BOARD OF STUDIES
NEW SOUTH WALES

STUDENT NUMBER

CENTRE NUMBER

HIGHER SCHOOL CERTIFICATE EXAMINATION

1995

RURAL TECHNOLOGY

2 UNIT

(85 Marks)

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

EXAMINER'S USE ONLY

Question	
1	
2	
3	
4	
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8	

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right-hand corner of this page.
- Attempt ALL Sections.
- The marks allocated to each Section are shown in this paper.
- Write your answers in the spaces provided in this paper.

SECTION I—FARM MACHINERY

(20 Marks)

QUESTION 1

(a) The approximate draught required to pull a tillage implement can be estimated from the implement's operating-width and the numbers shown in Tables 1 and 2.

TABLE 1. APPROXIMATE DRAUGHT OF TILLAGE IMPLEMENTS IN NSW

Implement	*Primary or secondary tillage*	*Depth* (mm)	*Speed* (km/h)	*Draught* (t/m width)		
				Heavy	Medium	Light
Offset disks	P	80	8	0·80	0·65	0·50
	S	80	8	0·50	0·40	0·30
Scarifier	P	80	8	0·55	0·45	0·35
	S	100	10	0·45	0·35	0·25
Cultivator	P	90	8	0·30	0·20	0·10
Chisel plough	P	70	7	0·60	0·45	0·30
	S	70	8	0·45	0·25	0·15
Blade plough	P	–	–	0·60	0·45	0·30

'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

TABLE 2. APPROXIMATE DRAUGHT OF TILLAGE IMPLEMENTS IN WA

Implement	*Primary or secondary tillage*	*Depth* (mm)	*Speed* (km/h)	*Draught* (t/m width)		
				Heavy	Medium	Light
Agrowplow	P	300	8	1·5	1·2	1·00
Disk plough	P	75	8	0·90	0·60	0·40
Scarifier	P	80	8	0·90	0·60	0·45
Cultivator	S	50	8	0·45	0·35	0·20
Combine	S	50	8	0·45	0·35	0·25

'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

Using the tables, answer the following questions.

(i) Do implements require more draught when working on heavier soils?

.....

(ii) Is the draught requirement of a scarifier in Western Australia higher than in New South Wales?

.....

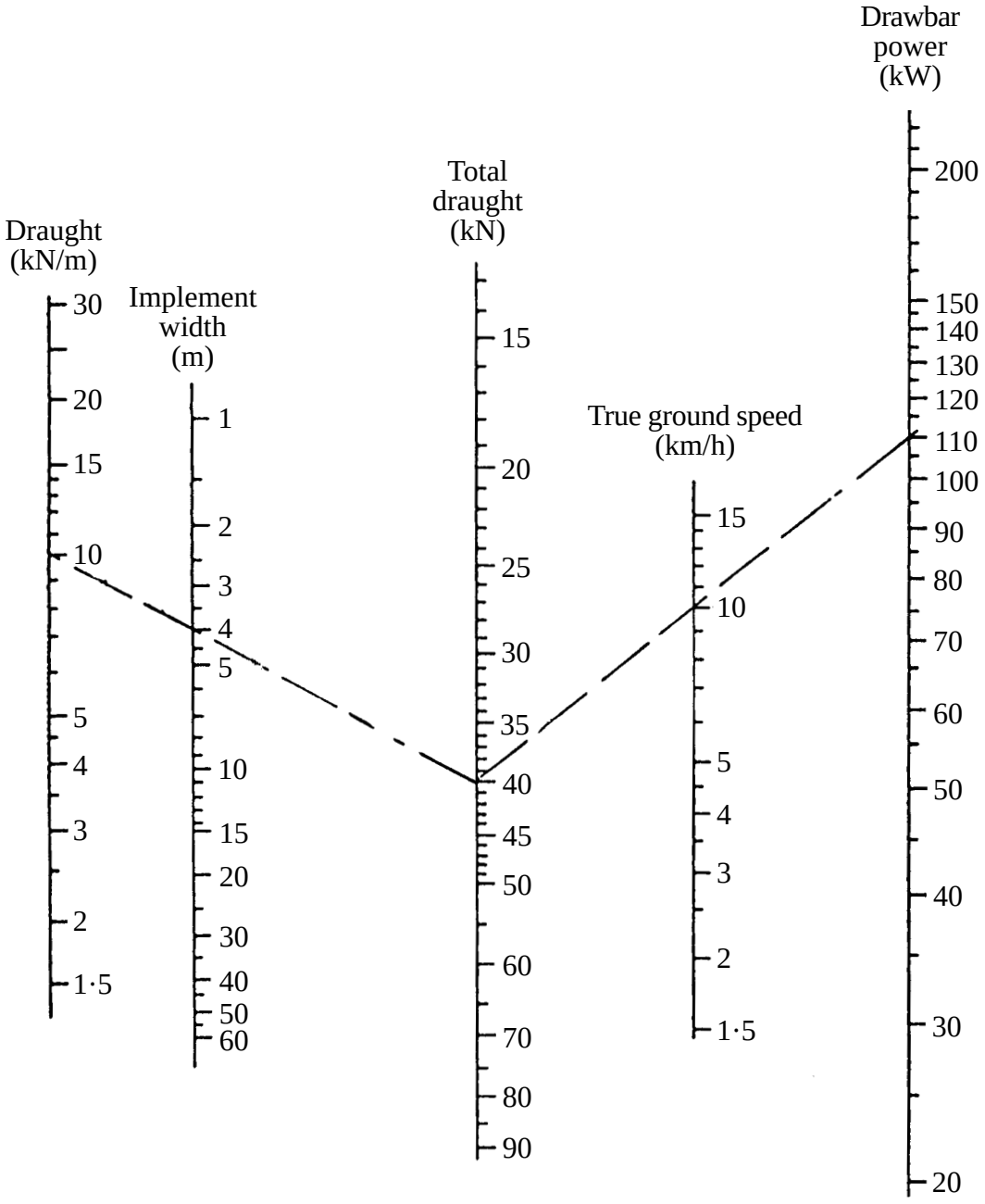
(iii) For New South Wales, how much less draught will a chisel plough for secondary tillage on heavy soil (70 mm deep) require over an offset disk for secondary tillage on the same soil (80 mm deep)? Answer in tonnes per metre width (t/m width).

.....

.....

QUESTION 1. (Continued)

(b) The nomograph in Figure 1 can be used to find drawbar power. The dashed line shows that for a draught of 10 kN/m, a 4-metre-wide implement travelling at a true ground speed of 10 km/h needs drawbar power of 110 kW. Find the new drawbar power required if the true ground speed is reduced to 5 km/h.



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

FIG. 1

Answer ..... kW

(c) What is the main difference between monograde oils and multigrade oils?

.....

.....

Question 1 continues on page 4

QUESTION 1. (Continued)

(d) Give TWO factors that contributed to the development of the inventions listed below.

(i) Stump-jump plough

1. .....

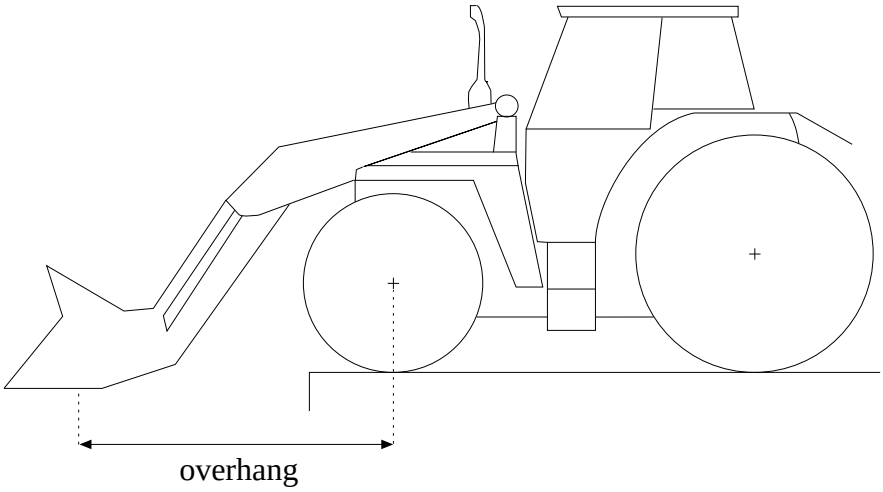
2. .....

(ii) Wool press

1. .....

2. .....

(e) A sketch of a front-end loader is given in Figure 2.



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

FIG. 2

The axles of a front-end loader may be damaged if the overhang is too large. Give THREE ways of reducing this risk.

(i) .....

(ii) .....

(iii) .....

(f) When spraying crops, smaller droplet size produces more spray drift than larger droplet size. Give TWO ways of increasing the droplet size.

(i) .....

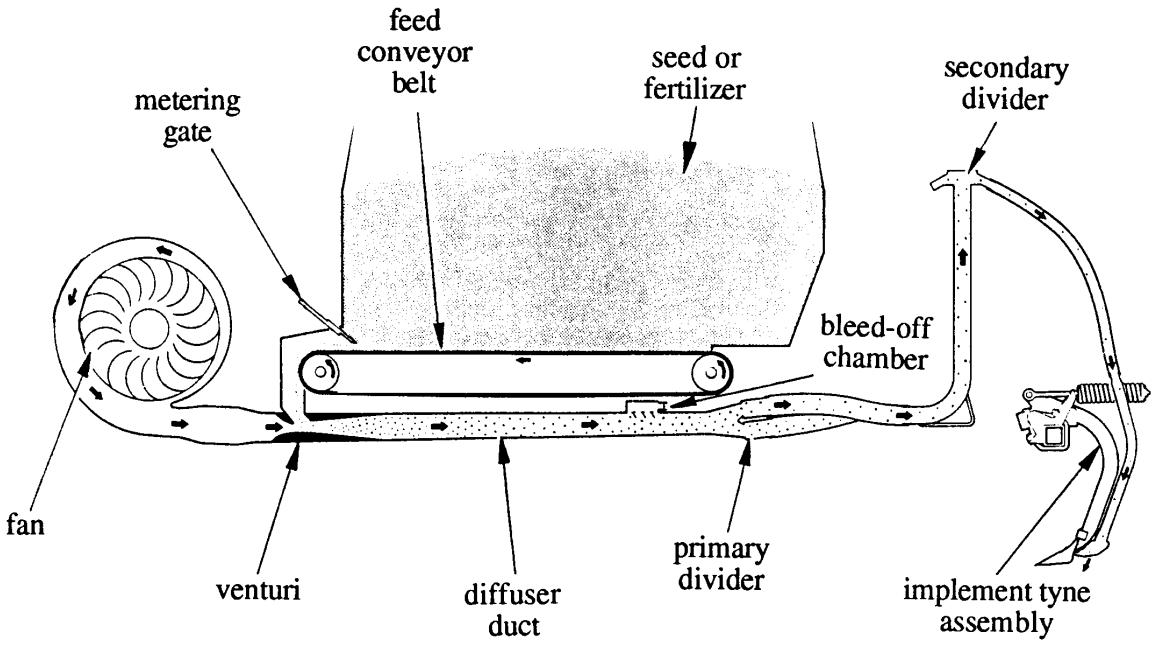
(ii) .....

QUESTION 1. (Continued)

(g) By drawing lines between the dots, match the following wind speeds with the correct spraying conditions.

(i)	Wind speed less than 2 km/h (calm) •	• ideal boom spraying
(ii)	Wind speed 3·2–6·5 km/h (light breeze) •	• avoid spraying
(iii)	Wind speed 6·5–9·5 km/h (gentle breeze) •	• avoid boom spraying (especially herbicides)

(h) A sketch of a Chamberlain 667 air seeder is given in Figure 3.



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

FIG. 3

(i) What is the purpose of the venturi?

.....

(ii) How would you control the seed (or fertilizer) application rate?

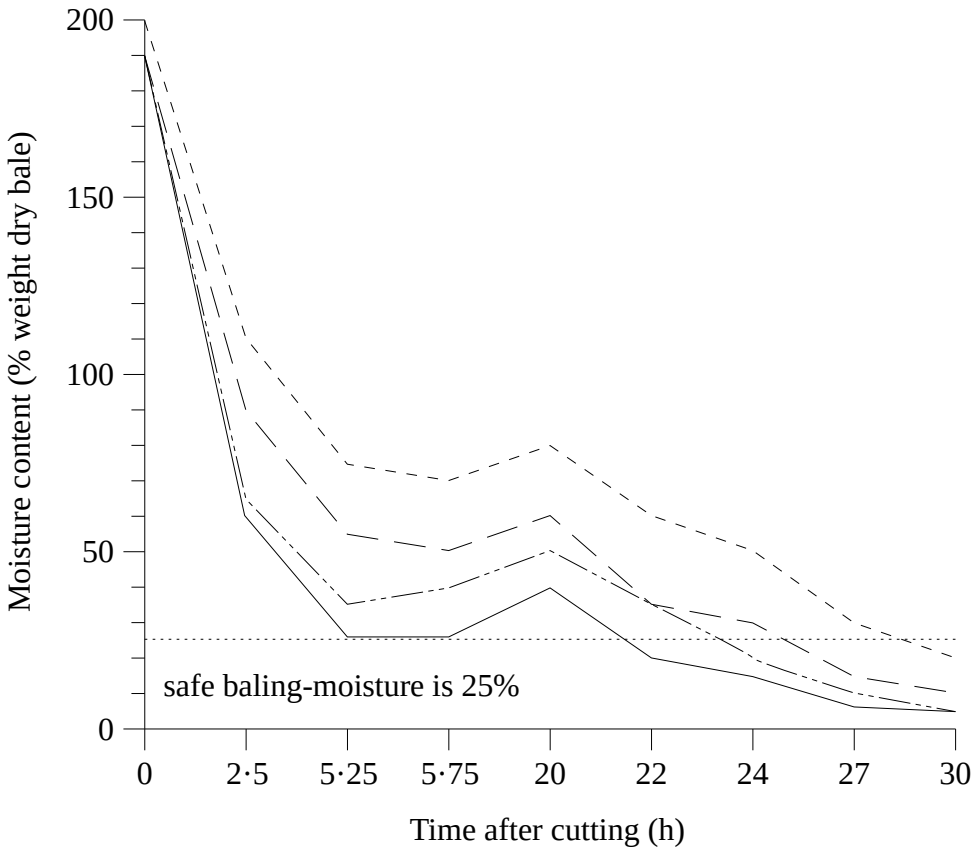
.....

.....

Question 1 continues on page 6

QUESTION 1. (Continued)

(i) Lucerne drying-times after cutting are given in the graph in Figure 4.



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

KEY

- - - - - - disk mower—not conditioner
— — — mower conditioner
—·-·— disk mower and potassium carbonate
——— mower conditioner and potassium carbonate

FIG. 4. LUCERNE DRYING-TIMES AFTER CUTTING

(i) What is the effect on drying-time when potassium carbonate is sprayed onto the crop at the time of cutting?

.....

(ii) Why will lucerne dry to a safe baling-moisture content more quickly if cut with a mower conditioner instead of a disk mower?

.....

.....

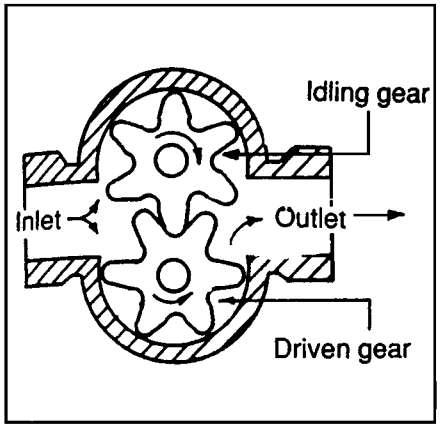
(j) Why does moist grain in a storage bin generate more heat than drier grain?

.....

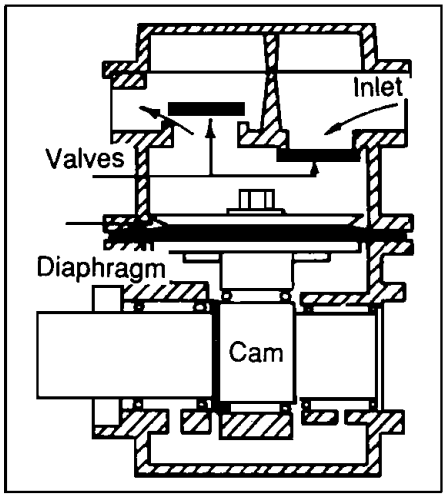
QUESTION 1. (Continued)

(k) Sketches of FOUR types of pumps used in spraying are given in Figure 5.

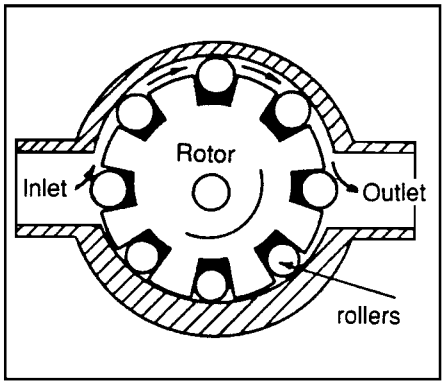
(i)



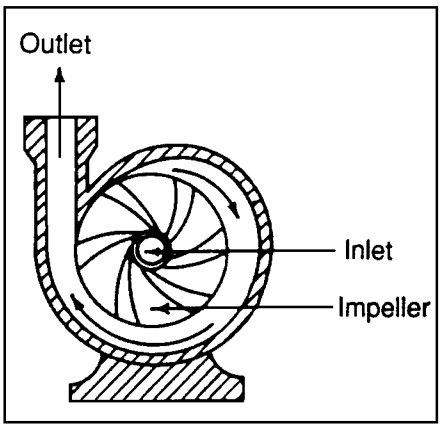
(ii)



(iii)



(iv)



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

FIG. 5

Name each type of pump in the space below.

(i) .....

(ii) .....

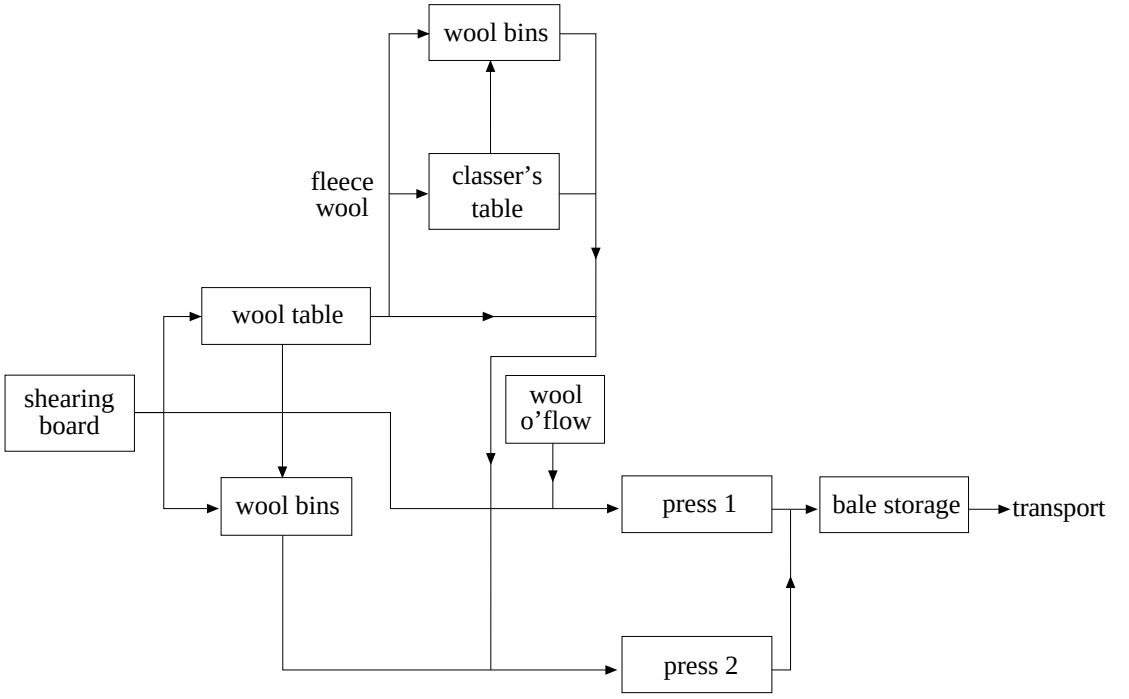
(iii) .....

(iv) .....

Question 1 continues on page 8

QUESTION 1. (Continued)

(l) A wool-handling flowchart is shown in Figure 6.



'Taking Tractors', M Casey & G Hamilton (eds), Kondinin Group.

FIG. 6. WOOL-HANDLING FLOWCHART

What is the main purpose of this flowchart?

.....

.....

.....

(m) Give TWO reasons for using a three-phase motor instead of a single-phase motor.

(i) .....

(ii) .....

(n) Explain why, in an electric circuit, a specified 15 A fuse should not be replaced with a 25 A fuse.

.....

QUESTION 1. (Continued)

(o) What is the Australian Standard colour-code for the following electrical wires?

(i) Earth wire

.....

(ii) Neutral wire

.....

(iii) Live wire

.....

(p) What is the purpose of an earth wire in an electrical system?

.....

SECTION II—FARM STRUCTURES

(10 Marks)

QUESTION 2

(a) What is a whole-farm plan?

.....

.....

(b) Give THREE reasons for subdividing a farm into paddocks.

(i) .....

(ii) .....

(iii) .....

(c) List FOUR factors that could influence the location of fences when subdividing paddocks.

(i) .....

(ii) .....

(iii) .....

(iv) .....

(d) List THREE factors that would make a farm suitable for sheep.

(i) .....

(ii) .....

(iii) .....

QUESTION 2. (Continued)

(e) The following questions refer to electric fencing.

(i) State why an electric fence needs to be insulated.

.....

.....

(ii) Explain with the aid of a sketch how an electric-fence wire is insulated. Name all the components.

(iii) What are typical values for the voltage and current of an operating electric fence?

Voltage .....

Current .....

(iv) Why is a low pulse-rate necessary in an electric-fence wire?

.....

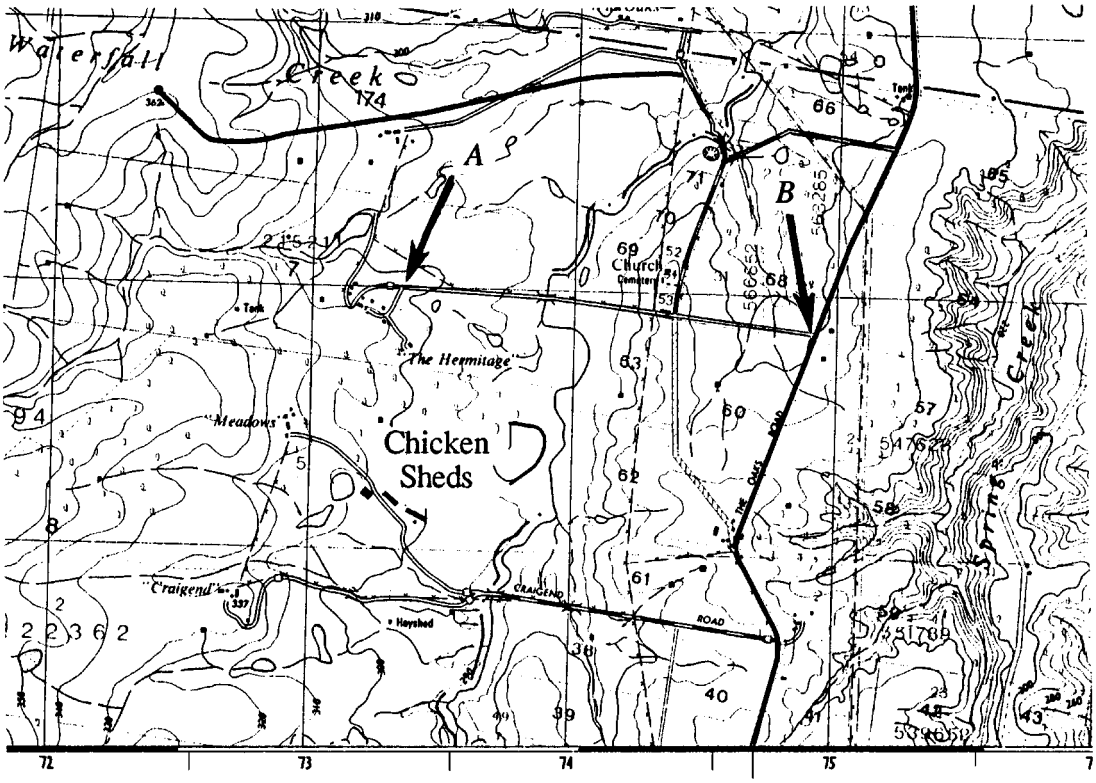
.....

(v) Explain with the aid of a sketch how the live wire can continue past a gate.

Question 2 continues on page 12

QUESTION 2. (Continued)

(f) A topographic map is given in Figure 7. Use this map to answer the following questions.



SCALE: 1 : 25 000

FIG. 7

(i) Using the scale given, calculate the distance from the road intersection at *A* to the road intersection at *B*.

.....

(ii) Give TWO advantages of locating the chicken sheds where they are.

1. .....

2. .....

QUESTION 2. (Continued)

(g) A grazier has initiated a re-fencing program. An area measuring 410 m × 520 m is to be re-fenced with new materials. The type of fencing is shown in Figure 8. The cost of the fencing components is shown in Table 3. Do not make allowances for gates.

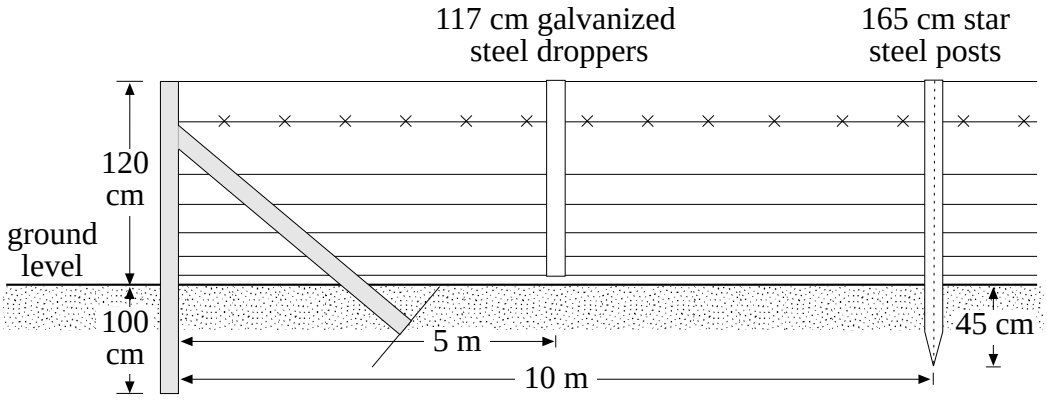


FIG. 8. PLAIN WIRE, BARBED WIRE, AND DROPPER FENCE. (CATTLE AND SHEEP)

TABLE 3

Corner/strainer assembly	\$55 each
Barbed wire (400 m per reel)	\$29 per reel
High-tensile fence wire (100 m per coil)	\$31 per coil
117 cm steel droppers	\$10 each
165 cm steel posts	\$13 each

(i) What is the cost of the fencing project? Show all calculations.

.....

.....

.....

.....

Answer .....

(ii) How is a person able to determine the length of wire left on a coil without unrolling it?

.....

.....

.....

SECTION III—FARM GRAPHICS

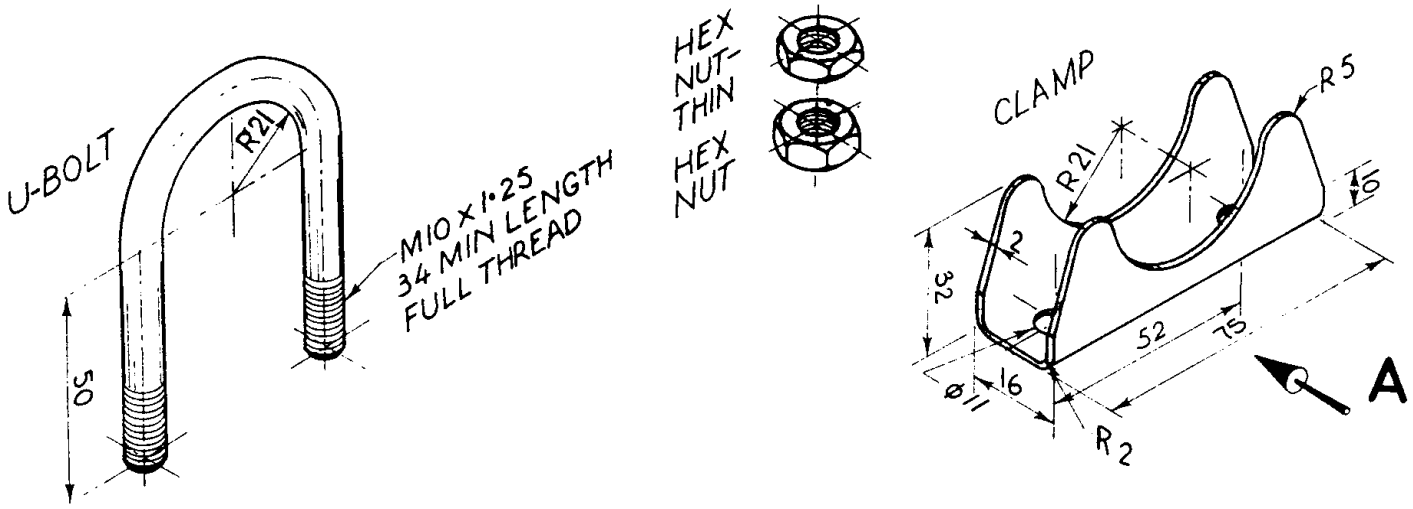
(20 Marks)

Question 3 is COMPULSORY.

You must also answer *EITHER* Question 4 *OR* Question 5.

QUESTION 3. (12 marks)

Details of parts of a pipe clamp from a tractor exhaust system are shown in Figure 9.



'Programmed Technical Drawing', R Mullins & D Cooper (eds), Longman Australia.

FIG. 9. PIPE CLAMP

(a) Draw a full-size orthogonal front view of a pipe clamp. The parts are to be drawn assembled on a 42 mm outside diameter pipe. Use the end view of the pipe on page 15 as a starting point.

The view is to be in the direction of the arrow *A*.

(b) Place SIX major dimensions on the assembled drawing.

(c) Give a parts list under your drawing. Include a suitable material from which to manufacture each part.

(d) Suggest an alternative means of preventing the nuts from vibrating loose.

.....

.....

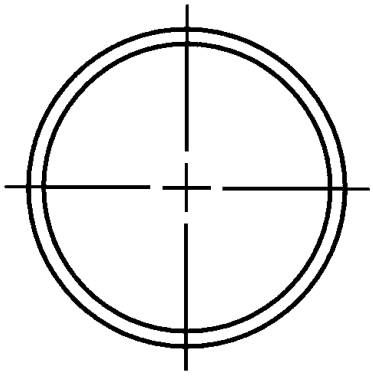
(e) What is meant by M10 × 1·25?

.....

(f) Calculate the length of material needed to make the U-bolt. Show your working.

Answer .....

QUESTION 3. (Continued)



EITHER

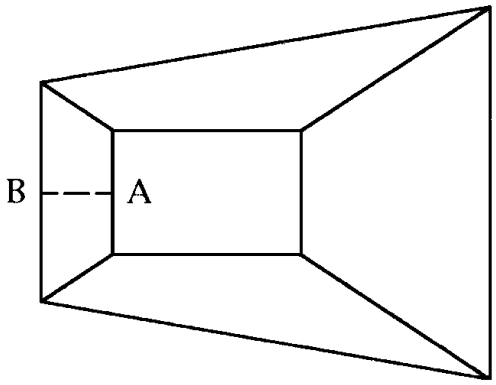
QUESTION 4. (8 marks)

Figure 10 shows the top and front views of a ventilation flue and duct made from galvanized steel.

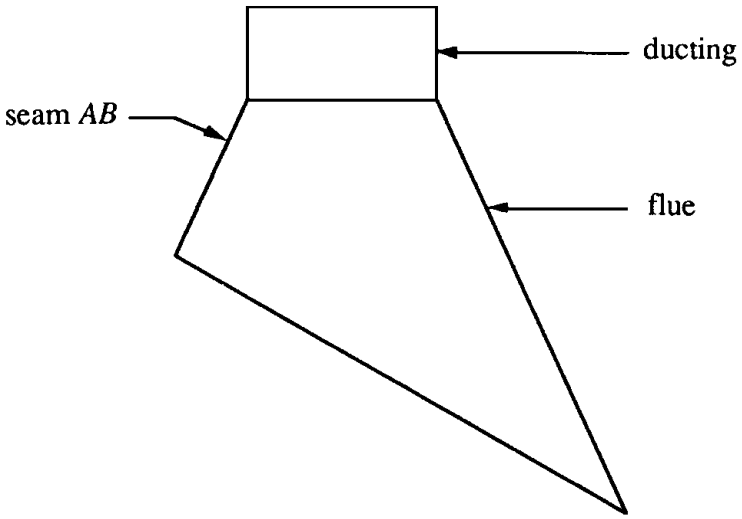
On page 17, draw a half-development of the flue. Provide a lap seam of 10 mm at the seam *AB*.

Take sizes from the views shown.

THIRD-ANGLE PROJECTION



Top view



Front view

FIG. 10

NOTE. This shape is derived from a rectangular pyramid.

OR

QUESTION 4. (Continued)

QUESTION 5. (8 marks)

Figure 11 shows an orthogonal drawing of a machine part in third-angle projection.

On page 19 draw an isometric drawing of the machine part, viewed in the direction of the arrow *A*. Use the starting point given on page 19.

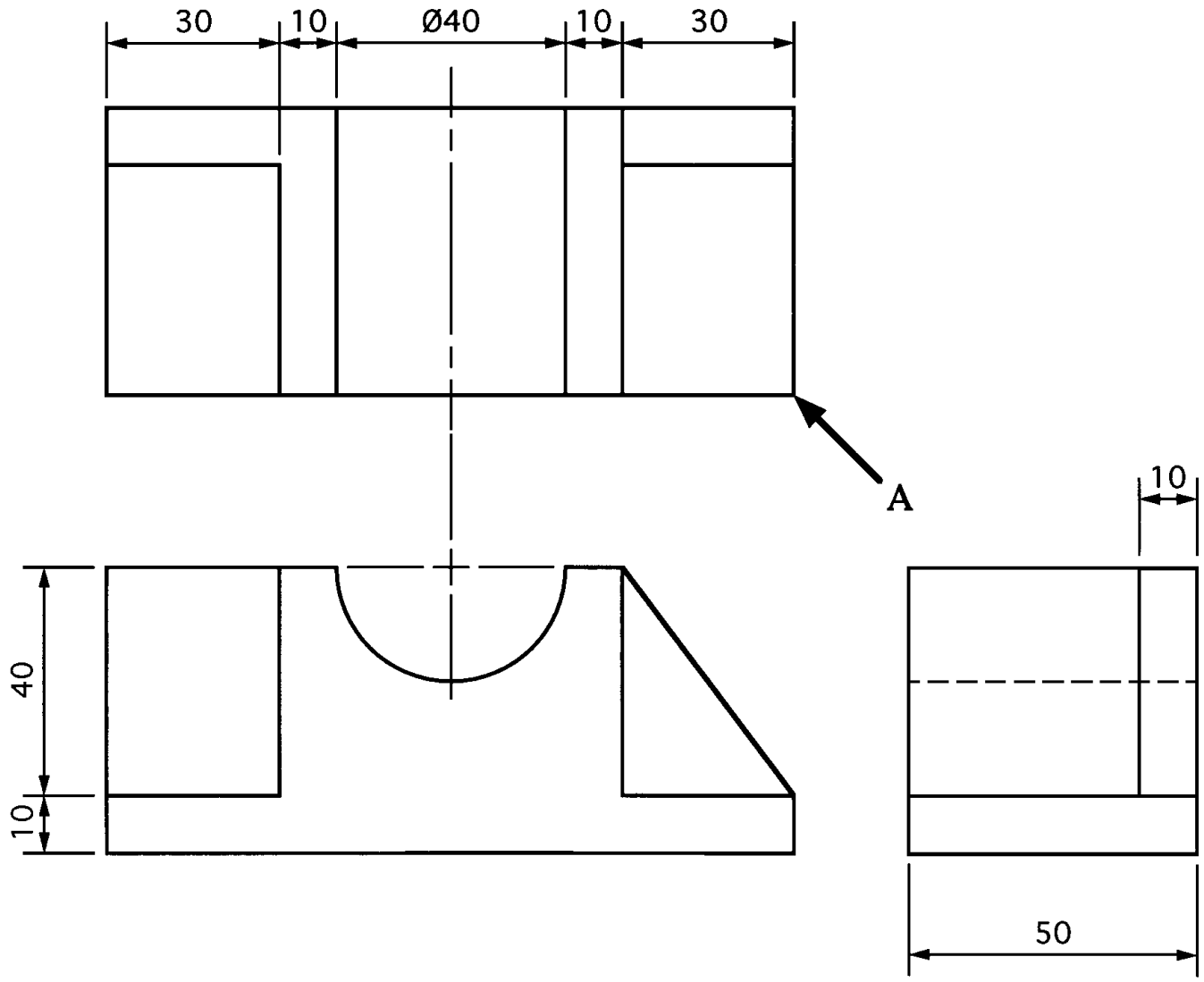
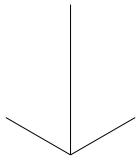


FIG. 11

QUESTION 5. (Continued)



Starting point

SECTION IV—RELATED MATERIALS SCIENCE

(10 Marks)

QUESTION 6

(a) A vehicle is registered as a 12-tonne truck.

(i) What is the mass of the truck in kilograms?

Mass..... kg

(ii) What is the weight of the truck? Include units in your answer.

Weight ..... units .....

(b) A tractor exerts a force of 15 kN to pull a plough over a distance of 40 m. How much work is done by the tractor? Show all calculations.

Answer ..... kJ

QUESTION 6. (Continued)

(c) A combination strainer assembly is shown in Figure 12. It utilizes a threaded shaft on which a nut is tightened to form a rigid triangle.

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FIG. 12

What type of force is exerted:

(i) in the threaded shaft?

.....

(ii) in the tubular stay?

.....

(iii) by the ground pad?

.....

(d) The repair manual for a header harvester indicates that a nut should be tightened to a torque value of 200 N m. What force needs to be applied to a 400 mm torque wrench to ensure the nuts are tightened to the correct value? Show calculations.

Answer .....

Question 6 continues on page 22

QUESTION 6. (Continued)

(e) Name FOUR causes of the deterioration or destruction of wood.

(i) .....

(ii) .....

(iii) .....

(iv) .....

(f) Briefly outline the process of making timber more durable by pressure preservation.

.....

.....

.....

.....

(g) List THREE seasoning defects in timber.

(i) .....

(ii) .....

(iii) .....

(h) Describe what is meant by ‘wet rot’.

(i) Wet rot .....

.....

(ii) Give TWO conditions that would encourage the development of wet rot.

1. .....

2. .....

QUESTION 6. (Continued)

(i) Figure 13 shows a pergola with all dimensions given in millimetres.

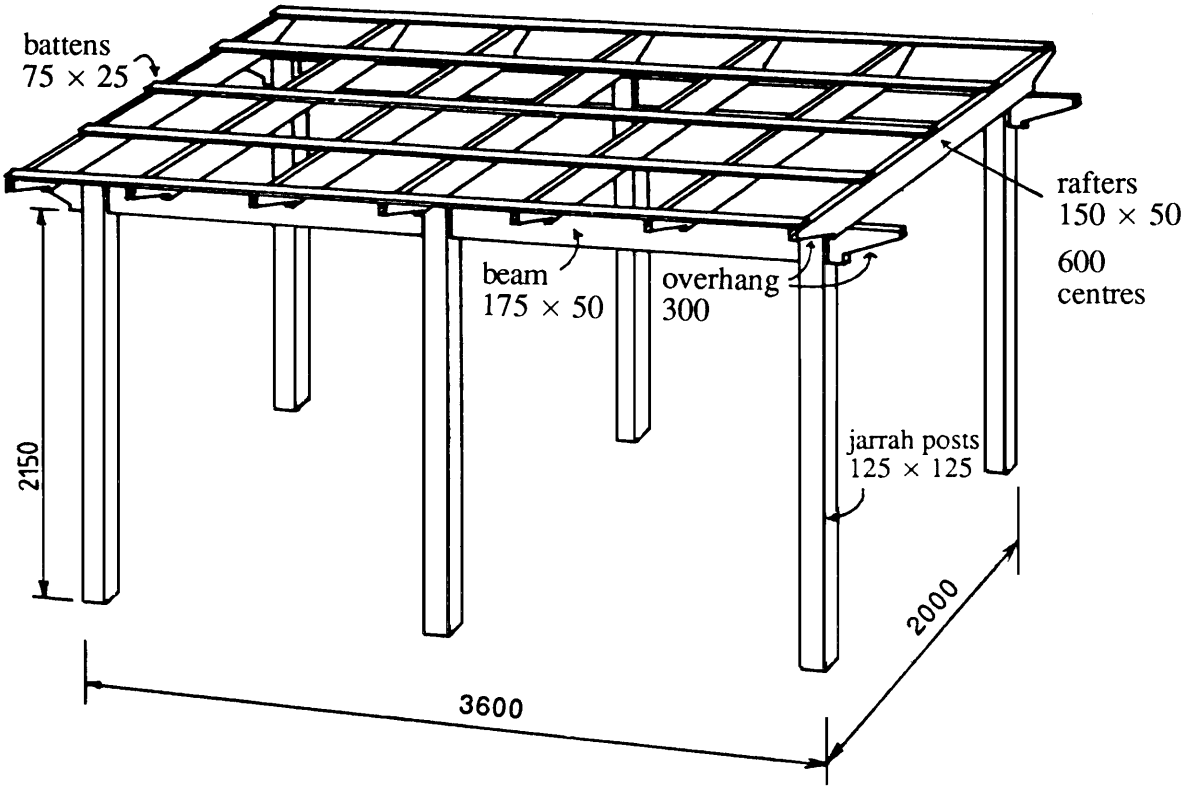

FIG. 13

(i) Write out a timber order for building the pergola.

.....

.....

.....

.....

(ii) Calculate the cost of the timber using the prices given in Table 4.

TABLE 4

125 × 125 jarrah	$15·00 per metre
175 × 50 hardwood	$12·50 per metre
150 × 50 hardwood	$16·00 per metre
75 × 25 hardwood	$4·00 per metre

.....

.....

.....

SECTION V—FARM WATER SUPPLIES

(15 Marks)

QUESTION 7

(a) All waste-water treatment systems rely on the actions of two types of bacteria. Name the types of bacteria and the conditions required for them to be effective.

	Type of bacterium	*Conditions required*
(i)		
(ii)		

(b) Make a neat sketch showing the plan view of a block of land containing an absorption trench connected to a septic tank. Indicate the direction of fall of the land.

(c) Give THREE factors that should be considered when establishing a suitable water supply for a rural home.

(i) .....

(ii) .....

(iii) .....

(d) What are FOUR advantages in using a travelling irrigator over other sprinkler methods?

(i) .....

(ii) .....

(iii) .....

(iv) .....

QUESTION 7. (Continued)

(e) The sketch in Figure 14 shows the possible trouble spots on a farm dam.

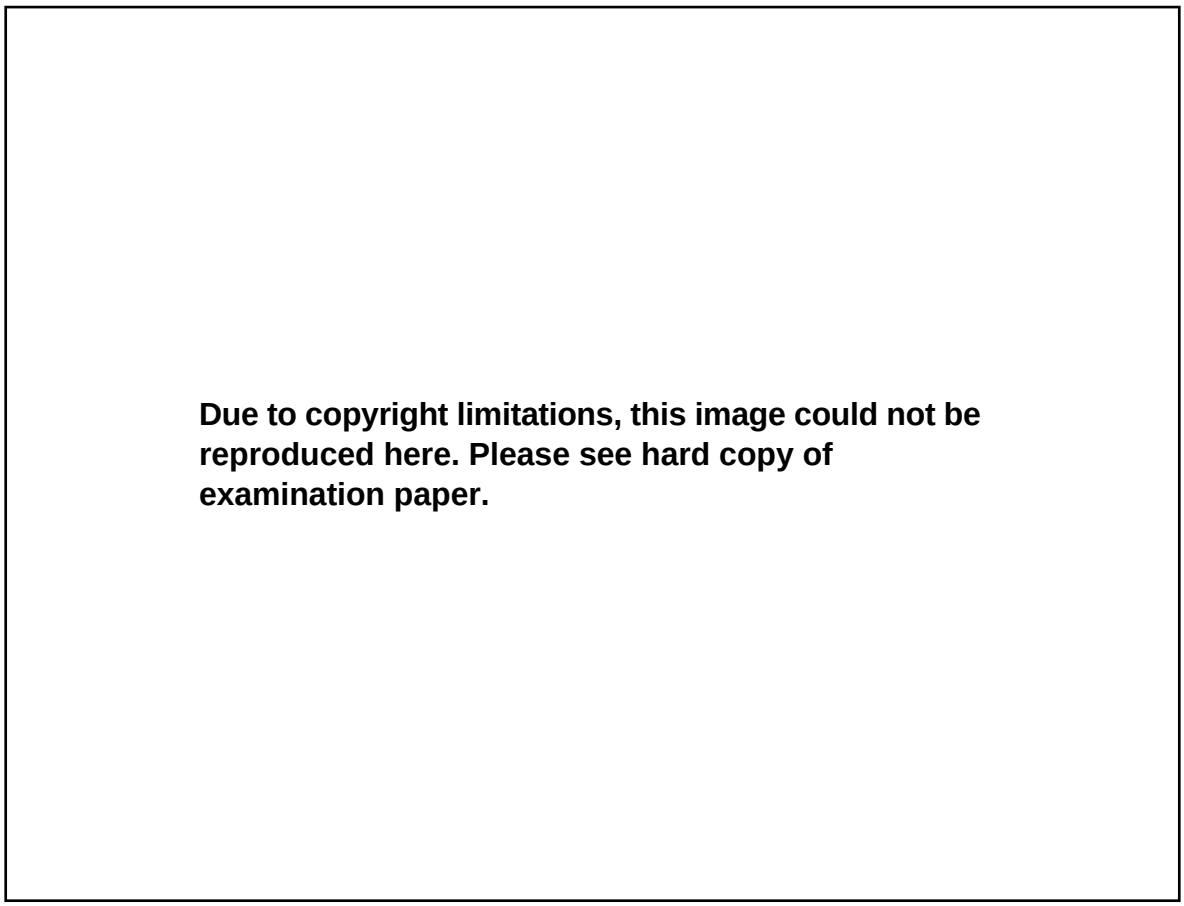

FIG. 14

Indicate how the following types of damage can be minimized.

(i) Rabbit damage

.....

(ii) Settlement

.....

(iii) Rilling

.....

(iv) Stock traffic

.....

(v) Wave action

.....

Question 7 continues on page 26

QUESTION 7. (Continued)

(f) A paddock measures 400 m by 700 m.

(i) Calculate its area in hectares.

Area .....

(ii) A rain gauge indicates that 22 mm of rain has fallen on the area. Calculate the rainfall in kilolitres per hectare.

Rainfall ..... kL/ha

(g) In surveying a property, an initial reading was taken from point *A* (datum point). The reading on the staff at point *B* was 4·9 m. The dumpy level was moved to point *B* and another reading taken at point *C*. This second reading was 3·6 m.

The height of the dumpy level above the ground in both cases was 1·5 m. What was the height of the datum point above point *C*?

Answer .....

(h) A newly constructed dam has an 'S : E' ratio of 49. What does this mean?

.....

.....

.....

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Question 7 continues on page 28

QUESTION 7. (Continued)

(i) The relationship between friction loss, velocity, and flow rate in a pumping system is given in Figure 15.

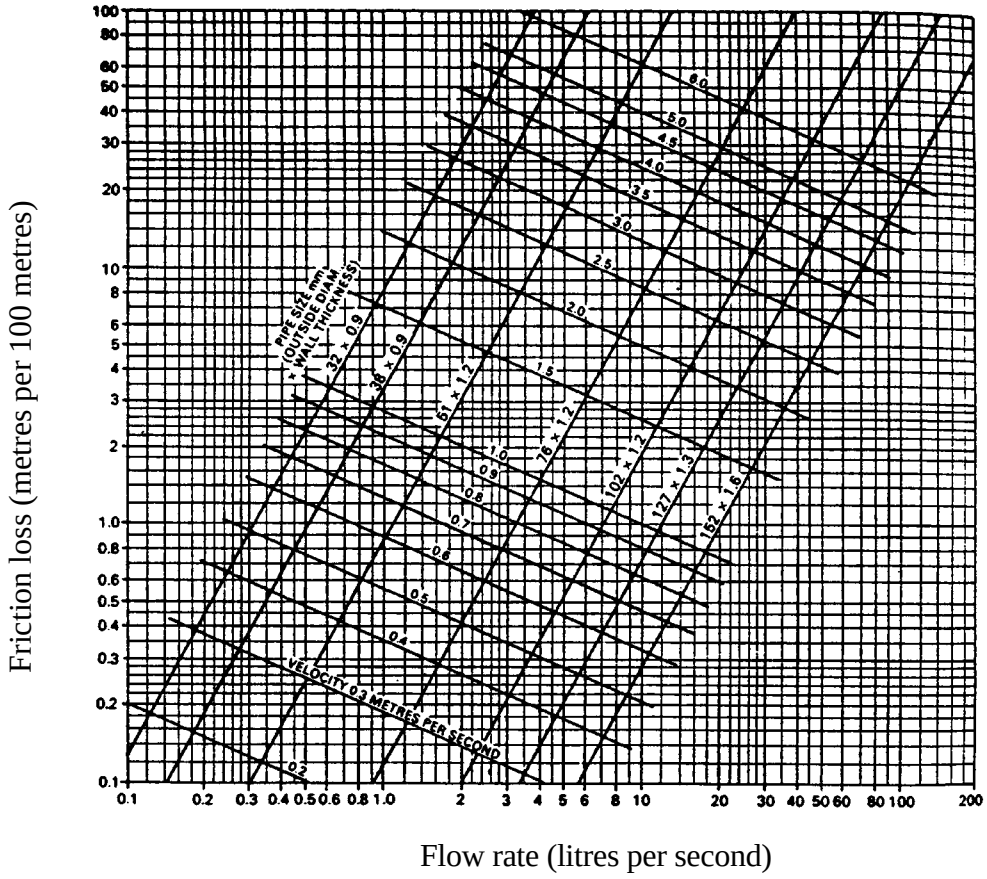

FIG. 15. FRICTION LOSS AND VELOCITY IN ALUMINIUM IRRIGATION TUBE

(i) Determine the difference in head loss per 100 m between a 76 mm and a 51 mm outside diameter pipe, if the flow rate is 5 L/s.

Answer .....

QUESTION 7. (Continued)

(ii) Using a 152 mm outside diameter pipe, the flow rate was doubled from 10 to 20 L/s. Determine the change in the friction loss.

Answer .....

(iii) If the head loss is 20 m per 100 m in a 76 mm outside diameter pipe, what would be the flow rate?

Answer .....

(iv) What will be the minimum pipe size required for a flow rate of 10 L/s where the maximum allowable head loss is 10 m per 100 m?

Answer .....

(j) What are the THREE ways in which the wind can move soil particles?

(i) .....

(ii) .....

(iii) .....

(k) Describe the difference between a gully and a flume.

.....

.....

.....

SECTION VI—TOPICAL STUDY

OPERATION OF THE MODERN MOTOR VEHICLE

(10 Marks)

QUESTION 8

(a) Many common motor vehicle maintenance procedures involve the simple correction of easily identified faults. Explain how the following faults can be rectified.

	Fault	*Solution*
(i)	Incorrect ignition timing	....
(ii)	Cooling-system overheating	....
(iii)	No fuel in carburettor or at injectors	....
(iv)	Blocked air filter	....
(v)	Soft or spongy brake pedal	....
(vi)	Tyres wearing on the outside edges	....

QUESTION 8. (Continued)

	Fault	*Solution*
(vii)	Engine misfires under load	....
(viii)	Starter turns engine slowly	....
(ix)	No spark at plug leads	....

(b) List THREE methods of improving fuel consumption.

(i) .....

(ii) .....

(iii) .....

(c) It is wise to carry spare parts in a motor vehicle when going on a trip to a remote area. List spare parts that may enable a roadside repair to be achieved for each of the following vehicle systems.

(i) Ignition system

1. .....

2. .....

(ii) Cooling-system

1. .....

2. .....

(iii) Electrical and lighting system

1. .....

2. .....

(iv) Lubrication system

.....

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