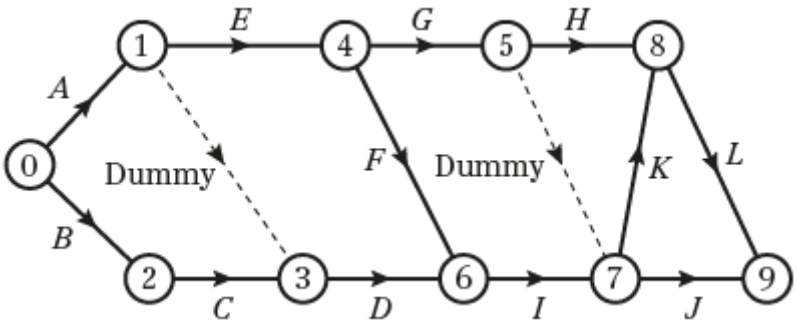
Critical path analysis Mixed exercise

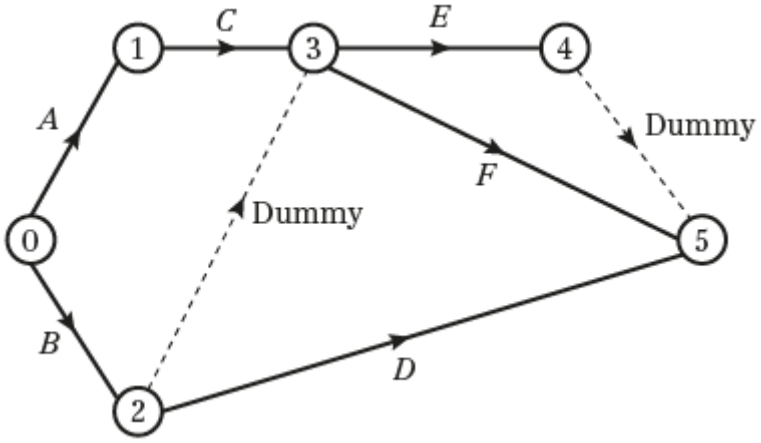
1 a Activity D depends on activities A and C, whereas activity E depends only on activity A. This shows that a dummy is required.

Activity J depends on activities G and I, whereas activity H depends only on activity G. This shows that a second dummy is required.

b



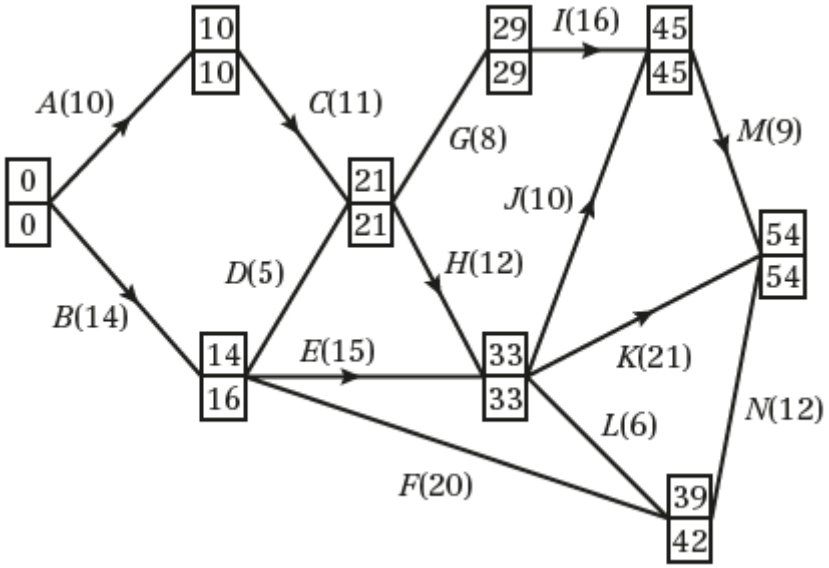
2 a



b Dummy 1 is needed to show *dependency*.
E and F depend on C and B, but D depends on B only.

Dummy 2 is needed so that each activity can be *uniquely* represented in terms of its event.

3 a

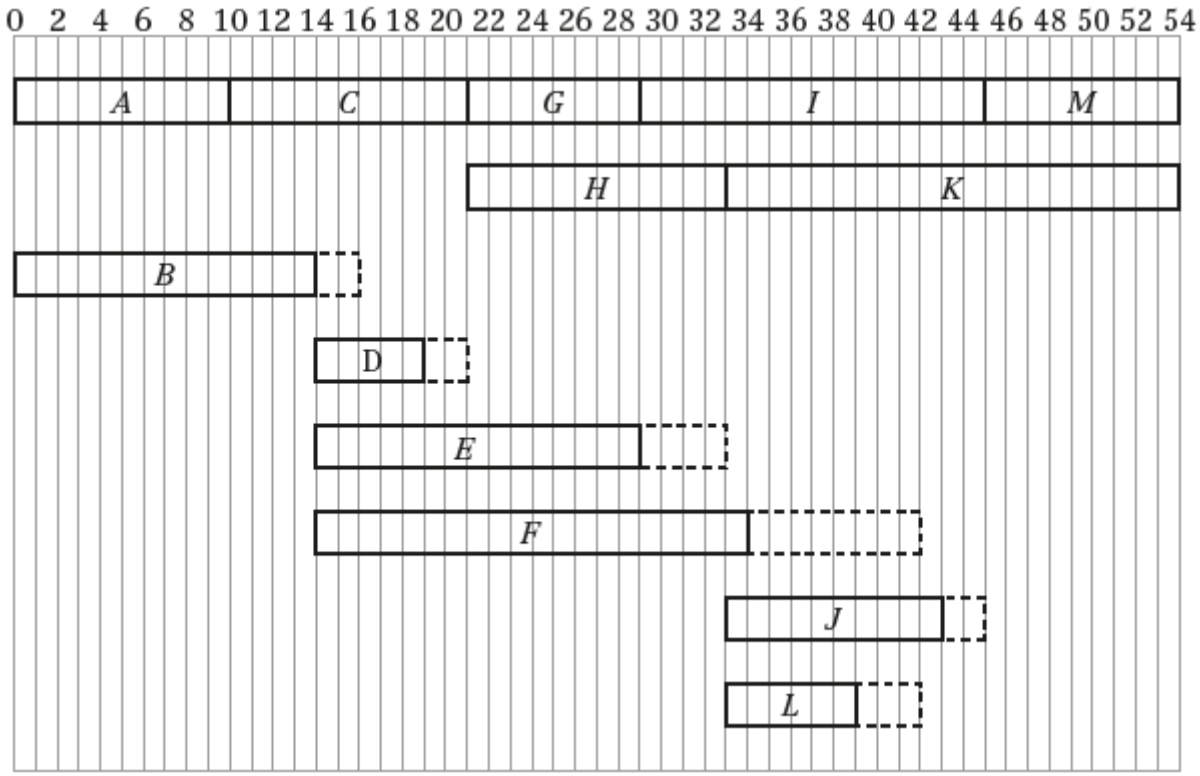


b There are *two* critical paths:
$A - C - G - I - M$ and $A - C - H - K$

The critical activities are A, C, G, H, I, K

c Total float on D is $21 - 5 - 14 = 2$
Total float on F is $42 - 20 - 14 = 8$

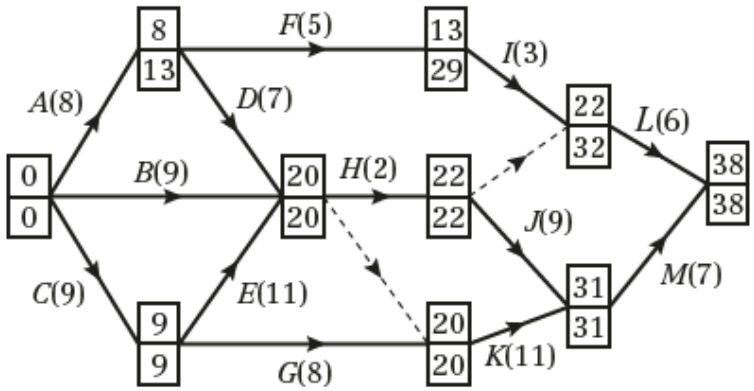
d



e Day 15: C
Day 25: G, H, E, F

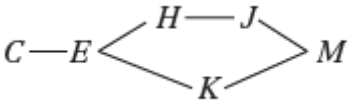
4 a J depends on H alone, but L depends on H and I.

b



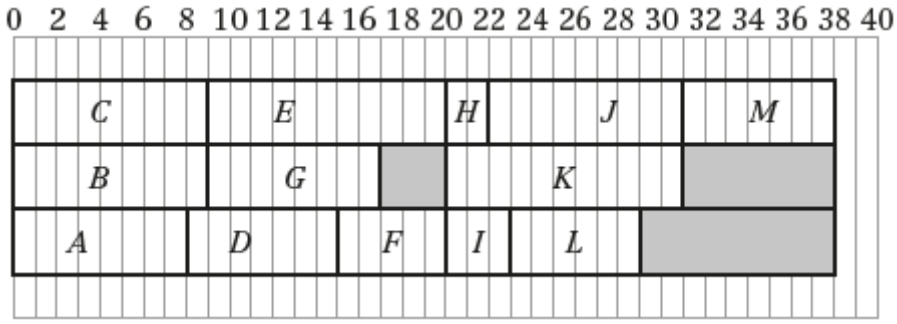
c Total float on $D = 20 - 7 - 8 = 5$
Total float on $E = 20 - 11 - 9 = 0$
Total float on $F = 29 - 5 - 8 = 16$

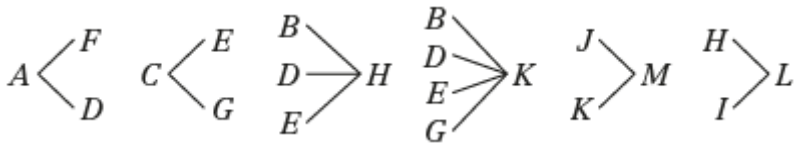
d



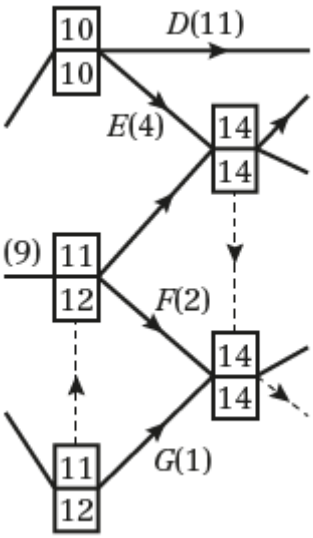
e $\frac{95}{38} = 2.5$ so 3 workers

f For example





5 a



b A critical path is a continuous path from the source node to the sink node such that a delay in any activity results in a corresponding delay in the whole project.

c The critical paths are: $A - E - H - K$ and $A - E - L$.

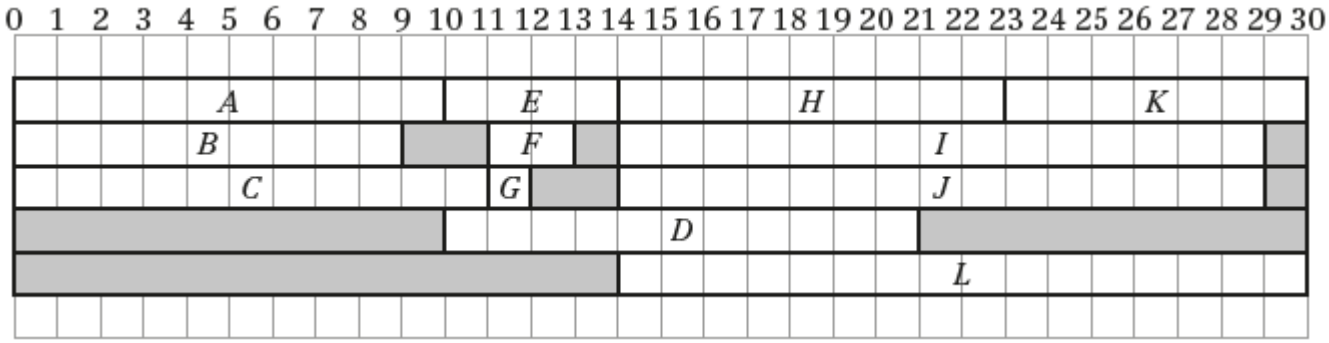
d $\dfrac{\text{Sum of all of the activity times}}{\text{critical time of the project}} = \dfrac{110}{30}$

Lower bound for number of workers is 4.

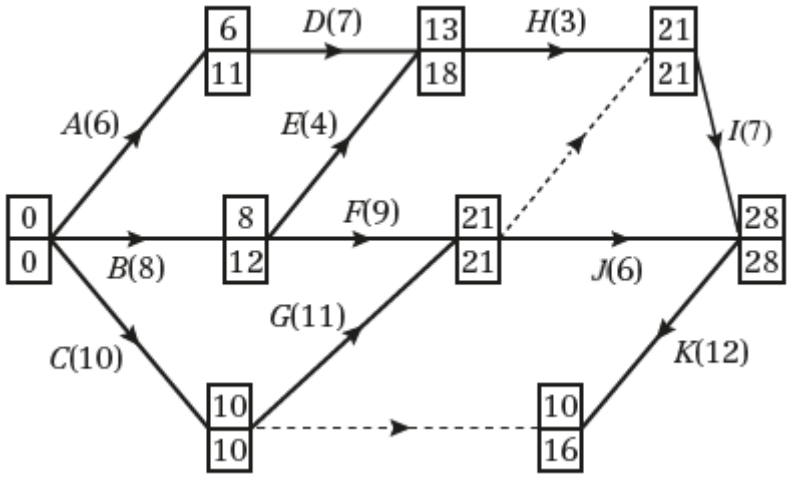
e D, H, I, J, L

f The answers to part **e** show that 5 workers are needed on day 20 in order to complete the project in the minimum time.

g



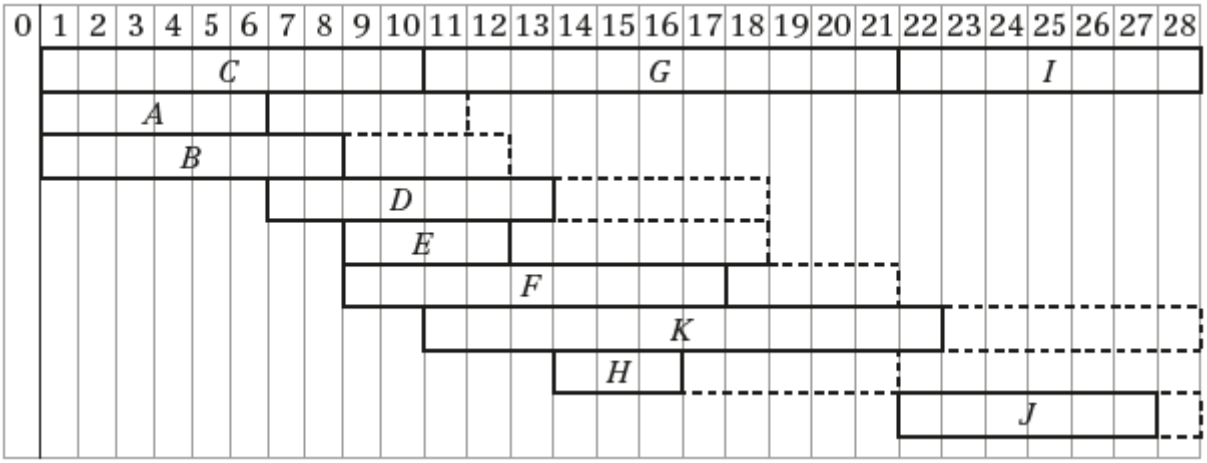
6 a



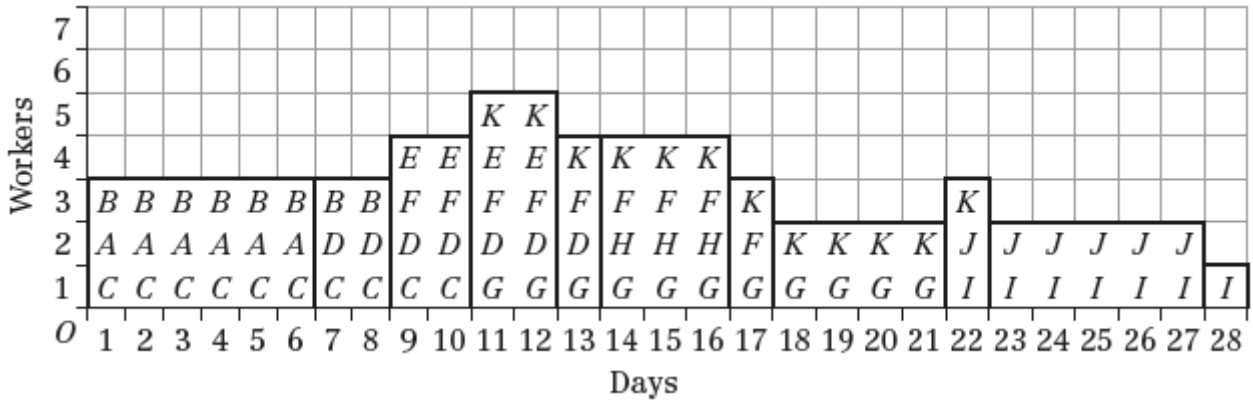
28 days

b $\frac{83}{28} = 2.96$ so the lower bound is 3.

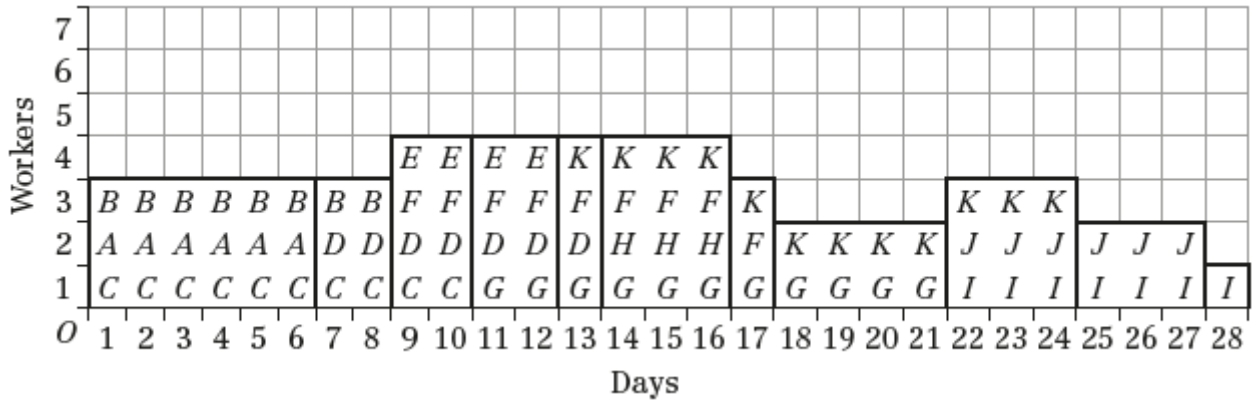
c



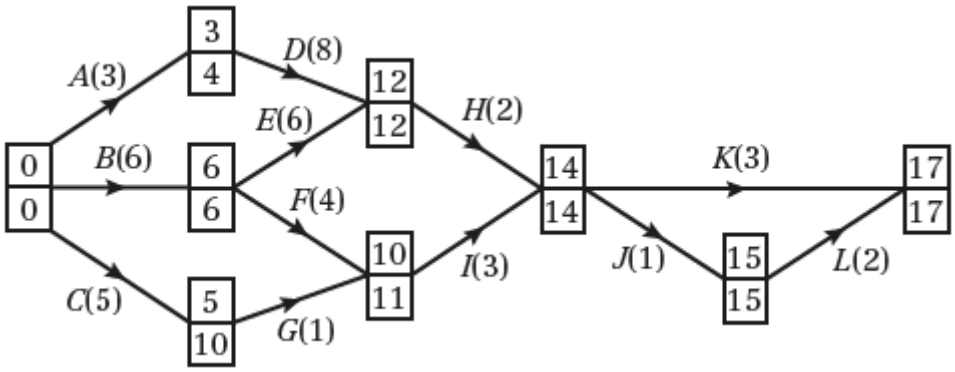
d



e

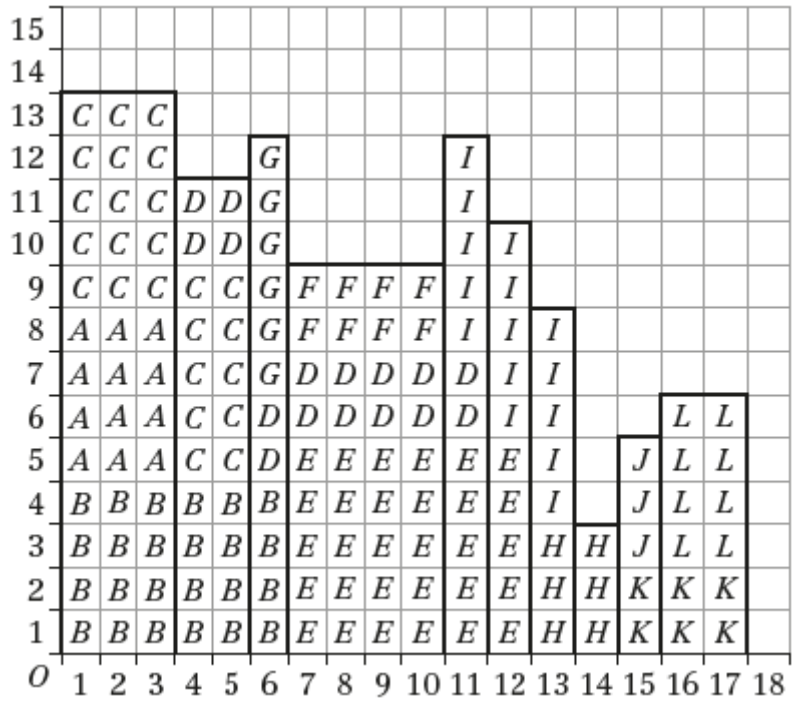


7 a Minimum time required to complete the project is 17 days.

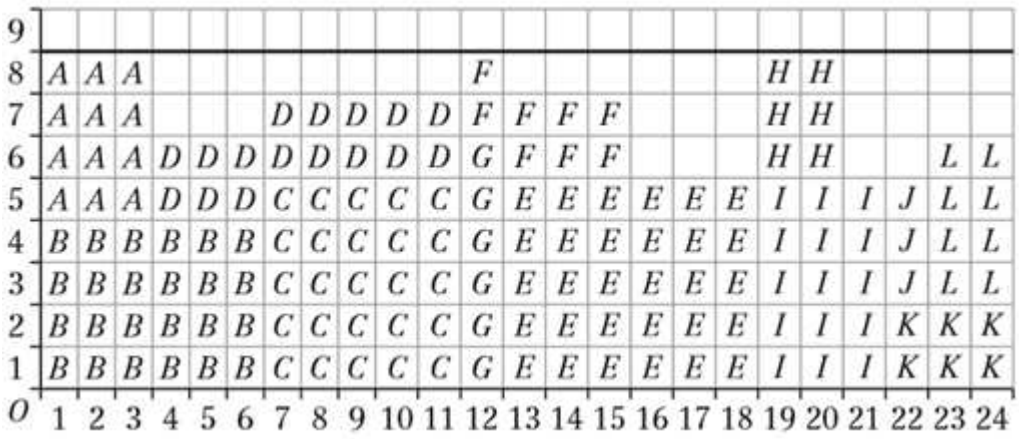


b $B - E - H - K$ and $B - E - H - J - L$

c



d



Challenge

a A, D, F critical. Total floats are B: 2, C: 8, E: 8

b i Reduce F by 3 days and D by 1 day, total cost £650.

ii Reduce F by 3 days, D by 4 days and B by two days. Total cost £1450.

c 27 days. Activity E has already been reduced by 2 days, and critical path is now ACE. No further reduction possible on critical path so no further reduction in total project time possible.

d $P = 100y_B + 200y_D + 400y_E + 150y_F$

e $x_1 \geqslant 12$
$x_2 + y_B \geqslant 25$
$x_3 - x_1 + y_D \geqslant 15$
$x_4 - x_1 \geqslant 8$
$x_5 - x_4 + y_E \geqslant 9$
$x_5 - x_3 + y_F \geqslant 10$
$x_3 - x_2 \geqslant 0$
$y_B \leqslant 8$
$y_D \leqslant 10$
$y_E \leqslant 2$
$y_F \leqslant 3$
$x_5 \leqslant 28$
$x_1, x_2, x_3, x_4, x_5, y_B, y_D, y_E, y_F \geqslant 0$