OCR
RECOGNISING ACHIEVEMENT

GCE

Design and Technology

Advanced GCE **2525/01**

Unit 8: Systems and Control Technology 2

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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1 (a) (i) As temperature of thermistor increases its resistance decreases, this causes the voltage drop across it to reduce VA. **[1]**

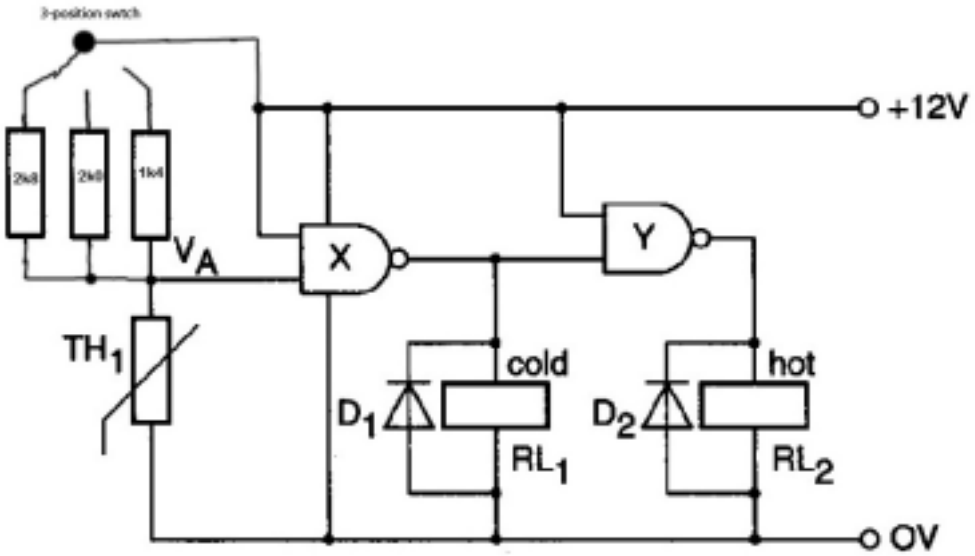
(ii) 45°C = 1k4 (1) 1400 x 12 / 3400 (1) = 4.94v (1) **[3]**

(iii) CMOS will operate over a wide range of voltages, has better noise immunity. **[1]**

(b) (i) Thermistor senses bath water temperature (1). Below 40° C both inputs to gate X are high so output is low ensuring COLD relay does not energises.(1) The inputs to gate Y are 1 and 0 so output is positive energising the HOT relay. (1) As temperature rises thermistor resistance reduces causing output of gate X to be positive, energising the COLD relay. (1) The two inputs to gate Y are now both high so the output is low switching off the HOT relay. (1) And so on. **[5]**

(ii) D1 and D2 are in parallel across the relay coil to offer an easy path for back EMFs (1) and so protect gates X and Y. (1) **[2]**

(iii)



As above or similar. (1) for each correct resistor value, where 2k8 = 35°
2k0 = 40°
1k4 = 45°

(1) for correct operation in circuit. **[4]**

(c) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence **[2]**

Possible reasons could be: cost to implement, potential savings, green issues, upheaval of home to implement, or similar responses.

Total [24]

2 (a) (i)

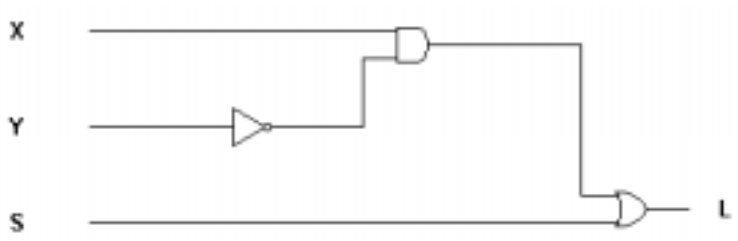
X	Y	S	L
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

One mark for columns X,Y and S. One mark for columns X,Y and S in correct numerical (binary) order.

One mark for column L correct. **[3]**

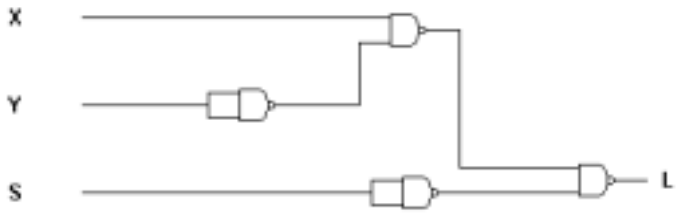
(ii) $X\overline{Y} = L$ or written explanation. [1]

(b) (i) $S + X\overline{Y} = L$



One mark for each gate correct gate, one mark for connected correctly. **[4]**

(ii)



Note: If (b)(i) incorrect error carried forward

One mark for each gate correctly placed in circuit. **[4]**

(iii) Greater packing density, easier to source, need to hold less spares. Any one, well explained. **[2]**

(c) $P = V^2/R$ Therefore, $240^2 / 500 = R$. (1) Therefore R = 115.2 Ohms(1) **[2]**

(d) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence. **[2]**
Possible reasons could be: cost of installation, installation upheaval, peace of mind, unsightly, deterrent or similar response. Lights at night, pollution, noise pollution.

Total [24]

3 **(a)** Ramps for disabled wheelchairs, wheel chocks, tail-gate ramp, threads, door wedge, Archimedes Screw or any other suitable response. Any two. **[2]**

(b) VR = R/r = 20/5 = 4:1 **[2]**

(c) **(i)** $2.6/\sin 20^o$ = hyp = 7.6m (2)

Therefore, E = 3600 x 9.81 x 2.6/ 7.6 = 12081N (2) **[4]**

(ii) $S = F/A = 7200/\pi \times 6^2 = 63.7 N/mm^2$ or $= 63.7 MN/m^2$ **[4]**

(d) Good quality sketch. Pawl and ratchet, worm gear or similar. **[2]**
Well described **[2]**

(e) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence. **[2]**

Issues might include:

Danger of injury, guarding, correct PSE, risk assessment, maintenance, training or other suitable issues.

Total [24]

4 **(a)** **(i)** Adv: can prevent expensive damage, protects motor from too heavy load. (1)
Dis: less power at output, less efficient. (1)
Well explained. (2) **[4]**

(ii) Lock shaft and pulley, give good positive drive, makes removal easier or similar **[2]**

(iii) grub screw and flat, spline or similar **[2]**

(b) **(i)** $P = T\omega$ T = F x radial distance = 5 x 0.2 = 1N (1)

$P = 1 \times 2500 \times 2\pi / 60$ (1) = 261.8 Watts

At 80 % efficiency 261.8/0.8 = 327.25 Watts (1) **[4]**

(ii) Stepped-cone pulley, motor speed control or similar (2 x 1)
Well explained (2 x 1) **[4]**

(c) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence. **[2]**

Issues might include:

Cost, quality assurance, improve quality / construction to avoid returns, returns department, repair or replace, more staff, more contact with public, training or similar suitable issues.

Total [24]

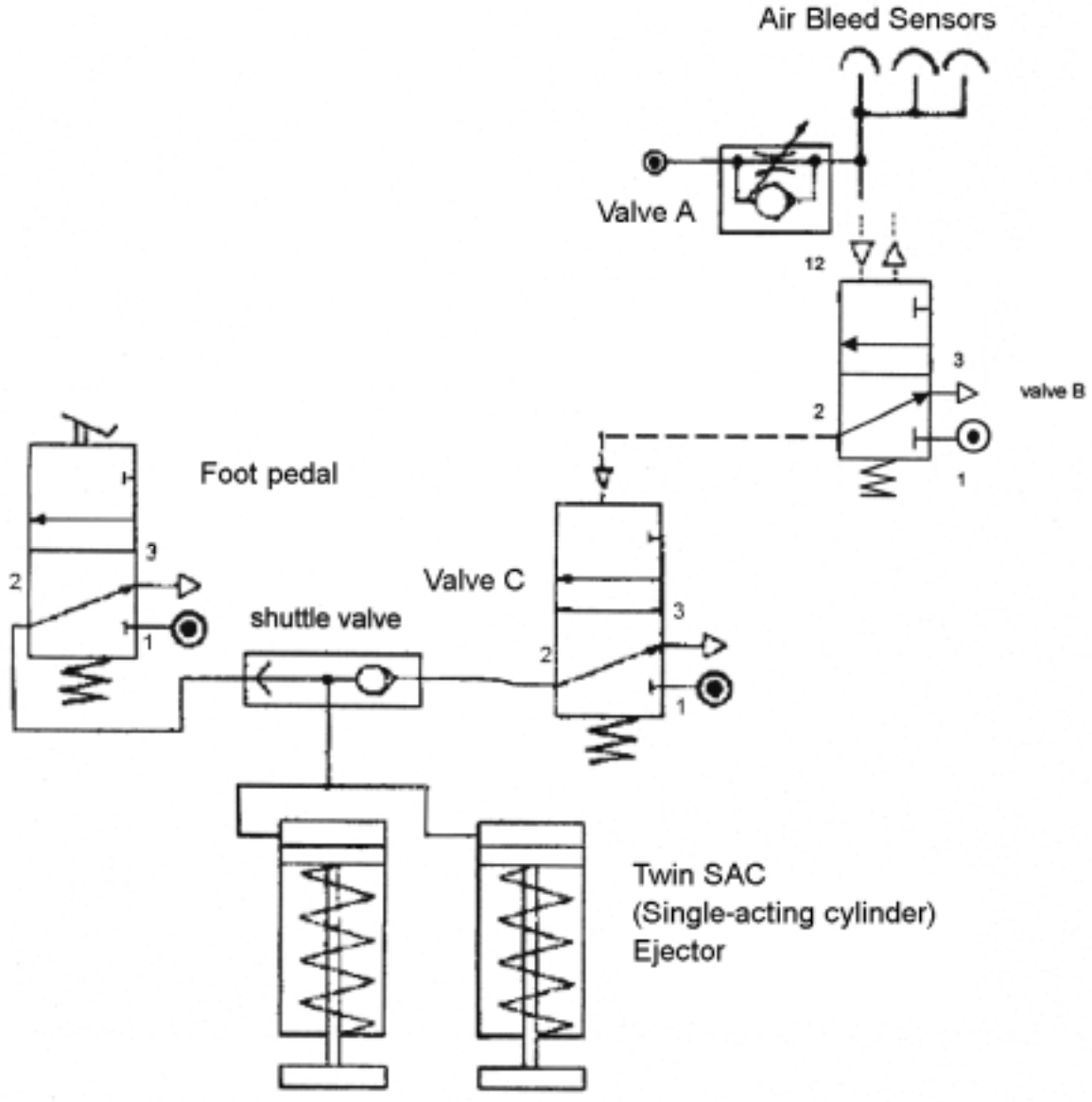
5 (a) (i) PIC, Stamp, Smart Box, PLC or similar. Any two, one mark each. **[2]**

(ii) Easy to change program, simpler to design, simpler to use, multiple use of same component, easier maintenance or similar. Any two, one mark each. **[2]**

(b) (i) Once air bleed is blocked, the restricted mains air from Valve A will have no access to exhaust [1] and so will cause Valve B to operate [1]. Air will operate Valve B12 and cause a pilot air signal on Valve C [1] which will allow main air through to cause both SAC's to outstroke [1]. **[4]**

(ii) The loading on each must be exactly the same [1] and piping must be symmetrical[1]. **[2]**

(iii) [1] for correct symbol of required valve, [1] for being in parallel (use of shuttle valve), [1] correct operation. **[3]**



(c) F = P x A So, 0.6 x π x 20^2 [1] = 754N. Both, therefore, 754 x 2 = 1508N [1] 95% efficiency so, 1508N x 0.95 = 1433N, [1] to nearest integer. **[3]**

(d) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence. **[2]**

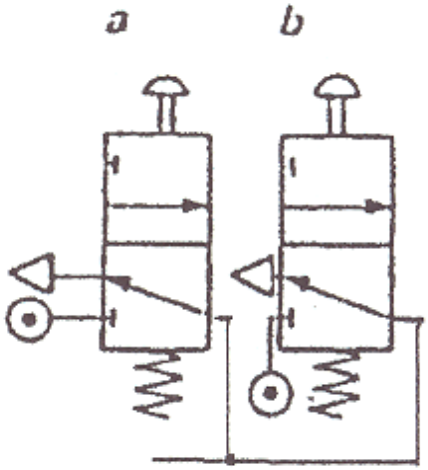
Issues might include:

Cost of ICT, CNC machines, easy to download prototype to CNC, easy to change/ develop prototype, less material waste / cost once system set up or similar issues.

Total [24]

6 **(a)** **(i)** AND **[1]**

(ii)



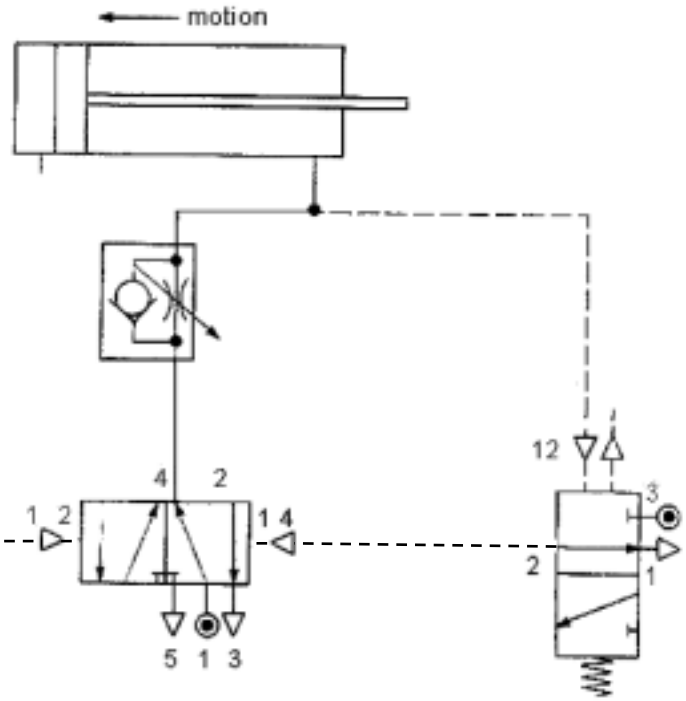
[2]

(iii) Avoids accidents, keeps BOTH hands out of machine, or similar. **[1]**

(b) **(i)** Roller-trip valve. **[1]**

(ii) Pressure decay sensing or time delay will give automatic return.

(1) flow regulator (1) reservoir or diaphragm valve (1) correct piping (1) explanation



As above or similar. **[4]**

(c) F = P x a A = (50^2 x π) / 4 = 1963.5mm^2 (1)
F = P x a F = 0.8 x 1963.5 (1) = 1571N Efficiency 90% so, F = 1571 x 0.9 = 1414N (1) **[3]**

(d) Valves A and B both off charges the reservoir (1). Both valves pressed at the same time main air from A and reservoir air from B go through restrictor to signal circuit (1). If either A or B are pressed first air discharges through opposite valve (1). Quality of explanation (1). **[4]**

(e) P = Identify a range of relevant issues / points. **[3]**
Q = Quality of explanation as to why these issues are relevant. **[3]**
S = Use of specific examples or supporting evidence. **[2]**

Points could be:

Cheaper components, quality control, quality assurance, easier maintenance/repair, simpler instructions, simpler training, or other correct responses.

Total [24]

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