

**UNIVERSITY OF BOLTON**  
**SCHOOL OF ENGINEERING**  
**MSc CIVIL ENGINEERING**  
**MSc CONSTRUCTION PROJECT MANAGEMENT**  
**SEMESTER ONE EXAMINATION 2019/2020**  
**PROJECT MANAGEMENT**  
**MODULE NO: CPM7002**

Date: Monday 13<sup>th</sup> January 2020

Time: 2:00pm – 5:00pm

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**INSTRUCTIONS TO CANDIDATES:**

This paper contains two sections: section 'A' and section 'B'

Section A contains TWO questions: you MUST answer these TWO questions. They are worth 50 marks.

Section B contains THREE questions: you should answer ANY TWO questions from these three questions. Each of these questions is worth 25 marks.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

A formulae sheet is attached to the back of the paper

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**Section A – Compulsory Questions**

**Question One** (Answer should be inserted in answer book as follows: Q1.1 A)

Q1.1 Which of the following layers is the **final** authority within the Project (i.e. who makes the major decisions)?

- A. Project Manager
- B. Team Manager
- C. Corporate/Programme
- D. Project Board

Q1.2 Which of the following roles is responsible for the day-to-day running of a project?

- A. Project Manager
- B. Team Manager
- C. Corporate/Programme
- D. Project Board

Q1.3 Who is the Project Board's "Boss"?

- A. Project Manager
- B. Team Manager
- C. Corporate, Programme Management, or Customer
- D. Project Board

Q1.4 How many Project Managers should a PRINCE2 project have?

- A. One
- B. As many as necessary
- C. Up to two
- D. A Project Manager is optional in PRINCE2

Q1.5 Which of the following is NOT a characteristic of a PRINCE2 project?

- A. Brings about a change
- B. Repeatable
- C. Temporary
- D. Cross-functional

Q1.6 Which of the following does the PRINCE2® method not specifically control?

- A. Quality
- B. Scope
- C. Profits
- D. Benefits

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Q1.7 Which of the following is NOT one of the four steps in PRINCE2's view of project management?

- A. Plan
- B. Delegate
- C. Manage
- D. Control

Q1.8 Which of the following is NOT one of the four "integrated elements" of a PRINCE2® project?

- A. Principles
- B. Themes
- C. Processes
- D. Techniques

Q1.9 Which Theme is concerned with uncertainty?

- A. Risk
- B. Change
- C. Manage by exception
- D. Quality

Q1.10 Which of the following Themes supports the "Focus On Products" principle?

- A. Business Case
- B. Risk
- C. Quality
- D. Organisation

Q1.11 Which of the following statements apply to a Stage Plan?  
(Select the correct combination of those offered at the bottom of the question)

1. Is produced with the knowledge of earlier stages
2. Provides the basis for control by the Project Board
3. Is produced close to the time when the planned events will take place
4. Provides the basis for day-to-day control by the Project Manager

- A. 1, 2, 3
- B. 1, 2, 4
- C. 1, 3, 4
- D. 2, 3, 4

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**Cont. Q1**

Q1.12 Which product triggers a PRINCE2 project?

- A. The Outline Business Case
- B. The Project Plan
- C. The Mandate
- D. The Initiation Stage Plan

Q1.13 How does the Directing a Project activity support the Manage By Stages principle?

- A. Towards the end of the previous stage the Board create the plan for the next stage
- B. In Giving Ad Hoc direction the Board authorise the next stage
- C. In Authorising a Project the Project Boar authorise all stage plans
- D. In Authorising a Stage or Exception Plan the Board authorise each stage (after the Initiation Stage)

Q1.14 Which one of the following Directing a Project activity is conducted at the end of the Starting up a Project process?

- A. Authorising a Stage or Exception Plan
- B. Giving Ad Hoc Direction
- C. Authorising Initiation
- D. Authorising a Project

Q1.15 Which one of the following is created after the Board approves Initiation?

- A. The Project Mandate
- B. The Project Brief
- C. The Quality Management Approach
- D. The Outline Business Case

Q1.16 Which one of the following statements about the Change Theme is TRUE?

- A. The Change theme addresses how a project can prevent change
- B. The Change theme addresses how uncertainty is to be handled
- C. The Change theme defines the plan levels
- D. The Change theme acknowledges that change is inevitable and must be controlled if the project is to be successful

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**Cont. Q1**

Q1.17 Which **one** of the following identifies the two Directing a Project activities that happen before the Controlling a Stage process?

- A. Authorising Initiation & Authorising a Project
- B. Authorising a Stage or Exception Plan & Appointing the Executive and Project Manager
- C. Design and Appoint the Project Management Team & Prepare the Outline Business Case
- D. Set up Project Controls & Prepare the Project Plan

Q1.18 Which of the following are true about a PRINCE2 Project Management team?  
*(Select the correct combination of those offered at the bottom of the question)*

- 1. The Project Team is based on roles not jobs
- 2. You can have the job of "Senior Mechanic" and the role of "Team Manager"
- 3. Roles identify an individual's responsibilities within the Project Team
- 4. You can have the role of "Senior Mechanic" and the job of "Team Manager"

- A. 1,2,3
- B. 1,2,4
- C. 2,3,4
- D. 1,3,4

Q1.19 Which is a purpose of the Managing Product Delivery process?

- A. Controls the link between the Project Manager and the Team Manager(s)
- B. Tracks the progress of a stage with the help of Checkpoint Reports
- C. Provides a link between the work of the Project Manager and the Project Board
- D. Maintains a focus on the delivery of benefits throughout the stage

Q1.20 Which is a purpose of the Closing a Project process?

- A. Define the procedure for handing over products
- B. Provide a fixed point at which acceptance for the project product is confirmed
- C. Define formal requirements for the acceptance, execution and delivery of project work
- D. Confirm all project benefits have been achieved

**[Total 20 marks]**

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**Question Two**

**Table Q2** contains 14 construction activities and their duration in a project. The construction manager thought the following dependency best describes the construction process.

Activity	Duration Days	Activity	Duration Days
A	2	H	10
B	2	I	8
C	6	J	8
D	3	K	4
E	3	L	3
F	5	M	2
G	5	N	2

**Table Q2**

**Construction dependency:**

- B and C can start the project
- D and E succeed B
- F and G succeed C
- H succeeds D and precedes J
- I follows E and merges with J into M
- N succeeds M
- F follows C and precedes L
- K follows G and merges with F into L
- N and L merge into A
- A completes the project

Complete the following tasks:

- (a) Draw a network diagram for the above activities using Precedence Diagram. **(8 marks)**
- (b) Carry out forward and backward passes to determine earliest & latest start times and earliest & latest finish times for each activity and the network critical path. **(8 marks)**
- (c) Calculate the Total Float (TF) and Free Float (FF) for all non-critical activities. **(8 marks)**
- (d) The construction manager discovered that duration of activity, G should be 10 days instead of 5 days and that of activity K should be 9 days instead of 4 days. Explain how this would affect the network critical path and the total duration of the project. **(6 marks)**

**[Total 30 marks]**

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**Section B – Answer any two questions**

**Question Three**

The activities involved in the construction of a road project are given in **Table Q3.1** together with their estimated durations, logical sequence and cost. Each of the activities will be done using a separate gang. At the end of day 13 from start of the project, the actual work status report is shown in **Table Q3.2**.

For this project, complete the following tasks:

- (a) Draw the project network using Precedence Diagram and determine the project critical path and duration. (7 marks)
- (b) Produce the project Gantt Chart using the supplied graph paper (5 marks)
- (c) Using the EVM technique, check whether the project is on track cost wise and schedule wise. (13 marks)

[Total 25 marks]

Activity	Predecessors	Duration (Day)	Cost/Day (£)	Total Cost (£)
A	-	7	300	2100
B	-	9	350	3150
C	A	8	450	3600
D	B	11	250	2750
E	C,D	4	400	1600
F	B	9	300	2700
G	F	7	400	2800
H	E,G	7	375	2625

**Table Q3.1**

Activity	Actual % Complete	Actual Cost (£)
A	100	2400
B	100	3000
C	50	2000
D	25	1000
E	30	500
F	0	0
G	0	0
H	0	0

**Table Q3.2**

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**Question Four**

- (a) Critically discuss the six main steps of value engineering, and the main tasks and outcomes of each stage.

**(12 marks)**

- (b) Critically evaluate the process of Project Risk Management and how each stage of risk analysis and risk response could be conducted including the techniques/tools used in each stage.

**(13 marks)**

**[Total 25 marks]**

**Question Five**

A Construction company is considering placing a bid on a building project. One of the company construction planners has determined that five activities would need to be performed to carry out the project. Using the **PERT** three-estimate approach, the planner has obtained the time estimates in **Table Q5** for how long these activities will take. Also shown are the precedence relationships for these activities.

Activity	Estimated Times (Weeks)			Preceded by
	<i>a</i> (Optimistic)	<i>m</i> (Most Likely)	<i>b</i> (Pessimistic)	
<b>A</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>-</b>
<b>B</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>A</b>
<b>C</b>	<b>3</b>	<b>5</b>	<b>6</b>	<b>B</b>
<b>D</b>	<b>1</b>	<b>3</b>	<b>5</b>	<b>A</b>
<b>E</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>B, D</b>

**Table Q5**

There is a financial penalty if the project is not completed in 11 weeks. Therefore, the planner is very interested in how likely it is that his company could finish the project in time. Based on the above information perform the following tasks:

- (a) Construct the network of this project.

**(5 marks)**

- (b) Find the estimate of the mean and variance of the duration for each activity.

**(8 marks)**

- (c) Find the mean critical path.

**(5 marks)**

- (d) Find the approximate probability of completing the project within 11 weeks.

**(7 marks)**

**[Total 25 marks]**

**END OF QUESTIONS**



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**Useful Formulae**

PERT Equations

$$t_e = \frac{a + 4m + b}{6} \quad ; \quad v_e = \left( \frac{b - a}{6} \right)^2$$

$$T = \sum_{i=1}^n t_e^i \quad ; \quad S = \sqrt{\sum_{i=1}^n v_e^i}$$

$$Z = \frac{d - T}{S} \quad ; \quad P(d \leq T) = 1 - P(T > d)$$

where,

$t_e$	= expected mean duration of activity
$v_e$	= variance of activity duration
$a$	= optimistic estimate for activity duration
$m$	= most likely estimate for activity duration
$b$	= pessimistic estimate for activity duration, ( $a < m < b$ )
$T$	= project mean duration
$S$	= standard deviation of project duration
$d$	= project required deadline duration
$n$	= number of activities along the critical path
$P(d \leq T)$	= probability of project required duration less than or equal project expected duration
$Z$	= standard normal random variable

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### EVM Terms and Equations

EVM Term		Definition	Formula
Planned Value*	PV	The budgeted cost for the work scheduled.	
Earned Value*	EV	The budgeted cost for the work actually completed.	
Actual Cost*	AC	The actual cost of the work actually completed.	
Schedule Variance	SV	The measure of schedule performance on a project.	$SV = EV - PV$
Cost Variance	CV	The measure of cost performance on a project.	$CV = EV - AC$
Schedule Performance Index	SPI	The measure of progress achieved compared to progress planned.	$SPI = EV / PV$
Cost Performance Index	CPI	The measure of the value of work completed compared to the actual cost or progress.	$CPI = EV / AC$

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**Standard Normal Probabilities**

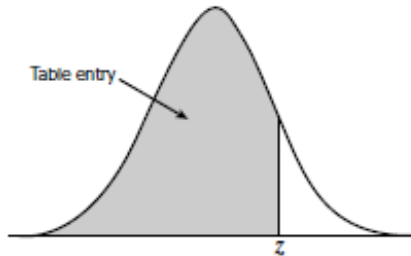


Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

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