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The question paper begins on page 3.**

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

1 The eight-member board of executive directors (BoD) of Chrysos Co, a large private, unlisted company, is considering the company’s long-term business and financial future. The BoD is considering whether or not to undertake a restructuring programme. This will be followed a few years later by undertaking a reverse takeover to obtain a listing on the stock exchange in order to raise new finance. However, a few members of the BoD have raised doubts about the restructuring programme and the reverse takeover, not least the impact upon the company’s stakeholders. Some directors are of the opinion that an initial public offering (IPO) would be a better option when obtaining a listing compared to a reverse takeover.

Chrysos Co was formed about 15 years ago by a team of five senior equity holders who are part of the BoD and own 40% of the equity share capital in total; 30 other equity holders own a further 40% of the equity share capital but are not part of the BoD; and a consortium of venture capital organisations (VCOs) own the remaining 20% of the equity share capital and have three representatives on the BoD. The VCOs have also lent Chrysos Co substantial debt finance in the form of unsecured bonds due to be redeemed in 10 years’ time. In addition to the BoD, Chrysos Co also has a non-executive supervisory board consisting of members of Chrysos Co’s key stakeholder groups. Details of the supervisory board are given below.

Chrysos Co has two business units: a mining and shipping business unit, and a machinery parts manufacturing business unit. The mining and shipping business unit accounts for around 80% of Chrysos Co’s business in terms of sales revenue, non-current and current assets, and payables. However, it is estimated that this business unit accounts for around 75% of the company’s operating costs. The smaller machinery parts manufacturing business unit accounts for the remaining 20% of sales revenue, non-current and current assets, and payables; and around 25% of the company’s operating costs.

The following figures have been extracted from Chrysos Co’s most recent financial statements:

**Profit before depreciation, interest and tax for the year to 28 February 2017**

	<b>\$m</b>
Sales revenue	16,800
Operating costs	(10,080)
Profit before depreciation, interest and tax	<u>6,720</u>

**Financial position as at 28 February 2017**

	<b>\$m</b>
<b>Non-current assets</b>	
Land and buildings	7,500
Equipment	5,400
<b>Current assets</b>	
Inventory	1,800
Receivables	900
<b>Total assets</b>	<u>15,600</u>
<b>Equity</b>	
Share capital (\$1 par value per share)	1,800
Reserves	5,400
<b>Non-current liabilities</b>	
4.50% unsecured bonds 2026 (from the VCOs)	4,800
Other debt	1,050
<b>Current liabilities</b>	
Payables	750
Bank overdraft	1,800
<b>Total equity and liabilities</b>	<u>15,600</u>

**Corporate restructuring programme**

The purpose of the restructuring programme is to simplify the company's gearing structure and to obtain extra funding to expand the mining and shipping business in the future. At present, Chrysos Co is having difficulty obtaining additional funding without having to pay high interest rates.

**Machinery parts manufacturing business unit**

The smaller machinery parts manufacturing business unit will be unbundled either by having its assets sold to a local supplier for \$3,102 million after its share of payables have been paid; or

The smaller machinery parts manufacturing business unit will be unbundled through a management buy-out by four managers. In this case, it is estimated that its after-tax net cash flows will increase by 8% in the first year only and then stay fixed at this level for the foreseeable future. The cost of capital related to the smaller business unit is estimated to be 10%. The management buy-out team will pay Chrysos Co 70% of the estimated market value of the smaller machinery parts manufacturing business unit.

**Mining and shipping business unit**

Following the unbundling of the smaller machinery parts manufacturing business unit, Chrysos Co will focus solely on the mining and shipping business unit, prior to undertaking the reverse takeover some years into the future.

As part of the restructuring programme, the existing unsecured bonds lent by the VCOs will be cancelled and replaced by an additional 600 million \$1 shares for the VCOs. The VCOs will pay \$400 million for these shares. The bank overdraft will be converted into a 15-year loan on which Chrysos Co will pay a fixed annual interest of 4.50%. The other debt under non-current liabilities will be repaid. In addition to this, Chrysos Co will invest \$1,200 million into equipment for its mining and shipping business unit and this will result in its profits and cash flows growing by 4% per year in perpetuity.

**Additional financial information**

Chrysos Co aims to maintain a long-term capital structure of 20% debt and 80% equity in market value terms. Chrysos Co's finance director has assessed that the 4.50% annual interest it will pay on its bank loan is a reasonable estimate of its long-term cost of debt, based on the long-term capital structure above.

Although Chrysos Co does not know what its cost of capital is for the mining and shipping business unit, its finance director has determined that the current ungeared cost of equity of Sidero Co, a large quoted mining and shipping company, is 12.46%. Chrysos Co's finance director wants to use Sidero Co's ungeared cost of equity to calculate its cost of capital for the mining and shipping business unit.

The annual corporation tax rate on profits applicable to all companies is 18% and it can be assumed that tax is payable in the year incurred. All the non-current assets are eligible for tax allowable depreciation of 12% annually on the book values. The annual reinvestment needed to keep operations at their current levels is equivalent to the tax allowable depreciation.

**Details of the supervisory board**

The non-executive supervisory board provides an extra layer of governance over the BoD. It consists of representatives from the company's internal stakeholder groups including the finance providers, employees and the company's management. It ensures that the actions taken by the BoD are for the benefit of all the stakeholder groups and to the company as a whole. Any issues raised in board meetings are resolved through negotiation until an agreed position is reached.

**Required:**

(a) Explain what a reverse takeover involves and discuss the relative advantages and disadvantages to a company, such as Chrysos Co, of obtaining a listing through a reverse takeover as opposed to an initial public offering (IPO). (9 marks)

(b) Prepare a report for the board of directors of Chrysos Co which includes:

(i) An extract of the financial position and an estimate of Chrysos Co's value to the equity holders, after undertaking the restructuring programme. (18 marks)

(ii) An explanation of the approach taken and assumptions made in estimating Chrysos Co's value to the equity holders, after undertaking the restructuring programme. (5 marks)

(iii) A discussion of the impact of the restructuring programme on Chrysos Co and on the venture capital organisations. (10 marks)

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

(c) Discuss why the attention Chrysos Co pays to its stakeholders represented on the supervisory board may change once it has obtained a listing. (4 marks)

**(50 marks)**

## Section B – TWO questions ONLY to be attempted

- 2 Bournelorth Co is an IT company which was established by three friends ten years ago. It was listed on a local stock exchange for smaller companies nine months ago.

Bournelorth Co originally provided support to businesses in the financial services sector. It has been able to expand into other sectors over time due to the excellent services it has provided and the high quality staff whom its founders recruited. The founders have been happy with the level of profits which the IT services have generated. Over time they have increasingly left the supervision of the IT services in the hands of experienced managers and focused on developing diagnostic applications (apps). The founders have worked fairly independently of each other on development work. Each has a small team of staff and all three want their teams to work in an informal environment which they believe enhances creativity.

Two apps which Bournelorth Co developed were very successful and generated significant profits. The founders wanted the company to invest much more in developing diagnostic apps. Previously they had preferred to use internal funding, because they were worried that external finance providers would want a lot of information about how Bournelorth Co is performing. However, the amount of finance required meant that funding had to be obtained from external sources and they decided to seek a listing, as two of Bournelorth Co's principal competitors had recently been successfully listed.

25% of Bournelorth Co's equity shares were made available on the stock exchange for external investors, which was the minimum allowed by the rules of the exchange. The founders have continued to own the remaining 75% of Bournelorth Co's equity share capital. Although the listing was fully subscribed, the price which new investors paid was lower than the directors had originally hoped.

The board now consists of the three founders, who are the executive directors, and two independent non-executive directors, who were appointed when the company was listed. The non-executive directors have expressed concerns about the lack of frequency of formal board meetings and the limited time spent by the executive directors overseeing the company's activities, compared with the time they spend leading development work. The non-executive directors would also like Bournelorth Co's external auditors to carry out a thorough review of its risk management and control systems.

The funds obtained from the listing have helped Bournelorth Co expand its development activities. Bournelorth Co's competitors have recently launched some very successful diagnostic apps and its executive directors are now afraid that Bournelorth Co will fall behind its competitors unless there is further investment in development. However, they disagree about how this investment should be funded. One executive director believes that Bournelorth Co should consider selling off its IT support and consultancy services business. The second executive director favours a rights issue and the third executive director would prefer to seek debt finance. At present Bournelorth Co has low gearing and the director who is in favour of debt finance believes that there is too much uncertainty associated with obtaining further equity finance, as investors do not always act rationally.

### Required:

- (a) **Discuss the factors which will determine whether the sources of finance suggested by the executive directors are used to finance further investment in diagnostic applications (apps).** (8 marks)
- (b) (i) **Identify the risks associated with investing in the development of apps and describe the controls which Bournelorth Co should have over its investment in development.** (6 marks)
- (ii) **Discuss the issues which determine the information Bournelorth Co communicates to external finance providers.** (3 marks)
- (c) (i) **Explain the insights which behavioural finance provides about investor behaviour.** (3 marks)
- (ii) **Assess how behavioural factors may affect the share price of Bournelorth Co.** (5 marks)

**(25 marks)**

**3** Buryecs Co is an international transport operator based in the Eurozone which has been invited to take over a rail operating franchise in Wirtonia, where the local currency is the dollar (\$). Previously this franchise was run by a local operator in Wirtonia but its performance was unsatisfactory and the government in Wirtonia withdrew the franchise.

Buryecs Co will pay \$5,000 million for the rail franchise immediately. The government has stated that Buryecs Co should make an annual income from the franchise of \$600 million in each of the next three years. At the end of the three years the government in Wirtonia has offered to buy the franchise back for \$7,500 million if no other operator can be found to take over the franchise.

Today's spot exchange rate between the Euro and Wirtonia \$ is €0.1430 = \$1. The predicted inflation rates are as follows:

Year	1	2	3
Eurozone	6%	4%	3%
Wirtonia	3%	8%	11%

Buryecs Co's finance director (FD) has contacted its bankers with a view to arranging a currency swap, since he believes that this will be the best way to manage financial risks associated with the franchise. The swap would be for the initial fee paid for the franchise, with a swap of principal immediately and in three years' time, both these swaps being at today's spot rate. Buryecs Co's bank would charge an annual fee of 0.5% in € for arranging the swap. Buryecs Co would take 60% of any benefit of the swap before deducting bank fees, but would then have to pay 60% of the bank fees.

Relevant borrowing rates are:

	Buryecs Co	Counterparty
Eurozone	4.0%	5.8%
Wirtonia	Wirtonia bank rate + 0.6%	Wirtonia bank rate + 0.4%

In order to provide Buryecs Co's board with an alternative hedging method to consider, the FD has obtained the following information about over-the-counter options in Wirtonia \$ from the company's bank.

The exercise price quotation is in Wirtonia \$ per €1, premium is % of amount hedged, translated at today's spot rate.

Exercise price	Call options	Put options
7.75	2.8%	1.6%
7.25	1.8%	2.7%

Assume a discount rate of 14%.

**Required:**

- (a) **Discuss the advantages and drawbacks of using the currency swap to manage financial risks associated with the franchise in Wirtonia.** (6 marks)
- (b) (i) **Calculate the annual percentage interest saving which Buryecs Co could make from using a currency swap, compared with borrowing directly in Wirtonia, demonstrating how the currency swap will work.** (4 marks)
  - (ii) **Evaluate, using net present value, the financial acceptability of Buryecs Co operating the rail franchise under the terms suggested by the government of Wirtonia and calculate the gain or loss in € from using the swap arrangement.** (8 marks)
- (c) **Calculate the results of hedging the receipt of \$7,500 million using the currency options and discuss whether currency options would be a better method of hedging this receipt than a currency swap.** (7 marks)

**(25 marks)**

4 Toltuck Co is a listed company in the building industry which specialises in the construction of large commercial and residential developments. Toltuck Co had been profitable for many years, but has just incurred major losses on the last two developments which it has completed in its home country of Arumland. These developments were an out-of-town retail centre and a major residential development. Toltuck Co's directors have blamed the poor results primarily on the recent recession in Arumland, although demand for the residential development also appears to have been adversely affected by it being located in an area which has suffered serious flooding over the last two years.

As a result of returns from these two major developments being much lower than expected, Toltuck Co has had to finance current work-in-progress by a significantly greater amount of debt finance, giving it higher gearing than most other construction companies operating in Arumland. Toltuck Co's directors have recently been alarmed by a major credit agency's decision to downgrade Toltuck Co's credit rating from AA to BBB. The directors are very concerned about the impact this will have on the valuation of Toltuck Co's bonds and the future cost of debt.

The following information can be used to assess the consequences of the change in Toltuck Co's credit rating.

Toltuck Co has issued an 8% bond, which has a face or nominal value of \$100 and a premium of 2% on redemption in three years' time. The coupon on the bond is payable on an annual basis.

The government of Arumland has three bonds in issue. They all have a face or nominal value of \$100 and are all redeemable at par. Taxation can be ignored on government bonds. They are of the same risk class and the coupon on each is payable on an annual basis. Details of the bonds are as follows:

Bond	Redeemable	Coupon	Current market value
			\$
1	1 year	9%	104
2	2 years	7%	102
3	3 years	6%	98

Credit spreads, published by the credit agency, are as follows (shown in basis points):

Rating	1 year	2 years	3 years
AA	18	31	45
BBB	54	69	86

Toltuck Co's shareholder base can be divided broadly into two groups. The majority of shareholders are comfortable with investing in a company where dividends in some years will be high, but there will be low or no dividends in other years because of the cash demands facing the business. However, a minority of shareholders would like Toltuck Co to achieve at least a minimum dividend each year and are concerned about the company undertaking investments which they regard as very speculative. Shareholders from both groups have expressed some concerns to the board about the impact of the fall in credit rating on their investment.

**Required:**

- (a) Calculate the valuation and yield to maturity of Toltuck Co's \$100 bond under its old and new credit ratings. (10 marks)
- (b) Discuss the factors which may have affected the credit rating of Toltuck Co published by the credit agency. (8 marks)
- (c) Discuss the impact of the fall in Toltuck Co's credit rating on its ability to raise financial capital and on its shareholders' return. (7 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

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

### 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>											
(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	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
(n)	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	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%	
<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	0.909	1
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.736	2
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.487	3
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.170	4
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.791	5
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.355	6
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.868	7
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.335	8
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.759	9
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	6.145	10
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.495	11
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.814	12
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	7.103	13
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	7.367	14
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.606	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	0.833	1
2	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	1.528	2
3	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	2.106	3
4	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	2.589	4
5	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	2.991	5
6	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	3.326	6
7	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	3.605	7
8	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	3.837	8
9	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	4.031	9
10	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192	4.192	10
11	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	4.327	11
12	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	4.439	12
13	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	4.533	13
14	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	4.611	14
15	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	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**