P Sq 5
NAD

Solution Notes - CGIP paper 5, 2003

(a) The A-buffer is described in detail in the notes [slides 173-178 of the 2000 notes] using a 4×8 sub-pixel mask. The requirement for a 4×4 subpixel mask is to separate out those students who have memorised the notes without understanding them.
The students need to reproduce the majority of slides 174 and 175, wrapped up in enough algorithmic detail to indicate that they understand it.

(b) Human vision can only see to a limited resolution. Below this resolution it averages together the intensities of what it sees so, at high enough resolution of black dots on white paper will look, to the human eye, like a single grey blob. By varying the proportion of black to white you can vary the perceived intensity of grey. The human eye can see ~300 pixels per inch in greyscale so you need black & white pixels at a higher resolution to get a good approximation. 1200 ppi in the case of part (c).

(c) This requires either an ordered dither or half-tone algorithm.
You need a 4×4 mask
For each greyscale pixel with value p, $0 \le p \le 255$
calculate $q = p/15$
Every pixel in the mask with value $\ge q$ is black, the rest are white.

13	5	9	15
11	1	3	6
7	4	2	10
16	12	8	14

HALF-TONE

1	9	3	12
13	5	14	6
4	11	2	10
16	7	15	8

ORDERED DITHER

This may be combined with error diffusion for even greater accuracy, but this is not required for full marks

MARKING SCHEME - CGIP paper 5, 2003 - page 2 of 2

(a) store a list of masks for each pixel — 1
what is a mask? — 2
need to store depth + colour for each mask — 1
how do I get the final colour of a pixel — 3
basic idea — 1
efficiency (no need to store masks behind a full mask) — 1
clarity & completeness of algorithm — 1

10

(b) human vision has limited resolution — 1
performs area averaging / integration over its area — 1
∴ a tiny bunch of black dots will look grey — 1
∴ varying the proportion of black:white gives greyscale — 1

4

(c)* basic idea — 2
correct 4×4 mask — 2
correct division/quantisation & black:white ratios — 2

6

20

*adding error diffusion will give an extra mark to someone who has otherwise scored less than 6 on part (c)

CGIP (Computer Graphics & Image Processing)
Overall Scheme for Exam Questions 2003

The course has four sections:

Background	3 lectures
2D Computer Graphics	4 lectures
3D Computer Graphics	5 lectures
Image Processing	3 lectures

These must all be tested in exam, preferably in proportion to the number of lectures given

Question	Slides in 2000 Notes	Marks Allocated BG	2D	3D	IP
p3 (a)	37 (29-38)	6			
(b)	269-271 (258-290)				6
(c)	78-84, 110-111		8		
p5 (a)	173-178 (161-179)			10	
(b)	17-26, 39-40	4			
(c)	246-250				6
p6 (a)	101-109, 124-133		1	11	
(b)	98-100		8		
		10	17	21	12

These questions give a good spread across the whole syllabus, test both algorithms and more general knowledge & require a student to understand at least two disparate parts of the course in order to get good marks on any of the questions.