UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	CONSTRUCTION PLANNING AND SCHEDULING
SUBJECT CODE	:	BFP 4013
COURSE	:	4 BFF
EXAMINATION DATE	:	APRIL / MAY 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS FROM **PART A** AND **TWO (2)** QUESTIONS ONLY IN **PART B.**

THIS PAPER CONSISTS THIRTEEN (13) PAGES

Part A

Q1   Based on **Table Q1**, answer all the questions below:

(a)   Estimate the total project duration and identify critical path using arrow diagram method

(15 marks)

(b)   Calculate the total float in one table for each activity in the project.

(2 marks)

(c)   Draw a bar chart based on your calculation in (a) and (b).

(8 marks)

Q2   Crashing a project means the process of accelerating an activity or multiple activities to shorten the overall duration of a project.

(a)   Based on Table **Q2a**, determine the normal overall project duration and the critical path.

(7 marks)

(b)   Based on the information in Table **Q2b**, crash the project activities appropriately to get the possible shortest project duration for activities shortened below:

(i). Activities shortened: D (2 days), H (1 day)

(2 marks)

(ii). Activities shortened: G (2 days), B (1 day), F (4 days), C (3 days)

(2 marks)

(iii). Activity shortened: J (1 day)

(2 marks)

(c)   Produce a table showing the crashing step in **Q2(b)** and its impact on the duration and direct cost of the project.

(6 marks)

(d)   Based on the information produced in **Q2(c)** and estimated indirect cost of RM 2,700 per day draw a crash curve to illustrate the cost-time relationship. Determine the most economic overall project duration.

(6 marks)

Part B

Q3 (a) Explain briefly the importance of WBS in construction project.

(5 marks)

(b) Explain the **three (3)** estimates of duration used in PERT.

(4 marks)

(c) Draw out **ADM** diagram and identify critical path with information given founded on **Table Q3a.**

(8 marks)

(d) Draw the precedence diagram (PDM) and identify critical path anchored in **Table Q3b**

(8 marks)

Q4 Resource leveling is an attempt to assign resources to project activities in a manner that will improve productivity and efficiency.

(a) Based on network diagram in Figure **Q4** and weekly labour requirement in Table **Q4**, draw a time-based networks using early start times (ES-TF) and a histogram of labour loading.

(8 marks)

(b) You are required to level your labour up to maximum 70 labours per day. Update your time-based networks and labour loading histogram produced in **Q4(a),** to depicts the labour loading after resource leveling is exercised.

(7 marks)

(c) Explain briefly on the resource smoothing and resource leveling in labour resource management.

(5 marks)

(d) Give **two (2)** examples of situation where resource leveling is appropriate to be employed.

(5 marks)

Q5 Program Evaluation and Review Technique (PERT) provides valuable information for assessing the risks of a schedule slippage of a project. Figure **Q5** shows the PERT network which uses three estimates for each activity's duration.

(a) Calculate the optimistic and pessimistic durations of the project for activity 1-2, 2-4, 4-8 and 8-10.

(6 marks)

(b) Calculate the expected time (t_e) for each activity.

(6 marks)

(c) Calculate the expected project duration (T_E) of the project.

(4 marks)

(d) With aid of Table **Q5**, calculate the probabilities of completing the project in 38.0 days or less.

(8 marks)

Q6 (a) As a developer for housing development, you were awarded a project to develop a housing complex for Taman Bahagia, Parit Raja, Batu Pahat, Johor. This project consists of three areas which are area A for west side, area B for east side and area C for south side. Pertaining to the project, client requires you to recommend and explain on the following:

(i) WBS for your project based on Project, Area, Activity and Sub-activity.

(6 marks)

(ii) OBS (with at least 5 levels) for your project.

(5 marks)

(b) A sub-contractor agreed to build 30 pile caps in 90 days at RM 750 per unit. Twenty days (20) later, the contractor has finished 12 pile caps with an actual total cost which is direct cost at RM 5,200 and indirect cost at RM 1,300.

(i) Determine the daily planned budget for the contractor.

(5 marks)

(ii) Using the "Earned Value" approach, determine the status of this project.

(9 marks)

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BAHAGIAN A

S1   Berdasarkan Jadual **Q1**, jawab soalan-soalan berikut:

(a)   Anggarkan jumlah tempoh projek menggunakan Kaedah Gambarajah Anak Panah.

(15 markah)

(b)   Hitungkan jumlah apungan bagi setiap aktiviti di dalam projek tesebut

(2 markah)

(c)   Lukiskan satu carta bar berdasarkan hitungan anda di S1(a) dan (b).

(8 marks)

S2   Pemendekan sesuatu projek bermaksud proses mempercepatkan aktiviti atau beberapa aktviti untuk memendekkan keseluruhan tempoh sesuatu projek.

(a)   Berdasarkan Jadual **Q2a** tentukan tempoh penyiapan normal dan laluan kritikal bagi projek tersebut.

(7 markah)

(b)   Berdasarkan maklumat di dalam Jadual **Q2b**, lakukan pemendekan aktiviti-aktiviti projek sewajarnya untuk mendapatkan tempoh terpendek projek bagi pemendekan aktiviti-aktiviti berikut.

(i) Pemendekan aktiviti-aktiviti: D (2 hari), H (1 hari)

(2 markah)

(ii) Pemendekan aktiviti-aktiviti: G (2 days), B (1 day), F (4 days), C (3 days)

(2 markah)

(iii) Pemendekan aktiviti: J (1 hari)

(2 markah)

(c)   Sediakan satu jadual yang menunjukan langkah-langkah pemendekan di **S2(b)** dan kesannya kepada tempoh penyiapan dan kos langsung projek tersebut.

(6 markah)

(d)   Berdasarkan maklumat yang dihasilkan di S5(c) dan anggaran kos tidak langsung RM 2,700 sehari, lukiskan graf-graf yang menggambarkan perhubungan kos-masa bagi projek tersebut. Tentukan tempoh penyiapan yang paling ekonomi bagi proek tersebut.

(6 markah)

BAHAGIAN B

S3 (a) Bincang dengan ringkas pentingnya WBS di dalam projek pembinaan

(5 markah)

(b) Terangkan **tiga (3)** masa anggaran yang digunakan di dalam PERT.

(4 markah)

(c) Lukiskan carta ADM dan tentukan laluan kritikal berdasarkan Jadual **Q3a**

(8 markah)

(d) Lukiskan carta PDM dan tentukan laluan kritikal berdasarkan Jadual **Q3b**

(8 markah)

S4 Pengarasan sumber adalah suatu usaha pengagihan sumber kepada aktiviti-aktiviti projek untuk meningkatkan produktiviti dan efisien.

(a) Berdasarkan gambarajah rangkaian di Rajah **Q4** dan keperluan mingguan buruh di dalam Jadual **Q4**, lukiskan rangkaian berasaskan masa *(time-based networks)* menggunakan masa mulaan terawal (ES-TF) dan satu histogram jumlah buruh.

(8 markah)

(b) Anda dikehendaki mengaras jumlah pekerja kepada maksimum 70 buruh sehari. Kemaskini rangkaian berasaskan masa *(time-based networks)* dan histogram jumlah buruh yang telah dihasilkan di **Q4 (a)** untuk menggambarkan agihan buruh selepas pengarasan sumber dilakukan.

(7 markah)

(c) Bincang dengan ringkas sumber *(resource smoothing)* dan pengarasan sumber di dalam pengurusan sumber tenaga kerja

(7 markah)

(d) Berikan **dua (2)** contoh situasi di mana pengarasan sumber sesuai digunakan.

(5 markah)

S5 *Program Evaluation and Review Technique (PERT)* menyediakan maklumat yang berharga untuk menilai risiko gelinciran jadual perancangan bagi sesuatu projek. Rajah **Q5** menunjukkan rangkaian PERT yang menggunakan tiga masa anggaran bagi setiap aktiviti.

(a) Hitungkan tempoh penyiapan *optimistic* dan *pessimistic* bagi aktiviti projek 1-2, 2-4,

4-8 and 8-10.

(6 marks)

(b) Hitungkan masa jangkaan *(expected time, t_e)* bagi setiap aktiviti.

(6 markah)

(c) Hitungkan tempoh penyiapan jangkaan *(expected project duration, T_E)* bagi projek tersebut.

(4 markah)

(d) Dengan bantuan Jadual **Q5**, hitungkan kebarangkalian untuk menyiapkan projek tersebut dalam masa 38.0 hari atau kurang.

(8 markah)

S6 (a) Sebagai seorang pemaju perumahan, anda telah diberikan satu projek untuk membangunkan sebuah kompleks perumahan bagi Taman Damai, Parit Raja, Batu Pahat, Johor. Projek ini meliputi tiga buah kawasan iaitu kawasan A di bahagian barat, kawasan B di bahagian timur dan kawasan C di bahagian selatan. Berhubung projek tersebut, klien meminta anda mencadang dan menerangkan perkara-perkara berikut:

(i). WBS bagi projek anda berdasarkan Projek, Kawasan, Aktiviti dan Sub-aktiviti.

(6 markah)

(ii). OBS (minimum 5 peringkat) bagi projek anda.

(5 markah)

(b) Seorang kontraktor telah bersetuju membina 30 tetopi cerucuk dalam masa 90 hari pada harga RM 750 per unit. Dua puluh (20) hari kemudian, kontraktor itu telah berjaya menyiapkan 12 unit pada jumlah kos sebenar di mana RM 5,200 adalah kos langsung dan RM 1,300 adalah kos tidak langsung.

(i) Tentukan bajet terancang harian bagi kontraktor tersebut.

(5 markah)

(ii) Menggunakan pendekatan "Earned Value', tentukan status projek ini.

(9 markah)

Table Q1: Project activities

ACTIVITY	SUCCESSOR	DURATION (WEEKS)
K	L, M, N	2
N	O	8
O	W	2
W	U	2
U	-	4
M	E, P	4
E	O	3
P	R	3
R	U	3
L	Q	4
Q	S, R	3
S	T, U	4

Table Q2a: Crashing Project activities

Activity	Successor	Duration
A	B, C	1
B	D	3
C	G, F	6
D	E, F	5
E	J	2
F	J	6
G	H	3
H	J	4
J	-	3

Table Q2b

Activity #	Time Normal	Time Crash	Cost Normal	Time Difference	Cost Difference	Slope $/Day
A	1	1	$1,000	0	0	
B	3	2	$2,000	1	$100	$100
C	6	1	$1,000	5	$450	$90
D	5	3	$1,000	2	$60	$30
E	2	1	$1,000	1	$40	$40
F	6	2	$1,000	4	$320	$80
G	3	1	$1,000	2	$150	$75
H	4	3	$1,000	1	$60	$60
J	3	2	$1,000	1	$150	$150
			$10,000			

Table Q3a

Activity	Preceded by	Duration
A	-	3
B	A	7
C	A	6
D	B	8
E	B	5
F	B	1
G	D	3
H	D,E	7
I	C,F	5
J	G,H	9
K	H,I	4
L	J,K	5

Table Q3b

Activity Description	Duration	Predecessors*/Lag
A	2	-
B	3	A
C	3	B/1
D	2	C SS/1
E	3	C FF/2
F	1	G FS/2
G	5	C, D
H	3	G
I	2	H, F
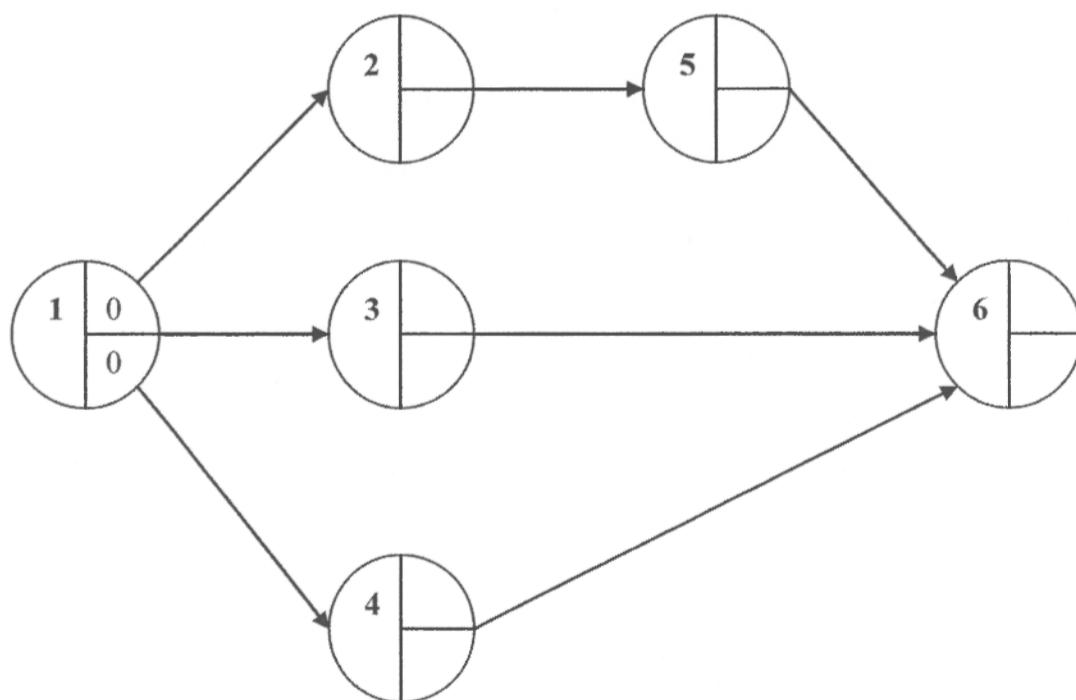
Figure Q4

Table Q4

Activity	labour	Week
A	30	8
B	10	4
C	30	4
D	40	4
E	30	4
F	10	4
G	30	4
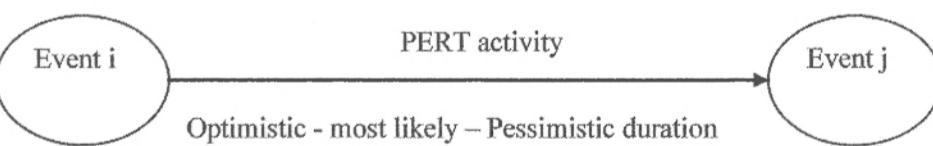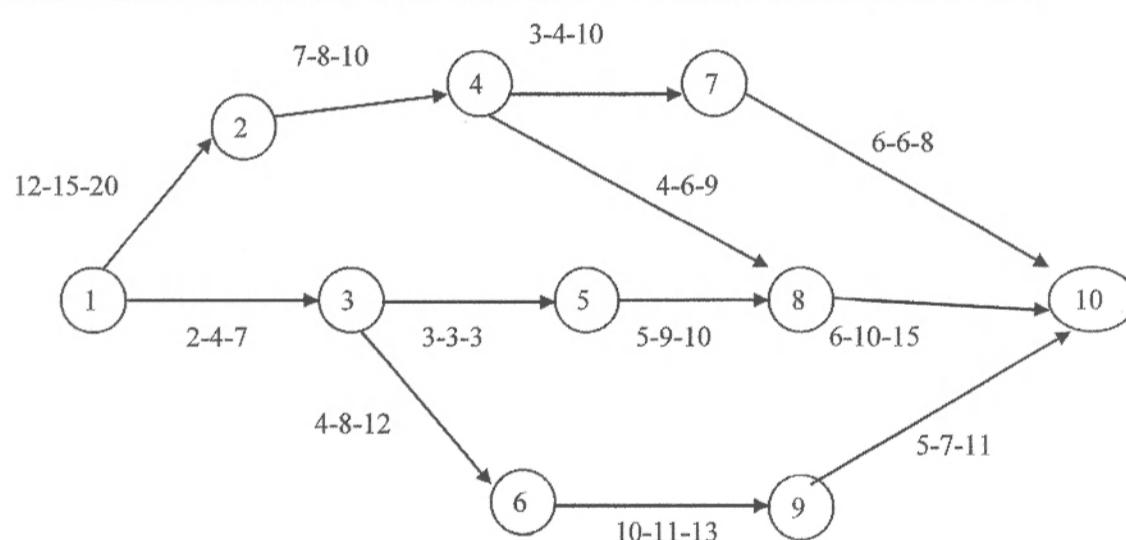
Figure Q5

Table Q5

$$f(z,0,1) = \frac{1}{\sqrt{2\pi}} e^{\frac{-z^2}{2}}$$ for Positive Values   When Z = 1.230, p = 0.8906514 or 89.1%

| Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000000	0.5039894	0.5079784	0.5119665	0.5159535	0.5199389	0.5239223	0.5279032	0.5318814	0.53585±:
0.10	0.5398279	0.5437954	0.5477585	0.5517168	0.5556700	0.5596177	0.5635595	0.5674949	0.5714237	0.5753±54
0.20	0.5792597	0.5831661	0.5870644	0.5909541	0.5948348	0.5987063	0.6025681	0.6064198	0.6102612	0.61409¹:
0.30	0.6179114	0.6217195	0.6255158	0.6293000	0.6330717	0.6368306	0.6405764	0.6443087	0.6480272	0.65173¹·
0.40	0.6554217	0.6590970	0.6627572	0.6664021	0.6700314	0.6736448	0.6772419	0.6808225	0.6843863	0.687933·
0.50	0.6914625	0.6949743	0.6984682	0.7019441	0.7054015	0.7088403	0.7122603	0.7156612	0.7190427	0.722404·
0.60	0.7257469	0.7290692	0.7323712	0.7356528	0.7389138	0.7421540	0.7453732	0.7485712	0.7517478	0.754903:
0.70	0.7580364	0.7611480	0.7642376	0.7673050	0.7703501	0.7733727	0.7763728	0.7793501	0.7823046	0.785236:
0.80	0.7881447	0.7910300	0.7938920	0.7967307	0.7995459	0.8023375	0.8051055	0.8078498	0.8105704	0.813267¹
0.90	0.8159399	0.8185888	0.8212136	0.8238145	0.8263912	0.8289439	0.8314724	0.8339768	0.8364569	0.838912⁹
1.00	0.8413447	0.8437523	0.8461358	0.8484950	0.8508300	0.8531409	0.8554277	0.8576903	0.8599289	0.862143⁴
1.10	0.8643339	0.8665004	0.8686431	0.8707618	0.8728568	0.8749280	0.8769755	0.8789995	0.8809998	0.882976·
1.20	0.8849303	0.8868605	0.8887675	0.8906514	0.8925122	0.8943502	0.8961653	0.8979576	0.8997274	0.901474c
1.30	0.9031995	0.9049020	0.9065824	0.9082408	0.9098773	0.9114919	0.9130850	0.9146565	0.9162066	0.917735⁵
1.40	0.9192433	0.9207301	0.9221961	0.9236414	0.9250663	0.9264707	0.9278549	0.9292191	0.9305633	0.931887⁹
1.50	0.9331928	0.9344783	0.9357445	0.9369916	0.9382198	0.9394292	0.9406200	0.9417924	0.9429466	0.944082⁶
1.60	0.9452007	0.9463011	0.9473839	0.9484493	0.9494974	0.9505285	0.9515428	0.9525403	0.9535214	0.954486¹
1.70	0.9554346	0.9563671	0.9572838	0.9581849	0.9590705	0.9599409	0.9607961	0.9616365	0.9624621	0.9632731
1.80	0.9640697	0.9648522	0.9656206	0.9663751	0.9671159	0.9678433	0.9685573	0.9692582	0.9699460	0.9706211
1.90	0.9712835	0.9719335	0.9725711	0.9731967	0.9738102	0.9744120	0.9750022	0.9755809	0.9761483	0.9767046
2.00	0.9772499	0.9777845	0.9783084	0.9788218	0.9793249	0.9798179	0.9803008	0.9807739	0.9812373	0.9816912
2.10	0.9821356	0.9825709	0.9829970	0.9834143	0.9838227	0.9842224	0.9846137	0.9849966	0.9853713	0.9857379
2.20	0.9860966	0.9864475	0.9867907	0.9871263	0.9874546	0.9877756	0.9880894	0.9883962	0.9886962	0.9889894
2.30	0.9892759	0.9895559	0.9898296	0.9900969	0.9903582	0.9906133	0.9908625	0.9911060	0.9913437	0.9915758
2.40	0.9918025	0.9920237	0.9922397	0.9924506	0.9926564	0.9928572	0.9930531	0.9932443	0.9934309	0.9936128
2.50	0.9937903	0.9939634	0.9941322	0.9942969	0.9944574	0.9946138	0.9947664	0.9949150	0.9950600	0.9952012
2.60	0.9953388	0.9954729	0.9956035	0.9957307	0.9958547	0.9959754	0.9960929	0.9962074	0.9963188	0.9964274
2.70	0.9965330	0.9966358	0.9967359	0.9968332	0.9969280	0.9970202	0.9971099	0.9971971	0.9972820	0.9973645
2.80	0.9974448	0.9975229	0.9975988	0.9976725	0.9977443	0.9978140	0.9978817	0.9979476	0.9980116	0.9980737
2.90	0.9981341	0.9981928	0.9982498	0.9983051	0.9983589	0.9984111	0.9984617	0.9985109	0.9985587	0.9986050
3.00	0.9986500	0.9986937	0.9987361	0.9987772	0.9988170	0.9988557	0.9988932	0.9989296	0.9989649	0.9989991

Table Q5: Continued

$$f(z,0,1) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}$$ for Negative Values   When Z = −1.230, p = 0.1093486 or 10.9%

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000000	0.4960106	0.4920216	0.4880335	0.4840465	0.4800611	0.4760777	0.4720968	0.4681186	0.4641435
−0.10	0.4601721	0.4562046	0.4522415	0.4482832	0.4443300	0.4403823	0.4364405	0.4325051	0.4285763	0.4246546
−0.20	0.4207403	0.4168339	0.4129356	0.4090459	0.4051652	0.4012937	0.3974319	0.3935802	0.3897388	0.3859082
−0.30	0.3820886	0.3782805	0.3744842	0.3707000	0.3669283	0.3631694	0.3594236	0.3556913	0.3519728	0.3482683
−0.40	0.3445783	0.3409030	0.3372428	0.3335979	0.3299686	0.3263552	0.3227581	0.3191775	0.3156137	0.3120669
−0.50	0.3085375	0.3050257	0.3015318	0.2980559	0.2945985	0.2911597	0.2877397	0.2843388	0.2809573	0.2775953
−0.60	0.2742531	0.2709308	0.2676288	0.2643472	0.2610862	0.2578460	0.2546268	0.2514288	0.2482522	0.2450970
−0.70	0.2419636	0.2388520	0.2357624	0.2326950	0.2296499	0.2266273	0.2236272	0.2206499	0.2176954	0.2147638
−0.80	0.2118553	0.2089700	0.2061080	0.2032693	0.2004541	0.1976625	0.1948945	0.1921502	0.1894296	0.1867329
−0.90	0.1840601	0.1814112	0.1787864	0.1761855	0.1736088	0.1710561	0.1685276	0.1660232	0.1635431	0.1610871
−1.00	0.1586553	0.1562477	0.1538642	0.1515050	0.1491700	0.1468591	0.1445723	0.1423097	0.1400711	0.1378566
−1.10	0.1356661	0.1334996	0.1313569	0.1292382	0.1271432	0.1250720	0.1230245	0.1210005	0.1190002	0.1170233
−1.20	0.1150697	0.1131395	0.1112325	0.1093486	0.1074878	0.1056498	0.1038347	0.1020424	0.1002726	0.0985254
−1.30	0.0968005	0.0950980	0.0934176	0.0917592	0.0901227	0.0885081	0.0869150	0.0853435	0.0837934	0.0822645
−1.40	0.0807567	0.0792699	0.0778039	0.0763586	0.0749337	0.0735293	0.0721451	0.0707809	0.0694367	0.0681121
−1.50	0.0668072	0.0655217	0.0642555	0.0630084	0.0617802	0.0605708	0.0593800	0.0582076	0.0570534	0.0559174
−1.60	0.0547993	0.0536989	0.0526161	0.0515507	0.0505026	0.0494715	0.0484572	0.0474597	0.0464786	0.0455139
−1.70	0.0445654	0.0436329	0.0427162	0.0418151	0.0409295	0.0400591	0.0392039	0.0383635	0.0375379	0.0367269
−1.80	0.0359303	0.0351478	0.0343794	0.0336249	0.0328841	0.0321567	0.0314427	0.0307418	0.0300540	0.0293789
−1.90	0.0287165	0.0280665	0.0274289	0.0268033	0.0261898	0.0255880	0.0249978	0.0244191	0.0238517	0.0232954
−2.00	0.0227501	0.0222155	0.0216916	0.0211782	0.0206751	0.0201821	0.0196992	0.0192261	0.0187627	0.0183088
−2.10	0.0178644	0.0174291	0.0170030	0.0165857	0.0161773	0.0157776	0.0153863	0.0150034	0.0146287	0.0142621
−2.20	0.0139034	0.0135525	0.0132093	0.0128737	0.0125454	0.0122244	0.0119106	0.0116038	0.0113038	0.0110106
−2.30	0.0107241	0.0104441	0.0101704	0.0099031	0.0096418	0.0093867	0.0091375	0.0088940	0.0086563	0.0084242
−2.40	0.0081975	0.0079763	0.0077603	0.0075494	0.0073436	0.0071428	0.0069469	0.0067557	0.0065691	0.0063872
−2.50	0.0062097	0.0060366	0.0058678	0.0057031	0.0055426	0.0053862	0.0052336	0.0050850	0.0049400	0.0047988
−2.60	0.0046612	0.0045271	0.0043965	0.0042693	0.0041453	0.0040246	0.0039071	0.0037926	0.0036812	0.0035726
−2.70	0.0034670	0.0033642	0.0032641	0.0031668	0.0030720	0.0029798	0.0028901	0.0028029	0.0027180	0.0026355
−2.80	0.0025552	0.0024771	0.0024012	0.0023275	0.0022557	0.0021860	0.0021183	0.0020524	0.0019884	0.0019263
−2.90	0.0018659	0.0018072	0.0017502	0.0016949	0.0016411	0.0015889	0.0015383	0.0014891	0.0014413	0.0013950
−3.00	0.0013500	0.0013063	0.0012639	0.0012228	0.0011830	0.0011443	0.0011068	0.0010704	0.0010351	0.0010009

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