Mark scheme
June 2003

GCSE

Design and Technology Systems and Control

3546

Higher

Design and Technology: Systems and Control Technology

Higher Tier

Section A Mechanisms Focus

Question 1

(a)   Correctly labelling missing pin numbers – 1 mark for each correct

Pin 1 - ground or 0v
Pin 2 - trigger
Pin 3 - output
Pin 8 – 9v or supply voltage   (4 marks)

Inserted with the correct **POLARITY or ORIENTATION or
DIRECTION OR SIMILAR OR RESISTOR**   (1 mark)
                                                                                        5 marks

(b)   Dual in line (1)   (1 mark)
        Use of a holder or DIL socket or a description of identifying PIN 1   (1 mark)
                                                                                        2 marks

(c)   Variable resistor – top   (1 mark)
        LDR bottom   (1 mark)
        Well drawn circuit diagram   (1 mark)
                                                                                        3 marks

(d)   Correctly drawn relay – sensing side   (1 mark)
        Correctly drawn relay – output side   (1 mark)
        (accept different conventions)   (1 mark)
        Diode   (1 mark)
        Well drawn and largely correct circuit diagram – protection diode
        correctly aligned within solution

                                                                                        4 marks

                                                                                        Total 14 marks

Question 2

(a)   (i)   Worm gear / worm wheel / worm   (1 mark)
        (ii)   Bevel gear   (1 mark)
        (iii)   Faster   (1 mark)
                                                           3 marks

(b)   Input and output appropriate size   1
        Use of idler gear to determine direction or chain/belt   1
        Quality of response (max 2 marks)   2
                                                           4 marks

(c)   Compound gear system   **1 mark**

(d)   GEAR RATIO 1

$$GR = \frac{\text{Teeth on driven}}{\text{Teeth on driver}} = \frac{60}{80} = \frac{3}{4} \qquad \text{(1 mark)}$$

GEAR RATIO 2

$$GR = \frac{\text{Teeth on driven}}{\text{Teeth on driver}} = \frac{30}{100} = \frac{3}{10} \qquad \text{(1 mark)}$$

COMBINING THEM

$$\text{Final GR} = \frac{3}{4} \times \frac{3}{10} = \frac{9}{40} \qquad \text{(1 mark)}$$

Units   (1 mark)

Reward for working i.e. $\dfrac{200 \times 40}{9}$ (1 mark)

889rpm (accept 888 – 890)   (1 mark)
                                                           6 marks

(e)   Advantages   Less maintenance or lower cost
                             Easier to assemble
                             Can be quieter
                             Slips if jams   (2 marks)

        Disadvantages   Greater maintenance
                             More complex to assemble   (2 marks)
                             Not for heavy loads
                             Allow other suitable

     'Costs' not acceptable

                                                           4 marks

                                                         Total 18 marks

AQA

Question 3

(a)	Main parts	Hopper	(1 mark)
		Ram	(1 mark)
		Screw thread	(1 mark)
		Heater elements	(1 mark)
		Split mould	(1 mark)
		Quality of drawing	(1 mark)
			6 marks

(b)	Web shown correctly on plan view		(2 marks)
	Web shown correctly on sectional front view		(1 mark)
	Web NOT sectioned		(1 mark)
			4 marks

(c)	Correctly identified roller bearing		(1 mark)
	Very good drawing	(2)	(2 marks)
	Recognisable response	(1)	
			3 marks
			Total 13 marks

Question 4

(a)   Cam has gentle start followed by sharp drop   (1 mark)
        Direction of rotation is correct for cam profile drawn   (1 mark)
        Drawing is high quality   (2)   (2 mark)
        Reasonable drawing quality   (1)

                                                                             4 marks

(b)   Correctly identified roller follower   (1 mark)
        Very well drawn   (3)   (3 marks)
        Well drawn   (2)
        Conveys minimal information   (1)

                                                                             4 marks

(c)   Quality of sketching   Very good   (3)
                                     Adequate   (2)
                                     Poor   (1)   (3 marks)

        Cam for up and down   suitable profile – showing the axle
                                     (3 – 4)
                                     Profile not entirely appropriate –   (4 marks)
                                     showing axle (1 – 2)

        Cam for rotational motion   uses an offset – well shown – (2)   (2 marks)
                                     Unclear evidence (1)
                                                                             (4 marks)

        Annotation   notes clearly describe all aspects(4)
                                     Notes help to explain function   (3)
                                     Little more than labelling   (2)
                                     Labels only   (1)

                                                                             13 marks

                                                                             Total 21 marks

AQA

Question 5

(a)   (i)   ease of modification
                  speed
                  accuracy – or other suitable   (2 marks)
    (ii)   cost
                  training – or other suitable   (1 mark)
                  3 marks

(b)   Only allowed to be installed on one machine   (1 mark)
    Allowed to be installed on the number of machines mentioned on license   (1 mark)
    Unlawfully copying software for another user (allowed user)   (1 mark)
                  3 marks

(c)   No harmful chemicals   (2 marks)
    Automatically drilled   (2 marks)
    Cost of original equipment/training   (2 marks)
    (allow accuracy repeatability speed)

    Quality of response determines whether 1 or 2 marks, qualified response
                  6 marks

(d)   (i)   Any suitable example   (1 mark)
    (ii)   consistent quality   (1 mark)
                  easy repeatability – or other suitable   (1 mark)
                  3 marks

(e)   Product placement   (1 mark)
    Internet advertising   (1 mark)
    Television advertising   (1 mark)
    Trade fairs – or other suitable   (1 mark)
    No generics

                  4 marks

                  Total 19 marks

Question 6

(a)   Decision box (diamond) for gate   (1 mark)
       Two possible options   (1 mark)
       Feedback loop for closed for no   (1 mark)
       Output to next stage for yes   (1 mark)

       Decision box (diamond) for pressure pad   (1 mark)
       Two possible options   (1 mark)
       Feedback to start   (1 mark)
       Output to sound alarm   (1 mark)

       Quality of drawing max 2   (2 marks)
                                                                                 10 marks

(b)   2 = 1 1 0 1 1 0 1   (1 mark)
       5 = 1 0 1 1 0 1 1   (1 mark)
       8 = 1 1 1 1 1 1 1   (1 mark)
       9 = 1 1 1 0 0 1 1   <u>OR</u>   1 1 1 1 0 1 1   (1 mark)
                                                                                 4 marks

(c)   Well explained relay   (2) Voltage interface
       Use of a relay   (1)
                                                                                 2 marks

(d)   Quality of idea Would clearly function as a counting trigger –
                        includes location on side of boat   (4)
                        A workable solution   (3)
                        Evidence of part of a workable solution   (2)
                        An attempt to draw a trigger mechanism   (1)

       Notes   Clearly show how mechanical trigger is activated   (3)
               Some evidence of understanding trigger   (2)
               Poor understanding of trigger   (1)

       Quality of drawing   Excellent communication of idea   (3)
                             Clear communication of idea   (2)
                             Understandable   (1)
                                                                                 10 marks

                                                                                 Total 26 marks

Question 7

Using any sensible method of showing PIC algorithm IN THIS ORDER

SUBROUTINE 1 (Close to wall)	IF distance sensor = 0 (not triggered) Lower tailgate from vertical to horizontal ENDIF		(3 marks)
SUBROUTINE 2 (Lowering if no obstruction)	WHILE obstruction sensor = 0 (not triggered) Lower the tailgate ENDWHILE		(3 marks)
SUBROUTINE 3 (If obstructed)	CASE obstruction sensor = 1 stop lowering and sound audible alarm		(3 marks)
suitable method	very clear 3	mainly clear 2 attempted 1	(3 marks)
use of subroutines	clear use 2	attempt 1	(2 marks)

Total 14 marks

PAPER TOTAL 125 MARKS

Section B Pneumatics Focus

Question 1

(a)   Correctly labelling missing pin numbers – 1 mark for each correct

          Pin 1 - ground or 0v
          Pin 2 – trigger
          Pin 3 – output
          Pin 8 – 9v or supply voltage   (4 marks)

          Inserted with the correct **POLARITY or ORIENTATION or**   (1 mark)
          DIRECTION – or RESISTOR

                                                                                          5 marks

(b)   Dual in line
          Use of a holder or description of identifying PIN 1   (1)
                                                                                          2 marks

(c)   Variable resistor – top   (1 mark)
          LDR bottom   (1 mark)
          Well drawn and largely correct circuit diagram   (1 mark)
                                                                                          3 marks

(d)   Correctly drawn relay – sensing side   (1 mark)
          Correctly drawn relay – output side   (1 mark)
          Diode   (1 mark)
          Well drawn and largely correct circuit diagram – Protection diode   (1 mark)
          correctly aligned within solution

                                                                                          4 marks

                                                                                          Total 14 marks

AQA

Question 2

(a)   Normally closed accept 'system safe' or 'to exhaust') - button operated -
       3 port valve – spring return   **4 marks**

(b)   Mainly correct drawing of components – (look at 3)   (2 marks)
       Flow regulator and reservoir in correct sequence   (1 marks)
       Quality of drawing   (1 mark)
                                                                                    4 marks

(c)   Using correct formula to find area of piston   (1 mark)
       Area of piston = 3.142 x rad x rad = 50 x 50 x 3.142 = 7855mm^2 (1 mark)
       Correct answer 7855mm²   (1 mark)
       Using correct formula to find force exerted   (1 mark)
       Correct answer = 7855 x 0.5 = 3927.5 Newtons   (1 mark)
       Correctly stating units for final answer   (1 mark)
                                                                                    6 marks

(d)   If it fails it stops in a safe position (or similar)   (1 mark)

       Circuit must ensure movement to safe position if primary circuit fails   (1 mark)

       Suitable example – guillotine, drilling machine – robot arm etc.   (1 mark)
       Must not be electrical
       Related explanation is clearly relevant to the situation described   (1 mark)
       Must not be electrical

                                                                                    4 marks

                                                                                    Total 18 marks

Question 3

(a)	Main parts	Hopper	(1 mark)
		Ram	(1 mark)
		Screw thread	(1 mark)
		Heater elements	(1 mark)
		Split mould	(1 mark)
		Quality of drawing	(1 mark)
			6 marks

(b)   Web shown correctly on plan view   (2 marks)
Web shown correctly on sectional front view   (1 mark)
Web NOT sectioned   (1 mark)
                                                          4 marks

(c)   Correctly identified roller bearing   (1 mark)
Very good drawing   (2)   (2 marks)
Recognisable response   (1)

                                                          3 marks

                                                          Total 13 marks

Question 4

(a)	Two three port valves	(1 mark)
	Plunger operated	(1 mark)
	Suitable inlet and exhausts shown	(1 mark)
	Workable position of actuators	(1 mark)
		4 marks

(b)	Well drawn – good circuit diagram for max mark	(2 marks)
	Valves detail completed - break down as follows for each value (2 x 3)	
	Input to valve (1)	
	Internal configuration (1)	
	Spring return (1)	(6 marks)
	Output ONLY when both valves pressed (in series)	(2 marks)
		10 marks

(c)	Excellent communication – good circuit diagram for max mark	(2 marks)
	Cylinder and activating rod correctly drawn – breakdown as follows	
	Use correct box (1)	
	Spring as a return (1)	
	Correctly single acting (1)	
	Actuating rod in position (1)	(4 marks)
	Connection of cylinder to output	(1 marks)
		7 marks

Total 21 marks

Question 5

(a)   (i)   ease of modification
                 speed
                 accuracy – or other suitable   (2 marks)
      (ii)   cost
                 training – or other suitable   (1 mark)
                                                              3 marks

(b)   Only allowed to be installed on one machine   (1 mark)
        Allowed to be installed on the number of machines mentioned on license (1 mark)
        Unlawfully copying software for another user   (1 mark)
                                                            3 marks

(c)   No harmful chemicals   (2 marks)
        Automatically drilled   (2 marks)
        Cost of original equipment – training   (2 marks)
        Allow accuracy / repeatability / speed
        Quality of response determines whether 1 or 2 marks

                                                             6 marks

(d)   (i)   Any suitable example   (1 mark)
      (ii)   consistent quality   (1 mark)
                 easy repeatability – or other suitable   (1 mark)
                                                        3 marks

(e)   Product placement   (1 mark)
        Internet advertising   (1 mark)
        Television advertising   (1 mark)
        Trade fairs – or other suitable   (1 mark)
        No generics

                                                             4 marks

                                                      Total 19 marks

Question 6

(a)   Decision box (diamond) for gate   (1 mark)
        Two possible options   (1 mark)
        Feedback loop for closed for no   (1 mark)
        Output to next stage for yes   (1 mark)

        Decision box (diamond) for pressure pad   (1 mark)
        Two possible options   (1 mark)
        Feedback to start   (1 mark)
        Output to sound alarm   (1 mark)

        Quality of drawing max 2   (2 marks)
                                                                     10 marks

(b)   2 = 1 1 0 1 1 0 1   (1 mark)
        5 = 1 0 1 1 0 1 1   (1 mark)
        8 = 1 1 1 1 1 1 1   (1 mark)
        9 = 1 1 1 0 0 1 1   <u>OR</u>   1 1 1 1 0 1 1   (1 mark)
                                                                     4 marks

(c)   Use of a relay   (1)   Well explained   (2)
                                                                     2 marks

(d)   Quality of idea Would clearly function as a pneumatic barrier –
                         includes location on side of boat   (4)
                         A workable solution   (3)
                         Evidence of part of a workable solution   (2)
                         An attempt to draw a trigger mechanism   (1)

        Notes   Clearly show how pneumatics operate   (3)
                         Evidence of understanding operation   (2)
                         Poor understanding of operation   (1)

        Quality of drawing   Excellent communication of idea   (3)
                                 Clear communication of idea   (2)
                                 Understandable   (1)
                                                                     10 marks

                                                                     Total 26 marks

Question 7

Using any sensible method of showing PIC algorithm IN THIS ORDER

SUBROUTINE 1 (Close to wall)	IF distance sensor = 0 (not triggered) Lower tailgate from vertical to horizontal ENDIF	(3 marks)
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suitable method	very clear 3	mainly clear 2 attempted 1	(3 marks)
use of subroutines	clear use 2	attempt 1	(2 marks)

Total 14 marks

PAPER TOTAL 125 MARKS

AQA