

Strategic Professional – Options

# Advanced Financial Management

Friday 7 September 2018



**Time allowed:** 3 hours 15 minutes

This question paper is divided into two sections:

Section A – This ONE question is compulsory and MUST be attempted

Section B – BOTH questions are compulsory and MUST be attempted

**Formulae and tables are on pages 10–14.**

**Do NOT open this question paper until instructed by the supervisor.**

**This question paper must not be removed from the examination hall.**

# Paper AFM

Think Ahead

**ACCA**

The Association of  
Chartered Certified  
Accountants

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The question paper begins on page 3.**

## Section A – This ONE question is compulsory and MUST be attempted

- 1 Washi Co is a large, unlisted company based in Japan and its local currency is the Japanese Yen (JPY). It manufactures industrial equipment and parts. Initially Washi Co's customers consisted of other Japanese companies, but over the last 12 years it has expanded into overseas markets and also sources its materials from around the world. The company's board of directors (BoD) believes that the strategy of overseas investments, through subsidiary companies, branches and joint ventures, has directly led to the company's substantial increase in value in the past few years.

Washi Co's BoD is considering investing in a project based in Airone, whose currency is the Airone Rand (ARD). It believes that the project will be an important addition to the company's portfolio of investments, because Washi Co does not currently have a significant presence in the part of the world where Airone is located. It is intended that the project will commence in one year's time. Details of the project are given below.

Washi Co intends to finance the project through proceeds from an agreed sale of a small European subsidiary, with any remaining funding requirement being met by additional debt finance issued in Japanese Yen. The company is due to receive the proceeds from the sale of a European subsidiary company in six months' time and it will then invest these funds in short-dated Japanese treasury bills for a further six months before they are needed for the project. Washi Co has a centralised treasury department, which hedges expected future cash flows against currency fluctuations.

### Funding and financial information

The agreed proceeds from the sale of the European subsidiary company receivable in six months' time are Euro (EUR) 80 million. The BoD is concerned about a negative fluctuation in EUR/JPY rate between now and in six months when the EUR 80 million will be received. Therefore, it has asked Washi Co's treasury department to hedge the expected receipt using one of currency forwards, currency futures or exchange traded currency options. Washi Co's treasury department has obtained the following information:

	JPY per EUR 1	ARD per EUR 1
Spot	129.2–132.4	92.7–95.6
Six-month forward rate	125.3–128.6	

### Currency futures (contract size EUR 125,000, quotation JPY per EUR 1)

Four-month expiry	126.9
Seven-month expiry	125.2

### Currency options (contract size EUR 125,000, exercise price quotation: JPY per EUR 1, premium quotation: JPY per EUR 1)

At an exercise price of JPY 126.0 per EUR 1

	Four-month expiry	Seven-month expiry
Calls	2.3	2.6
Puts	3.4	3.8

Annualised yield on short-dated Japanese treasury bills 1.20%

Airone's annual inflation rate is 9% currently, but has fluctuated markedly in the last five years. The Japanese annual inflation rate is 1.5% and has been stable for many years.

Pato Bank has offered Washi Co the possibility of using over-the-counter options to hedge the EUR receipt instead of exchange traded currency options.

### Airone project information

A member of Washi Co's finance team has produced the following estimates of the Airone project which is expected to last for four years. The estimates are based on the notes given below but not on the further information. The estimates have been checked and verified independently for their numerical accuracy.

All figures are in ARD millions

Project year	0	1	2	3	4
Sales revenue		13,000	30,800	32,300	4,500
Costs		(10,200)	(24,200)	(24,500)	(3,200)
Tax allowable depreciation		(1,000)	(1,000)	(1,000)	(1,000)
Pre-tax profits		1,800	5,600	6,800	300
Tax at 15%		(270)	(840)	(1,020)	(45)
Tax allowable depreciation		1,000	1,000	1,000	1,000
Working capital	(400)				400
Investment in buildings	(5,750)				
Investment in machinery	(4,000)				
Cash flows in ARD	(10,150)	2,530	5,760	6,780	1,655

**Notes (incorporated into the estimates above):**

1. The estimates are based on using the end of the first year, when the project commences, as the start of the project (year 0). The numbers are given in ARD million (m).
2. The total investment required for the project is ARD 10,150m and separated into buildings, machinery and working capital in the table above. The machinery is eligible for tax allowable depreciation on a straight-line basis and the working capital is redeemable at the end of the project.
3. The impact of inflation has been incorporated into the sales revenue and cost figures, at Airone's current annual inflation figures.
4. Corporation tax has been included based on Airone's annual rate of 15%. The tax is payable in the year that the tax liability arises.

**Further information (not incorporated into the estimates above):**

1. Undertaking the Airone project will result in lost sales for Washi Co. These sales would have generated a pre-tax contribution of JPY 110m in the first year of the project, rising by the Japanese rate of inflation in the following years 2 to 4 of the project.
2. The Airone project costs include components which are made in Japan by Washi Co and would be imported to the Airone project. The pre-inflation revenues generated from the sale of the components are estimated to be as follows:

In JPY millions

Project year	1	2	3	4
Components revenue	1,200	2,400	2,500	300

These revenues are expected to increase by the Japanese inflation rate in years 2 to 4 of the project. The contribution which Washi Co expects to earn on these components is 25% of revenue.

3. The Japanese annual corporation tax rate is 30% and tax is payable in the year that the tax liability arises. A bilateral tax treaty exists between Japan and Airone, which permits offset of overseas tax against any Japanese tax liability on overseas earnings.
4. Washi Co's finance department has estimated a cost of capital of 12% to be used as a discount rate for the project.

**Required:**

- (a) Discuss how investing in overseas projects may enable Washi Co to gain competitive advantage over its competitors, who only invest in domestic projects. (5 marks)
- (b) Discuss the advantages and drawbacks of exchange traded option contracts compared with over-the-counter options. (5 marks)
- (c) Prepare a report for the board of directors of Washi Co which:
- (i) Estimates the expected amount of JPY receivable under each hedge choice and the additional debt finance needed to fund the Airone project for the preferred hedge choice; (12 marks)
  - (ii) Estimates the net present value of the Airone project in Japanese Yen, based on the end of year one being the start of the project (year 0); (9 marks)
  - (iii) Evaluates the preferred hedge choice made, the debt finance needed and whether the Airone project should be undertaken, considering both financial and non-financial factors. (8 marks)

Professional marks will be awarded in part (c) for the format, structure and presentation of the report. (4 marks)

- (d) Washi Co's chief operations officer (COO) has suggested that it would be more beneficial for the company to let its major subsidiary companies have their own individual treasury departments, instead of having one centralised treasury department for the whole company.

**Required:**

**Discuss the validity of the COO's suggestion.** (7 marks)

**(50 marks)**

## Section B – BOTH questions are compulsory and MUST be attempted

### 2 Tillinton Co

Tillinton Co is a listed company which has traditionally manufactured children's clothing and toys with long lives. Five years ago, it began manufacturing electronic toys and has since made significant investment in development and production facilities. The first electronic toys which Tillinton Co introduced into the market were received very well, partly as it was seen to be ahead of its competitors in making the most of the technology available.

The country where Tillinton Co is listed has seen a significant general increase in share prices over the last three years, with companies in the electronic goods sector showing particularly rapid increases.

#### Statement by Tillinton Co's chief executive

Assume it is now September 20X3. Tillinton Co's annual report for the year ended 31 March 20X3 has just been published. Its chief executive commented when announcing the company's results:

'I am very pleased to report that revenue and gross profits have shown bigger increases than in 20X2, resulting in higher post-tax earnings and our company being able to maintain increases in dividends. The sustained increase in our share price clearly demonstrates how happy investors are with us. Our cutting-edge electronic toys continue to perform well and justify our sustained investment in them. Our results have also benefited from improvements in operational efficiencies for our older ranges and better working capital management. We are considering the development of further ranges of electronic toys for children, or developing other electronic products for adults. If necessary, we may consider scaling down or selling off our operations for some of our older products.'

Steph Slindon represents an institutional investor who holds shares in Tillinton Co. Steph is doubtful whether its share price will continue to increase, because she thinks that Tillinton Co's situation may not be as good as its chief executive suggests and because she believes that current share price levels generally may not be sustainable.

#### Financial information

Extracts from Tillinton Co's financial statements for the last three years and other information about it are given below.

#### Tillinton Co statement of profit or loss in years ending 31 March (all amounts in \$m)

	20X1	20X2	20X3
Sales revenue	1,385	1,636	1,914
Gross profit	381	451	528
Operating profit	205	252	300
Finance costs	(46)	(50)	(66)
Profit before tax	159	202	234
Taxation	(40)	(51)	(65)
Profit after tax	119	151	169
Dividends	(60)	(72)	(84)

**Tillinton Co statement of financial position in years ending 31 March  
(all amounts in \$m)**

	20X1	20X2	20X3
Non-current assets	2,070	2,235	2,449
Cash and cash equivalents	10	15	15
Other current assets	150	130	125
<b>Total non-current and current assets</b>	<u>2,230</u>	<u>2,380</u>	<u>2,589</u>
<b>Equity</b>			
Ordinary shares (\$0.50)	400	400	400
Reserves	805	884	969
<b>Total equity</b>	<u>1,205</u>	<u>1,284</u>	<u>1,369</u>
<b>Non-current liabilities</b>	920	970	1,000
<b>Current liabilities</b>	105	126	220
<b>Total equity and liabilities</b>	<u>2,230</u>	<u>2,380</u>	<u>2,589</u>
<b>Other information</b>			
Market price per \$0.50 share (in \$, \$2.50 at 31 March 20X0, \$5.06 in September 20X3)	2.76	3.49	4.44
Earnings per share (\$)	0.15	0.19	0.21
Dividend per share (\$)	0.075	0.09	0.105
<b>Analysis of revenue</b>			
Electronic toys	249	319	390
Non-electronic toys	302	350	404
Clothing	834	967	1,120
	<u>1,385</u>	<u>1,636</u>	<u>1,914</u>
<b>Analysis of gross profit</b>			
Electronic toys	100	112	113
Non-electronic toys	72	88	105
Clothing	209	251	310
	<u>381</u>	<u>451</u>	<u>528</u>

**Note:** None of Tillinton Co's loan finance in 20X3 is repayable within one year.

**Required:**

- (a) Evaluate Tillinton Co's performance and business prospects in the light of the chief executive's comments and Steph Slindon's concerns. Provide relevant calculations for ratios and trends to support your evaluation.**

Note: 10 marks are available for the calculations.

(20 marks)

- (b) Discuss how behavioural factors may have resulted in Tillinton Co's share price being higher than is warranted by a rational analysis of its position.**

(5 marks)

**(25 marks)**

### **3 Selorne Co**

Selorne Co is one of the biggest removal companies in Pauland, offering home and business removals. It has a number of long-term contracts with large businesses, although it has not won any new major contracts in the last two years. Selorne Co is listed on Pauland's stock market for smaller companies. Selorne Co is financed by a mixture of equity and short and long-term debt, but its gearing level is below the average for its sector.

Selorne Co has four executive directors, who each own 20% of the company's share capital, with the other 20% owned by external shareholders. Selorne Co has paid a constant dividend since it has been listed and its share price has risen slightly over the last three years.

Selorne Co is based in a number of the large cities and towns in Pauland and owns the majority of the sites where it is located. Many of its employees have worked for the company for a long time. Drivers of the lorries used by Selorne Co are required to have a special, heavy vehicles licence. Salary levels at Selorne Co are relatively high compared with other companies in the sector.

#### **Chawon Co**

Selorne Co is currently considering making a bid for Chawon Co, an unlisted company specialising in distribution and delivery services. Chawon Co is owned 100% by its founder, Chris Chawon. Chawon Co has built up a portfolio of small contracts over time. It has made unsuccessful bids for two larger contracts over the last 12 months, the bids being rejected primarily because Chawon Co was not felt to be big enough to be able to guarantee the level of service required.

Chawon Co is based in many of the same cities and towns where Selorne Co is located, although Chawon's premises are all rented. The drivers of Chawon's vehicles do not require a heavy vehicles licence. Chawon Co has a few long-serving employees who are mostly centre managers. Most of its drivers and staff, however, stay at Chawon Co for only a short time. Salary levels are low, although Chawon Co pays high levels of overtime and high bonuses if target profit levels are achieved. Chawon Co is highly geared, leading to recent media speculation about its financial viability.

#### **Terms of bid for Chawon Co**

In initial discussions about the acquisition, Chris Chawon indicated that he would prefer the consideration to be a share-for-share exchange, the terms being one Chawon Co share for five Selorne Co shares.

Chawon Co has 2 million \$1 shares in issue, and Selorne Co has 50 million \$0.50 shares in issue. Each Selorne Co share is currently trading at \$6.50, which is a multiple of 8 of its free cash flow to equity. The multiple of 8 can be assumed to remain unchanged if the acquisition takes place. Chawon Co's free cash flow to equity is currently estimated at \$7 million, with an expected annual growth rate of 3%, and it is expected to generate a return on equity of 15%.

Chris Chawon expects that the total free cash flows to equity of the combined company will increase by \$5 million due to synergy benefits. He believes that Selorne Co will be able to win more contracts because it is larger and because it will be diversifying the services which it offers. He also believes that significant operational synergies can be achieved, pointing out the time Selorne Co drivers spend idle during the winter months when removal activity is traditionally lower. Chris Chawon believes that he can achieve the synergies if he is given management responsibility for the operational reorganisation, including dealing with the staff employment and retention issues. Chris Chawon thinks that synergies could also be achieved in central administration and in premises costs.

The chief executive and the finance director of Selorne Co are in favour of bidding for Chawon Co. However, one of the other executive directors is opposed to the bid. He is sceptical about the level of synergies which can be achieved and does not want Chris Chawon to be brought into the management of Selorne Co. He suggests that if the bid is to go ahead, it should be a cash offer rather than a share exchange. Selorne Co's chief executive has responded that Chris Chawon is likely to ask for a higher equivalent price if the purchase is for cash.

#### **Financing the bid for Chawon Co**

Selorne Co's finance director has pointed out that Selorne Co will need additional funding if Chawon Co is purchased for cash. He has suggested that there may be a number of possible sources of finance:

- A rights issue
- A fixed rate, long-term, bank loan
- A three-year, unsecured, mezzanine loan facility
- Convertible debt, with conversion rights being exercisable in five years' time

**Required:**

- (a) (i) Estimate the equity value of the combined company and the expected additional value arising from the combination of Selorne Co and Chawon Co. (6 marks)
- (ii) Estimate the share of the gain from the combination created for Chris Chawon and the share of the gain created for Selorne Co's shareholders and comment on your results. (6 marks)
- (b) Evaluate how reliable the estimates of the synergies for the combined company are likely to be and discuss the factors which may prevent the forecast synergies from being achieved. (7 marks)
- (c) Discuss the factors which Selorne Co's board will consider when determining which source or sources of finance are chosen to finance a possible cash bid for the share capital of Chawon Co. (6 marks)

**(25 marks)**

## Formulae

### Modigliani and Miller Proposition 2 (with tax)

$$k_e = k_e^i + (1 - T)(k_e^i - k_d) \frac{V_d}{V_e}$$

### The Capital Asset Pricing Model

$$E(r_i) = R_f + \beta_i(E(r_m) - R_f)$$

### The asset beta formula

$$\beta_a = \left[ \frac{V_e}{(V_e + V_d(1 - T))} \beta_e \right] + \left[ \frac{V_d(1 - T)}{(V_e + V_d(1 - T))} \beta_d \right]$$

### The Growth Model

$$P_0 = \frac{D_0(1 + g)}{(r_e - g)}$$

### Gordon's growth approximation

$$g = br_e$$

### The weighted average cost of capital

$$WACC = \left[ \frac{V_e}{V_e + V_d} \right] k_e + \left[ \frac{V_d}{V_e + V_d} \right] k_d(1 - T)$$

### The Fisher formula

$$(1 + i) = (1 + r)(1 + h)$$

### Purchasing power parity and interest rate parity

$$S_1 = S_0 \times \frac{(1 + h_c)}{(1 + h_b)} \qquad F_0 = S_0 \times \frac{(1 + i_c)}{(1 + i_b)}$$

### Modified Internal Rate of Return

$$MIRR = \left[ \frac{PV_R}{PV_I} \right]^{\frac{1}{n}} (1 + r_e) - 1$$

### The Black-Scholes option pricing model

$$c = P_a N(d_1) - P_e N(d_2) e^{-rt}$$

Where:

$$d_1 = \frac{\ln(P_a / P_e) + (r + 0.5s^2)t}{s\sqrt{t}}$$

$$d_2 = d_1 - s\sqrt{t}$$

### The Put Call Parity relationship

$$p = c - P_a + P_e e^{-rt}$$

### Present Value Table

Present value of 1 i.e.  $(1 + r)^{-n}$

Where  $r$  = discount rate  
 $n$  = number of periods until payment

		<i>Discount rate (r)</i>										
<i>Periods</i>		1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
<b>(n)</b>		<b>1%</b>	<b>2%</b>	<b>3%</b>	<b>4%</b>	<b>5%</b>	<b>6%</b>	<b>7%</b>	<b>8%</b>	<b>9%</b>	<b>10%</b>	
1		0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	1
2		0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	2
3		0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	3
4		0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	4
5		0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	5
6		0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564	6
7		0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	7
8		0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	8
9		0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	9
10		0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	10
11		0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350	11
12		0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319	12
13		0.879	0.773	0.681	0.601	0.530	0.469	0.415	0.368	0.326	0.290	13
14		0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0.299	0.263	14
15		0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239	15
<b>(n)</b>		<b>11%</b>	<b>12%</b>	<b>13%</b>	<b>14%</b>	<b>15%</b>	<b>16%</b>	<b>17%</b>	<b>18%</b>	<b>19%</b>	<b>20%</b>	
1		0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	1
2		0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694	2
3		0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579	3
4		0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482	4
5		0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402	5
6		0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335	6
7		0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279	7
8		0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233	8
9		0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194	9
10		0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162	10
11		0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135	11
12		0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112	12
13		0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093	13
14		0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078	14
15		0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065	15

### Annuity Table

Present value of an annuity of 1 i.e.  $\frac{1 - (1 + r)^{-n}}{r}$

Where  $r$  = discount rate  
 $n$  = number of periods

		<i>Discount rate (r)</i>										
<i>Periods</i>		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	1	
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	2	
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	3	
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	4	
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	5	
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	6	
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	7	
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	8	
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	9	
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	10	
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	11	
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	12	
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	13	
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	14	
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	15	
<i>(n)</i>	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	1	
2	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	2	
3	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	3	
4	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	4	
5	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	5	
6	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	6	
7	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	7	
8	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	8	
9	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	9	
10	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192	10	
11	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	11	
12	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	12	
13	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	13	
14	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	14	
15	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	15	

**Standard normal distribution table**

	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
0·0	0·0000	0·0040	0·0080	0·0120	0·0160	0·0199	0·0239	0·0279	0·0319	0·0359
0·1	0·0398	0·0438	0·0478	0·0517	0·0557	0·0596	0·0636	0·0675	0·0714	0·0753
0·2	0·0793	0·0832	0·0871	0·0910	0·0948	0·0987	0·1026	0·1064	0·1103	0·1141
0·3	0·1179	0·1217	0·1255	0·1293	0·1331	0·1368	0·1406	0·1443	0·1480	0·1517
0·4	0·1554	0·1591	0·1628	0·1664	0·1700	0·1736	0·1772	0·1808	0·1844	0·1879
0·5	0·1915	0·1950	0·1985	0·2019	0·2054	0·2088	0·2123	0·2157	0·2190	0·2224
0·6	0·2257	0·2291	0·2324	0·2357	0·2389	0·2422	0·2454	0·2486	0·2517	0·2549
0·7	0·2580	0·2611	0·2642	0·2673	0·2704	0·2734	0·2764	0·2794	0·2823	0·2852
0·8	0·2881	0·2910	0·2939	0·2967	0·2995	0·3023	0·3051	0·3078	0·3106	0·3133
0·9	0·3159	0·3186	0·3212	0·3238	0·3264	0·3289	0·3315	0·3340	0·3365	0·3389
1·0	0·3413	0·3438	0·3461	0·3485	0·3508	0·3531	0·3554	0·3577	0·3599	0·3621
1·1	0·3643	0·3665	0·3686	0·3708	0·3729	0·3749	0·3770	0·3790	0·3810	0·3830
1·2	0·3849	0·3869	0·3888	0·3907	0·3925	0·3944	0·3962	0·3980	0·3997	0·4015
1·3	0·4032	0·4049	0·4066	0·4082	0·4099	0·4115	0·4131	0·4147	0·4162	0·4177
1·4	0·4192	0·4207	0·4222	0·4236	0·4251	0·4265	0·4279	0·4292	0·4306	0·4319
1·5	0·4332	0·4345	0·4357	0·4370	0·4382	0·4394	0·4406	0·4418	0·4429	0·4441
1·6	0·4452	0·4463	0·4474	0·4484	0·4495	0·4505	0·4515	0·4525	0·4535	0·4545
1·7	0·4554	0·4564	0·4573	0·4582	0·4591	0·4599	0·4608	0·4616	0·4625	0·4633
1·8	0·4641	0·4649	0·4656	0·4664	0·4671	0·4678	0·4686	0·4693	0·4699	0·4706
1·9	0·4713	0·4719	0·4726	0·4732	0·4738	0·4744	0·4750	0·4756	0·4761	0·4767
2·0	0·4772	0·4778	0·4783	0·4788	0·4793	0·4798	0·4803	0·4808	0·4812	0·4817
2·1	0·4821	0·4826	0·4830	0·4834	0·4838	0·4842	0·4846	0·4850	0·4854	0·4857
2·2	0·4861	0·4864	0·4868	0·4871	0·4875	0·4878	0·4881	0·4884	0·4887	0·4890
2·3	0·4893	0·4896	0·4898	0·4901	0·4904	0·4906	0·4909	0·4911	0·4913	0·4916
2·4	0·4918	0·4920	0·4922	0·4925	0·4927	0·4929	0·4931	0·4932	0·4934	0·4936
2·5	0·4938	0·4940	0·4941	0·4943	0·4945	0·4946	0·4948	0·4949	0·4951	0·4952
2·6	0·4953	0·4955	0·4956	0·4957	0·4959	0·4960	0·4961	0·4962	0·4963	0·4964
2·7	0·4965	0·4966	0·4967	0·4968	0·4969	0·4970	0·4971	0·4972	0·4973	0·4974
2·8	0·4974	0·4975	0·4976	0·4977	0·4977	0·4978	0·4979	0·4979	0·4980	0·4981
2·9	0·4981	0·4982	0·4982	0·4983	0·4984	0·4984	0·4985	0·4985	0·4986	0·4986
3·0	0·4987	0·4987	0·4987	0·4988	0·4988	0·4989	0·4989	0·4989	0·4990	0·4990

This table can be used to calculate  $N(d)$ , the cumulative normal distribution functions needed for the Black-Scholes model of option pricing. If  $d_i > 0$ , add 0·5 to the relevant number above. If  $d_i < 0$ , subtract the relevant number above from 0·5.

**End of Question Paper**