Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	ENERGY MANAGEMENT & CONSERVATION
COURSE CODE	:	BDE 40203
PROGRAMME	:	4 BDD
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE(5)** OF SIX (6) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Among the initiative of the Malaysian government to reduce the amount of fossil fuel consumption is through the introduction of Feed-in Tariff which was managed by SEDA. Discuss the Feed-in-Tariff mechanism and its direct benefits to the nation.

(10 marks)

(b) Upon achieving the objective of Feed-in-Tariff, SEDA later introduced Net Energy Metering. Discuss the reason for the introduction of Net Energy Metering and highlight the differences between Feed-in-Tariff and Net Energy Metering.

(10 marks)

Q2 (a) Electrical power producing companies around the world imposes maximum demand charges for commercial and industrial electricity tariffs. Elaborate:

(i) the importance of maximum demand;
(ii) how maximum demand is determined; and
(ii) methods for reducing the maximum demand charges.

(10 marks)

(b) Electrical energy usage from 1st to 7th October 2016 for Apartment Cempaka is given in **Figure Q2 (b)**. Based on the information in **Figure Q2 (b)** and **Table Q2 (b)**, determine the electricity bill for Apartment Cempaka from 1st to 7th October 2016 using:

(i) C1 tariff;
(ii) C2 tariff; and
(iii) discuss which tariff is preferable for Apartment Cempaka

(10 marks)

Q3 (a) To ensure the implementation of energy efficiency initiatives during design and development of commercial and industrial buildings, the Malaysian government via SIRIM has introduced Malaysian Standard MS1525. Discuss the scope of this standard and its importance to engineers.

(8 marks)

(b) A cubical building (10 m x 10 m x 10 m) with glass window on every side of the wall is shown **Figure Q3(b)**. The opaque wall is made by various materials with properties as in **Table Q3(b, i)**and **Table Q3(b, ii)**. If the solar absorptivity, α of the opaque wall is 0.5 while the thermal transmittance value of all windows are 2.1 W/m^{2}K, determine:

(i) the building's Overall Thermal Transfer Value (OTTV); and
(ii) total wall heat load.

(12 marks)

Q4 (a) MS1525 standard also outlines the architectural and passive design strategies to reduce overall energy consumption in buildings. Briefly discuss three (3) passive design strategies in MS1525 standard.

(6 marks)

(b) **Figure Q4 (b)** shows a building with 3 skylights on each section of the roof facing east and west. The roof is inclined 35° from horizontal plane. The opaque roof and skylight consist of several components shown in **Table Q4 (b, i)** and **Table Q4 (b, ii)**, while it's olar coorrection factor is given in **Table Q4 (b,iii)**. The shading co-efficient (SC) of skylight is 0.4 while the equivalent temperature difference is 20 K. If the temperature inside the building is maintained at 24°C while the ambient temperature outside is 33°C, calculate:

(i) the Roof Thermal Transfer Value (RTTV); and
(ii) total roof heat load

(14 marks)

Q5 (a) As a maintenance engineer in a factory, you have been asked to evaluate an energy efficiency project involving replacement of 985 T12 bulbs and 40 T8 bulbs as tabulated in **Table Q5 (a)**. Taking the burnt out rate of the lights as 12% for T12 bulbs and 5% for T8 bulbs,

(i) determine the total energy cost for lighting using tariff B as in **Table Q2 (b)**;
(ii) compare the monthly electrical energy cost if all the bulbs were replaced with T5 bulbs with specification given in **Table Q5 (a)**; and
(iii) calculate the simple payback period of the project.

(12 marks)

(b) An electrical components manufacturing facility records monthly electrical energy consumption of 200,000 kWh with reactive energy consumption of 250,000 kVArh. The facility uses tariff C1 as in **Table Q2 (b)**. If TNB imposes a 1.5% surcharge of total bill for power factor between 0.85 to 0.75 and 3% surcharge for power factor below 0.75, calculate the total payable bill by the facility to TNB.

(8 marks)

Q6 (a) **Figure Q6(a)** shows a typical daily electrical energy consumption in FNS Solution Sdn. Bhd. Based on the load profile, calculate the load factor and propose methods to improve the load factor.

(8 marks)

(b) Upon energy audit, an office building in Johor Bahru was found to have excessive amount ventilation air provided. This results result in higher amount of energy consumption in the air-conditioning system. Based on the audit data provided in **Table Q6 (b)**, evaluate the:
(i) amount of excess air provided for ventilation;
(ii) possible amount of electrical energy reduction; and
(iii) total saving (RM) in a year if the building operates 300 days/year and 8 hours/day if the amount of excess air avoided

(12 marks)

- END OF QUESTION –

FINAL EXAMINATION

SEMESTER / SESSION	: SEMESTER I / 2017-2018	COURSE	: 4 BDD
SUBJECT	: ENERGY MANAGEMENT & CONSERVATION	SUBJECT CODE	: BDE 40203

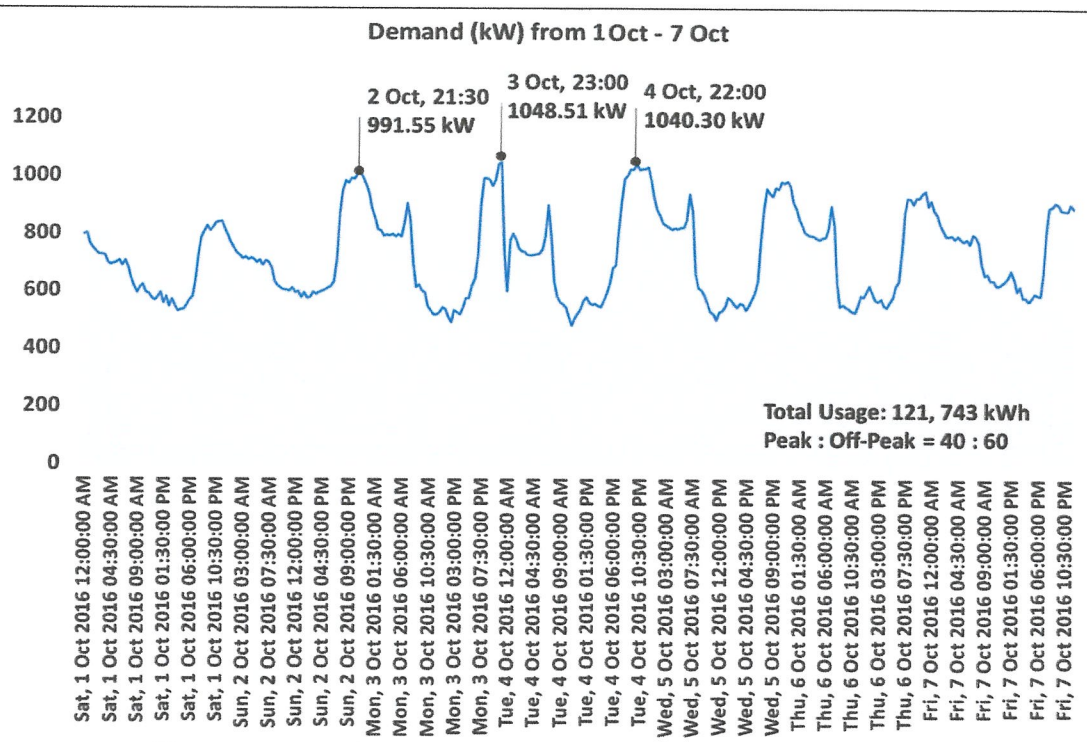


Figure Q2(b) Electrical energy usage for Apartment Cempaka

TARIFF CATEGORY	CURRENT RATES(1 JAN 2014)
TARIFF B - LOW VOLTAGE COMMERCIAL TARIFF	
For the first 200 kWh (1 -200 kWh) per month	43.5 sen/kWh
For the next kWh (201 kWh onwards) per month	50.9 sen/kWh
The minimum monthly charge is RM7.20	
TARIFF C1 - MEDIUM VOLTAGE GENERAL COMMERCIAL TARIFF	
For each kilowatt of maximum demand per month	30.3 RM/kW
For all kWh	36.5 sen/kWh
The minimum monthly charge is RM600.00	
TARIFF C2 - MEDIUM VOLTAGE PEAK/OFF-PEAK COMMERCIAL TARIFF	
For each kilowatt of maximum demand per month during the peak period	45.1 RM/kW
For all kWh during the peak period	36.5 sen/kWh
For all kWh during the off-peak period	22.4 sen/kWh
The minimum monthly charge is RM600.00	

Table Q2 (b) Electricity Tariff

FINAL EXAMINATION

SEMESTER / SESSION	: SEMESTER I / 2017-2018	COURSE	: 4 BDD
SUBJECT	: ENERGY MANAGEMENT & CONSERVATION	SUBJECT CODE	: BDE 40203

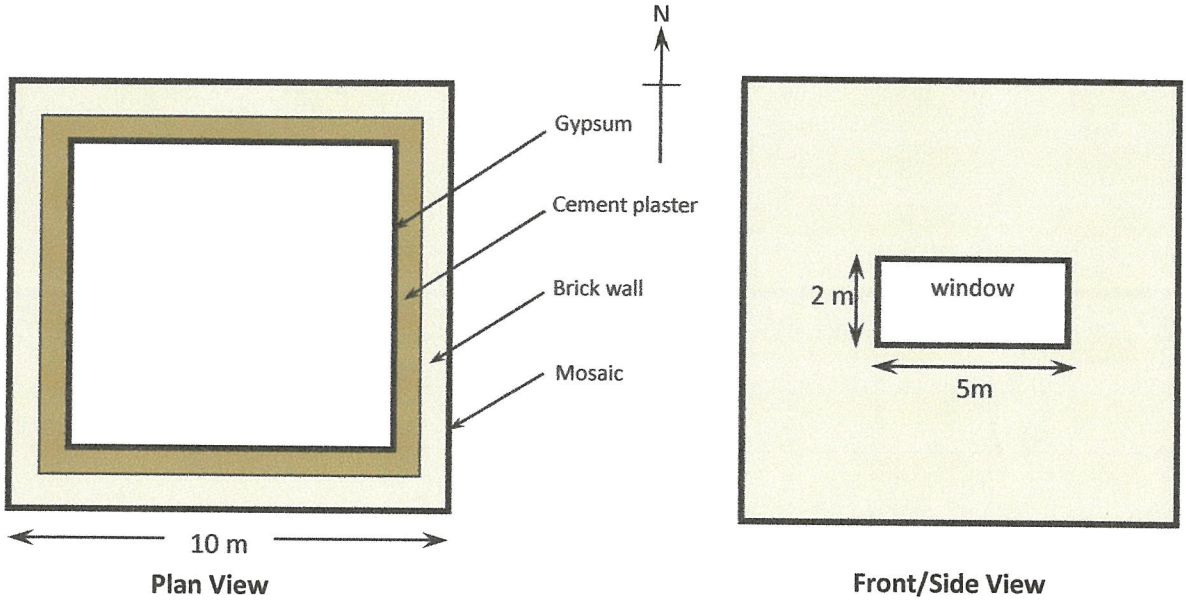


Figure Q3 (b) Building's view

Component	R (m^2K/W)
Outside air film	0.051
Gypsum	0.071
Cement Plaster	0.031
Brick wall	0.141
Mosaic	0.011
Inside air film	0.121

Table Q3(b, i) Wall properties

Orientation	N	NE	E	SE	S	SW	W	NW
CF	0.90	1.09	1.23	1.13	0.92	0.90	0.94	0.90

Table Q3(b, ii) Solar Correction Factor

Individual wall:

$$OTTV_i = 15\alpha(1 - WWR)U_w + 6(WWR)U_f + (194 \times CF \times WWR \times SC)$$

Overall:

$$OTTV = \frac{A_1 \times OTTV_1 + A_2 \times OTTV_2 + \ldots A_n \times OTTV_n}{A_1 + A_2 + \ldots A_n}$$

FINAL EXAMINATION

SEMESTER / SESSION	: SEMESTER I / 2017-2018	COURSE	: 4 BDD
SUBJECT	: ENERGY MANAGEMENT & CONSERVATION	SUBJECT CODE	: BDE 40203

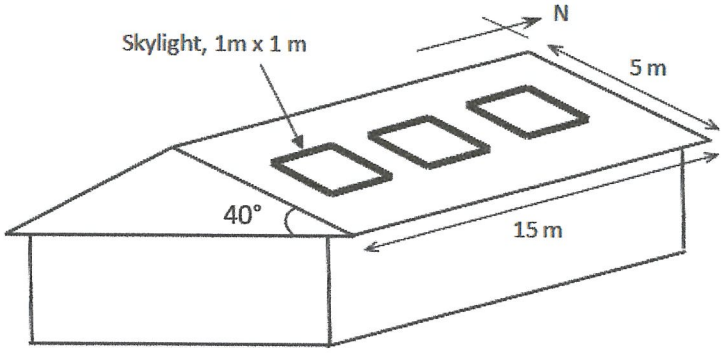


Figure Q4 (b) Roof configuration of the building

Component	R (m^2K/W)
Outside air film	0.051
Cement plaster	0.031
RC Roof	0.171
Fibreglass	2.141
Gypsum board	0.071
Inside air film	0.141

Table Q4(b, i) Opaque roof

Component	R (m^2K/W)
Outside air film	0.051
Glass	0.008
Air space	0.175
Inside air film	0.162

Table Q4(b, ii) Skylight

Slope Angle (°)	Orientation				
	North/South	East	West	Northeast/ Southeast	Northwest/ Southwest
5 – 30	1.00	1.01	0.99	1.01	0.99
35 – 45	0.88	0.96	0.83	0.94	0.84
50 – 55	0.77	0.88	0.73	0.84	0.73
**Note: The correction factors for other orientations and other pitch angles may be found by interpolation*					

Table Q4(b,iii) Solar correction factor for roof

Individual roof:

$$RTTV = \frac{(A_r \times U_r \times TD_{eq}) + (A_s \times U_s \times \Delta T) + (A_s \times SC \times SF)}{A_0}$$

Overall:

$$RTTV = \frac{A_1 \times RTTV_1 + A_2 \times RTTV_2 + \ldots A_n \times RTTV_n}{A_1 + A_2 + \ldots A_n}$$

$$SF = 323 \times CF$$

FINAL EXAMINATION

SEMESTER / SESSION	: SEMESTER I / 2017-2018	COURSE	: 4 BDD
SUBJECT	: ENERGY MANAGEMENT & CONSERVATION	SUBJECT CODE	: BDE 40203

Type	Quantity	Watt	Daily Usage (Hour)	Price Per Unit (RM)
T12	985	34	6.5	11
T8	40	32	6.0	16
T5	-	18	-	21

Table Q5 (a) Bulbs specification

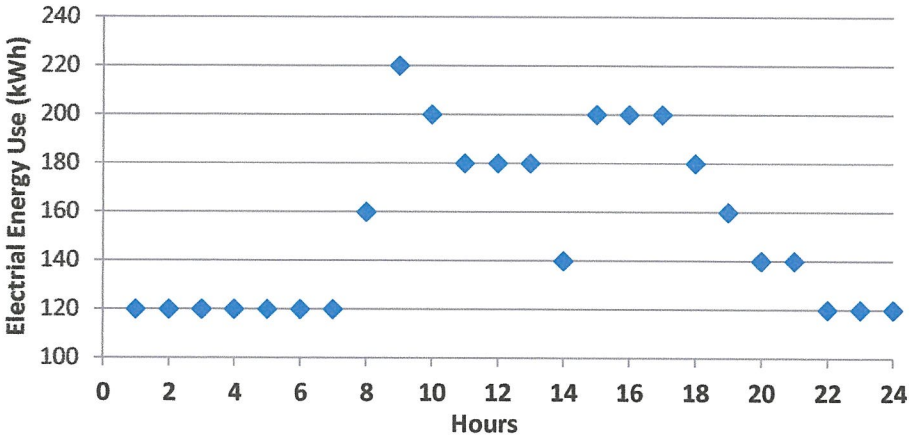


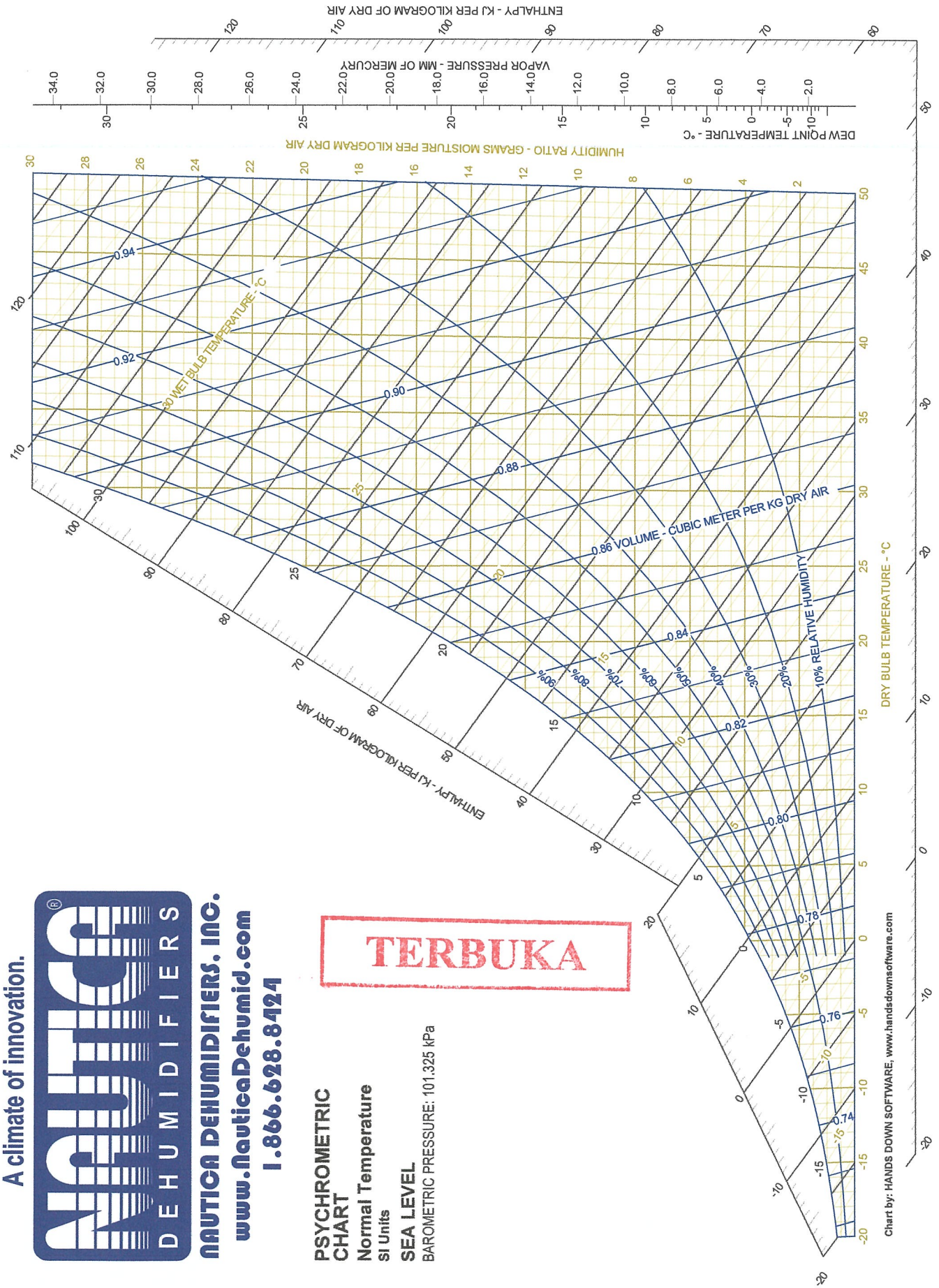
Figure Q6 (a) Load profile for a typical day in FNS Solution Sdn. Bhd.

Outside air temperature	:	35°C
Inside air temperature	:	25°C
Outside Relative Humidity	:	70%
Inside Relative Humidity	:	50%
Total occupancy	:	80 persons
Required ventilation/person	:	5 litres/person
Floor area	:	525 m^2
Ventilation duct size	:	0.25 m^2
Ventilation air velocity	:	2.5 m/s
COP of air-cond. system	:	3.5
Electricity tariff (C1)	:	RM 0.365/kWh

Table Q6 (b) Energy audit data from office building

$SH = 1.21 \times \dot{Q} \times \Delta T$

$LH = 3 \times \dot{Q} \times \Delta M$



CONFIDENTIAL