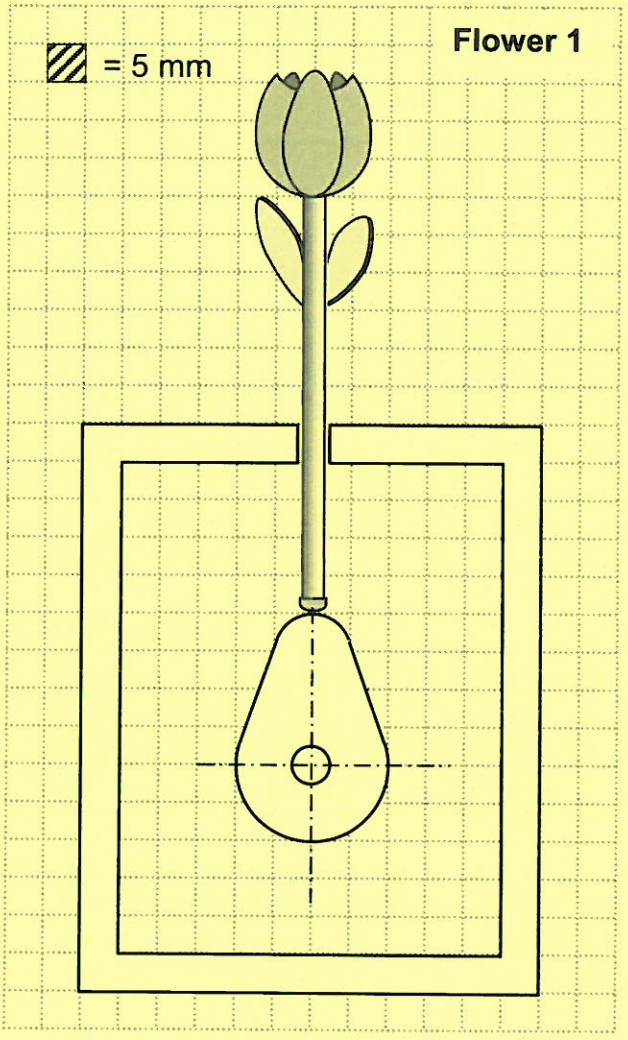
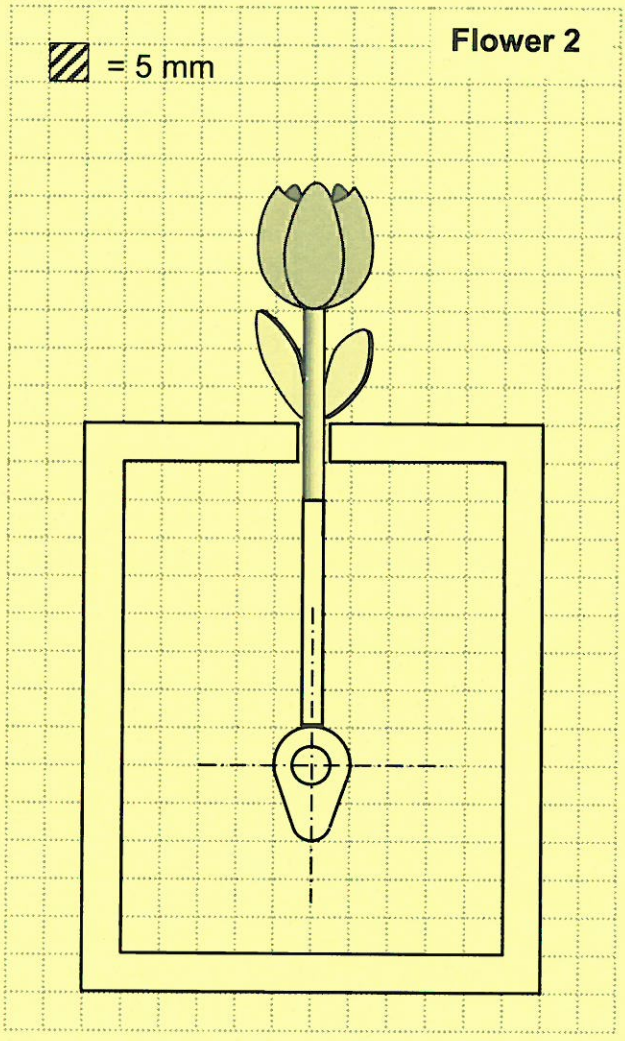
20. Complete the diagram of the mechanical system for flower 2, taking into account the following specifications:

- The same mechanical system is used for both flowers.
- The length of the stem must be the same for both flowers.
- At first, when flower 1 is at its highest position, flower 2 is at its lowest position.
- The range of motion of flower 2 is half the range of motion of flower 1. (Flower 2 goes up half as much and goes down half as much as flower 1.)





Appropriate representation of the mechanical system **Alternating motion** Give 2 marks for an inverted ( ) or horizontal ( ) cam, regardless of its dimensions. Deduct 1 mark for a cam whose axis of rotation is in the reverse position ( ).		2	1 0
Range of motion Give 1 mark for a cam whose size is reduced correctly (half the size of the other cam). Give 1 mark for a stem of the same length.		1 1	0 0

Answer Key for Part C (Technological Analysis Questions)

21. Explain how the mechanisms in the domino dispenser work. For each mechanism, explain **two** of the aspects listed below.

	Explanation of the Mechanism
Double gear and worm	*This mechanism . . .* *. . . transmits (the) rotational motion (of the worm to the double gear) and decreases (the rotational) speed (of the double gear).* OR . . . *transmits (the) rotational motion (of the worm to the double gear) while changing the direction of the axis of rotation (of the double gear).* OR . . . *decreases rotational speed and changes the direction of the axis of rotation.* OR . . . *decreases speed and is irreversible.*
Gear assembly	*This mechanism . . .* *. . . transmits rotational motion (between the gear wheels) and decreases (the initial) rotational speed (of the motor since the driven component is bigger).* OR . . . *transmits rotational motion (between the gear wheels) while reversing the direction of rotation.* OR . . . *decreases (the) rotational speed (of the driven gear) while reversing the direction of rotation.* ✱
Pulleys and belt	*This mechanism . . .* *. . . transmits rotational motion (from one pulley to another) and increases (the) speed (of the driven pulley).* OR . . . *transmits rotational motion between two distant pulleys.* OR . . . *increases (the) rotational speed (of the driven pulley) with the direction of rotation remaining the same (as that of the driver pulley).*
Slider crank on the actuator arm	*This mechanism transmits the rotational motion of the crank to the actuator arm's slide without any increase or decrease in speed.*
Note: This is a case of motion transmission because the driven component is guided so as to bring about its partial and alternating rotation. Rotational motion becomes partial and alternating rotation.	
Connecting rod and crank	*This mechanism . . .* *. . . transforms (the) rotational motion (of the crank) into (the) translational motion (of the connecting rod) without any increase or decrease (or without any change) in speed.* OR . . . *transforms, in a reversible manner, (the) rotational motion (of the crank) into (the) translational motion (of the connecting rod so that the dominos can be dispensed).*

Note: The parenthetical information indicated above in grey type is not an essential part of the expected answer and is regarded as additional information.

MARKING SCALE

4 marks	4 appropriate explanations
3 marks	3 appropriate explanations
2 marks	2 appropriate explanations
1 mark	1 appropriate explanation
0 marks	No appropriate explanations

22. Using the diagram, identify two combinations of linked components.

First identify a combination of components held together by a **complete** link, and explain why this link must have this characteristic.

Then identify a combination of components held together by a **partial** link, and explain why this link must have this characteristic.

Combination ___E___ is held together by a **complete** link because *the wheels and axle are interdependent and in this way, the wheels can move the dispenser forward.* OR because *the axle does not rotate in the wheel and the dispenser can move forward.*

OR

Combination ___H___ is held together by a **complete** link because *the side wall is attached to the housing in such a way that the two components cannot move independently of each other.*

AND

Combination ___A___ is held together by a **partial** link because *the crank must be able to rotate within the round hole in the actuator arm.*

OR

Combination ___B___ is held together by a **partial** link because *the connecting rod rotates (partially) in moving the pusher plate.* OR because *the pivot allows for the (rotational) motion of the connecting rod.*

OR

Combination ___F___ is held together by a **partial** link because *the switch button slides independently of the side wall.*

Note – Do not accept:

Combination C, because there is no link between the groove and the pusher plate pin. If this were a link, both ends of the groove would be closed.

Combination D, because the wheel is used to link the axle and axle hole. In this combination, one component guides the other.

Complete link		
Give 1 mark for an appropriate combination.	1	0
Give 1 mark for an appropriate explanation of the combination identified.	1	0
Partial link		
Give 1 mark for an appropriate combination.	1	0
Give 1 mark for an appropriate explanation of the combination identified.	1	0

23. Using the diagram, identify four combinations of components in which one component guides the other. Name the combinations you have chosen and check off the correct box to indicate the type of guiding involved.

Combination	Type of Guiding Involved		
A	■ Rotational	☐ Translational	☐ Helical
B	■ Rotational	☐ Translational	☐ Helical
C	☐ Rotational	■ Translational	☐ Helical
D	■ Rotational	☐ Translational	☐ Helical
G	☐ Rotational	■ Translational	☐ Helical

Note: – Do not accept *Translational* for combination *B*. The connecting rod and crank together ensure the translational guidance of the pusher plate. The pusher plate pivot ensures the rotational guidance of the connecting rod.

– For each combination, give 1 mark for correctly identifying the type of guiding involved.

MARKING SCALE

4 marks	4 correct combinations with the type of guiding correctly identified
3 marks	3 correct combinations with the type of guiding correctly identified
2 marks	2 correct combinations with the type of guiding correctly identified
1 mark	1 correct combination with the type of guiding correctly identified
0 marks	No correct combinations

24. State two changes that could be made to the wheels *(item 4)*, the gear wheel *(item 18)* or the double gear *(item 21)* so that the dispenser moves **more slowly** with the same motor.

Complete the following tables by naming the two components to be changed and the change to be made. Explain why.

Component to Be Changed	Change to Be Made
Double gear (item 21)	*Increase the number of teeth on (the diameter of) the (big) gear wheel that meshes with the worm.*
Explanation	
Because . . . *(each rotation of the worm moves the double gear one tooth forward.) if the gear wheel has more teeth (a larger diameter), it will rotate more slowly (the worm will have to complete more rotations before the gear wheel completes one rotation).*	

OR

Component to Be Changed	Change to Be Made
Double gear (item 21)	*Decrease the number of teeth on (the diameter of) the small gear wheel.*
Explanation	
Because . . . *the speed decreases when the driver component is smaller than the driven component.* OR *a smaller gear wheel will have to complete more rotations before the driven gear wheel completes one full rotation.*	

OR

Component to Be Changed	Change to Be Made
Gear wheel (item 18)	*Increase the number of teeth on (the diameter of) the gear wheel.*
Explanation	
Because . . . *the speed decreases when the driven component is bigger than the driver component.* OR *if the gear wheel has more teeth (is bigger) than the driver component (the small gear wheel in the double gear), the driver component (the small gear wheel in the double gear) will have to complete more rotations before the gear wheel completes one full rotation.*	

OR

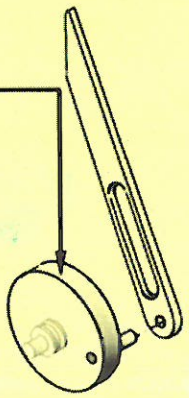
Component to Be Changed	Change to Be Made
Wheel (item 4)	*Decrease the diameter of the wheels.*
Explanation	
Because . . . *the domino dispenser moves forward as the wheels rotate. The smaller the wheels, the shorter the distance covered.*	

Note: The parenthetical information indicated above in grey type is not an essential part of the expected answer.

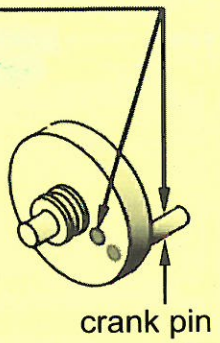
Component and Change 1		
Give 1 mark if an appropriate change is suggested for the component identified.	1	0
Give 1 mark for an appropriate explanation of the suggested change.	1	0
Component and Change 2		
Give 1 mark if an appropriate change is suggested for the component identified.	1	0
Give 1 mark for an appropriate explanation of the suggested change.	1	0

25. a) For each change indicated below, check off the appropriate box to identify its effect on the operation of the domino dispenser.

	Change 1 If the diameter of the **crank** were increased . . .
■	. . . **fewer** dominos would be placed over any given distance covered by the domino dispenser.
☐	. . . **more** dominos would be placed over any given distance covered by the domino dispenser.
☐	. . . **the same number** of dominos would be placed over any given distance covered by the domino dispenser.



	Change 2 If the crank pin were moved toward the centre of the **crank** . . .
■	. . . the range of motion of the actuator arm (how much it moves) would **decrease**.
☐	. . . the range of motion of the actuator arm (how much it moves) would **increase**.
☐	. . . the range of motion of the actuator arm (how much it moves) would **remain the same**.



b) What effect would a broken belt have on the electrical and mechanical operation of the domino dispenser?

Effect on the Electrical Operation	Effect on the Mechanical Operation
None *(because the electrical circuit would remain closed and the domino dispenser would continue to move forward).*	*It would be impossible to dispense the dominos* *(because there would be no way to activate the actuator arm)*. OR *The domino dispenser would continue to move forward without dispensing the dominos.* Note – Also accept: *The driven pulley, the crank and the actuator arm would no longer rotate, and the pusher plate could no longer be moved.*

Note: The parenthetical information indicated above in grey type is not an essential part of the expected answer.

MARKING SCALE

4 marks	4 correct answers
3 marks	3 correct answers
2 marks	2 correct answers
1 mark	1 correct answer
0 marks	No correct answers