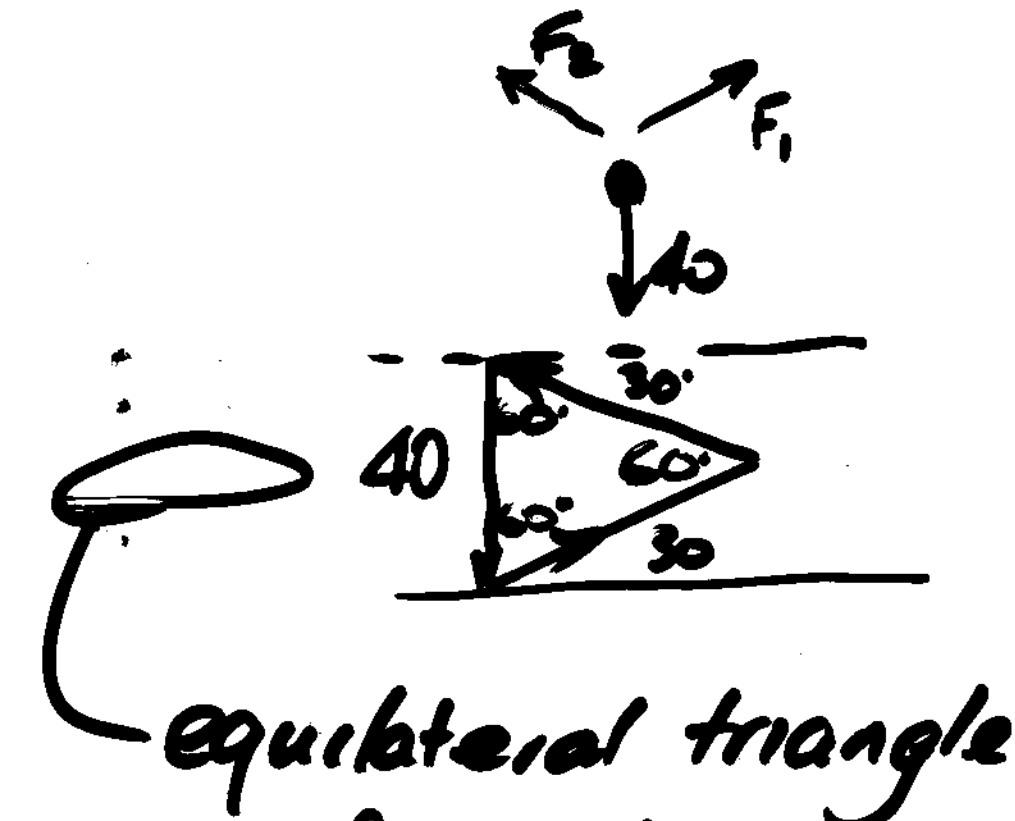
HSC ANSWERS 2009.

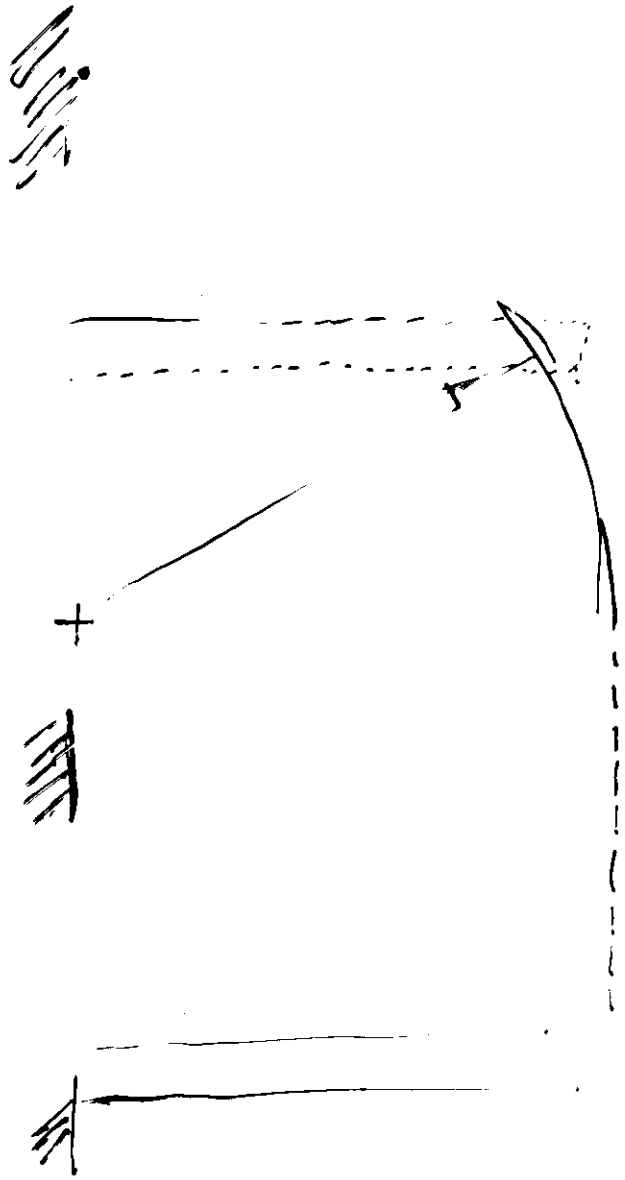
- Print these out onto overheads
- Get a copy of the 2009 HSC
- Overlay the transparency onto the exam paper.
- Voila!- a set of worked answers



equilateral triangle
= force solution

3

4



=> scale drwg
= Graphical
solution

80mm x 100
= 8000 mm
= 8 m

6

$\mu = 0.33$

$\tan^{-1} 0.33 = \theta_k$

$\theta_k = 18.3°$

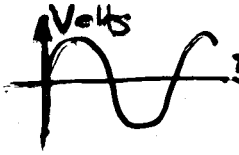
∴ slips down

7

Not weldability % heat treated

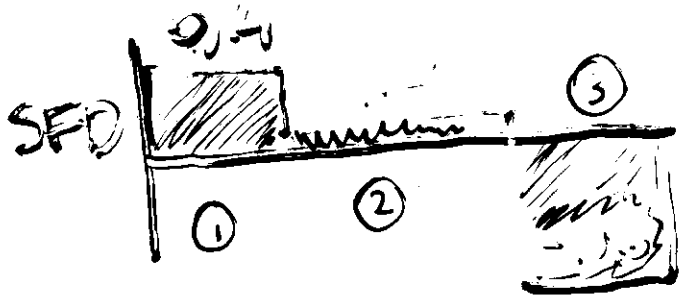
missing word???

The equivalent RMS voltage of an AC voltage is 0.707 × Peak AC voltage.

"The equivalent DC voltage of this 

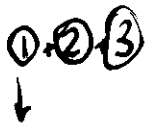
= Ø

? → see →



area 1 = + 32.9 kNm
area 2 = + 4.2 kNm
area 3 = − 37.1 kNm

MAXIMUM BENDING MOMENT



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Section II

(a)

- Manage to a budget
- Manage to timeline (keep on track)
- Ensure safety regulation adhered to.

} plus alot more

(b) → sketch in general terms

(i) Prefabrication = Innovation in construction method
- Sections of the bridge made offsite & transported to jobsite, erected as a unit.

[could also be electric arc welding as another]

(ii) Alloy Steels – In 1890, not much was known about alloy steel. By adding alloying elements to steel, you increase its strength & hardness by restricting dislocation movement.

Question 11

(c)

= more than 1

Provide characteristics & features

Issues that engineers would need to consider would include a way to avoid sections from rotting as it's a timber bridge. - paint (chemical treatments.) They would also have to source & specify suitable replacement timber as solid ironbark 14" - 18" square needs to be now sourced especially from old growth forests. It appears as though the bridge is still used (Armco guardrail) ⇒ engineers would also determine suitable weight limits.

Provide Why & how

This bridge carries rail traffic over a roadway.

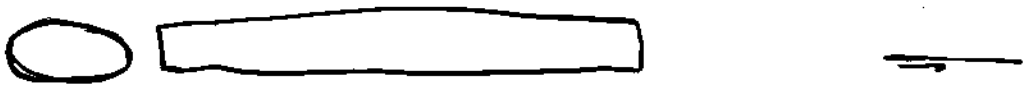
- During construction, engineers from the RTA would have worked to ensure that road traffic was impacted minimally by construction, the Rail Engineers would have worked to manage rail systems in working order, while CIVIL Engineers would have built the bridge for their employer.

It is important that they work in teams to minimise potential disruption & inconvenience to the public and to provide their particular expertise to the planning.

Question 12

(a)

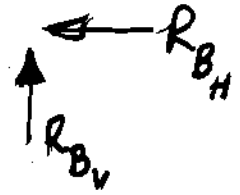
Sketch in general terms



Mechanical Properties

- Hardness: Hardness increases with increasing cold rolling
- Toughness: Toughness decreases with " " "

Yield
- strength: Yield strength increases with increased cold work
- Ductility: Ductility decreases with " " "



$\circlearrowleft \Sigma M_A = 0$

$= -3 \times 8 - 7.5 \times 4 - 12 \times 16 + 20 R_B$

$20 R_B = 24 + 30 + 192 = 246$

$R_{B_V} = \frac{246}{20} = 12.3 \text{ kN} \uparrow$

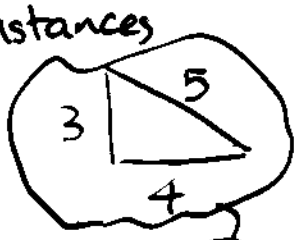
$\overrightarrow{+} \Sigma F_H = 0$

$= -8 + R_{B_H}$

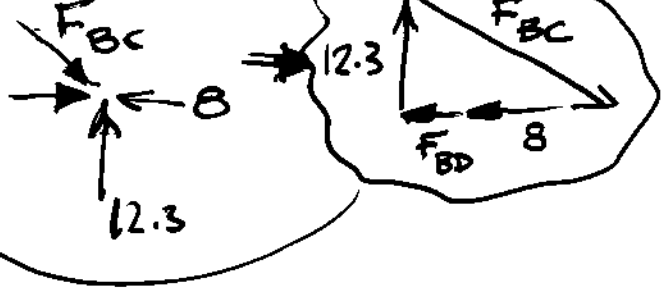
8 ← direction

12.3 dirn = ↑

distances



Method of joints



Force triangle

$\frac{F_{BC}}{12.3} = \frac{5}{3}$

$F_{BC} = \frac{5 \times 12.3}{3}$

$= 5 \times 4.1$

20.5

Provide why & how

Location A has the least effect on bending strength of the beam as it is closest to the neutral axis, which means that it has minimum impact on the behaviour of the beam under load.

Rounded corners would be used as they minimise stress concentration compared to rounded corners, thereby reducing the risk of fatigue cracking or failure under load.

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Question 13

(a)

Which allows any residual dye to be easily detected, showing where the crack was

(i)

DYE PENETRANT TESTING

ALSO MAG PARTICLE?

1. The surface of the rail is cleaned of any oils
2. A low viscosity dye is sprayed onto the rail surface
   - it seeps via capillary action into any cracks.
3. Surface dye is removed by wiping / cleaning
4. A chalk solution is sprayed onto the surface,

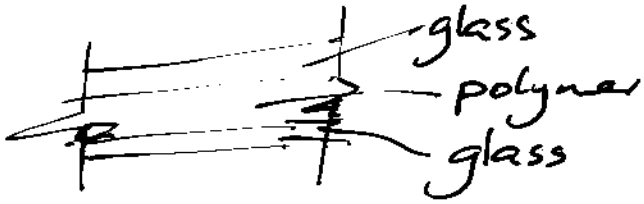
(ii)

(A) The simplest heat treatment process here is induction hardening.
The rail head is passed under a strong, varying ~~electro~~ magnetic field. The varying magnetic field induces current flow in the rail head that produces heat % resistance. By heating the rail heat to a temp > 750°C & then water quenching, martensite is produced.

-15- This would be a continuous process

Question 13

(b)



- Laminated glass consists of two sheets of glass with an intermediate layer of very flexible Polyvinyl Butyrate.

It protects people from accident as:

(1) Any damage to the inside layer of glass is "stuck" together by the P.V.B.

(2) The flexible P.V.B. absorbs some impact when the outer layer is broken, preventing the inner layer of glass from shattering

(3) The polymer toughens the glass by absorbing stress at the crack tip (2)

Driver request	1		
Brakes off	0	1	
Emergency	1		1
Train moving	0		1

Driver request
Brakes off
Emergency

Question 14

(a)

•A

(i)

(working in tonne, not N)

$+\circlearrowleft \Sigma M_A = 0$

$= 65M - 15 \times 9$

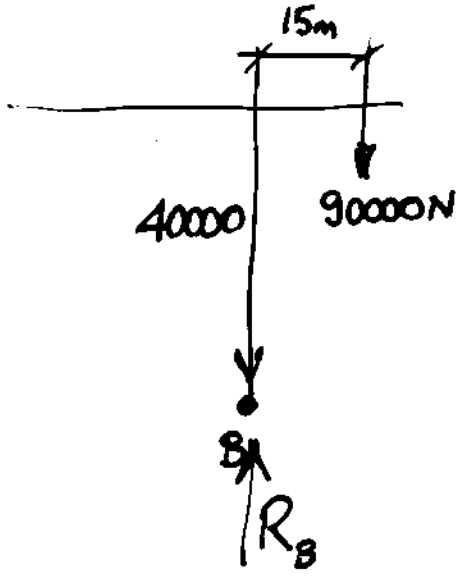
$M = \frac{15 \times 9}{65} = \frac{27}{13}$

2.077

(ii)

$\overline{F = ma} = 4000 \times 10 = 40\,kN$

$\overline{F = 90000N}$



$+\uparrow \Sigma F_V = 0$

$= R_B - 40 - 90$

$+\circlearrowleft \Sigma M = 0 = -15 \times 90 + M_B$

$= 1350\,kNm$

130 ↑

1.35 ↺

Question 14

(b)

(i)

Stress at point A is in the elastic range, where any deformation is reversed upon unloading. ie: "The bolt stays tight". Stress at point B is plastic stress. If the bolt is stressed to "B", then it is permanently stretched and remains loose when the load is removed.

(ii)

$F = 76350\,N$

$\sigma = 300 \times 10^6$

$\sigma = \frac{F}{a}$

$a = \frac{F}{\sigma}$

$a = \frac{76350}{300 \times 10^6}$

$= 0.0002545\,m^2$

$\frac{\pi D^2}{4} = 0.0002545$

$D^2 = 0.000324$

$D = (0.000324)^{1/2}$

$D_{min} = 18\,mm$

(c)

Pulse width modulation involves turning the voltage to the motor on or off to reduce the 'average' voltage that the motor 'sees'. The motor speed is proportional to average voltage, so the motor speed can be controlled accordingly

Gas turbine compresses air and fuel mixture which is burnt to spin turbine at rear, then motion sent forward through reduction gear box to prop.

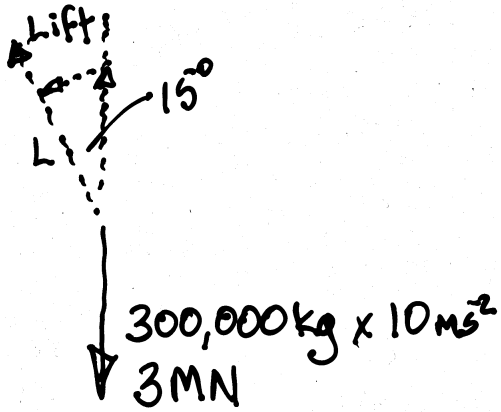
Air flowing over the elevators increases or decreases lift at the rear of the aircraft This vector causes the aircraft to pitch up or down.

Advantages - quick + easy application
- greater surface area - provide continuous bond
- vibration reduction seals as well as adheres.
- improves corrosion resistance

Disadvantages - sealing may result in electrical insulation of components
- difficult to dismantle
- cure time may slow construction

$\cos 15 = \frac{L}{3}$

$L = 3\cos 15° MN$



Lift is $3\cos 15° MN$

$2.89777 MN$

Drag is $\frac{1}{8}$ of Lift so Drag $= \frac{2.8977}{8}$

$= .362222 MN$

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