Algorithms 1E

1 a Lower bound $= \dfrac{18+4+23+8+27+19+3+26+30+35+32}{50} = \dfrac{225}{50}$

$= 4.5$

Therefore 5 bins (4 bins will be insufficient)

b i Bin 1: $18+4+23+3$
Bin 2: $8+27$
Bin 3: $19+26$
Bin 4: 30
Bin 5: 35
Bin 6: 32

ii Putting list into descending order

35 32 30 27 26 23 19 18 8 4 3

Bin 1: $35+8+4+3$
Bin 2: $32+18$
Bin 3: $30+19$
Bin 4: $27+23$
Bin 5: 26

iii For example
Bin 1: $32+18$
Bin 2: 27+23
Bin 3: $35+8+4+3$
} Full bins
Bin 4: 19+26
Bin 5: 30

2 a Bin 1: $A(30)+B(30)+C(30)+D(45)+E(45)$
Bin 2: $F(60)+G(60)+H(60)$
Bin 3: $I(60)+J(75)$
Bin 4: $K(90)$
Bin 5: $L(120)$
Bin 6: $M(120)$

2 b Bin 1: $M(120)+I(60)$

Bin 2: $L(120)+H(60)$

Bin 3: $K(90)+J(75)$

Bin 4: $G(60)+F(60)+E(45)$

Bin 5: $D(45)+C(30)+B(30)+A(30)$

c Lower bound $= \dfrac{30+30+30+45+45+60+60+60+60+75+90+120+120}{180}$

$= \dfrac{825}{180}$

$= 4.5$ so 5 tapes needed at least.

Since a minimum of 5 tapes are needed and **b** uses 5 tapes it is optimal.

d For example

Bin 1: $M(120)$

Bin 2: $L(120)$

Bin 3: $K(90)+A(30)$

Bin 4: $G(60)+F(60)$

Bin 5: $H(60)+I(60)$

Bin 6: $J(75)+E(45)$

Bin 7: $B(30)+C(30)+D(45)$

} Full bins

3 a First-fit does not rely on observation, it takes the items in the order given. Whereas full-bin uses observation to find combinations of items.

b Bin 1: A(4) B(7) C(13) D(6)
Bin 2: E(13) F(4) G(12)
Bin 3: H(14) I(6)
Bin 4: J(11)
This uses 4 lanes.

c By inspection,

$A(4)+B(7)+C(13)+D(6)=30$

$E(13)+I(6)+J(11)=30$

$F(4)+G(12)+H(14)=30$

Bin 1: A, B, C, D
Bin 2: E, I, J
Bin 3: F, G, H
Each of the three lanes is full, so solution is optimal.

4 a $\dfrac{3+3+4+4+4+4+5+5+5+7+8+8}{15} = 4$ rolls

b For example,
Bin 1: L(8) J(7)
Bin 2: K(8) I(5)
Bin 3: H(5) G(5) F(4)
Bin 4: E(4) D(4) C(4) B(3)
Bin 5: A(3)
5 rolls used and 15 m wasted.

c Doesn't always give an optimal solution.

d For example,
Bin 1: A(3) C(4) L(8)
Bin 2: B(3) D(4) E(4) F(4)
Bin 3: G(5) H(5) I(5)
Bin 4: J(7) K(8)
4 rolls used and no carpet is wasted, so solution is optimal.

5 a Bin 1: H(25) + A(8)
Bin 2: G(25)
Bin 3: F(24) + B(16)
Bin 4: E(22) + C(17)
Bin 5: D(21)

b Lower bound $= \dfrac{8+16+17+21+22+24+25+25}{40}$

$= \dfrac{158}{40}$

$= 3.95$

$\therefore$ Lower bound is 4

c There are 5 programs over 20MB. It is not possible for any two of these to share a bin. So at least 5 bins will be needed, so 4 will be insufficient.