CHRISTIAN SOCIAL SERVICES COMMISSION (CSSC)

NORTHEN ZONE JIONT EXAMINATIONS SYNDICATE (NZ-JES)

FORM FOUR PRE-NATIONAL EXAMINATION 2024

ENGINEERING SCIENCE

MARKING SCHEME

1.

i	Ii	iii	iv	v	vi	vii	viii	ix	x
D	B	E	A	B	C	A	B	A	A

10 marks @ 01

2

LIST A	I	ii	iii	iv	v	vi
LIST B	G	I	F	E	K	D

06marks @01 mark

SECTION B

3. Data given

R = 10m

Angle = 45° 01mark

H_{max} = ?

R/H_{max} = 4/Tan angle 01mark

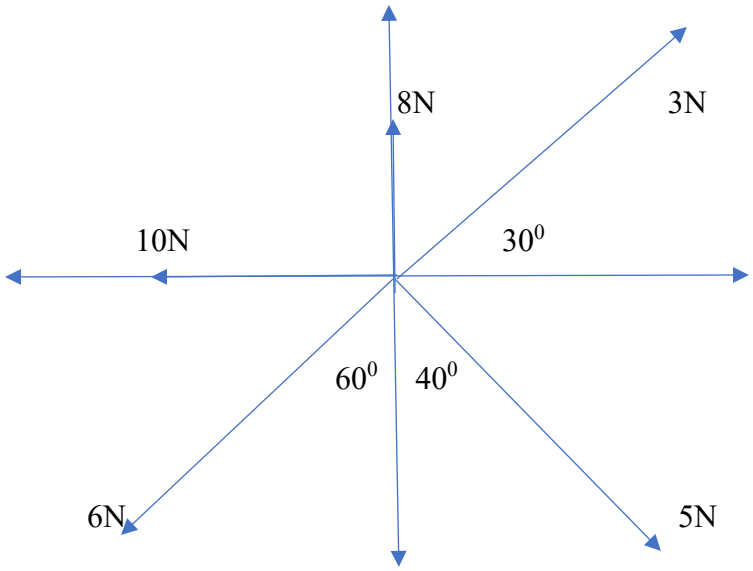
$10m/H_{max}$ =4/Tan 45°

$10m/H_{max}$ = 4/1

H_{max} = 10m/4

H_{max} = 2.5m 01 mark

(b)



01 mark

Rx = F2cos 0° +F3cos 30° +F4 cos 45° +F5cos30°

Rx = -10N + -5.2N +3.54N + 2.6N

Rx = -9.06N 01mark

Ry = F1sin90° + F3sin30°+ F4 sin45° + F5sin 30°

Ry = 8N - 3N -3.54N + 1.5N

Ry= 2.96N 01mark

Resultant (P) = $\sqrt{Rx^2+Ry^2}$

P = $\sqrt{-9.06^2+2.96^2}$

P= $\sqrt{82.1+8.76}$

P= $\sqrt{90.86}$

P= 9.53N. 02 marks

Direction of resultant (P)

Angle = $\tan^{-1}(Ry/Rx)$

Angle = $\tan^{-1}(2.96/-9.06)$

Angle= $\tan^{-1}(-0.327)$

Angle=18°. 01 mark!

4.(a) When the efficiency of machine is 100%,this means that the total work done by the machine is equal to the total workput by the machine or mechanical advantage is equal to the velocity ratio. 02mark

(b) Data given

L = 2.6 m

V.R = 8

Efficiency = 68%

L = 80N. 01mark

Ed =?

E= ?

From; V.R = Ed/Le

But L = Ed + Ld. ½mark

2.6 = Ed + Ld

Ed = 2.6 – Ld ½mark

8 = 2.6 - Ld/Ld

8Ld = 2.6- Ld

8Ld+Ld = 2.6

9Ld = 2.6 Divide by 9 both sides

Ld = 0.29m 02 mark

Distance moved by effort is 2.31m

(ii) Efficiency = M.A/V.R × 100%. 01mark

68% = M.A/8 × 100%

M.A = 5.44

From M.A = L/E

5.44 =80/E

E = 14.7N. 02 mark

5.(a) The space is left to allow the iron girder to expand during the hot weather there by preventing damage to the bridge. 02 mark

(b) $T_1 = 20°C$

$L_o = 9.32mm$

$L = 9.36mm$

Cofficient of linear expansion (&) = 0.000017/°C. 01 mark

$T_2 = ?$

& = L - L_o/L_o× rise in temp

Rise in temp = L_1 - L_o/&× Lol. 01 mark

= 9.36 - 9.32/0.000017×9.32

=253.2°C. 03 marks

But rise in temp=T_2-T_1

T_2 = Rise in temp+T_1

T_2 = 253.2 +28

T_2 = 281.2°C. 02marks

6.(i) During the day there is high temperature which cause the increase in length of vibrating body , results the decrease in frequency. 01mark

(ii) Each music instrument is designed to produce a specific note ,the note produced by violin which is string instrument is different with the note produced by flute which is wind instrument. 01 mark

(b). Data given

L = 40cm = 0.4m

m = 2×10^{-3} Kg

T = 100N

f_1 = ? 01 mark

f_2 =?

$f_n = nv/2L.$ 01 mark

But $V = \sqrt{T/M}$

$M = m/L$

$M = 0.002/0.4$

$M = 0.005Kg/m$ 02mark

$V = \sqrt{100/0.005}$

$V = \sqrt{20000}$

$V = 141.42m/s.$ 01 mark

$f_1 = 1 \times 141.42/2 \times 0.4$

$f_1 = 141.42/0.8$

$f_1 = 176.8$ Hz 01 mark

$f_2 = 2 \times 141.42/2 \times 0.4$

$f_2 = 282.84/0.8.$ 01 mark

$f_2 = 353.55$ Hz

7.(a) Data given

Torque = 150Nm

$w_o = 0$ rev/min

$w_1 = 250$rev/min 01 mark

t = 15s

From

(i) $w = 2\pi \times 250/60s$

$w = 1570.8$rad/60s

$w = 26.2$rad/s 01 mark

(ii) $w = w_o + at$

$26.2 = 0 + 15a$

$a = 1.7\ rad/sec^2$ 01 mark

(b) Data given

$m = 500g = 0.5\ Kg$

$T_1 = -15°C$

$T_2 = 100°C$

$H_t = ?$

$C_i = 2100J/KgK.$ 01 mark

$C_w = 4200J/KgK$

$L_i = 33,600J/Kg$

$L_s = 2,260,000J/Kg$

Heat required to raise temperature of steam from -15°C to 0°C

$H_1 = 0.5 \times 2100 \times 15$

$H_1 = 15,750J$ 01mark

Heat required to convert ice into water

$H_2 = m_i \times L_i$

$H_2 = 0.5 \times 33,600$

$H_2 = 16,800J.$ 01mark

Heat required to raise temperature of water from 0°C to 100°C

$H_3 = 0.5 \times 4200 \times 100$

$H_3 = 210,000J.$ 01mark

Heat required to convert water into steam

$H_4 = m_s \times L_v$

$H_4 = 0.5 \times 2260000$

$H_4 = 1,130,000J$ 01mark

Totat Heat,$= H_1 + H_2 + H_3 + H_4$

Ht = 1,570J + 16,800J + 210,000J +1,130,000J

Ht =1,372,550J 01mark

8 (a) The output voltage is d.c and is always positive in value 01 mark

03 marks

(b) Data given

L = 120cm = 1.2m

n = 40 oscillations

t = 88s. 01 mark

g=?

From $T = 2\pi\sqrt{L/g}$

$T^2 = (2\pi\sqrt{L/g})^2$

$T^2 = 4\pi^2 L/g$

$g = 4\pi^2 L/T^2$. 02 mark

But T = t/n

T = 88/40

T= 2.2s

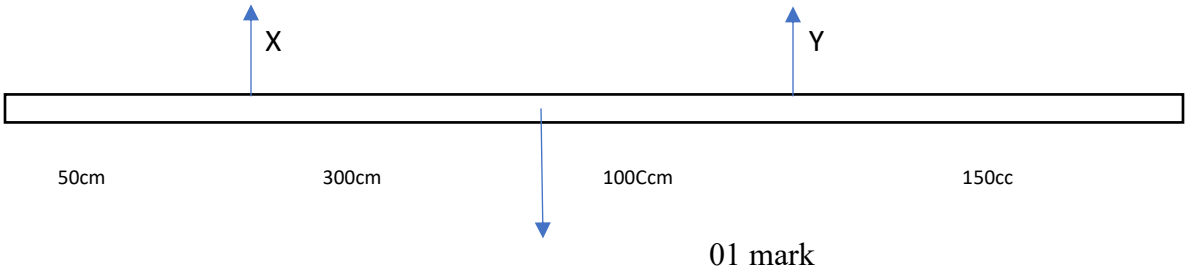
$g = 4 \times (3.14)^2 \times 1.2/2.2^2$

$g = 47.33m/4.84s^2$

$g = 9.8m/s^2$. 02 mark

SECTION C

9.(a)



01 mark

Take X be a fulcrum

Mclockwise = M anticlockwise. 01 mark

9Kg × 200cm = Y × 300cm

1800Kgcm = 300cmY ,Divide by 300 cm both side

Y = 6Kg ,but 1Kg = 10N

Y = 60N. 02 marks

From Upward forces = Downward forces

X + Y = 90N

X + 60N = 90N

X = 90N - 60N

X = 30N 02marks

The tensions of the wires are 60N and 30 N.

(b) Data given

V = 240V

m = 150 Kg

T_1 =20°C

T_2 =40°C

R = 25 Ohms 02 marks

C_w = 4200J/Kg°C

t = ?

Electrical energy = Heat energy

I t v = m c_w T 01 mark

But I = V/R

V^2t/R = m c_w T

$240^2t/25 = 150 \times 4200 \times 20$ 01 mark

2304t = 12,600,000 divide by 2304 both sides

t = 5,468.75 Seconds. 02 marks

(ii) P = IV

But I = V/R

$P = V^2/R$ 01 mark

$P = 240^2/25$

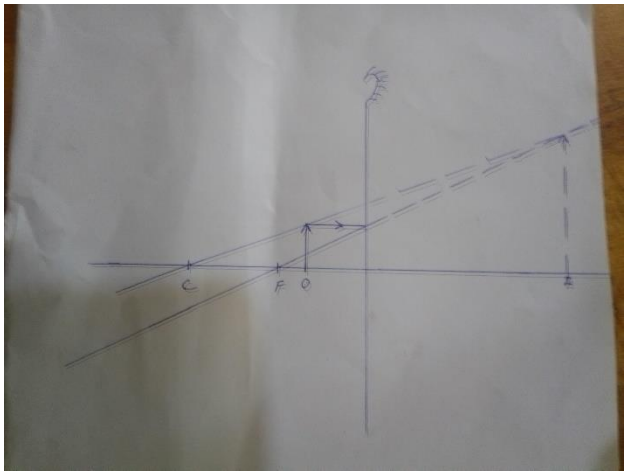
P = 57,600/25

P = 2304 Watts 02 marks

10 (a) (i) - it produce small and erect image

- it has a wide field of view. 02 marks

(ii)



03 marks

(b) Data given

f = +20cm

$h_i = 3h_o$

u = ? 02 marks

v = ?

$M = h_i/h_o = v/u$ 01 mark

$3h_o / h_o = v/u$

$v = 3u$ 02 marks

Then, $1/f = 1/u + 1/v$ 01 mark

$1/20 = 1/u + 1/3u$

$1/20 = 3 + 1/3u$

$3u = 80$ divide by 3 both sides

$u = 26.67$ cm. 02 marks

The object distance is 26.67 cm

(ii) from $v = 3u$

$v = 3 \times 26.67$ cm

$v = 80$ cm. 02 marks

The image distance is 80 cm

11.(a) Data given

$V = 2$ V

$R_g = 300$ Ohms. 01 mark

$I = ?$

$I = V/R.$

$I = 2/300$

$I = 0.0067$A. 02 marks

But $V_m = 15$ V

From $R_m = V_m - IR_g / I.$ 0½mark

$R_m = 15 - 0.0067 \times 300/0.0067$

$R_m = 12.99/0.0067$

R_m = 1938.8 Ohms. 01½marks

(ii) R_s = IgRg /Im 0½marks

Rs = 0.0067 × 300/0.2

Rs = 10.05 Ohms. 01½ marks

(b) Data given

Efficiency = 80%

V_p = 24 V

V_s = 240 V

N_p =100 turns

I_p = 3A. 01 mark

N_s = ?

I_p = ?

(i) Np/Ns = Vp/Na

100/Ns = 24/240 by crossing multiplication

24Ns/24 = 24,000/24

Ns = 1000 turns. 02 marks

Number of turns in secondary coil is 1000 turns

(ii) Efficiency = Ps/Pp × 100%. 0½mark

But Pp = IpVp

Pp = 3 × 24

Pp = 72 Watts. 01½ marks

80% = Ps/72 × 100% By crossing multiplication

100%Ps = 5760%. Divide by 100% both sides

Ps = 57.6 W. 01 mark

But Ps = IsVs

Is = Ps/Vs

Is = 57.6/240

Is = 0.24 A. 02 marks

The current in secondary coil is 0.24 A