

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

ENGINEERING

05822–05825, 05873

Unit 24 Summer 2023 series

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

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Unit 24 series overview

This series has seen some successful responses relating to leadership styles that a project manager could adopt, as illustrated by responses to Question 1(c). Examiners have also seen some improvement in candidates' understanding of how to manage stakeholders, as illustrated by responses to Question 2(a). However, yet again, LO5.2 appears to be an area of the specification where candidates need to be more fully prepared. In particular LO5.2.2d (other external factors that affect project outcomes) as highlighted by responses to Question 4(c).

As ever, those candidates who showed a sound understanding across the breadth of the specification, coupled with numerical skill and an ability to analyse and evaluate, did well on this paper.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> • had a good understanding across the breadth of the specification • were able to demonstrate the accurate use of project management tools i.e. PERT (Question 3(a)) and Gantt charts (Question 3(c)) • were able to demonstrate numerical skills including interpreting a graph (Question 2(a)), calculating percentage change (Question 4(b)(i)) and drawing a bar chart to the required degree of accuracy (Question 4(b)(ii)) • wrote responses in line with the command word in the question, e.g. state, explain, analyse, etc. • made judgements supported by justified reasoning (Question 1(c) extended response question). 	<ul style="list-style-type: none"> • had significant gaps in their understanding leaving entire questions blank • showed limited or no understanding of project management tools or gave answers without their units • showed incorrect understanding of how to calculate, hand and interpret percentages (Question 4(b)(i) and (iii)) • tended to ignore the command words in the question and, in the main, gave short answers to all questions rather than developing them into explanation or analysis • demonstrated little or no knowledge of leadership styles that a project manager could adopt (Question 1(c)).

The paper is split into four sections, each supported by text detailing a project management scenario. It is important that candidates assimilate this information as they work through the paper as it provides the basis for answering many of the questions. Many of the questions require numerical competency and an understanding of project management skills. Other questions test understanding of project management as a process, including planning, initiation, monitoring and feedback.

As always, there was one high tariff, extended response question on the paper, in this case Question 1(c). Extended response questions are level of response marked. Candidates need to demonstrate the skills of analysis (Level 3) and evaluation (Level 4) to gain the highest marks.

Analytical skill (Level 3)

Analysis requires candidates to develop their responses to include impacts on the project or the project management process. For Question 1(c) analytical comments might refer to the impact on creativity, decision-making, quality of deliverables, speed of completion, etc.

It should be noted that phrases such as 'this will affect problem-solving' or 'this will impact on the duration of the project' cannot be given marks because the direction of the impact is unclear. Candidates need to make explicit the direction of the impact i.e. 'faster/slower problem-solving', or 'this will increase/decrease the duration of the project'.

Impacts on stakeholders, e.g. impacts on Nina or team members may be valid points for Level 2, but they are not analytical (Level 3) because the chain of argument stops short of suggesting the impact on the project itself.

Evaluative skill (Level 4)

Evaluation requires a reasoned decision that answers the question. For Question 1(c) the decision required was which leadership style Nina should use and the reasoning for why.

Candidates should be encouraged to reach decisions and give detailed justification to support their argument using contextual information. While an accurate judgement that applies to most projects would achieve a Level 4 mark, a response which argues using the particular circumstances of the project detailed in the text would be given at least 11 of the available 12 marks.

Areas which caused most problems on this paper were economic factors that can cause an adverse variance (Question 4(c)), ways to motivate the team (Question 2(b)) and formal feedback methods (Question 4(d)(ii)). On the other hand, Question 2(a) on managing stakeholders, Question 2(c)(i) requiring the completion of a Gantt chart and Question 4(a) about debt finance, were well answered.

Question 1 (a)

Text 1

Sykes Components Ltd is a British manufacturer of plastic components; it uses computer-aided design (CAD) software coupled with modern injection moulding processes to produce custom-made parts for the automotive industry.

Zac Sykes formed the company in 2002. The company now has three directors, including Zac its Managing Director, who is a leading member of the UK Injection Moulding Society. This is a prestigious trade organisation which seeks to promote innovation in the plastics industry.

Employing 37 people, the company uses three different production processes, each with their own production cells.

- GAIM (Gas assisted injection moulding) × 6 cells.
A fast process for producing hollow components or ones with complex shapes, e.g. car door handles and fuel level sensors.
- MMIM (Multiple material injection moulding) × 2 cells.
A process used when two or more materials with different properties are needed, e.g. soft touch CD buttons or arm rests.
- RIM (Reaction injection moulding) × 4 cells.
A slower process which produces lightweight but solid components, e.g. steering wheels and bumpers.

Sykes Components Ltd has a reputation for excellence in design and for the production of superior, high precision, components. However, this level of customer service and quality comes at a high price.

In recent years production costs have been too high and company profits have been falling. An investigation found that the use of robots to load and unload the cells would cut production times and lower wastage, thus reducing production costs.

This matter is now urgent. A new project has been commissioned. The required deliverables are three robots (one to serve each of the three production processes). The objective is to reduce overall production cost by at least 3.5%. The three directors comprise the project board.

Nina Dixon, the company's newly appointed Robotics Engineer, has been assigned as project manager. Nina was recruited straight from university and has a degree in robotic engineering. Nina is keen to do well in her first job. She is not a born leader, however, and is risk averse. She has never been part of a project before, nor has she been trained in project management.

The managers of each of the three production processes have been assigned as project team members. All are fully qualified engineers who have worked for the company for many years:

- Kofi (GAIM) – approaching retirement, prefers traditional production methods, dislikes robotics
- Jamal (MMIM) – eager to change, but busy preparing to speak at an engineering conference
- Amir (RIM) – project manager last year, is disappointed not to be project manager again.

1 Refer to Text 1.

- (a) Explain **one** benefit to Nina of reading company documentation from previous projects before managing this project.

.....

.....

.....

..... [2]

Most candidates were able to state a benefit of reading previous project reports and gained one of the 2 available marks. Many stopped at that point. It should be noted that the question begins with the command word 'explain' and asks for a benefit 'to Nina'. To gain the second mark candidates needed to develop their response to explain the benefit to Nina.

Question 1 (b)

(b) Explain **one** purpose of each of the following plans that Nina needs to produce:

- resource plan

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.....

- quality plan

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.....
.....

- project schedule.

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.....
.....

[6]

Most candidates were able to state a purpose of the resource plan and the project schedule. Few were able to state the purpose of a quality plan. Again, the command word for the question was 'explain' so the response needs to be developed for each extra mark.

Question 1 (c)

(c) Discuss **three** leadership styles that Nina could use to manage this project.

Which **one** of these leadership styles should Nina use? Justify your view.

[12]

This question is level of response marked. Each level equates to a mark band of 3 marks. Level 1 indicates Knowledge, Level 2 Understanding, Level 3 Analysis and Level 4 Evaluation. Please see the series overview at the beginning of this report for further details about what is meant by Analysis and Evaluation on this Unit.

This question centres around leadership styles and which one Nina should use. The type of response examiners were looking for is shown in the exemplar response in the published mark scheme. The specification lists four leadership styles – directive, supportive, collaborative and responsive. An alternative classification of authoritative, democratic, paternalistic and laissez faire was also accepted by examiners.

Those candidates who did well on this question constructed their response clearly. They began by naming a leadership style, identified at least one of its features and then discussed the impact (positive or negative) that this leadership style would have on the project. This format was then repeated in further paragraphs covering additional leadership styles. The final paragraph selected one the leadership styles and gave reasons for the choice. Those who gave a contextual reason scored at least 11 marks.

Those candidates with robust knowledge of leadership styles did well on this question. However, there were a significant number of candidates who did not seem aware of the concept of leadership styles and instead wrote vague responses about being bossy or working as a team, etc. Such responses could not be awarded.

Some candidates were able to identify one or more leadership styles (and thus scored Level 1 marks) but then got confused between them. For example suggesting that a supportive leadership style just allowed the team to do what they thought appropriate.

Misconception



There appears to be a common misconception among candidates that a directive leadership style means that a leader is bossy or authoritarian. This is not the case.

A directive leadership style simply means that the leader tells their subordinates what they want doing and how they want it done. This is in contrast to a supportive leader who tells their subordinates that they want doing, but with the leader's agreement supports them achieving it in the way they think is most suitable.

A collaborative leadership style involves agreeing together both what should be done and how, with the leader intervening when felt necessary to manage their combined decisions. A responsive leadership style allows the team to decide among themselves what needs doing and how, with the leader only intervening when asked to do so.

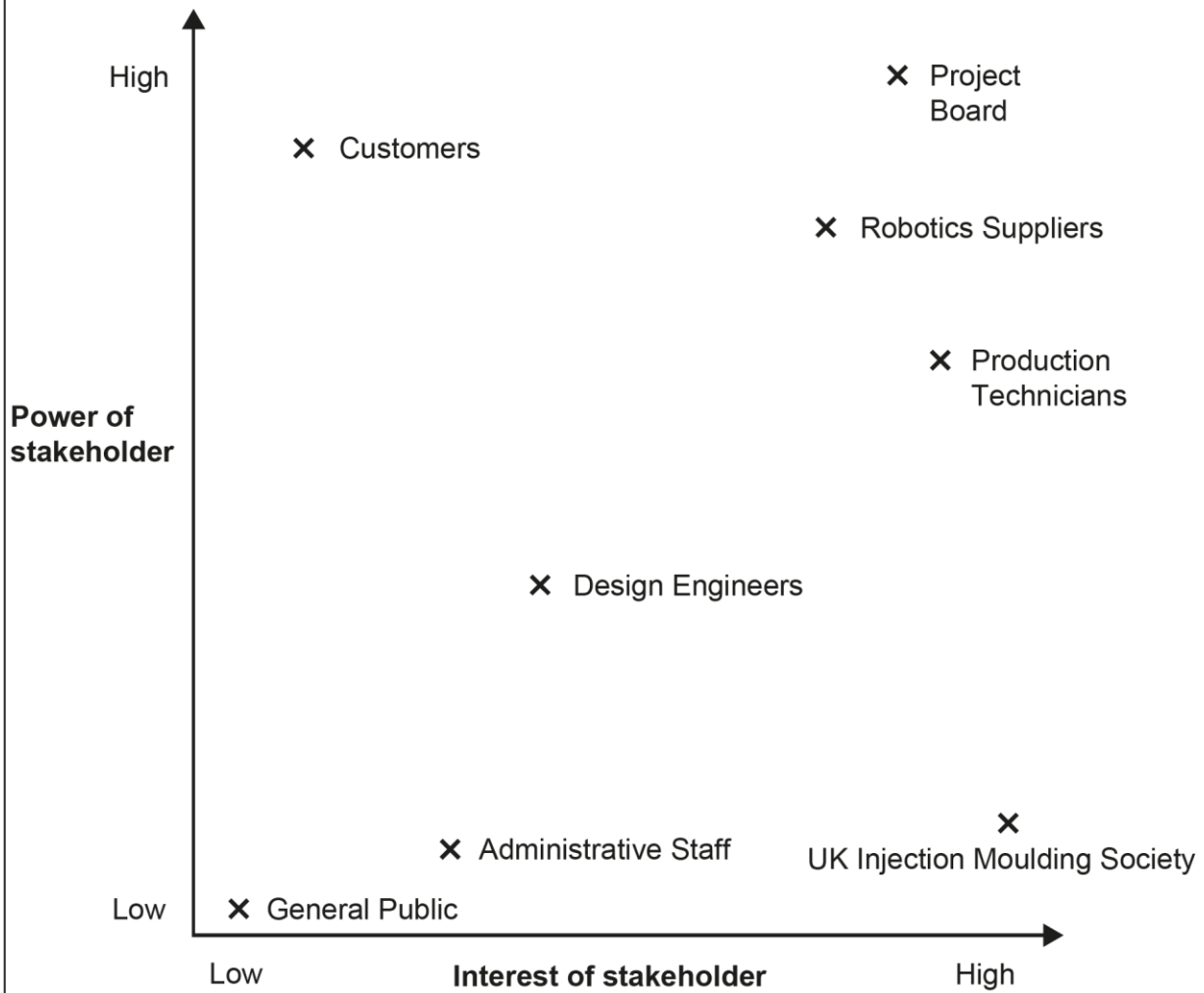
Question 2 (a)

Text 2

Nina is considering how to manage the project's stakeholders. A graph showing the levels of power and interest of project stakeholders is shown in **Fig. 1**.

Fig. 1

Graph showing project stakeholders according to their levels of power and interest



2 Refer to Text 2.

(a) Fig. 1 shows the power and interest levels of internal and external stakeholders.

Complete the unshaded cells in the table below to advise Nina how to manage each of the four **external** stakeholders shown in **Fig. 1**.

	External stakeholder	Level of power? (high, medium or low)	Level of interest? (high, medium or low)	How should this external stakeholder group be managed?
1				
2				
3				
4				

[12]

This question was generally well answered with most candidates scoring at least 8 marks. Of those that didn't score so highly, by far the most common error was to select from the graph internal stakeholders rather than external stakeholders.

The righthand column of the table was completed less well than the other columns. The specification indicates how each type of stakeholder (as identified by their power and interest levels) should be managed. Please see the specification and published mark scheme for valid responses.

Assessment for learning



Candidates should be given plenty of opportunity to work out how various stakeholder groups should be managed. This could be done throughout the programme of study by using a stakeholder graph as a lesson starter while waiting for all students to arrive.

Question 2 (b)

- (b) Nina realises that an effective project manager needs to be able to motivate the team. Analyse **two** ways Nina could motivate her project team members.

1

.....

.....

.....

.....

2

.....

.....

.....

[6]

This question was looking for practical suggestions as to how Nina could motivate her team, for methods that would work in real life. Responses to this question varied significantly in quality. Some candidates had a very clear grasp of motivation methods appropriate to a professional environment. Others appeared to rely on their life experience and suggested offering the team sweets or a cookie or a sticker on a star chart. These were not deemed appropriate ways for a project manager to motivate a professional team.

Some responses suggested ways that would only work if Nina was their employer. Suggestions such as higher wages, bonuses and enhanced holiday entitlement could not be awarded because Nina, in her role as project manager, would not have these motivational tools at her disposal.

The most common valid responses seen by examiners were praise, positive feedback, social events and group gelling exercises. In the main, candidates who gave these responses were also able to explain how they worked to improve motivation, e.g. making employees feel important or valued, etc. However very few candidates demonstrated analytical skill as required by the question, limiting themselves to 4 of the available 6 marks. For analysis examiners were looking for an impact on the project of that particular motivational tool, e.g. praise costs nothing or social events take up a significant amount of time, etc. Please see the series overview at the beginning of this report for more details on how to demonstrate analytical skill.

Question 3 (a)

Text 3

Nina is aware of her inexperience in planning, managing and monitoring a project.

Nina intends to use PERT to estimate the expected duration of the project.

Her calculations suggest that:

- 'most likely time' = 8 months
- 'optimistic time' = 6 months

She is unsure what figure to use for 'pessimistic time'.

Nina also intends to use a series of Gantt charts to help monitor the project.

3 Refer to Text 3.

- (a) Nina is considering whether to set the 'pessimistic time' for PERT to 16 months or to 28 months.

Calculate, using PERT, by how much the estimated expected duration of the project would increase if Nina used a 'pessimistic time' of 28 months rather than 16 months.

.....

.....

.....

.....


.....

.....

..... [7]

This question was a good differentiator. Those that knew the formula calculated correctly and often gained the full 7 marks. Those that did not tended to forget to add the units, i.e. months and scored 6 marks for the answer $11 - 9 = 2$. Those who could not recall the formula were unable to attempt the calculations and scored zero marks. There were few candidates in between; virtually full marks were given or zero.

Assessment for learning



Candidates need to learn the PERT formula. The formula will not be provided for them in the examination.

Question 3 (b)

(b) State **one** benefit to Nina of using Gantt charts to monitor the project.

.....
..... [1]

Responses to this 1-mark question did not meet expectations. Many candidates gave statements about what a Gantt chart is, rather than a benefit of using a Gantt chart. Please see the published mark scheme for a list of suggested responses.

Question 3 (c) (i)

(c) Details of the activities in the implementation stage of the project are shown in **Table 1**, below.

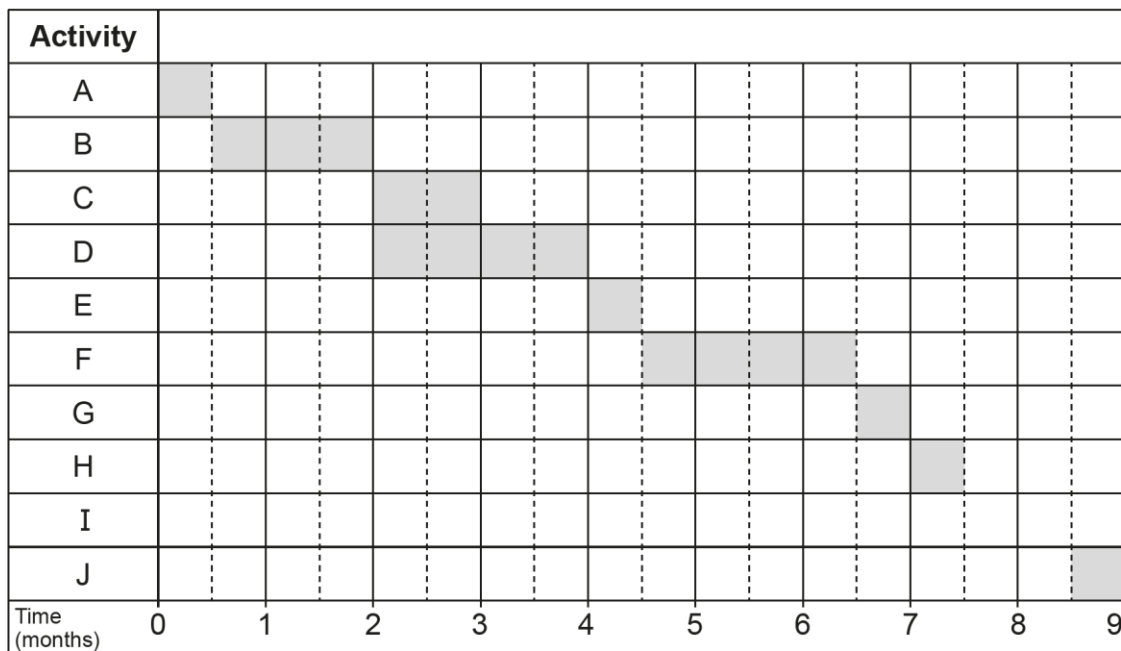
Table 1

Activity	Description	Dependent activities*	Duration of activity (months)
A	Kick-off meeting to agree parameters		0.5
B	Assess technical feasibility	A	1.5
C	Finalise functionality specifications	B	1
D	Negotiate with robotic suppliers	B	2
E	Select preferred robotic supplier and confirm order	C, D	0.5
F	Lead time for supply of three robots	E	2
G	Delivery, installation and commissioning of robots	F	0.5
H	On-the-job training of production technicians	G	0.5
I	Live testing of robots in GAIM, MMIM and RIM	H	1
J	Give feedback to supplier and confirm obligations	I	0.5

* **Finish to start dependency – activity to start when predecessor finishes.**

Nina has produced a Gantt chart for the implementation stage of the project, see **Fig. 2**, below.

Fig. 2



Key: = activity time = slack time

- (i) Complete the Gantt chart, **Fig. 2** on the previous page, by:
- shading in the activity time for 'Activity I: Live testing of robots in GAIM, MMIM and RIM'
 - shading in the slack time for 'Activity C: Finalise functionality specifications'.
- [2]**

This question tested candidates' ability to use a Gantt chart. Most candidates did well on this question and were given both marks. Occasionally no attempt was made to answer the question and the chart was left totally blank.

Question 3 (c) (ii)

- (ii) Nina thinks that 'Activity C: Finalise functionality specifications' is a critical activity. Explain whether Nina is correct.

.....

.....

.....

..... **[2]**

In Question 3(c)(i) candidates had been asked to shade in the slack time for Activity C. In this question they were asked whether Activity C is a critical activity. Activity C cannot be on the critical path because it has slack time. Examiners were looking for this understanding. Nina was wrong because Activity C has slack time. Very few candidates correctly identified that Nina was incorrect. Far fewer gained full marks for the reason.

Question 3 (c) (iii)

- (iii) Nina knows that depending on which supplier is chosen, the duration of 'Activity F: Lead time for supply of three robots' may need to be adjusted.

Calculate the minimum completion time for the implementation stage of the project if the duration of 'Activity F: Lead time for supply of three robots' needs to be increased to 5 months.

.....

.....

.....

..... [2]

Generally well answered. Most candidates identified that it would take three additional months. Those who added this to the current nine months' completion time gave the response of 12 months (1 year) and scored both marks.

By far the most common error from candidates who did not score both marks was the omission of the units, i.e. months. '12' gained a mark, but '12 months' gained 2 marks. '12' alone could not be given a mark as it could have related to '12 weeks' or '12 years', etc.

Assessment for learning



Candidates should be encouraged to always check that they have added the correct units to all numerical questions. Even candidates who know the correct units can forget to write them in the heat of the exam. A deliberate policy of checking is good exam technique in the same way that estimating the magnitude of a numerical response in advance of a calculation is good practice to check for decimal point/power of ten errors.

Question 3 (d)

(d) Nina is concerned about a number of factors that could significantly affect the outcome of the project.

In the table below, identify with a tick (✓) whether these factors are internal factors or external factors.

You should only place **one** tick in each row.

Factor	Internal factor	External factor
Nina's own lack of skills as a project manager		
Sykes Components Ltd's policies and procedures		
Market dynamics in the robotics industry		
The scope of the project		

[4]

Generally well answered with most candidates scoring full marks.

Question 3 (e)

(e) Identify **one** control technique that could help Nina keep the project on track.

.....
..... [1]

The most common correct responses related to holding frequent review meetings or receiving frequent reports. Please see the published mark scheme for other suggested responses.

Question 4 (a)

Text 4

Sykes Components Ltd's preferred robotic supplier is The Kaashawi Corporation in Japan. Nina had insisted that any purchase be subject to a free exchange if the model failed to deliver the required cost reductions during testing. The Kaashawi Corporation was the only supplier willing to agree to this requirement.

The Kaashawi Corporation has worked alongside Sykes Components Ltd's engineers to help them understand the capabilities of its range of robots. Sykes Components Ltd eventually chose model CH6P, a compact high-performance robot. The CH6P robot is capable of servicing the production cells at high speed across 6-axes, with a tolerance of less than 0.02 mm. The combined cost for three CH6P robots is £150 000. The purchase has been funded by debt finance.

The three CH6P robots are currently being tested.

4 Refer to Text 4.

(a) State what is meant by the term 'debt finance'.

.....
..... [1]

Candidates had a good understanding of what was meant by 'debt finance' with the most common responses referring to 'borrowing' or needing to 'pay back' the money.

Question 4 (b) (i)

(b) 'Activity I: Live testing of robots in GAIM, MMIM and RIM' is now complete. Cost data for before and after the introduction of the three robots is shown in the table below.

(i) Complete the '% reduction in average unit cost' column in the table below.
Give your answers correct to one decimal place.

Production process	Average unit cost of production <u>before</u> the introduction of robot CH6P	Average unit cost of production <u>after</u> the introduction of robot CH6P	% reduction in average unit cost (correct to 1 d.p.)
GAIM	2p	1.88p	
MMIM	16p	15.44p	
RIM	150p	148.50p	

[3]

Generally well answered by most candidates with the instruction to provide responses correct to one decimal place causing little issue. Of those candidates who did not score full marks the most common error was to give the response as a decimal (by forgetting to multiply by 100). Since the question clearly requested a percentage, these responses could not be awarded.

Question 4 (b) (ii)

- (ii) Produce a bar chart for Nina to include in the final project report. The bar chart should show the percentage cost reduction achieved for each of the three production processes.

You should draw, and fully label, your bar chart on the graph paper below. Use a scale that demonstrates the required degree of accuracy.



[3]

While most were able to draw bars of the correct height according to their responses to the previous question, a much smaller proportion accurately labelled the vertical axis. In addition there were numerous examples of what appeared to be carelessness in the labelling of the bars, either by using initials that did not match what the question was looking for, e.g. MMM instead of MMIM or labelling the incorrect bar, e.g. tallest bar labelled as RIM, when RIM should be the shortest bar.

Question 4 (c)

- (c) Project monitoring has revealed an adverse variance on the budget spend for the three robots.

Identify **two** economic factors that may have affected the outcomes of the project.

For each factor, explain how it may have contributed to this adverse variance.

Economic factor 1

Contribution to adverse variance

.....
.....
.....

Economic factor 2

Contribution to adverse variance

.....
.....
.....

[6]

To gain full marks candidates needed to name two economic factors, explain how these could lead to adverse cost variance, and do so contextually. Very few candidates were able to name two economic factors, many erroneously referred to legal or competitor factors. Please see the published mark scheme for a list of valid responses.

Those who could identify economic factors were generally also able to explain how they lead to an adverse cost variance, e.g., inflation means higher prices need to be paid, increasing cost. Very few answered in context. By context, examiners mean with specific reference to the text. An example would be inflation causes the price of the robots to increase ('robots' being the contextual reference). Another example would be interest rates increasing because they have borrowed £150,000 (£150,000 being the contextual reference).

Question 4 (d) (i)

(d) At project closure Nina intends to collect as much feedback as possible.

(i) Identify the types of feedback shown in the table below.

Show your answer by **circling** your choices.

You should only draw **one** circle in each row.

Feedback	Type of feedback	
Opinions of project board members	Objective	Subjective
Issue logs	Objective	Subjective
The reputation of Sykes Components Ltd as perceived by the UK Injection Moulding Society	Objective	Subjective

[3]

Generally well answered, with the majority of candidates scoring full marks. Of those that did not, the most common error seemed to be a complete reversal. This may indicate that these candidates have confused the meaning of the two terms, i.e., 'objective' and 'subjective'.

Assessment for learning



It is worth spending time checking that candidates' understanding of these terms is the correct way around, i.e., subjective based on opinion, objective based on measurable facts.

Similar pairs of terms worth checking include qualitative and quantitative, formal and informal, and optimistic and pessimistic (for PERT).

Question 4 (d) (ii)

- (ii) Identify **one** formal method which Nina could use to obtain feedback from the company's production technicians.

Explain **one** advantage to Nina of using this method.

Method

Advantage

.....

.....

.....

[3]

While identifying a formal method posed little problem to most candidates, suggesting an advantage of the method did. Examiners were looking for responses such as a meeting encourages detailed feedback, a questionnaire encourages targeted feedback dependant on the questions listed, or a written report provides feedback that can be referred back to in the future.

Question 4 (d) (iii)

- (iii) Identify **one** reason why it is important to review lessons learned at the end of a project.

.....
..... [1]

The final question on the paper was well answered, indicating that not only did candidates know the answer but they had managed their time appropriately throughout the examination.

The most common correct response related to avoiding similar mistakes on future projects.

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