

T Level Technical Qualification in Building Services Engineering for Construction

**Air conditioning engineering (8710-38)
(351)**

Candidate pack

Practical Assignment 2020 – Sample

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1. Assessment

This assessment is for the air conditioning engineering occupational specialism component of the Technical Qualification. This pack consists of a practical assignment that includes a project brief including drawing and diagrams as necessary along with several tasks for you to complete.

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2. Candidate guidance

General guidance

This is a formal assessment that you will be marked and graded on. You will be marked on the quality and accuracy of the practical work you produce. It is therefore important that you carry your work out to the highest standard you can.

Plagiarism

This is an assessment of your abilities, so the work must be all your own work and carried out under the conditions stated. You will be asked to sign a declaration that you have not had any help with the assignment.

Your tutor is allowed to give you some help understanding the instructions if necessary, but they will record any other guidance you need, and this will be taken into account during marking.

Plagiarism is the failure to acknowledge sources properly and/or the submission of another person's work as if it were your own. Plagiarism is not allowed in this project.

Where research is allowed, your tutor must be able to identify which work you have done yourself, and what you have found from other sources. It is therefore important to make sure you acknowledge sources used and clearly reference any information taken from them.

Timings and planning

You are advised to study the details of the assessment before starting.

You should check with your tutor that you have all the relevant materials, equipment and information/data sources that you need before starting the assessment.

You should take care when planning to make sure you have divided the time available between parts of the assignment tasks appropriately. Timings for tasks are provided within this pack to support with planning and time allocation.

If you have a good reason for needing more time, you will need to explain the reasons to your tutor and agree a new deadline date. Changes to dates will be at the discretion of the tutor, and they may not mark work that is handed in after the agreed deadlines.

If you have a good reason for needing more time, you will need to explain the reasons to your tutor and this must be agreed by City & Guilds.

Health and Safety

You must always work safely, in particular while you are carrying out practical tasks.

You must always follow any relevant Health and Safety regulations, Risk Assessments and codes of practice in line with centre requirements.

If your tutor sees you working in a way that is unsafe for yourself or others, they will highlight the issue and ask you to stop the task immediately. Your tutor will not be able to reassess you until they are sure you are ready for assessment and can work safely.

Presentation of work

Presentation of work must be appropriate to the task.

You should make sure that each piece of evidence including any forms are clearly labelled with your name and the project reference.

All electronic files must be given a clear file name that allows your tutor to identify it as your work.

Written work may be word-processed or hand written unless stated otherwise.

All sketches and drawings should be neat and tidy, to scale and annotated.

Calculations should be set out clearly, with all working shown, as well as any assumptions made. You should use appropriate units at all times, consistent with the requirements of the assignment.

Instructions for this assignment

Ensure you read all the provided assessment information contained in this candidate pack

You must work independently and not share your work with any other candidates in supervised assessment sessions.

Your work will be kept secure during any supervised breaks that are taken.

Internet access is not allowed.

You must complete all the tasks and present all evidence that is detailed in each task.

This assessment booklet contains:

- An assignment brief
- Task 1
- Task 2
- Task 3
- Task 4

Within each task you will find the following:

Conditions of assessment: This will tell you the duration and rules you must follow when completing a task.

What must be produced for marking: This describes the evidence you must submit when the task is completed. Be aware failure to submit any evidence requested can adversely affect your overall mark for the assessment

Additional evidence for this task: This describes other forms of evidence that will be collected by the assessor to support the marking of your performance. This will often include but not limited to photographic and video evidence

3. Assignment Brief

You have been called to a commercial property to undertake the design, planning and installation of a 2-3KW cooling capacity air conditioning system in an office space.

Your supervisor has asked you to carry out a survey of the proposed installation

The customer has identified the wall space that they want to locate the indoor unit on and the outdoor area to site the outdoor unit.

The general layout of the installation is shown in **figure 1 and figure 2**.

The power supply will be taken from a local isolator provided by others.

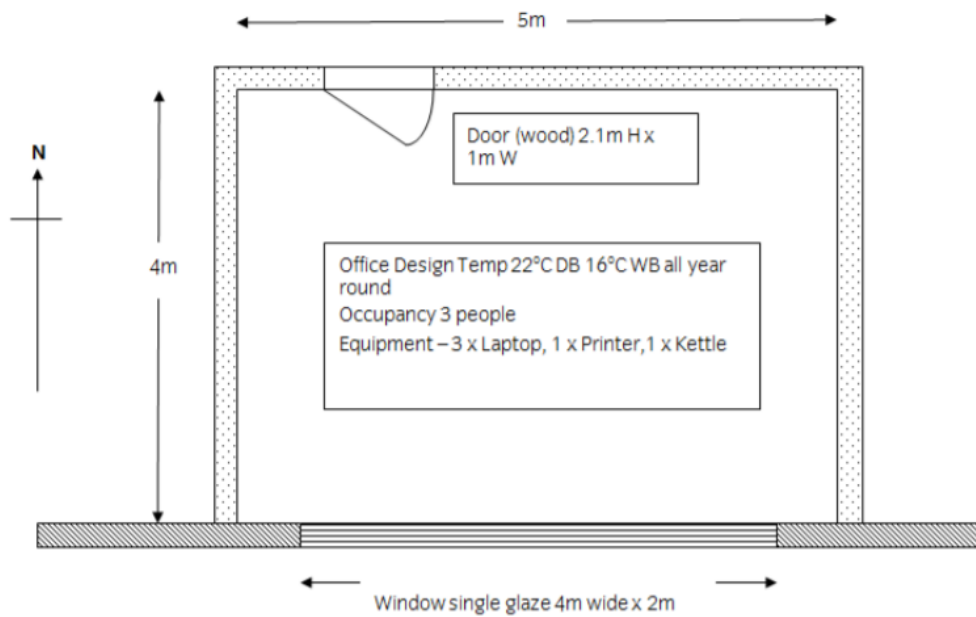
Condensate drainage will be connected to the main drain line provided by others.

Your supervisor will notify you of the requirements of the installation and a plan of the proposed space and location of existing services where you will carry out the installation.

Whilst on site the customer asked for an inspection of a faulty air conditioning heat pump unit. After inspection you are required to carry out a service and maintenance operation to rectify the system. You are required to discuss this with the customer and agree to carry out this work.

This assignment has a time of 28 hours. Plan your time accordingly to enable timely completion

Figure 1



Room design specification

Design Temperatures

Outside ambient = 32°C

Internal surrounding temperature (walls/ floor/ceiling) = 25°C

U values

External wall = 0.52 W/m²K

Internal wall = 1.7 W/m²K

Window = 4.8 W/m²K

Door = 3.2 W/m²K

Floor/Ceiling = 2.25 W/m²K

(Internal room height is 3.2m)

Outside Air Infiltration rate = 1.0

Solar gain

Window has transmittance factor of 0.9

Occupancy

Laptop computer = 500W

Printer = 750W

Kettle = 1kW

Lighting

50

Figure 2 Split air conditioning installation layout

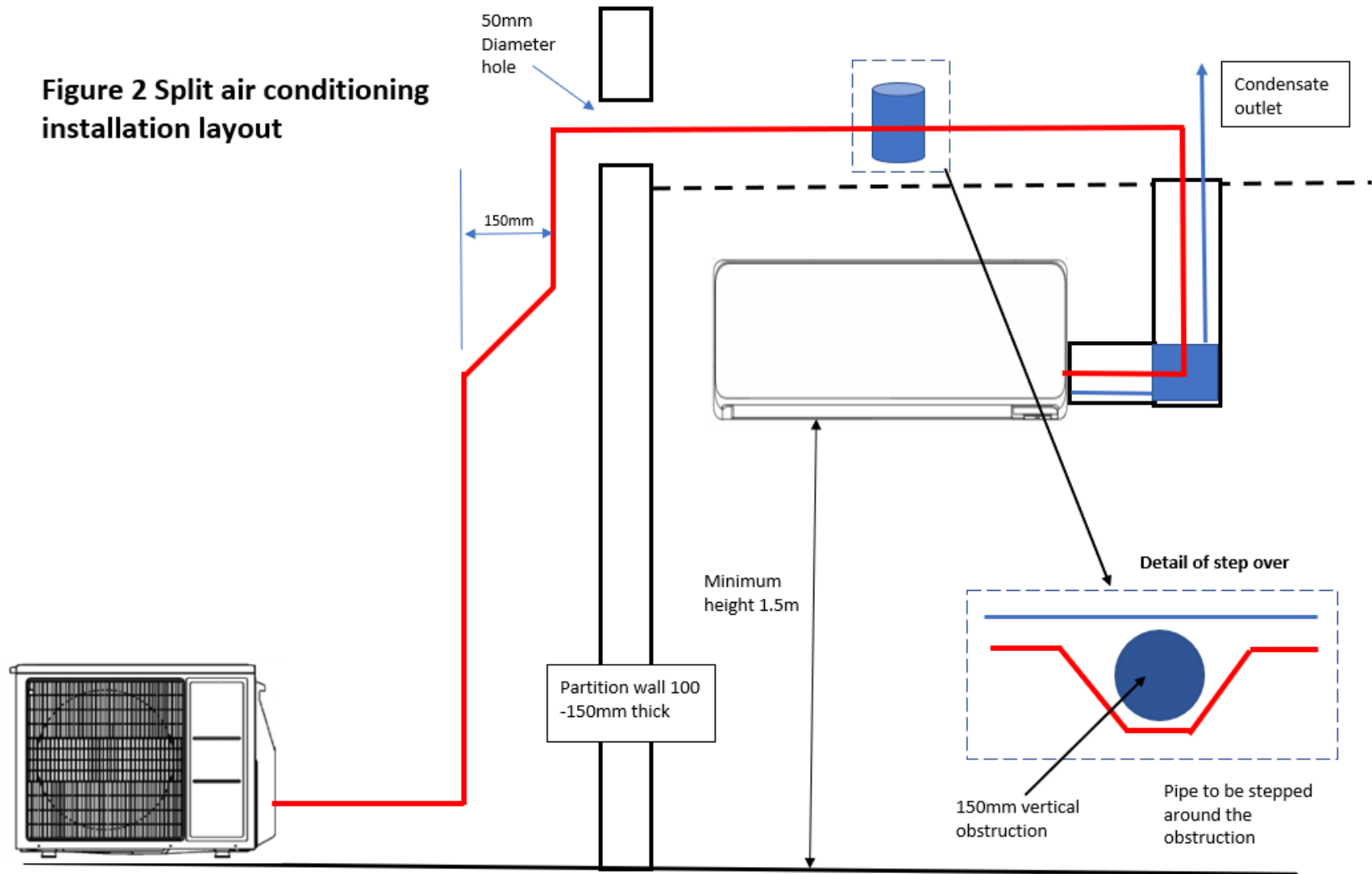


Figure 3 – Solar data

2-26

Environmental design

Table 2.30 Design 97.5 percentile of beam and diffuse irradiance on vertical and horizontal surfaces: London area (Bracknell) (1981–1992) — continued

Date and times of sunrise/sunset	Orientation	Type	Daily mean irradiance (J W^{-2}) and mean hourly irradiance (J W^{-2}) for stated solar time*																		
			Mean	0330	0430	0530	0630	0730	0830	0930	1030	1130	1230	1330	1430	1530	1630	1730	1830	1930	2030
Apr 28	Normal to beam		343	—	74	235	440	555	674	707	744	765	761	740	724	655	568	408	218	69	—
Sunrise: 04:46 Sunset: 19:14	N	Beam	7	—	27	59	24	0	0	0	0	0	0	0	0	0	0	22	55	26	—
		Diffuse	56	—	25	43	53	87	101	117	130	139	141	131	120	100	88	52	41	25	—
	NE	Beam	47	—	68	202	316	298	220	71	0	0	0	0	0	0	0	0	0	0	—
		Diffuse	64	—	33	86	123	142	142	119	145	139	141	131	120	100	77	47	22	8	—
	E	Beam	103	—	69	226	423	497	519	417	276	96	0	0	0	0	0	0	0	0	—
		Diffuse	74	—	34	93	146	183	196	185	171	143	155	131	120	100	77	47	22	8	—
	SE	Beam	128	—	29	118	282	405	513	519	483	392	253	92	0	0	0	0	0	0	—
		Diffuse	77	—	25	61	115	164	195	202	205	196	179	136	138	100	77	47	22	8	—
	S	Beam	122	—	0	0	0	76	207	317	407	458	455	404	324	202	78	0	0	0	—
		Diffuse	74	—	8	24	57	90	139	168	192	207	212	194	174	138	91	56	23	8	—
	SW	Beam	127	—	0	0	0	0	0	0	92	255	390	480	531	499	415	262	109	27	—
		Diffuse	77	—	8	23	48	77	101	134	135	175	201	207	210	192	165	110	58	25	—
	W	Beam	101	—	0	0	0	0	0	0	0	0	97	275	427	504	509	392	210	64	—
		Diffuse	74	—	8	23	48	77	101	117	130	152	146	173	192	193	184	139	86	34	—
NW	Beam	45	—	0	0	0	0	0	0	0	0	0	0	73	214	305	293	187	63	—	
	Diffuse	64	—	8	23	48	77	101	117	130	139	141	146	122	140	143	117	80	33	—	
	Horiz.	Beam	199	—	1	26	119	235	377	475	558	605	602	555	486	367	240	110	25	1	—
	Horiz.	Diffuse	73	—	18	44	80	117	138	151	163	170	177	166	157	138	116	80	43	18	—
	Horiz.	Global	272	—	19	70	199	352	515	626	721	775	779	721	643	505	356	190	68	19	—
May 29	Normal to beam		386	—	145	350	482	580	685	753	787	794	793	787	758	693	623	511	371	154	—
Sunrise: 04:01 Sunset: 19:59	N	Beam	22	—	73	114	66	0	0	0	0	0	0	0	0	0	0	70	120	78	—
		Diffuse	68	—	49	72	77	108	116	126	137	143	142	134	125	113	104	73	68	43	—
	NE	Beam	63	—	140	308	360	333	255	117	0	0	0	0	0	0	0	0	0	0	—
		Diffuse	74	—	64	121	144	159	154	136	159	143	142	134	125	108	87	60	36	15	—
	E	Beam	112	—	125	323	444	498	505	426	280	96	0	0	0	0	0	0	0	0	—
		Diffuse	81	—	59	124	162	191	197	188	170	145	153	134	125	108	87	60	36	14	—
	SE	Beam	117	—	36	148	268	372	460	486	443	343	207	47	0	0	0	0	0	0	—
		Diffuse	80	—	44	81	125	167	189	197	194	184	165	126	134	108	87	60	36	14	—
	S	Beam	98	—	0	0	0	28	145	261	347	389	388	347	262	147	30	0	0	0	—
		Diffuse	72	—	16	39	72	89	133	163	180	191	190	177	159	128	85	68	37	14	—
	SW	Beam	120	—	0	0	0	0	0	0	47	207	343	443	489	465	399	284	157	38	—
		Diffuse	79	—	16	39	64	90	111	137	128	165	184	190	193	183	160	118	76	39	—
	W	Beam	116	—	0	0	0	0	0	0	0	0	96	280	429	511	535	471	342	132	—
		Diffuse	80	—	16	39	64	90	111	126	137	153	145	168	184	191	184	153	117	53	—
NW	Beam	66	—	0	0	0	0	0	0	0	0	0	0	118	258	357	382	327	149	—	
	Diffuse	74	—	17	39	64	90	111	126	137	143	142	157	134	149	153	136	114	56	—	
	Horiz.	Beam	243	—	10	74	175	296	439	564	649	685	649	567	444	318	186	79	10	—	
	Horiz.	Diffuse	77	—	33	70	101	133	146	153	156	162	161	153	148	140	121	91	63	29	—
	Horiz.	Global	320	—	43	144	276	429	585	717	805	847	846	802	715	584	439	277	142	39	—
Jun 21	Normal to beam		414	64	191	387	554	683	747	797	826	837	840	809	771	705	639	531	390	192	65
Sunrise: 03:49 Sunset: 20:11	N	Beam	27	40	100	132	85	0	0	0	0	0	0	0	0	0	0	82	133	100	40
		Diffuse	71	25	55	76	85	111	117	125	134	139	140	135	127	121	114	85	77	58	25
	NE	Beam	74	64	185	342	417	397	285	134	0	0	0	0	0	0	0	0	0	0	0
		Diffuse	77	32	72	124	157	158	150	134	158	139	140	135	127	113	94	69	42	21	9
	E	Beam	124	50	162	352	504	579	544	445	290	100	0	0	0	0	0	0	0	0	0
		Diffuse	83	27	66	126	175	189	189	180	163	140	149	135	127	113	94	69	42	20	8
	SE	Beam	122	7	44	155	296	422	484	496	447	345	204	36	0	0	0	0	0	0	0
		Diffuse	79	21	50	82	133	163	180	187	183	173	157	123	134	113	94	69	42	20	8
	S	Beam	94	0	0	0	0	18	141	256	342	387	389	335	247	133	17	0	0	0	0
		Diffuse	72	8	18	41	77	83	125	154	170	179	180	172	158	130	87	77	42	20	8
	SW	Beam	118	0	0	0	0	0	0	0	37	203	346	438	479	457	395	284	157	44	7
		Diffuse	80	8	18	41	69	91	110	132	122	156	175	185	193	188	169	133	83	52	21
	W	Beam	120	0	0	0	0	0	0	0	0	0	101	284	431	513	542	483	355	163	51
		Diffuse	83	8	18	41	69	91	110	125	134	148	140	165	185	197	196	175	128	69	27
NW	Beam	71	0	0	0	0	0	0	0	0	0	0	0	130	269	371	399	345	186	65	
	Diffuse	77	9	19	41	69	91	110	125	134	139	140	159	138	156	164	157	126	75	32	
	Horiz.	Beam	264	1	17	91	214	362	493	610	694	735	738	679	590	465	339	205	92	18	1
	Horiz.	Diffuse	76	16	37	71	104	120	132	140	141	144	146	146	149	146	131	107	72	38	16
	Horiz.	Global	341	17	54	162	318	482	625	750	835	879	884	825	739	611	470	312	164	56	17

* Mean over hour centred at stated solar time

Table continues

Note: italicised values are calculated for time halfway between sunrise and the end of the sunrise hour or halfway between the beginning of the sunset hour and sunset; the figures shown in bold type, when added together, give the peak total irradiance (i.e. beam plus diffuse) for the stated orientation.

Figure 4 – Occupation data

Table 6.3 Typical rates at which heat is given off by human beings in different states of activity.

Degree of activity	Typical building	Total rate of heat emission for adult male / W	Rate of heat emission for mixture of males and females / W			Percentage of sensible heat that is radiant heat for stated air movement / %	
			Total	Sensible	Latent	High	Low
Seated at theatre	Theatre, cinema (matinee)	115	95	65	30	—	—
Seated at theatre, night	Theatre, cinema (night)	115	105	70	35	60	27
Seated, very light work	Offices, hotels, apartments	130	115	70	45	—	—
Moderate office work	Offices, hotels, apartments	140	130	75	55	—	—
Standing, light work; walking	Department store, retail store	160	130	75	55	58	38
Walking; standing	Bank	160	145	75	70	—	—
Sedentary work	Restaurant	145	160	80	80	—	—
Light bench work	Factory	235	220	80	140	—	—
Moderate dancing	Dance hall	265	250	90	160	49	35
Walking; light machine work	Factory	295	295	110	185	—	—
Bowling	Bowling alley	440	425	170	255	—	—
Heavy work	Factory	440	425	170	255	54	19
Heavy machine work; lifting	Factory	470	470	185	285	—	—
Athletics	Gymnasium	585	525	210	315	—	—

Source: ASHRAE Handbook: *Fundamentals* (2001)⁽⁶⁾

4. Tasks

Task 1 – Design

Using the office floor plan in **figure 1** and specification provided including both solar data (**figure 3**) and occupation data (**figure 4**) charts. You have been asked to calculate the summer heat gain in kW for June between 12-1pm for the office.

You need to determine:

- a) heat ingress through walls
- b) solar gain
- c) internal occupancy heat loads

Conditions of assessment:

- The time allocated for this task is 3 hours
- You must carry out the task on your own, under controlled conditions

What must be produced for marking:

- Completed calculations showing all workings

Task 2 – Planning the installation

Your assessor will provide you with a specific working area and a drawing template to ensure the dimensions meet the centre's resources. You must ensure the drawing is applicable to the location you are being assessed in and all plans are to a suitable scale.

- a) Plan the installation of the air conditioning system as per the brief given **figure 2**.
- b) Measure and mark out work area as detailed in your plan

Conditions of assessment:

- The time allocated for this task is 3 hours
- You must carry out the task on your own, under controlled conditions

What must be produced for marking:

- Risk assessment
- Method statement with justifications

- Scale drawing of proposed working area
- Materials list

Additional evidence for this task:

- Assessor observation of measurements and marking out of space allocation/ work area checked against scale drawing

Task 3 – Install and Commission

- a) Carry out the installation of the air conditioning system in accordance with your drawing and as agreed by your assessor.
- b) All pipework is to be pressure tested (strength and tightness)
- c) Safely isolate the system then connect the electrical supply and interconnecting wiring to the air conditioning system and condensate pump from a suitably supplied electrical isolator.
- d) Upon successful completion of pressure and leak testing, commission the system as per manufacturer's instructions and handover.

Conditions of assessment:

- The time allocated for this task is 15 hours
- You must carry out the task on your own, under controlled conditions

What must be produced for marking:

- Completed installation
- Pressure test certificate
- Commissioning checklist
- Handover the system to the client

Additional evidence of this task:

Assessor observations: the installation of the system including the use of tools and working to tolerances, safe isolation procedure and handover.

Photographic evidence: the installation of the system, safe isolation, commissioning and handover.

Task 4 – Service and maintenance

Your assessor will provide you with three compressors

- a) Diagnose faults on each of the compressors
- b) Safely isolate then remove and refit a compressor from a designated charged condensing unit as directed by the assessor
- c) Conduct routine maintenance of a heat pump system and handover
- d) Produce a maintenance report including justifications for the work carried out

What must be produced for marking:

- Completed repair of the faults
- A report covering the service and maintenance that has been carried out with justification for methods used
- Legislative paperwork

Conditions of assessment:

- The time allocated for this task is 8 hours
- You must carry out the task on your own, under controlled conditions

Additional evidence for this task:

Assessor observation: fault diagnosis, decommissioning, safe isolation, and rectification of the fault.

End of Assessment

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