MERCHANT SHIPPING SECRETARIAT
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : SHIP BOARD OPERATIONS
DATE : 23rd November 2017 at 0900hrs

Time allowed THREE hours	Total marks : 180
ANSWER ALL QUESTIONS	Pass marks : 60%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **not** allowed.

1) With regard to Trading Certificates on board a vessel,

a) Explain how and why flag states delegate the responsibilities to Classification Societies for the purpose of maintain the safe operation of their vessels. **(12 marks)**

b) Explain the benefit of harmonizing the surveys on board from the viewpoint of ship owner, vessel's class and seafarer. **(10 marks)**

c) What main differences could you highlight in the trading certificates of a Bulk Carrier and a Passenger vessel ? **(08 marks)**

2) With regard to the IMDG Code,

a) Explain the objectives of the code. **(08 marks)**

b) Explain how a DG package of multiple hazards and a severe pollutant by nature is labeled before being placed on board a vessel. **(08 marks)**

c) Explain the importance of entries under the following columns in the Dangerous Cargo manifest.

(i) Subsidiary Risk (ii) Limited Quantities (iii) Packing group **(09 marks)**

d) What are the content of the dangerous goods declaration form? . **(05 marks)**

3) a) Ballast water convention was adopted years ago in 2004 and now it will come into enforce in September 2017. Describe the reasons for this long delay. (05 marks)

b) What certificates, documents and records are required to carry on board vessels engaged in international trade to comply with the ballast water convention requirements? (05 marks)

c) Explain LD_1 and D_2 standards of ballastwater management (10 marks)

d) With reference to MARPOL, all vessels when discharging machinery space bilges shall comply with Annex I in special areas as well as outside special areas. Describe how you discharge machinery space bilges from your vessel. (10 marks)

4) Answer the following questions with regard to carriage of goods:

a) During the process of drawing stowage plan, ship's officers are required to gather various information to develop an effective stowage plan. List the important information you should consider when preparing an effective stowage plan. (12 marks)

b) Over carriage and short landing of cargoes will leads to huge financial losses in merchant shipping trade. Briefly explain what precautions to be taken as a chief officer to minimize such claims. (08 marks)

c) Ventilation in merchant ships is being used for varieties of situations. Briefly explain main purposes of ventilation and give practical examples for each purpose you mention. (10 marks)

5) A ship of Length 170 m; Beam 30 m; GM 2.6 m; Speed 16 knots is to load at 0.3L on deck low. Specification of cargo unit are mass = 58 t; dimensions = 12 x 3 x 6 m.

With the aid of the attached data tables, find the minimum required number of lashing if following lashings is to use.

Securing material to use are:
Wire rope (re-useable), breaking strength = 150 kN
Shackles, turnbuckles, deck rings: breaking strength = 160 kN
Stowage on dunnage boards

(30 marks)

6) With reference to grain regulations explain,

a) what are the minimum criterion to comply for a vessel to set out to sea with a consignment of grain?

(10 marks)

b) how the heeling arm due to grain shift is derived and what are the parameters for the vessel to remain seaworthy?

(10 marks)

c) what actions you could take to improve the situation if the vessel is found not complying with the requirements?

(10 marks)

Shipboard Operations

Formulas and Tables to be used for Lashing Calculations

External forces calculating formula

$$F_{(x,y,z)} = ma_{(x,y,z)} + F_{w(x,y)} + F_{s(x,y)}$$

Balance forces calculation formulas

Transverse sliding : $\mathbf{Fy \leq \mu \cdot m \cdot g + fy_1 \cdot CS_1 + ... + fy_n \cdot CS_n}$

Longitudinal sliding : $\mathbf{Fx \leq \mu(m \cdot g - Fz) + fx_1 \cdot CS_1 + ... + fx_n \cdot CS_n}$

Transverse tipping : $\mathbf{Fy \cdot a \leq b \cdot m \cdot g + 0.9(CS_1 \cdot c_1 + CS_2 \cdot c_2 + ... + CS_n \cdot c_n)}$

MSLs for different securing devices (Table 1)

Material	MSL
Shackles, deckeyes, twistlocks, lashing rods, D-rings, stackers, bridge fittings, turnbuckles of mild steel	50% of breaking strength
Fibre rope	33% of breaking strength
Wire rope (single use)	80% of breaking strength
Wire rope (re-useable)	30% of breaking strength
Steel band (single use)	70% of breaking strength
Chains	50% of breaking strength
Web lashings	50% of breaking strength

The basic acceleration data (Table 2)

Transverse acceleration a_y in m/s²										Longitudinal acceleration a_x in m/s²
on deck, high	7.1	6.9	6.8	6.7	6.7	6.8	6.9	7.1	7.4	3.8
on deck, low	6.5	6.3	6.1	6.1	6.1	6.1	6.3	6.5	6.7	2.9
'tween-deck	5.9	5.6	5.5	5.4	5.4	5.5	5.6	5.9	6.2	2.0
lower hold	5.5	5.3	5.1	5.0	5.0	5.1	5.3	5.5	5.9	1.5
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9 L
Vertical acceleration a_z in m/s²										
	7.6	6.2	5.0	4.3	4.3	5.0	6.2	7.6	9.2	

Correction factors for length and speed (Table 3)

Length [m] / Speed [kN]	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300
9	1,37	1,31	1,20	1,09	1,00	0,92	0,85	0,79	0,70	0,63	0,57	0,53	0,49	0,41	0,36
12	1,56	1,47	1,34	1,22	1,12	1,03	0,96	0,90	0,79	0,72	0,65	0,60	0,56	0,48	0,42
15	1,75	1,64	1,49	1,36	1,24	1,15	1,07	1,00	0,89	0,80	0,73	0,68	0,63	0,55	0,48
18	1,94	1,80	1,64	1,49	1,37	1,27	1,18	1,10	0,98	0,89	0,82	0,76	0,71	0,61	0,54
21	2,13	1,96	1,78	1,62	1,49	1,38	1,29	1,21	1,08	0,98	0,90	0,83	0,78	0,68	0,60
24	2,32	2,13	1,93	1,76	1,62	1,50	1,40	1,31	1,17	1,07	0,98	0,91	0,85	0,74	0,66

Table 3 – Correction factors for length and speed

Correction factor for B/GM<13 (Table 4)

B / GM	4	5	6	7	8	9	10	11	12	13 →
on deck, high	2,30	1,96	1,72	1,56	1,40	1,27	1,19	1,11	1,05	1,00
on deck, low	1,92	1,70	1,53	1,42	1,30	1,21	1,14	1,09	1,04	1,00
Tween-deck	1,54	1,42	1,33	1,26	1,19	1,14	1,09	1,06	1,03	1,00
lower hold	1,31	1,24	1,19	1,15	1,12	1,09	1,06	1,04	1,02	1,00

Table 4 - Correction factors for B/GM < 13

Friction coefficients (μ) (Table 5)

Materials in contact	**Friction coefficient, (μ)**
timber-timber, wet or dry	0,4
steel-timber or steel-rubber	0,3
steel-steel, dry	0,1
steel-steel, wet	0,0

Table 5 – Friction coefficients

Table 7 – fx-values and fy-values as a function of α, β and μ

Table 7.1 for μ = 0.4

β for fy	α														β for fx
	-30	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.67	0.80	0.92	1.00	1.05	1.08	1.07	1.02	0.99	0.95	0.85	0.72	0.57	0.40	**90**
10	0.65	0.79	0.90	0.98	1.04	1.06	1.05	1.01	0.98	0.94	0.84	0.71	0.56	0.40	**80**
20	0.61	0.75	0.86	0.94	0.99	1.02	1.01	0.98	0.95	0.91	0.82	0.70	0.56	0.40	**70**
30	0.55	0.68	0.78	0.87	0.92	0.95	0.95	0.92	0.90	0.86	0.78	0.67	0.54	0.40	**60**
40	0.46	0.58	0.68	0.77	0.82	0.86	0.86	0.84	0.82	0.80	0.73	0.64	0.53	0.40	**50**
50	0.36	0.47	0.56	0.64	0.70	0.74	0.76	0.75	0.74	0.72	0.67	0.60	0.51	0.40	**40**
60	0.23	0.33	0.42	0.50	0.56	0.61	0.63	0.64	0.64	0.63	0.60	0.55	0.48	0.40	**30**
70	0.10	0.18	0.27	0.34	0.41	0.46	0.50	0.52	0.52	0.53	0.52	0.49	0.45	0.40	**20**
80	-0.05	0.03	0.10	0.17	0.24	0.30	0.35	0.39	0.41	0.42	0.43	0.44	0.42	0.40	**10**
90	-0.20	-0.14	-0.07	0.00	0.07	0.14	0.20	0.26	0.28	0.31	0.35	0.38	0.39	0.40	**0**

Table 7.2 for μ = 0.3

β for fy	α														β for fx
	-30	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.72	0.84	0.93	1.00	1.04	1.04	1.02	0.96	0.92	0.87	0.76	0.62	0.47	0.30	**90**
10	0.70	0.82	0.92	0.98	1.02	1.03	1.00	0.95	0.91	0.86	0.75	0.62	0.47	0.30	**80**
20	0.66	0.78	0.87	0.94	0.98	0.99	0.96	0.91	0.88	0.83	0.73	0.60	0.46	0.30	**70**
30	0.60	0.71	0.80	0.87	0.90	0.92	0.90	0.86	0.82	0.79	0.69	0.58	0.45	0.30	**60**
40	0.51	0.62	0.70	0.77	0.81	0.82	0.81	0.78	0.75	0.72	0.64	0.54	0.43	0.30	**50**
50	0.41	0.50	0.58	0.64	0.69	0.71	0.71	0.69	0.67	0.64	0.58	0.50	0.41	0.30	**40**
60	0.28	0.37	0.44	0.50	0.54	0.57	0.58	0.58	0.57	0.55	0.51	0.45	0.38	0.30	**30**
70	0.15	0.22	0.28	0.34	0.39	0.42	0.45	0.45	0.45	0.45	0.43	0.40	0.35	0.30	**20**
80	0.00	0.06	0.12	0.17	0.22	0.27	0.30	0.33	0.33	0.34	0.35	0.34	0.33	0.30	**10**
90	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.19	0.21	0.23	0.26	0.28	0.30	0.30	**0**

Table 7.3 for μ = 0.2

β for fy	α														β for fx
	-30	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.77	0.87	0.95	1.00	1.02	1.01	0.97	0.89	0.85	0.80	0.67	0.53	0.37	0.20	**90**
10	0.75	0.86	0.94	0.98	1.00	0.99	0.95	0.88	0.84	0.79	0.67	0.52	0.37	0.20	**80**
20	0.71	0.81	0.89	0.94	0.96	0.95	0.91	0.85	0.81	0.76	0.64	0.51	0.36	0.20	**70**
30	0.65	0.75	0.82	0.87	0.89	0.88	0.85	0.79	0.75	0.71	0.61	0.48	0.35	0.20	**60**
40	0.56	0.65	0.72	0.77	0.79	0.79	0.76	0.72	0.68	0.65	0.56	0.45	0.33	0.20	**50**
50	0.46	0.54	0.60	0.64	0.67	0.67	0.66	0.62	0.60	0.57	0.49	0.41	0.31	0.20	**40**
60	0.33	0.40	0.46	0.50	0.53	0.54	0.53	0.51	0.49	0.47	0.42	0.36	0.28	0.20	**30**
70	0.20	0.25	0.30	0.34	0.37	0.39	0.40	0.39	0.38	0.37	0.34	0.30	0.26	0.20	**20**
80	0.05	0.09	0.14	0.17	0.21	0.23	0.25	0.26	0.26	0.26	0.26	0.25	0.23	0.20	**10**
90	-0.10	-0.07	-0.03	0.00	0.03	0.07	0.10	0.13	0.14	0.15	0.17	0.19	0.20	0.20	**0**

Table 7.4 for μ = 0.1

β for fy	α														β for fx
	-30	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.82	0.91	0.97	1.00	1.00	0.97	0.92	0.83	0.78	0.72	0.59	0.44	0.27	0.10	**90**
10	0.80	0.89	0.95	0.98	0.99	0.96	0.90	0.82	0.77	0.71	0.58	0.43	0.27	0.10	**80**
20	0.76	0.85	0.91	0.94	0.94	0.92	0.86	0.78	0.74	0.68	0.56	0.42	0.26	0.10	**70**
30	0.70	0.78	0.84	0.87	0.87	0.85	0.80	0.73	0.68	0.63	0.52	0.39	0.25	0.10	**60**
40	0.61	0.69	0.74	0.77	0.77	0.75	0.71	0.65	0.61	0.57	0.47	0.36	0.23	0.10	**50**
50	0.51	0.57	0.62	0.64	0.65	0.64	0.61	0.56	0.53	0.49	0.41	0.31	0.21	0.10	**40**
60	0.38	0.44	0.48	0.50	0.51	0.50	0.48	0.45	0.42	0.40	0.34	0.26	0.19	0.10	**30**
70	0.25	0.29	0.32	0.34	0.35	0.36	0.35	0.33	0.31	0.30	0.26	0.21	0.16	0.10	**20**
80	0.10	0.13	0.15	0.17	0.19	0.20	0.20	0.20	0.19	0.19	0.17	0.15	0.13	0.10	**10**
90	-0.05	-0.03	-0.02	0.00	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.10	**0**

Table 7.5 for μ = 0.0

β for fy	α														β for fx
	-30	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.87	0.94	0.98	1.00	0.98	0.94	0.87	0.77	0.71	0.64	0.50	0.34	0.17	0.00	**90**
10	0.85	0.93	0.97	0.98	0.97	0.93	0.85	0.75	0.70	0.63	0.49	0.34	0.17	0.00	**80**
20	0.81	0.88	0.93	0.94	0.93	0.88	0.81	0.72	0.66	0.60	0.47	0.32	0.16	0.00	**70**
30	0.75	0.81	0.85	0.87	0.85	0.81	0.75	0.66	0.61	0.56	0.43	0.30	0.15	0.00	**60**
40	0.66	0.72	0.75	0.77	0.75	0.72	0.66	0.59	0.54	0.49	0.38	0.26	0.13	0.00	**50**
50	0.56	0.60	0.63	0.64	0.63	0.60	0.56	0.49	0.45	0.41	0.32	0.22	0.11	0.00	**40**
60	0.43	0.47	0.49	0.50	0.49	0.47	0.43	0.38	0.35	0.32	0.25	0.17	0.09	0.00	**30**
70	0.30	0.32	0.34	0.34	0.34	0.32	0.30	0.26	0.24	0.22	0.17	0.12	0.06	0.00	**20**
80	0.15	0.16	0.17	0.17	0.17	0.16	0.15	0.13	0.12	0.11	0.09	0.06	0.03	0.00	**10**
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0**

Remark: $fx = \cos\alpha \cdot \sin\beta + \mu \cdot \sin\alpha$ $fy = \cos\alpha \cdot \cos\beta + \mu \cdot \sin\alpha$

Answers

Answer 5

Fx=161Kn ,Fy= 350Kn , Fz=290Kn (rounded values)
Fwd/Aft Lashing :3 Lashing each side or to be compensate with transverse lashings
Transverse Lashings: 6 Lashings each side
Vertical Lashings: Not required