2.2 Critical Path Analysis: Network Diagrams and the Critical Path

Total Marks

AQA 7132 · Calculator allowed · about 55 minutes · Write-in edition

Name: _____ Date: ____ / ____ / _____

Answer ALL questions in the spaces provided. Show working for every calculation. The project details needed for questions 4, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16 are given in question 4's prompt and repeated where necessary.

1 Which one of the following best describes the critical path in a project network diagram?

- ☐ A) The path with the greatest number of activities
- ☐ B) The sequence of activities that has the longest total duration and zero float
- ☐ C) The path that finishes first
- ☐ D) The sequence of activities with the smallest durations

(Total for Question 1 is 1 mark)

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2 State the meaning of 'float' (also called slack) for an activity in a network diagram.

(Total for Question 2 is 1 mark)

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3 Identify one benefit of using critical path analysis (CPA) for project planning in a small business.

(Total for Question 3 is 1 mark)

4 Greenway Cafe refurbishment project, activities, durations (days) and dependencies. Use these figures for questions 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16.

Activities:

A: Design layout, duration 2 days, no predecessors

B: Remove old fittings, duration 3 days, predecessor A

C: Electrical rewiring, duration 4 days, predecessor A

D: New plumbing, duration 2 days, predecessor B

E: Decorating and painting, duration 3 days, predecessors C and D

F: Furnishing and final fit-out, duration 2 days, predecessor E

Using the table above, how many activities are listed for this project?

(Total for Question 4 is 1 mark)

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5 State two limitations of critical path analysis as a planning tool.

(Total for Question 5 is 2 marks)

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6 Name the two passes used in critical path calculation and state briefly what each pass finds.

(Total for Question 6 is 2 marks)

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7 Identify the critical path for the Greenway Cafe project using the calculations above.

(Total for Question 7 is 1 mark)

8 What is the minimum project completion time for the Greenway Cafe refurbishment, in days, as found from the forward pass?

(Total for Question 8 is 1 mark)

9 Explain one operational benefit to Greenway Cafe of identifying the critical path for this refurbishment project. Use the project context in your answer.

(Total for Question 9 is 3 marks)

10 Using the Greenway Cafe activity data (question 4), perform the forward pass to calculate each activity's earliest start (ES) and earliest finish (EF) times. Show your working and give ES and EF for A, B and C.

(Total for Question 10 is 3 marks)

11 Continuing the forward pass for Greenway Cafe, give ES and EF for activities D, E and F and show brief working.

(Total for Question 11 is 3 marks)

12 Using your ES/EF and LS/LF values, calculate the float for activity C. Show your working and give the float in days.

(Total for Question 12 is 2 marks)

13 Which activity has a float of 1 day? Answer using the activity letter and justify in one short sentence referring to ES and LS or EF and LF.

(Total for Question 13 is 3 marks)

14 Explain one limitation of critical path analysis for Greenway Cafe's refurbishment project. Use the project context in your answer.

(Total for Question 14 is 3 marks)

15 Perform a backward pass using the project finish time found from the forward pass. Calculate the latest finish (LF) and latest start (LS) times for activities A, B and C. Show your working.

(Total for Question 15 is 3 marks)

16 Evaluate the usefulness of critical path analysis for planning Greenway Cafe's refurbishment project. In your answer, consider benefits and limitations and reach a justified judgement that refers to the project data given in this pack.

(Total for Question 16 is 9 marks)

Mark scheme · 2.2 Critical Path Analysis: Network Diagrams and the Critical Path

Question 1

B cao **B1**

Answer: B

Question 2

float is the amount of time an activity can be delayed without delaying the project completion **B1**

Answer: Float is the amount of time an activity can be delayed without delaying the project completion date.

Question 3

identifies a correct benefit, e.g. shows the shortest possible completion time or helps prioritise resources **B1**

Answer: Shows the shortest possible project completion time and helps prioritise resources for critical activities.

Question 4

6 cao **B1**

Answer: 6 activities.

Question 5

it requires accurate duration estimates which may be hard to predict **B1**

it ignores some qualitative risks and resource conflicts unless these are modelled separately **B1**

Answer: It needs accurate duration estimates which may be hard to predict; it can ignore qualitative risks and resource conflicts unless modelled separately.

Question 6

forward pass, which finds earliest start and earliest finish times **B1**

backward pass, which finds latest finish and latest start times **B1**

Answer: Forward pass finds earliest start and earliest finish times; backward pass finds latest finish and latest start times.

Question 7

A-B-D-E-F cao **B1**

Answer: A - B - D - E - F.

Question 8

12 days cao **B1**

Answer: 12 days.

Question 9

identifies a benefit, e.g. helps the owner to prioritise resources on critical activities **B1**

develops the point in context, e.g. ensures workers and materials are scheduled for A, B, D, E and F first **B1**

links to an outcome, e.g. reducing the risk of delaying the cafe opening and losing trade **B1**

Answer: It helps the owner to prioritise resources on critical activities: by scheduling workers and materials first for A, B, D, E and F the cafe reduces the risk of delaying the opening and losing trade.

Question 10

correct method for forward pass stated or used: ES of start activity = 0 and for successors ES = max(EF of predecessors) **M1**

ES and EF correctly calculated for A and B or evidence of correct substitution, e.g. A ES 0 EF 2; B ES 2 EF 5 **M1**

C ES 2 EF 6 cao **A1**

Answer: A: ES 0, EF 2. B: ES 2, EF 5. C: ES 2, EF 6.

Question 11

method applied: ES of an activity is the maximum EF of its predecessors **M1**

correct ES and EF for D and E seen or implied, e.g. D ES 5 EF 7; E ES 7 EF 10 **M1**

F ES 10 EF 12 cao **A1**

Answer: D: ES 5, EF 7. E: ES 7, EF 10. F: ES 10, EF 12.

Question 12

correct method for float, e.g. float = LS - ES or float = LF - EF **M1**

1 day cao **A1**

Answer: Float for C = LS - ES = 3 - 2 = 1 day.

Question 13

identifies activity C **B1**

shows the calculation, e.g. LS - ES = 3 - 2 **B1**

gives the float as 1 day **B1**

Answer: Activity C. LS 3 minus ES 2 = 1 day float, so C has 1 day float.

Question 14

identifies a limitation, e.g. durations may be uncertain or underestimated **B1**

develops the point in context, e.g. if electrical work takes longer than 4 days or a supplier delay occurs the plan becomes inaccurate **B1**

links to an outcome, e.g. this could cause the project to overrun despite the CPA plan **B1**

Answer: Durations may be uncertain: if the electrical rewiring or material deliveries take longer than estimated the CPA schedule becomes inaccurate and the project could overrun despite the plan.

Question 15

sets project finish as EF of final activity, 12 days, and states backward pass method: for an activity LF = min(LS of successors) **M1**

correct LF and LS for B and C seen or implied, e.g. B LF 5 LS 2; C LF 7 LS 3 **M1**

A LF 2 LS 0 cao **A1**

Answer: A: LF 2, LS 0. B: LF 5, LS 2. C: LF 7, LS 3.

Question 16

Level 1 Makes simple, undeveloped statements about CPA, such as naming a benefit or limitation, with little or no reference to the project data and no clear judgement. **1-3**

Level 2 Provides developed points about CPA, using some project figures (for example the 12 day duration or the identification of the critical path A-B-D-E-F), but analysis is not balanced or the conclusion is not fully justified. **4-6**

Level 3 Weighs benefits and limitations with clear use of the project data, shows how CPA helps reduce completion time and allocate resources to A-B-D-E-F, but also considers issues such as uncertainty in duration estimates and resource conflicts, and reaches a justified and balanced judgement. **7-9**

Indicative content:

- Benefits: CPA shows the minimum completion time is 12 days and identifies the critical activities A-B-D-E-F, allowing the cafe to schedule labour and deliveries for those activities to avoid delays.
- Benefits: knowing floats, for example C has 1 day float, lets managers be flexible with less-critical tasks and protect the critical path.
- Limitations: CPA assumes the given durations are accurate; if electrical rewiring actually takes 6 days rather than 4, or if plumbing is delayed, the critical path and project finish date change and the plan is undermined.
- Limitations: CPA does not automatically resolve resource conflicts, for example if the same specialist is needed for electrical and furnishing, the schedule must be adjusted and CPA alone may not indicate the best resolution.
- Judgement: a balanced view could argue CPA is highly useful as a starting point for the Greenway Cafe project because it gives a clear minimum timescale and shows where to focus resources, but the cafe should combine CPA with contingency planning, monitoring and flexible scheduling to allow for uncertainty in durations and resource availability.