## CIMA

## Performance Pillar

## P2 - Performance Management

## 23 May 2012 - Wednesday Afternoon Session

## Instructions to candidates

| You are allowed three hours to answer this question paper. |
| :--- |
| You are allowed 20 minutes reading time before the examination begins <br> during which you should read the question paper and, if you wish, make <br> annotations on the question paper. However, you will not be allowed, under <br> any circumstances, <br> calculator during this reading time answer book and start writing or use your |
| You are strongly advised to carefully read ALL the question requirements <br> before attempting the question concerned (that is all parts and/or sub- <br> questions). |
| ALL answers must be written in the answer book. Answers written on the <br> question paper will not be submitted for marking. |
| You should show all workings as marks are available for the method you use. |
| ALL QUESTIONS ARE ComPULSORY. |
| Section A comprises 5 questions and is on pages 2 to 6. |
| Section B comprises 2 questions and is on pages 8 to 11. |
| Maths tables and formulae are provided on pages 13 to 16. |
| The list of verbs as published in the syllabus is given for reference on page <br> 19. |
| Write your candidate number, the paper number and examination subject title <br> in the spaces provided on the front of the answer book. Also write your <br> contact ID and name in the space provided in the right hand margin and seal <br> to close. |

Tick the appropriate boxes on the front of the answer book to indicate which questions you have answered.


## SECTION A - 50 MARKS <br> [You are advised to spend no longer than 18 minutes on each question in this section.]

ANSWER ALL FIVE QUESTIONS IN THIS SECTION. EACH QUESTION IS WORTH 10 MARKS. YOU SHOULD SHOW YOUR WORKINGS AS MARKS ARE AVAILABLE FOR THE METHOD YOU USE.

## Question One

A company is developing a new product. During its expected life it is expected that 8,000 units of the product will be sold for $\$ 90$ per unit.

The direct material and other non-labour related costs will be \$45 per unit throughout the life of the product.

Production will be in batches of 1,000 units throughout the life of the product. The direct labour cost is expected to reduce due to the effects of learning for the first four batches produced. Thereafter the labour cost will remain at the same cost per batch as the $4^{\text {th }}$ batch. The direct labour cost of the first batch of 1,000 units is expected to be $\$ 40,000$ and a $90 \%$ learning effect is expected to occur.

There are no fixed costs that are specific to the product.

## Required:

(a)
(i) Calculate the average direct labour cost per batch of the first four batches.
(ii) Calculate the direct labour cost of the $4^{\text {th }}$ batch.
(iii) Calculate the contribution earned from the product over its lifetime.
(2 marks)
Note: The learning index for a $90 \%$ learning curve $=-0.152$

Due to the low lifetime product volume of 8,000 units the company now believes that learning may continue throughout its entire product life.
(b) Calculate the rate of learning required (to the nearest whole percentage) to achieve a lifetime product contribution target of $\$ 150,000$, assuming that a constant rate of learning applies throughout the product's life.
(4 marks)
(Total for Question One = 10 marks)

## Question Two

A small town with a population of 35,000 has a community library. The nearest alternative library is 15 miles away. A further 20,000 people live within a ten mile radius of the town. Of these, 5,000 people live nearer to the alternative library.

The library has 25,000 registered users and on average each of the registered users borrows two books and one DVD every week. The library has 125,000 books and 50,000 DVDs on its inventory lists, though this is constantly changing as old items are removed and new items are added.

The library offers a variety of types of book and DVD in order to attract interest from a large range of potential users, and for some of the more popular items it has more than one copy.

The library does not charge a fee to its users; it is funded by donations and by government. However it does need to measure its performance and is considering the use of a Balanced Scorecard.

## Required:

(a) Explain the key features of the Balanced Scorecard approach to performance measurement.
(4 marks)
(b) State TWO perspectives of the Balanced Scorecard and for EACH of these, recommend with reasons, ONE performance measure that could be used to measure the performance of the library.

## Question Three

A company has prepared the following summary from its functional budgets for the year ended 30th September 2013.

|  | \$000 | \$000 |
| :---: | :---: | :---: |
| Sales (100,000 units) |  | 1,500 |
| Opening inventory (zero units) | nil |  |
| Production costs (115,000 units): |  |  |
| Direct materials | 460 |  |
| Direct labour | 575 |  |
| Variable overhead | 115 |  |
| Fixed overhead | $\underline{230}$ |  |
|  | 1,380 |  |
| Closing inventory (15,000 units) | 180 |  |
| Cost of Sales |  | 1,200 |
| Gross Profit |  | 300 |
| Other overhead costs |  | $\underline{200}$ |
| Net Profit |  | 100 |

The directors of the company have now met to review the above statement. They have decided to revise the budget as follows:

- Due to competition, reduce the selling price by $\$ 5$ per unit and despite the reduction in selling price the demand for the product will reduce to 90,000 units.
- Increase some of the unit production costs: direct labour by 10\% and variable overhead by $5 \%$. No change is expected to any other costs.
- Reduce production to 100,000 units.


## Required:

(a) Prepare a summary statement (in the same format as that shown above) which clearly shows the effect of all of the changes proposed by the directors of the company.
(b) Discuss the motivational factors in involving functional managers in the setting of functional budgets.
(4 marks)
(Total for Question Three = 10 marks)

## Question Four

A company has predicted its sales demand for each of the four quarters of 2013 as follows:

| Quarter | 1 | 2 | 3 | 4 |
| :--- | :---: | :---: | :---: | :---: |
| Sales volume (units) | 100,000 | 110,000 | 190,000 | 140,000 |

The company has a normal production capacity of 135,000 units per quarter without needing to utilise any overtime working. However the capacity can be increased by up to $40 \%$ by working overtime.

It is current company policy to manufacture units using a constant level production system. This means that although the opening and closing levels of inventory for the year are zero units there are increases and decreases in the quarterly inventory levels. On this basis the selling price, variable production costs and contribution for 2013 are expected to be as follows:

## Selling price

> \$ per unit

| Direct materials | 30.00 |  |
| :--- | :--- | :--- |
| Direct labour | 35.00 |  |
| Variable production overhead | $\underline{10.00}$ | $\underline{75.00}$ |
|  |  | $\underline{15.00}$ |

However, any overtime working will increase the unit direct labour cost by $50 \%$ and the unit variable production overhead cost by $30 \%$ for those units produced during overtime working.

In addition, the company incurs a storage cost of \$4 per unit per quarter for each item that is held in inventory. These costs are not included in the production costs above.

The company is considering whether it should change to a just-in-time (JIT) production system, but is concerned that due to the fluctuating levels of its sales demand this may not be financially beneficial. If the company did change to a JIT production system:

- No inventory would be held.
- There would be no change in the behaviour of variable production costs.


## Required:

(a) Calculate the cost of holding inventory (based on average inventory levels in each of the quarters) for each of the quarters and the year in total under the current production system. Assume that sales occur evenly during each quarter.
(4 marks)
(b) Calculate the financial impact of changing to a JIT production system.
(6 marks)
(Total for Question Four = 10 marks)

## Question Five

A company uses "total cost plus" pricing. Recent results show that profits are falling and that the company is losing market share in what is becoming a very competitive market.

## Required:

(a) Explain TWO disadvantages of "total cost plus" pricing.
(b) Explain how target costing could be of benefit to the company.
(6 marks)
(Total for Question Five = 10 marks)

## End of Section A Section B starts on page 8

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SECTION B - 50 MARKS
[You are advised to spend no longer than 45 minutes on each question in this section.]

## ANSWER BOTH QUESTIONS IN THIS SECTION. EACH QUESTION IS WORTH 25 MARKS. YOU SHOULD SHOW YOUR WORKINGS AS MARKS ARE AVAILABLE FOR THE METHOD YOU USE.

## Question Six

WRX manufactures three products using different quantities of the same resources. Details of these products are as follows:

| Product | W <br> \$/unit | $R$ <br> $\$ /$ unit | X <br>  <br> Market selling price |
| :--- | ---: | ---: | ---: |
|  | 90 | 126 | 150 |
| Direct labour (\$7/hour) | 14 | 28 |  |
| Material A (\$3/kg) | 15 | 12 | 35 |
| Material B (\$6/kg) | 24 | 36 | 21 |
| Variable overhead (\$4/hour) | 8 | 16 | 30 |
| Fixed overhead | $\underline{12}$ | $\underline{73}$ | 20 |
|  | $\underline{99}$ | $\underline{12}$ | $\underline{118}$ |
| Profit | 17 | 27 | 32 |

The management of WRX has predicted the demand for these products for July as follows:

| Product W | 500 units |
| :--- | ---: |
| Product R | 800 units |
| Product X | 1,600 units |

These demand estimates do NOT include an order from a major customer to supply 400 units per month of each of the three products, at a discount of $\$ 10$ per unit from the market selling price.

During July the management of WRX anticipate that there will be a shortage of material $B$, and that only $17,500 \mathrm{kgs}$ will be available.

It is not possible for WRX to hold inventory of any raw materials, work in progress or finished products.

## Required:

(a) Prepare calculations to show the optimum product mix to maximise WRX's profit for July, assuming that the order with the major customer is supplied in full.
(7 marks)
WRX has now realised that the contract with the major customer does not have to be met in full for any of the three products. The customer will accept whatever WRX is prepared to supply at the contracted prices but they will charge a financial penalty if WRX does not supply them in full in July.
(b) Calculate the lowest value of the financial penalty that the major customer would need to insert in the contract to ensure that WRX meets its order in full in July.
(8 marks)
(c) Now that you have presented your answers to (a) and (b) above to the management team of WRX, the production manager has advised that, due to holidays, the number of direct labour hours available will be reduced to a total of 9,800 hours in July.

A decision has been made that WRX will fulfil its order with the major customer in full in July, and it has been agreed that a linear programming model will be used to determine the optimum usage of the resources that will be available after setting aside those required for the major customer's order.

Required:
(i) Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July.
(6 marks)
(ii) The optimal solution has been determined as:

> W 500 units
> R $\quad 0$ units
> X 880 units

Explain which of the constraints you stated in (c)(i) are binding on the solution. (You are not required to draw a graph.)
(Total for Question Six = 25 marks)

## Question Seven

The GHYD company comprises two divisions: GH and YD.
GH manufactures components using a specialised machine. It sells the same components both externally and to YD. The variable costs of producing the component are as follows:

|  | $\$ /$ unit |
| :--- | :--- |
| Direct materials | 25.00 |
| Direct labour | 35.00 |
| Variable overhead | $\underline{10.00}$ |
|  | $\underline{70.00}$ |

GH currently sells its components to the external market for $\$ 125$ per unit.
GH also sells 4,000 components per month to YD. These are transferred at the same price as the external selling price.

YD uses two of these components in each unit of its CX product. The current selling price of the CX product is $\$ 375$ per unit and at this selling price the demand for the CX is 2,000 units per month. The variable costs of producing a unit of CX are as follows:

|  | \$/unit |
| :--- | ---: |
| Direct materials | 35.00 |
| Components transferred from GH @ \$125 each | 250.00 |
| Direct labour | 15.00 |
| Variable overhead | 10.00 |

At this level of activity the total monthly contribution earned by YD from the sale of the CX product is $\$ 130,000$.

An analysis of the demand for the CX product indicates that for every $\$ 25$ increase in its selling price the monthly demand would reduce by 500 units, and that for every $\$ 25$ decrease in its selling price demand would increase by 500 units.

Note: If $\mathrm{P}=\mathrm{a}-\mathrm{bx}$ then $\mathrm{MR}=\mathrm{a}-2 \mathrm{bx}$

## Required:

(a)
(i) Calculate the selling price per unit of CX that would maximise the profits generated by that product for the YD division.
(ii) Calculate, based on the selling price you calculated in (a)(i) above, the monthly contribution that CX would generate for:

- GHYD as a whole
- GH division
- YD division

Note: Your answer should show three separate amounts.
(b) GHYD has now reviewed its transfer pricing policy and decided that all transfer prices should be set so as to lead to optimal decision making for the company as a whole. Assuming that the transfer price for the component is changed to reflect this new policy:
(i) Calculate the selling price per unit of CX that would maximise the profits earned by CX for the company as a whole. Note: you should assume that there is sufficient capacity within the company.
(ii) Calculate, based on the selling price you calculated in (b)(i) above, the monthly contribution that CX would generate for:

- GHYD as a whole
- GH division
- YD division

Note: Your answer should show three separate amounts.
(c) Discuss, using your answers to (a) and (b) above, the impact that alternative transfer prices have on the divisional profits of GH and YD and on the company as a whole.

## End of question paper

## Maths tables and formulae are on pages 13 to 16

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## PRESENT VALUE TABLE

Present value of 1 unit of currency, that is $(1+r)^{-n}$ where $r=$ interest rate; $n=$ number of periods until payment or receipt.

| Periods | Interest rates (r) |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ( $n$ ) | 1\% | 2\% | 3\% | 4\% | 5\% | 6\% | 7\% | 8\% | 9\% | 10\% |
| 1 | 0.990 | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 |
| 2 | 0.980 | 0.961 | 0.943 | 0.925 | 0.907 | 0.890 | 0.873 | 0.857 | 0.842 | 0.826 |
| 3 | 0.971 | 0.942 | 0.915 | 0.889 | 0.864 | 0.840 | 0.816 | 0.794 | 0.772 | 0.751 |
| 4 | 0.961 | 0.924 | 0.888 | 0.855 | 0.823 | 0.792 | 0.763 | 0.735 | 0.708 | 0.683 |
| 5 | 0.951 | 0.906 | 0.863 | 0.822 | 0.784 | 0.747 | 0.713 | 0.681 | 0.650 | 0.621 |
| 6 | 0.942 | 0.888 | 0.837 | 0.790 | 0.746 | 0705 | 0.666 | 0.630 | 0.596 | 0.564 |
| 7 | 0.933 | 0.871 | 0.813 | 0.760 | 0.711 | 0.665 | 0.623 | 0.583 | 0.547 | 0.513 |
| 8 | 0.923 | 0.853 | 0.789 | 0.731 | 0.677 | 0.627 | 0.582 | 0.540 | 0.502 | 0.467 |
| 9 | 0.914 | 0.837 | 0.766 | 0.703 | 0.645 | 0.592 | 0.544 | 0.500 | 0.460 | 0.424 |
| 10 | 0.905 | 0.820 | 0.744 | 0.676 | 0.614 | 0.558 | 0.508 | 0.463 | 0.422 | 0.386 |
| 11 | 0.896 | 0.804 | 0.722 | 0.650 | 0.585 | 0.527 | 0.475 | 0.429 | 0.388 | 0.350 |
| 12 | 0.887 | 0.788 | 0.701 | 0.625 | 0.557 | 0.497 | 0.444 | 0.397 | 0.356 | 0.319 |
| 13 | 0.879 | 0.773 | 0.681 | 0.601 | 0.530 | 0.469 | 0.415 | 0.368 | 0.326 | 0.290 |
| 14 | 0.870 | 0.758 | 0.661 | 0.577 | 0.505 | 0.442 | 0.388 | 0.340 | 0.299 | 0.263 |
| 15 | 0.861 | 0.743 | 0.642 | 0.555 | 0.481 | 0.417 | 0.362 | 0.315 | 0.275 | 0.239 |
| 16 | 0.853 | 0.728 | 0.623 | 0.534 | 0.458 | 0.394 | 0.339 | 0.292 | 0.252 | 0.218 |
| 17 | 0.844 | 0.714 | 0.605 | 0.513 | 0.436 | 0.371 | 0.317 | 0.270 | 0.231 | 0.198 |
| 18 | 0.836 | 0.700 | 0.587 | 0.494 | 0.416 | 0.350 | 0.296 | 0.250 | 0.212 | 0.180 |
| 19 | 0.828 | 0.686 | 0.570 | 0.475 | 0.396 | 0.331 | 0.277 | 0.232 | 0.194 | 0.164 |
| 20 | 0.820 | 0.673 | 0.554 | 0.456 | 0.377 | 0.312 | 0.258 | 0.215 | 0.178 | 0.149 |


| Periods |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | :---: | :---: |
| $(n)$ | Interest rates $(r)$ |  |  |  |  |  |  |  |  |  |  |  |
|  | $11 \%$ | $12 \%$ | $13 \%$ | $14 \%$ | $15 \%$ | $16 \%$ | $17 \%$ | $18 \%$ | $19 \%$ | $20 \%$ |  |  |
| 1 | 0.901 | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 |  |  |
| 2 | 0.812 | 0.797 | 0.783 | 0.769 | 0.756 | 0.743 | 0.731 | 0.718 | 0.706 | 0.694 |  |  |
| 3 | 0.731 | 0.712 | 0.693 | 0.675 | 0.658 | 0.641 | 0.624 | 0.609 | 0.593 | 0.579 |  |  |
| 4 | 0.659 | 0.636 | 0.613 | 0.592 | 0.572 | 0.552 | 0.534 | 0.516 | 0.499 | 0.482 |  |  |
| 5 | 0.593 | 0.567 | 0.543 | 0.519 | 0.497 | 0.476 | 0.456 | 0.437 | 0.419 | 0.402 |  |  |
| 6 | 0.535 | 0.507 | 0.480 | 0.456 | 0.432 | 0.410 | 0.390 | 0.370 | 0.352 | 0.335 |  |  |
| 7 | 0.482 | 0.452 | 0.425 | 0.400 | 0.376 | 0.354 | 0.333 | 0.314 | 0.296 | 0.279 |  |  |
| 8 | 0.434 | 0.404 | 0.376 | 0.351 | 0.327 | 0.305 | 0.285 | 0.266 | 0.249 | 0.233 |  |  |
| 9 | 0.391 | 0.361 | 0.333 | 0.308 | 0.284 | 0.263 | 0.243 | 0.225 | 0.209 | 0.194 |  |  |
| 10 | 0.352 | 0.322 | 0.295 | 0.270 | 0.247 | 0.227 | 0.208 | 0.191 | 0.176 | 0.162 |  |  |
| 11 | 0.317 | 0.287 | 0.261 | 0.237 | 0.215 | 0.195 | 0.178 | 0.162 | 0.148 | 0.135 |  |  |
| 12 | 0.286 | 0.257 | 0.231 | 0.208 | 0.187 | 0.168 | 0.152 | 0.137 | 0.124 | 0.112 |  |  |
| 13 | 0.258 | 0.229 | 0.204 | 0.182 | 0.163 | 0.145 | 0.130 | 0.116 | 0.104 | 0.093 |  |  |
| 14 | 0.232 | 0.205 | 0.181 | 0.160 | 0.141 | 0.125 | 0.111 | 0.099 | 0.088 | 0.078 |  |  |
| 15 | 0.209 | 0.183 | 0.160 | 0.140 | 0.123 | 0.108 | 0.095 | 0.084 | 0.079 | 0.065 |  |  |
| 16 | 0.188 | 0.163 | 0.141 | 0.123 | 0.107 | 0.093 | 0.081 | 0.071 | 0.062 | 0.054 |  |  |
| 17 | 0.170 | 0.146 | 0.125 | 0.108 | 0.093 | 0.080 | 0.069 | 0.060 | 0.052 | 0.045 |  |  |
| 18 | 0.153 | 0.130 | 0.111 | 0.095 | 0.081 | 0.069 | 0.059 | 0.051 | 0.044 | 0.038 |  |  |
| 19 | 0.138 | 0.116 | 0.098 | 0.083 | 0.070 | 0.060 | 0.051 | 0.043 | 0.037 | 0.031 |  |  |
| 20 | 0.124 | 0.104 | 0.087 | 0.073 | 0.061 | 0.051 | 0.043 | 0.037 | 0.031 | 0.026 |  |  |

## CUMULATIVE PRESENT VALUE TABLE

Cumulative present value of 1 unit of currency per annum, Receivable or Payable at the end of each year for $n$ years $\frac{1-(1+r)^{-n}}{r}$

| Periods <br> ( $n$ ) | Interest rates (r) |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1\% | 2\% | 3\% | 4\% | 5\% | 6\% | 7\% | 8\% | 9\% | 10\% |
| 1 | 0.990 | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 |
| 2 | 1.970 | 1.942 | 1.913 | 1.886 | 1.859 | 1.833 | 1.808 | 1.783 | 1.759 | 1.736 |
| 3 | 2.941 | 2.884 | 2.829 | 2.775 | 2.723 | 2.673 | 2.624 | 2.577 | 2.531 | 2.487 |
| 4 | 3.902 | 3.808 | 3.717 | 3.630 | 3.546 | 3.465 | 3.387 | 3.312 | 3.240 | 3.170 |
| 5 | 4.853 | 4.713 | 4.580 | 4.452 | 4.329 | 4.212 | 4.100 | 3.993 | 3.890 | 3.791 |
| 6 | 5.795 | 5.601 | 5.417 | 5.242 | 5.076 | 4.917 | 4.767 | 4.623 | 4.486 | 4.355 |
| 7 | 6.728 | 6.472 | 6.230 | 6.002 | 5.786 | 5.582 | 5.389 | 5.206 | 5.033 | 4.868 |
| 8 | 7.652 | 7.325 | 7.020 | 6.733 | 6.463 | 6.210 | 5.971 | 5.747 | 5.535 | 5.335 |
| 9 | 8.566 | 8.162 | 7.786 | 7.435 | 7.108 | 6.802 | 6.515 | 6.247 | 5.995 | 5.759 |
| 10 | 9.471 | 8.983 | 8.530 | 8.111 | 7.722 | 7.360 | 7.024 | 6.710 | 6.418 | 6.145 |
| 11 | 10.368 | 9.787 | 9.253 | 8.760 | 8.306 | 7.887 | 7.499 | 7.139 | 6.805 | 6.495 |
| 12 | 11.255 | 10.575 | 9.954 | 9.385 | 8.863 | 8.384 | 7.943 | 7.536 | 7.161 | 6.814 |
| 13 | 12.134 | 11.348 | 10.635 | 9.986 | 9.394 | 8.853 | 8.358 | 7.904 | 7.487 | 7.103 |
| 14 | 13.004 | 12.106 | 11.296 | 10.563 | 9.899 | 9.295 | 8.745 | 8.244 | 7.786 | 7.367 |
| 15 | 13.865 | 12.849 | 11.938 | 11.118 | 10.380 | 9.712 | 9.108 | 8.559 | 8.061 | 7.606 |
| 16 | 14.718 | 13.578 | 12.561 | 11.652 | 10.838 | 10.106 | 9.447 | 8.851 | 8.313 | 7.824 |
| 17 | 15.562 | 14.292 | 13.166 | 12.166 | 11.274 | 10.477 | 9.763 | 9.122 | 8.544 | 8.022 |
| 18 | 16.398 | 14.992 | 13.754 | 12.659 | 11.690 | 10.828 | 10.059 | 9.372 | 8.756 | 8.201 |
| 19 | 17.226 | 15.679 | 14.324 | 13.134 | 12.085 | 11.158 | 10.336 | 9.604 | 8.950 | 8.365 |
| 20 | 18.046 | 16.351 | 14.878 | 13.590 | 12.462 | 11.470 | 10.594 | 9.818 | 9.129 | 8.514 |


| Periods <br> $(n)$ | Interest rates $(r)$ |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $11 \%$ | $12 \%$ | $13 \%$ | $14 \%$ | $15 \%$ | $16 \%$ | $17 \%$ | $18 \%$ | $19 \%$ | $20 \%$ |
| 1 | 0.901 | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 |
| 2 | 1.713 | 1.690 | 1.668 | 1.647 | 1.626 | 1.605 | 1.585 | 1.566 | 1.547 | 1.528 |
| 3 | 2.444 | 2.402 | 2.361 | 2.322 | 2.283 | 2.246 | 2.210 | 2.174 | 2.140 | 2.106 |
| 4 | 3.102 | 3.037 | 2.974 | 2.914 | 2.855 | 2.798 | 2.743 | 2.690 | 2.639 | 2.589 |
| 5 | 3.696 | 3.605 | 3.517 | 3.433 | 3.352 | 3.274 | 3.199 | 3.127 | 3.058 | 2.991 |
| 6 | 4.231 | 4.111 | 3.998 | 3.889 | 3.784 | 3.685 | 3.589 | 3.498 | 3.410 | 3.326 |
| 7 | 4.712 | 4.564 | 4.423 | 4.288 | 4.160 | 4.039 | 3.922 | 3.812 | 3.706 | 3.605 |
| 8 | 5.146 | 4.968 | 4.799 | 4.639 | 4.487 | 4.344 | 4.207 | 4.078 | 3.954 | 3.837 |
| 9 | 5.537 | 5.328 | 5.132 | 4.946 | 4.772 | 4.607 | 4.451 | 4.303 | 4.163 | 4.031 |
| 10 | 5.889 | 5.650 | 5.426 | 5.216 | 5.019 | 4.833 | 4.659 | 4.494 | 4.339 | 4.192 |
| 11 | 6.207 | 5.938 | 5.687 | 5.453 | 5.234 | 5.029 | 4.836 | 4.656 | 4.486 | 4.327 |
| 12 | 6.492 | 6.194 | 5.918 | 5.660 | 5.421 | 5.197 | 4.988 | 7.793 | 4.611 | 4.439 |
| 13 | 6.750 | 6.424 | 6.122 | 5.842 | 5.583 | 5.342 | 5.118 | 4.910 | 4.715 | 4.533 |
| 14 | 6.982 | 6.628 | 6.302 | 6.002 | 5.724 | 5.468 | 5.229 | 5.008 | 4.802 | 4.611 |
| 15 | 7.191 | 6.811 | 6.462 | 6.142 | 5.847 | 5.575 | 5.324 | 5.092 | 4.876 | 4.675 |
| 16 | 7.379 | 6.974 | 6.604 | 6.265 | 5.954 | 5.668 | 5.405 | 5.162 | 4.938 | 4.730 |
| 17 | 7.549 | 7.120 | 6.729 | 6.373 | 6.047 | 5.749 | 5.475 | 5.222 | 4.990 | 4.775 |
| 18 | 7.702 | 7.250 | 6.840 | 6.467 | 6.128 | 5.818 | 5.534 | 5.273 | 5.033 | 4.812 |
| 19 | 7.839 | 7.366 | 6.938 | 6.550 | 6.198 | 5.877 | 5.584 | 5.316 | 5.070 | 4.843 |
| 20 | 7.963 | 7.469 | 7.025 | 6.623 | 6.259 | 5.929 | 5.628 | 5.353 | 5.101 | 4.870 |

## PROBABILITY

$A \cup B=A$ or $B . \quad A \cap B=\boldsymbol{A}$ and $\boldsymbol{B}$ (overlap).
$P(B \mid A)=$ probability of $B$, given $A$.

## Rules of Addition

If $A$ and $B$ are mutually exclusive:
If $A$ and $B$ are not mutually exclusive:

$$
\begin{aligned}
& P(A \cup B)=P(A)+P(B) \\
& P(A \cup B)=P(A)+P(B)-P(A \cap B)
\end{aligned}
$$

## Rules of Multiplication

If $A$ and $B$ are independent:

$$
\begin{aligned}
& P(A \cap B)=P(A) * P(B) \\
& P(A \cap B)=P(A) * P(B \mid A)
\end{aligned}
$$

If $A$ and $B$ are not independent:
$E(X)=\sum$ (probability * payoff)

## DESCRIPTIVE STATISTICS

Arithmetic Mean

$$
\bar{x}=\frac{\sum x}{n} \quad \bar{x}=\frac{\sum f x}{\sum f} \quad \text { (frequency distribution) }
$$

Standard Deviation

$$
S D=\sqrt{\frac{\sum(x-\bar{x})^{2}}{n}} \quad S D=\sqrt{\frac{\sum \mathrm{fx}^{2}}{\sum \mathrm{f}}-\overline{\mathrm{x}^{2}}} \text { (frequency distribution) }
$$

## INDEX NUMBERS

Price relative $=100 * P_{1} / P_{0} \quad$ Quantity relative $=100 * Q_{1} / Q_{0}$
Price: $\quad \frac{\sum w *\left(\frac{P_{1}}{P_{0}}\right)}{\sum w} \times 100$
Quantity: $\quad \frac{\sum w *\left(\frac{Q_{1}}{Q_{0}}\right)}{\sum w} \times 100$

## TIME SERIES

Additive Model
Series = Trend + Seasonal + Random

Multiplicative Model
Series = Trend * Seasonal * Random

## FINANCIAL MATHEMATICS

## Compound Interest (Values and Sums)

Future Value $S$, of a sum of $X$, invested for $n$ periods, compounded at $r \%$ interest

$$
S=X[1+r]^{n}
$$

## Annuity

Present value of an annuity of $£ 1$ per annum receivable or payable for $n$ years, commencing in one year, discounted at $r \%$ per annum:

$$
\mathrm{PV}=\frac{1}{r}\left[1-\frac{1}{[1+r]^{n}}\right]
$$

## Perpetuity

Present value of $£ 1$ per annum, payable or receivable in perpetuity, commencing in one year, discounted at $r \%$ per annum:

$$
\mathrm{PV}=\frac{1}{r}
$$

## LEARNING CURVE

$$
Y_{x}=a x^{b}
$$

where:
$Y_{X}=$ the cumulative average time per unit to produce $X$ units;
$a=$ the time required to produce the first unit of output;
$X=$ the cumulative number of units;
$b=$ the index of learning.
The exponent $b$ is defined as the log of the learning curve improvement rate divided by $\log 2$.

## INVENTORY MANAGEMENT

Economic Order Quantity

$$
\mathrm{EOQ}=\sqrt{\frac{2 \mathrm{C}_{0} \mathrm{D}}{\mathrm{C}_{\mathrm{h}}}}
$$

where: $\mathrm{C}_{0}=$ cost of placing an order
$C_{h}=$ cost of holding one unit in inventory for one year
D $\quad=\quad$ annual demand

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## LIST OF VERBS USED IN THE QUESTION REQUIREMENTS

A list of the learning objectives and verbs that appear in the syllabus and in the question requirements for each question in this paper.
It is important that you answer the question according to the definition of the verb.

| LEARNING OBJECTIVE | VERBS USED | DEFINITION |
| :---: | :---: | :---: |
| Level 1 - KNOWLEDGE |  |  |
| What you are expected to know. | List | Make a list of |
|  | State | Express, fully or clearly, the details/facts of |
|  | Define | Give the exact meaning of |
| Level 2 - COMPREHENSION |  |  |
| What you are expected to understand. | Describe | Communicate the key features |
|  | Distinguish | Highlight the differences between |
|  | Explain | Make clear or intelligible/State the meaning or purpose of |
|  | Identify | Recognise, establish or select after consideration |
|  | Illustrate | Use an example to describe or explain something |
| Level 3 - APPLICATION |  |  |
| How you are expected to apply your knowledge. | Apply | Put to practical use |
|  | Calculate | Ascertain or reckon mathematically |
|  | Demonstrate | Prove with certainty or to exhibit by practical means |
|  | Prepare | Make or get ready for use |
|  | Reconcile | Make or prove consistent/compatible |
|  | Solve | Find an answer to |
|  | Tabulate | Arrange in a table |
| Level 4 - ANALYSIS |  |  |
| How are you expected to analyse the detail of what you have learned. | Analyse | Examine in detail the structure of |
|  | Categorise | Place into a defined class or division |
|  | Compare and contrast | Show the similarities and/or differences between |
|  | Construct | Build up or compile |
|  | Discuss | Examine in detail by argument |
|  | Interpret | Translate into intelligible or familiar terms |
|  | Prioritise | Place in order of priority or sequence for action |
|  | Produce | Create or bring into existence |
| Level 5 - EVALUATION |  |  |
| How are you expected to use your learning to evaluate, make decisions or recommendations. | Advise | Counsel, inform or notify |
|  | Evaluate | Appraise or assess the value of |
|  | Recommend | Advise on a course of action |

## Performance Pillar

## Management Level Paper

P2 - Performance Management

## May 2012

## Wednesday Afternoon Session

