

# **Cambridge Technicals Engineering**

## **Unit 24: Project management for engineers**

Level 3 Cambridge Technical Certificate/Diploma in Engineering  
**05822 - 05825**

## **Mark Scheme for June 2019**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

© OCR 2019

**Annotations**

<b>Annotation</b>	<b>Meaning</b>
Tick	Valid point, mark awarded
Cross	Incorrect
Question mark	Response unclear
BOD	Benefit of doubt (mark awarded)
TV	Too vague (mark not awarded)
REP	Repetition (no additional marks awarded)
NAQ	Not answered question (incorrect focus)
L1	Level 1 response (identification)
L2	Level 2 response (explanation)
L3	Level 3 response (analysis)
L4	Level 4 response (evaluation)
CONT	Context (required for high L4 award only)

**Subject specific marking instructions**

For Level of Response marked questions marked over 4 levels, the candidate can access at L1 or L2. In either case, they can analyse the point made and proceed directly to L3.

L3 analysis is required before L4 can be accessed.

Question		Answer	Marks	Guidance																				
1	(a)	Indicative content: <table border="1"> <thead> <tr> <th></th> <th>Project initiation</th> <th>Project planning</th> <th>Project implementation</th> <th>Project closure</th> </tr> </thead> <tbody> <tr> <th>Risk analysis</th> <td></td> <td>✓</td> <td></td> <td></td> </tr> <tr> <th>Feasibility study</th> <td>✓</td> <td></td> <td></td> <td></td> </tr> <tr> <th>Variance analysis</th> <td></td> <td></td> <td>✓</td> <td></td> </tr> </tbody> </table>		Project initiation	Project planning	Project implementation	Project closure	Risk analysis		✓			Feasibility study	✓				Variance analysis			✓		3	One mark for each correct identification, to a maximum of three marks.  Contradictory response rule applies to each of three documents (see preamble item 5).
	Project initiation	Project planning	Project implementation	Project closure																				
Risk analysis		✓																						
Feasibility study	✓																							
Variance analysis			✓																					
1	(b)	Responses may include: <ul style="list-style-type: none"> <li>• activities involved</li> <li>• order of completion</li> <li>• durations/timings</li> <li>• start dates</li> <li>• finish dates</li> <li>• dependencies.</li> </ul>	3	One mark for a correct identification, to a maximum of three marks.																				
1	(c)	Responses may include: <ul style="list-style-type: none"> <li>• time creep</li> <li>• project delay</li> <li>• slower than the competition</li> <li>• tasks need to be rushed/take short cuts</li> <li>• run over/out of time.</li> </ul> Exemplar response:  e.g. The project is not likely to complete on time (1). This may mean that Industrial Robotics Ltd loses out to the sales (1).	2	Up to two marks for explanation.																				

Question		Answer	Marks	Guidance
1	(d)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• an alternative plan/plan b</li> <li>• to make provision for negative events</li> <li>• to plan for unfortunate eventualities</li> <li>• to minimise disruption/delay</li> <li>• to minimise the impact of negative circumstances</li> <li>• to get back on track as quickly as possible</li> <li>• to have alternative resources available</li> <li>• to be proactive</li> <li>• to maintain control</li> <li>• to ensure emergencies can be dealt with efficiently</li> <li>• avoids reactive fire-fighting.</li> </ul> <p>Exemplar response:</p> <p>e.g. A contingency plan is important because it requires Zhang to consider negative eventualities which may affect the progress of the project (1). This helps to ensure that the project team are prepared should such events occur (1), minimising any delay to the project (1). This could be critical since the company needs to get its robotic innovations to market before the competition (1).</p>	4	<p>One mark for each valid point to a maximum of four such points, allow development.</p> <p>Accept answers relating to a contingency plan or the activity of contingency planning.</p>

Question		Answer	Marks	Guidance
1	(e)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• lack of skill in-house/beyond own expertise</li> <li>• not a core competence</li> <li>• prefer to concentrate on hardware development</li> <li>• insufficient human resources</li> <li>• would require significant financial resourcing e.g. programming tools, coding software</li> <li>• to save time/shorten the project</li> <li>• to allow employees to concentrate on developing the prototype</li> <li>• contractor may have superior skills</li> <li>• benefits of specialisation e.g. higher quality</li> <li>• have positive experience of using software contractors on previous projects</li> <li>• cost saving/cheaper than doing it in-house.</li> </ul>	2	<p>One mark for a correct identification, to a maximum of two marks.</p> <p>Do <b>not</b> award 'specialist' as it is given in the question.</p> <p>Do <b>not</b> award answers relating to independent/ external/objective, the response to why a specialist should be used.</p>

Question		Answer	Marks	Guidance									
1	(f)	<p>Indicative content:</p> <ul style="list-style-type: none"> <li>• competition e.g. nature of competition, size of competition, strength of competition, competitor behaviour.</li> <li>• market conditions e.g. market size, market growth, market dynamics, demand.</li> </ul> <p>Exemplar responses:</p> <p>e.g. If the company hears that the competitors are also developing the uneven floor and stairway mobility of their robots (1) then Industrial Robotics Ltd may need to change the focus of its project (1), perhaps enhancing robotic perception or manipulation (1).</p> <p>e.g. Significant growth in the size of the market could affect the project (1) because Rachel may be willing to throw more resources into the project (1) because of its potential for greater profits (1).</p>	3 x 2	<p>In both cases, one mark for an impact on the project, plus up to two further marks for explanation.</p> <p>Impacts can be positive or negative.</p>									
2	(a)	<p>Indicative content:</p> <table border="1"> <thead> <tr> <th>Project management tool</th> <th colspan="2">Source of information</th> </tr> </thead> <tbody> <tr> <td>Gantt chart</td> <td>Internal</td> <td>External</td> </tr> <tr> <td>PERT</td> <td>Internal</td> <td>External</td> </tr> </tbody> </table>	Project management tool	Source of information		Gantt chart	Internal	External	PERT	Internal	External	2	<p>One mark for each correct identification, to a maximum of two marks.</p> <p>Contradictory response rule applies to each of the tools (see preamble item 5).</p>
Project management tool	Source of information												
Gantt chart	Internal	External											
PERT	Internal	External											

Question			Answer	Marks	Guidance
2	(b)	(i)	Indicative content:  3 months	1	For one mark.  Award equivalents e.g. quarter of a year.  Units required.
2	(b)	(ii)	Indicative content:  Activity D: External testing of prototypes in industrial market <b>AND</b> Activity E: Accelerated time testing of robotic prototype.	1	For one mark.  Both required for one mark.
2	(b)	(iii)	Indicative content:  Activity B: Phase 2 testing and refinement of robotic prototype <b>AND</b> Activity H: Off-site software creation by contractor.	1	For one mark.  Both required for one mark.
2	(b)	(iv)	Indicative content:  <ul style="list-style-type: none"> <li>• A, B, C, D, G, H, I, J, K, L, N, O</li> <li>• All apart from Activities E, F and M.</li> </ul>	1	For one mark.  Do <b>not</b> award answers that give additional activities or miss out an activity.
2	(b)	(v)	Indicative content:  14 months	1	For one mark.  Accept equivalents e.g. 1 year 2 months.  Units required.



Question		Answer	Marks	Guidance
2	(c)	<p>Responses include:</p> <ul style="list-style-type: none"> <li>• timings are imprecise e.g. whole months</li> <li>• no dates given, only durations</li> <li>• too simplistic for effective monitoring of complex projects</li> <li>• cannot show multiple scheduling possibilities</li> <li>• cannot show intricate task dependencies</li> <li>• does not show bottlenecks</li> <li>• does not show where resources have been assigned</li> <li>• does not identify the critical path</li> <li>• the size of the bar does not indicate the amount of work</li> <li>• difficult to do on paper/requires IT</li> <li>• lacks the clear visual sequencing of CPA</li> <li>• can be complex to portray graphically</li> <li>• difficult to draw</li> <li>• time consuming to produce</li> <li>• difficult to understand</li> <li>• does not factor in contingencies</li> <li>• needs to be constantly updated</li> <li>• not easy to edit/update</li> <li>• time consuming to update</li> <li>• only suitable for straightforward projects.</li> </ul> <p>Exemplar responses:</p> <p>e.g. Precise timings cannot be shown (1) because the graph works in whole cells e.g. whole weeks or months (1).</p> <p>e.g. The Gantt chart will need to be updated frequently in the light of actual progress made (1) and this is likely to be a time-consuming process (1).</p>	3 x 2	<p>One mark for each correct limitation to a maximum of three, plus one further mark for each of three explanations.</p> <p>Accept explanation of cause or consequence.</p>

Question		Answer	Marks	Guidance
2	(d)	<p>Indicative content:</p> $E = \frac{O + 4M + P}{6}$ $O = 14$ $P = 28 \quad (14 \times 2 = 28)$ $M = 18 \quad (14 + 12/3 = 14 + 4 = 18) \quad 4M = 72$ $E = \frac{14 + 72 \text{ (OFR)} + 28 \text{ (OFR)}}{6} = \frac{114}{6} = \mathbf{19 \text{ months}}$	6	<p>Up to 6 marks.</p> <p>Award full marks (6 marks) for correct answer irrespective of working. Correct units required.</p> <p>1 mark for correct formula/method stated or applied.</p> <p>1 mark for each correct figure for O, P and M.</p> <p>Award 5 marks for an answer of '19' with incorrect units (or no units) given.</p> <p>Award equivalents e.g. 19 months = 1 year 7 months.</p>
2	(e)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• quality management</li> <li>• control techniques</li> <li>• frequent reporting/regular meetings.</li> </ul>	2	<p>One mark for a correct identification, to a maximum of two marks.</p> <p>Accept specific examples.</p>

Question		Answer	Marks	Guidance
3	(a)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>Issue 1: medium (1) e.g. important but not time critical, needs to be investigated, may be a good reason, needs to be chased, no serious effect unless the delay continues, no one has been injured, is not an issue that the media would get hold of, nevertheless will delay the project if it is not dealt with soon, the software development is a key part of the overall project.</li> <li>Issue 2: low (1) e.g. very limited impact, no urgency, internal impact only, slight delay, employee expected to return shortly, Activity E has 2 months of slack time, as long as completed within the three-month period the project will not be delayed, self-limiting issue, self-rectifying.</li> <li>Issue 3: high (1) e.g. urgent, serious impact, external impact, people have been injured, potential legal action, potential compensation claim, third party involvement, may jeopardise future focus groups, another focus group scheduled very soon, two fewer prototypes available for future focus groups, involves potential industrial customers, high risk to reputation, risk of getting media attention, potential to jeopardise future sales, safety testing of prototypes required, remedial action to prototypes needed, health and safety issue, potential to happen again, potential to escalate, needs to be reported to Rachel.</li> </ul> <p>Exemplar responses:</p> <p>e.g. Issue 1 is medium priority (1). The software needs to be fully tested before the product can be brought to market (1). However, this matter does put the reputation of the company at immediate risk, so is not as urgent as Issue 3 (1).</p>	3 x 3	In each case, award: one mark for appropriate priority plus up to two marks for explanation.

Question			Answer	Marks	Guidance
			<p>e.g. Issue 2 is low priority (1). This issue is likely to be automatically resolved when the engineer returns to work (1). A slight delay to Activity E will not delay the overall project (1).</p> <p>e.g. Issue 3 is high priority (1). Someone has been injured while the company was attempting to demonstrate the safety of the robots (1). This has the potential to cause adverse media publicity (1).</p>		
<b>3</b>	<b>(b)</b>		<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• product material/type of metal</li> <li>• dimensions</li> <li>• metrics</li> <li>• shape/template</li> <li>• attribute specification</li> <li>• degree of precision/tolerance</li> <li>• grade</li> <li>• quality</li> <li>• tensile strength.</li> </ul>	<b>2</b>	One mark for a correct identification, to a maximum of two marks.

Question		Answer	Marks	Guidance																					
3	(c)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• lower cost components</li> <li>• longer trade credit period</li> <li>• better deals</li> <li>• shorter lead time</li> <li>• faster delivery</li> <li>• better delivery terms</li> <li>• better quality products</li> <li>• improved goodwill</li> <li>• supplier more amenable/flexible to requests</li> <li>• supplier may prioritise orders from Industrial Robotics.</li> </ul> <p>Exemplar response:</p> <p>e.g Zhang may be able to negotiate cheaper prices (1) for the components. This will reduce business costs (1), potentially increasing business profits (1).</p>	2 x 3	<p>One mark for each of two benefits, plus one further mark for each of two explanations and one further mark for each of two analyses.</p> <p>Accept benefits to the project or the business.</p>																					
3	(d) (i)	<p>Indicative content:</p> <table border="1"> <thead> <tr> <th>Durability of upgraded component (<math>n</math> cycles, in millions)</th> <th>Frequency</th> <th>Cumulative frequency</th> </tr> </thead> <tbody> <tr> <td><math>n \leq 3.0</math></td> <td>0</td> <td>0</td> </tr> <tr> <td><math>3.0 &lt; n \leq 3.5</math></td> <td>8</td> <td>8</td> </tr> <tr> <td><math>3.5 &lt; n \leq 4.0</math></td> <td>30</td> <td>38</td> </tr> <tr> <td><math>4.0 &lt; n \leq 4.5</math></td> <td>36</td> <td>74</td> </tr> <tr> <td><math>4.5 &lt; n \leq 5.0</math></td> <td>16</td> <td>90</td> </tr> <tr> <td><math>5.0 &lt; n \leq 5.5</math></td> <td>10</td> <td>100</td> </tr> </tbody> </table>	Durability of upgraded component ( $n$ cycles, in millions)	Frequency	Cumulative frequency	$n \leq 3.0$	0	0	$3.0 < n \leq 3.5$	8	8	$3.5 < n \leq 4.0$	30	38	$4.0 < n \leq 4.5$	36	74	$4.5 < n \leq 5.0$	16	90	$5.0 < n \leq 5.5$	10	100	2	<p>Award full marks if all four correct. Award max one mark (for method) if one error.</p>
Durability of upgraded component ( $n$ cycles, in millions)	Frequency	Cumulative frequency																							
$n \leq 3.0$	0	0																							
$3.0 < n \leq 3.5$	8	8																							
$3.5 < n \leq 4.0$	30	38																							
$4.0 < n \leq 4.5$	36	74																							
$4.5 < n \leq 5.0$	16	90																							
$5.0 < n \leq 5.5$	10	100																							

Question			Answer	Marks	Guidance
3	(d)	(ii)	<p>Indicative content:</p> <p>Smooth line through the following co-ordinates: (3.5, 8), (4.0, 38), (4.5, 74), (5.0, 90).</p>	2	<p>Up to two marks.</p> <p>Award full marks for smooth line through correct co-ordinates.</p> <p>Award max one mark for correct co-ordinates joined by straight lines.</p> <p>OFR applies to cumulative frequency given in part (i).</p>
3	(d)	(iii)	<p>Indicative content:</p> <p>Median value (at 50<sup>th</sup> percentile level) indicated on graph. Answer: 4.15 ± 0.1 million cycles (OFR)</p>	1	<p>For one mark.</p> <p>Award any correct attempt to show the median value on graph e.g. horizontal line drawn across at 50 or a cross or ring at appropriate point on the curve.</p> <p>NB median value does not need to be stated, the question only requires it to be 'shown'.</p> <p>OFR applies to graph drawn in part (ii).</p>
4	(a)		<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• (software) contractor</li> <li>• (component) supplier</li> <li>• customers/manufacturing industries</li> <li>• consumers/end users of manufactured products</li> <li>• competitors/other robotic manufacturers</li> <li>• media.</li> </ul>	2	<p>One mark for a correct identification, to a maximum of two marks.</p> <p>Do not award 'sponsors' as they could be internal.</p> <p>Do not award 'local businesses', 'investors', annotate TV.</p>

Question		Answer	Marks	Guidance
4	(b)	<p>Responses may include:</p> <ul style="list-style-type: none"> <li>• a balanced viewpoint</li> <li>• so that nothing is overlooked</li> <li>• more information/more detail</li> <li>• different stakeholders might have different perspectives</li> <li>• so that all stakeholders feel valued.</li> </ul> <p>Exemplar response:</p> <p>e.g. Getting feedback from all relevant stakeholders should help to avoid bias (1). This is important because otherwise something important could be overlooked (1) which might have benefitted future projects (1).</p>	3	One mark for each valid point to a maximum of three such points, allow development.
4	(c)	<p>Use level of response criteria.</p> <p>Responses may include:</p> <ul style="list-style-type: none"> <li>• objective feedback methods <ul style="list-style-type: none"> <li>○ completion figures (e.g. deliverables, scope, time cost, acceptance)</li> <li>○ issue logs</li> <li>○ complaints analysis</li> </ul> </li> <li>• subjective feedback methods <ul style="list-style-type: none"> <li>○ informal methods e.g. chat, business breakfast, media coverage</li> <li>○ formal methods e.g. meetings, questionnaires.</li> </ul> </li> </ul>	12	<p>Level of response:</p> <p>Level 4: 10-12 marks Candidate evaluates feedback methods Zhang can use to review his own performance as manager of the project.</p> <p>Level 3: 7-9 marks Candidate analyses the benefits and drawbacks of feedback methods Zhang can use to review his own performance as manager of the project.</p> <p>Level 2: 4-6 marks Candidate explains the benefits and drawbacks of feedback methods Zhang can use to review his own performance as manager of the project.</p>

Question	Answer	Marks	Guidance
	<p>Exemplar response:</p> <p>e.g. Zhang could use project completion figures (L1). By comparing the time the project actually takes to time projected by the schedule he can work out the time creep of the project (L2). However, this method will only give him basic details, for example the magnitude of any time creep, it will not explain 'why' any time creep occurred (L3).</p> <p>In contrast, issuing questionnaires to project team members (L1) would allow Zhang to collect information about how they feel he managed the project (L2). This method has the advantage of providing an insight into who or what may be to blame for any time creep (L3).</p> <p>Despite the feedback from questionnaires being subjective and open to bias, this method will provide far more information which Zhang can use to judge whether his planning and time management skills (CONT) were satisfactory or the cause of any time creep. In addition, the information will come from those who were most closely involved in the project and, therefore, are most likely to be able to most accurately review his personal performance. For these reasons, I believe that issuing questionnaires to team members is a far better method than comparing planned and actual timescales (L4).</p>		<p>Level 1: 1-3 marks Candidate identifies feedback methods Zhang can use to review his own performance as manager of the project.</p> <p>For Level 4:</p> <p>Award 10 marks for a justified selection of method (no context), e.g. best because ....</p> <p>Award 11 marks for a justified selection of method (with context) e.g. best because ... with context. Context annotation required.</p> <p>Award 12 marks for a comparative, justified selection with context. E.g. better than ... because ... with context. Context annotation required.</p> <p>NB at least two methods must have been identified before L4 can be considered awarded.</p> <p>NB L3 required to enter L4 (see p.4 item 11).</p> <p>Do not award self-evaluation, project closure reports.</p>



**OCR (Oxford Cambridge and RSA Examinations)**  
**The Triangle Building**  
**Shaftesbury Road**  
**Cambridge**  
**CB2 8EA**

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

**Oxford Cambridge and RSA Examinations**  
is a Company Limited by Guarantee  
Registered in England  
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA  
Registered Company Number: 3484466  
OCR is an exempt Charity

**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

© OCR 2019

 **Cambridge  
Assessment**

