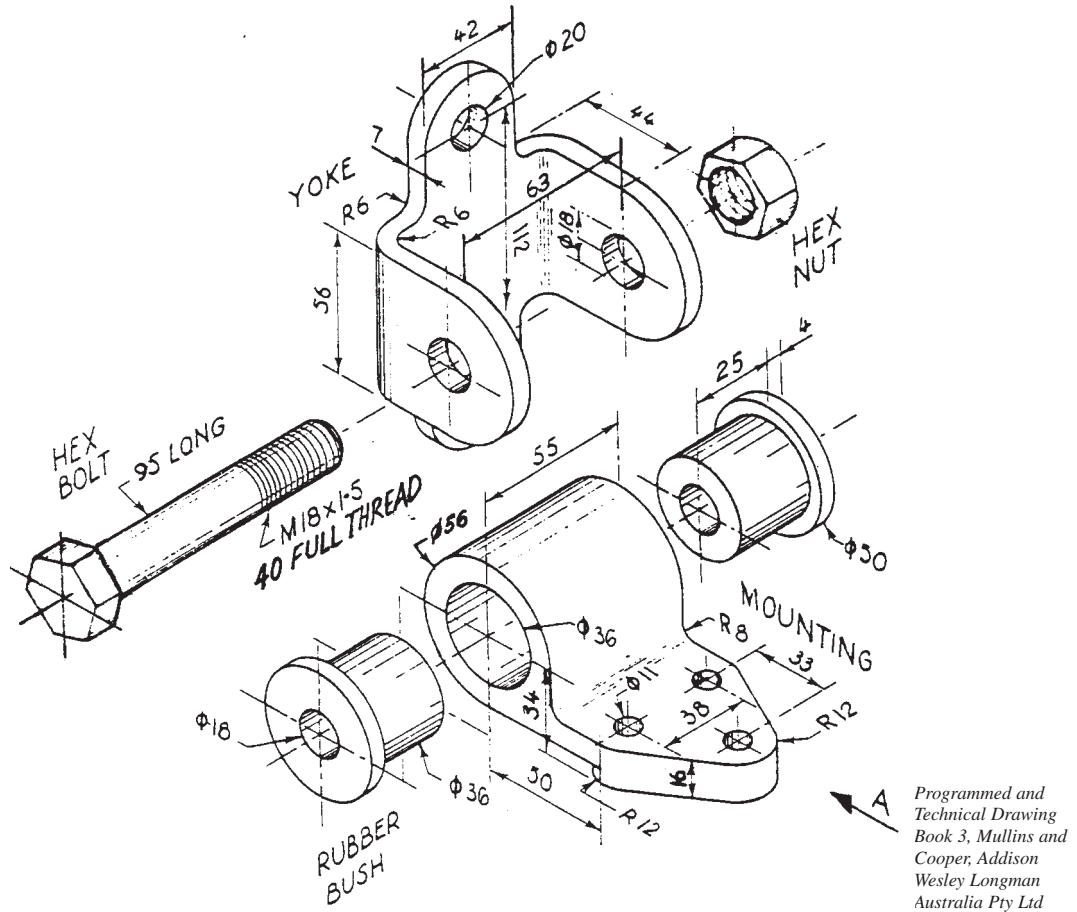
Programmed and Technical Drawing Book 3, Mullins and Cooper, Addison Wesley Longman Australia Pty Ltd

FIG. 8

(a)   Using the centre line and information provided on the following page, complete a fully sectioned 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 below.

1	MOUNTING		
ITEM	PART NAME	MATERIAL	QUANTITY

QUESTION 3. (Continued)
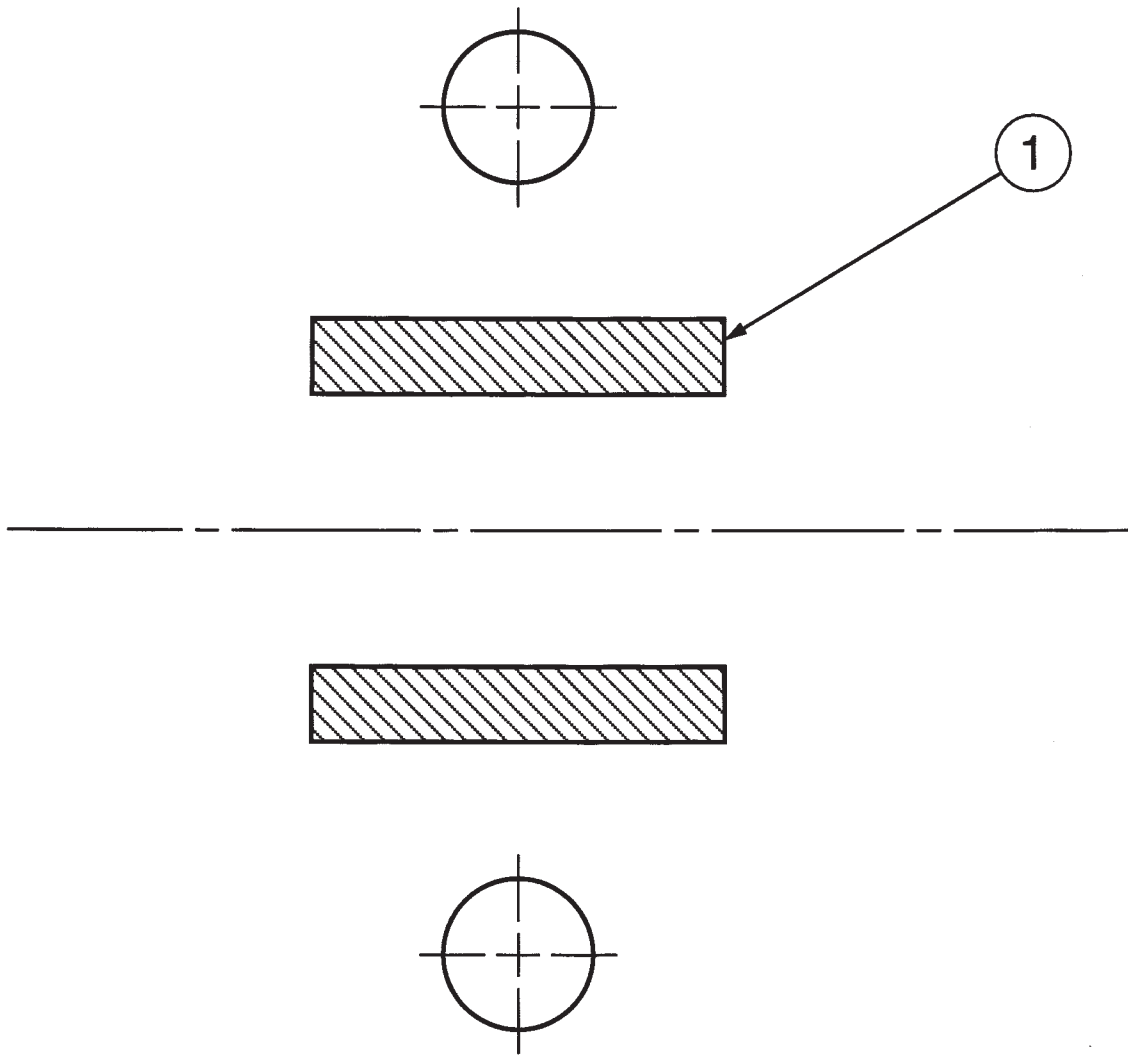
QUESTION 4. (5 marks)

Figure 9 shows top, front and side views of part of a guttering system. The drain pipe is to be rolled from a single piece of sheet material with the join on the line AB.

Use sizes taken from Figure 9 below to draw a full development of the drain pipe.

The line AB on the following page has been given as a starting point.

Do not add any seam allowances.

TOP VIEW

DRAIN PIPE

FRONT VIEW

SIDE VIEW
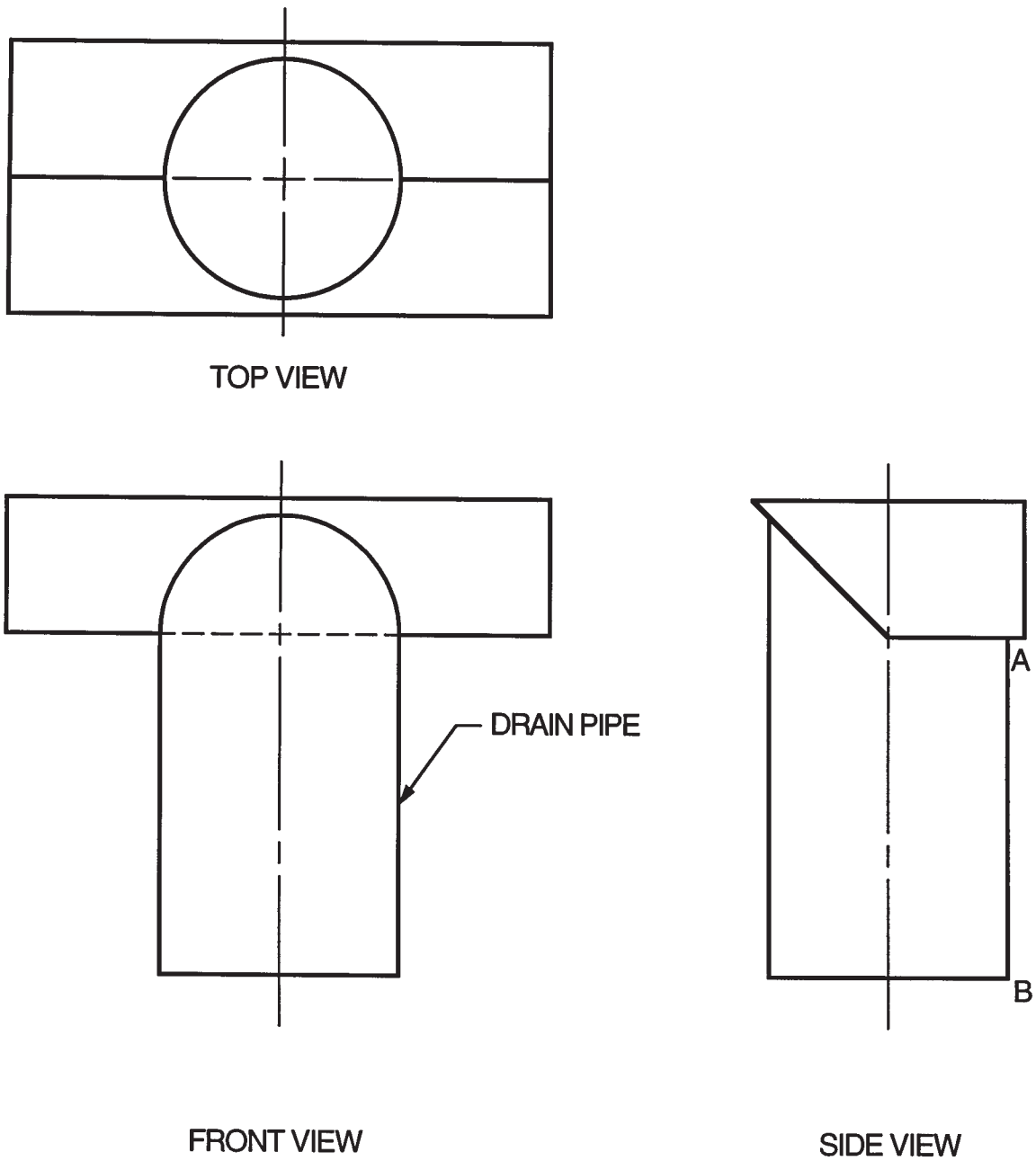
FIG. 9

QUESTION 4. (Continued)

A

B

QUESTION 5. (5 marks)

Details of a steel spanner are given in Figure 10 below.

Make an isometric drawing of the spanner when viewed in the direction indicated by arrow A. The spanner is 10 mm thick.

Use the starting point given on the following page.
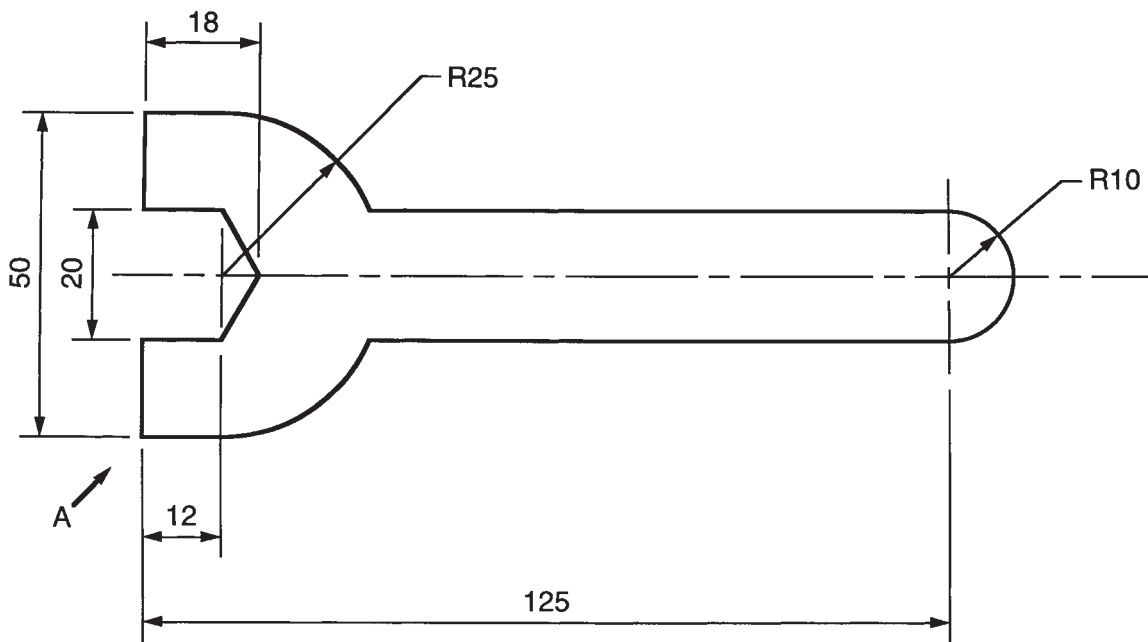
FIG. 10

QUESTION 5. (Continued)

A
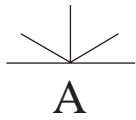
SECTION IV—RELATED MATERIALS SCIENCE

(10 Marks)

QUESTION 6

(a)   A truck is registered as a 12 tonne vehicle. With a load of wheat, the weighbridge reading is 37·5 tonnes. What is the mass and the weight of the wheat?

.... kg

.... newtons

(b)   A 'pink slip' registration test specifies that a truck travelling at 55 km/h must stop when it is forced to decelerate at 5 m/s^2. What time will it take for the truck to stop under these conditions?

....

....

....

....

....

(c)   A tractor applies a force of 1500 newtons to move a log 50 metres.

(i)   How much work is done in the operation?

Work done .... joules

(ii)   If the operation takes three minutes, how much power is consumed?

Power .... watts

QUESTION 6. (Continued)

(d)   A plan view of a strainer post has two forces applied to it as shown in Figure 11.
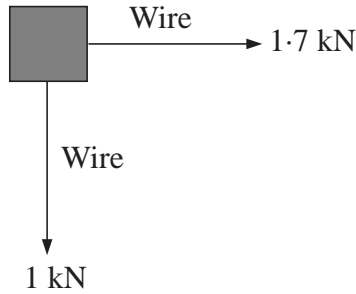
FIG. 11

What is the value of the equilibrant force? Show on the diagram where it would act.

....

(e)   What must be included in an order for timber to make a pergola or a carport?

(i)   ....

(ii)   ....

(iii)   ....

(iv)   ....

(v)   ....

(f)   In order to tighten a nut on the wheel of a tractor, a torque of 195 N m is required. The operator can only exert a force of 200 newtons and has a spanner that is 600 millimetres long.

Will the operator be able to tighten the nut to the required torque? Show calculations to justify your answer.

....

....

....

Question 6 continues on page 20

QUESTION 6. (Continued)

(g)   Timber that has undergone preservation treatment should be marked with numbers as shown in the example below.

<div align="center">110   16   6</div>

    (i)   Which number represents the hazard level?

....

    (ii)   Which number represents the mill?

....

    (iii)   Which number represents the chemical used?

....

(h)   What safe disposal procedures should be carried out with off-cuts of preservative-treated timber?

    (i)   ....

    (ii)   ....

(i)   Indicate the type of force that results in the failure of the following items.

    (i)   Drive shaft of a baling machine ....

    (ii)   Pin connecting a pulley to a shaft ....

    (iii)   Concrete floor of a shed ....

    (iv)   Fencing wire ....

(j)   What is meant by the *EMC* of timber?

....

....

QUESTION 6. (Continued)

(k)   The tractor in Figure 12 has a counterweight fitted to the front to balance a load being carried at the rear.

C of M

1.0 m   0.8 m   1.1 m
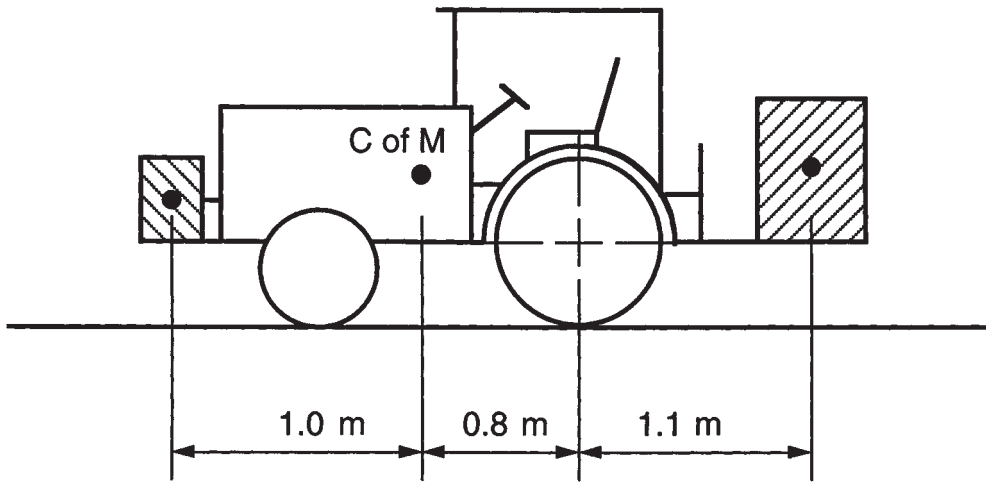
FIG. 12

Mass of tractor = 1 tonne

Mass of load = 950 kg

Determine the MINIMUM mass of the counterweight if the tractor is just on the point of tipping backwards.

Minimum mass .... kg

SECTION V—FARM WATER SUPPLIES

(15 marks)

QUESTION 7

(a) A farmer wants to put in a dam and has two possible locations. The anticipated SE ratios of the dams are 10 and 17. With all other factors the same, which would be the best location for the dam? Give reasons for your choice.

....

....

(b) If a rainfall gauge shows a reading of 7 millimetres, what is the reading expressed in kilolitres per hectare?

.... kL/ha

(c) Explain how the mechanical system used in a windmill is able to pump water.

....

....

....

(d)   (i)   When using solar power, what is meant by the tilt angle?

....

....

(ii)   Why should the tilt angle be adjusted when using solar power?

....

....

QUESTION 7. (Continued)

(e)   (i)   Laser levelling can be used to form flat areas of land. Explain how laser levelling is used to produce an area of land that has a maximum change in height of 10 millimetres.

....

....

....

....

    (ii)   Give TWO advantages of laser levelling over conventional earth levelling procedures.

1.   ....

2.   ....

(f)   Name THREE materials commonly used for pipes in drainage works.

(i)   ....

(ii)   ....

(iii)   ....

(g)   What is the difference between a solids trap and a grease trap?

....

....

....

(h)   List TWO procedures that can be adopted to control the odour associated with septic tanks.

(i)   ....

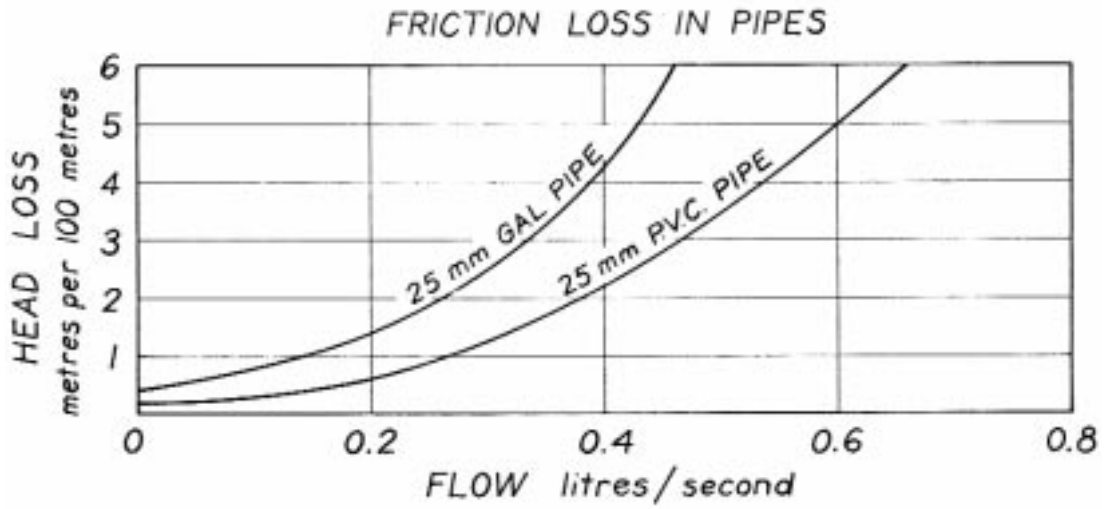(ii)   ....

(i)   An irrigation system has 8 sprinklers, each operating at 200 kPa in a lateral pipe. Ignoring friction loss, what is the minimum pressure required by the pump to operate those sprinklers?

....

QUESTION 7. (Continued)

(j)

FRICTION LOSS IN PIPES

Department of Education Examination, 1979, p 12

FIG. 13

With reference to the graph shown in Figure 13 above, answer the following questions.

(i)   What is meant by 'head loss'?

....

(ii)   For a flow of 0·3 litres/second, how great is the head loss on each type of pipe?

Galvanised steel ....

P.V.C. ....

(iii)   Which pipe causes the least drag on the water? Give TWO reasons to support your answer.

Type of pipe ....

1.   ....

2.   ....

QUESTION 7. (Continued)

(k)

FIG. 14

To determine the size of the pump needed for the sprinkler shown above in Figure 14, critical factors must be measured.

By means of dimensioning lines and the appropriate letter, show the following critical measurements on the sketch above:

- static suction head (P);

- static delivery head (Q);

- friction head loss in suction pipe (R);

- friction head loss in delivery pipe (S).

SECTION VI—TOPICAL STUDY

COMPUTERS AND MICROCHIPS
IN FARM MACHINERY AND
ON THE FARM

(10 Marks)

QUESTION 8

(a)   The quotation below refers to a new computer-controlled herbicide-spraying technique.

> 'An Australian invention is revolutionising broad-acre spraying.   The
> Detectspray formerly called the WASP (weed-activated spray process) uses a
> series of boom-mounted light sensors to "see" and then activate the appropriate
> nozzle to spray scattered weeds in both fallow and crop situations.'

Reed Educational & Professional Publishing

Use your knowledge of the spraying technique to answer the following questions.

(i)   Explain how the boom-mounted light sensors actually 'see' and identify the weed.

....

....

....

(ii)   Describe how the computer activates and controls the application of herbicide to
the weed.

....

....

....

(iii)   Explain how this technology can advantage the profitability of crop production.

....

....

QUESTION 8. (Continued)

    (iv)   Explain how this technology can help in crop management in ways other than financial benefits.

          ....

          ....

          ....

    (v)   Explain how this technology can be of benefit to the wider (off-farm) environment.

          ....

          ....

          ....

    (vi)   Explain why some farmers may be reluctant to adopt this technology into their farm operations.

          ....

          ....

          ....

          ....

QUESTION 8. (Continued)

(b) The schematic diagram in Figure 15 shows the basic components of a computer control system.

With reference to the components shown, describe the operation of a computer-controlled farm machine or system (other than a crop-spraying system) that you have studied.
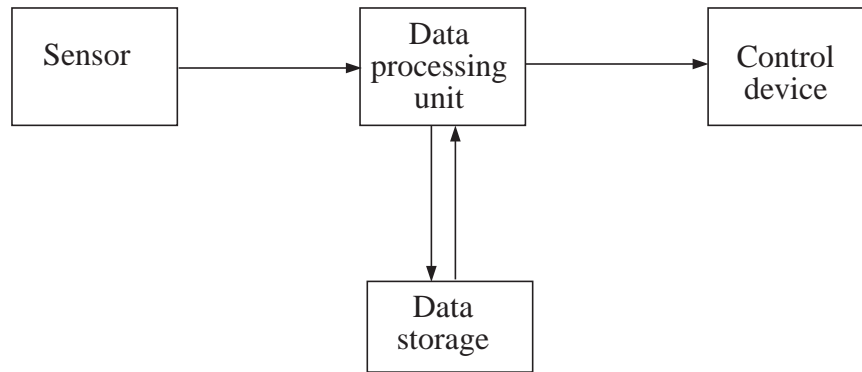

FIG. 15

....

....

....

....

....

....

....

....

....

....

....

....

....

....

End of paper

1998
HIGHER SCHOOL CERTIFICATE EXAMINATION
RURAL TECHNOLOGY
2 UNIT

Not to be collected at the conclusion of the examination.

FORMULAE

Dynamics

$v = u + at$

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

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

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

$F = ma$

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

$W = Fs$

Statics

If a body is in equilibrium, then :

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

$M = Fd$

Machines

$RPM_1 \times Dia_1 = RPM_2 \times Dia_2$

Area of circle

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

Circumference of circle

$C = \pi d$

400a

BLANK PAGE