

Year 11 Mathematics Specialist
Test 1B

INSTRUCTIONS:

Calculator

Notes not allowed

Full working must be shown for all questions (or parts) worth more than 2 marks.

Marks will be deducted for rounding and unit errors.

Name: SOLUTIONS

Time: 45 minutes

Total _____ / 40

Question 1

[1, 1 = 2 marks]

21 items are to be split into 5 boxes. Find the value of n if

- a) There will be at least one box with no more than n items

pigeon hole

$$\frac{21}{5} = 4.2 \quad n = 4 \quad \checkmark$$

- b) There will be at least one box with at least n items

$$n = 5 \quad \checkmark$$

Question 2

[3 marks]

There are 25 students who play in at least one of the three sporting teams - tennis, cricket and soccer. There are 12 students in the cricket team, 13 in the soccer team and 10 in the tennis team. If five students play cricket and soccer, six play cricket and tennis and four play cricket and tennis, how many students are in all three teams?

$$25 = 12 + 13 + 10 - (5 + 6 + 4) + x$$

inc. x

$$25 = 35 - 15 + x$$

$$25 = 20 + x$$

$$x = 5 \quad \checkmark$$

Question 3

[4 marks]

The English Club has 15 members and the Maths Club has 20 members. There is only one member common to both clubs. In how many ways can a committee of 5 people be formed with at least one member from each club?

$$1 \left(\binom{33}{4} \right) + \left[\left(\binom{33}{5} \right) - \left(\binom{14}{5} \right) - \left(\binom{19}{5} \right) \right]$$

$$40920 + [237336 - 2002 - 11628]$$

$$= 264626$$

$$40920 + [223706]$$

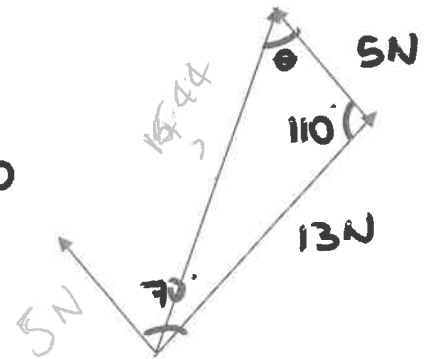
Question 4

[4 marks]

Two forces have magnitude 5 N and 13 N and the angle between them is 70° . Find the magnitude of the resultant and the angle it makes with the smaller of the two forces.

$$x^2 = 13^2 + 5^2 - 2(13)(5) \cos 110$$

$$x = 15.44 \text{ N}$$



$$\frac{\sin \theta}{13} = \frac{\sin 110}{15.44}$$

$$\theta = 52.3^\circ$$

Question 5

[7 marks]

A cyclist travels 3.8 km on a bearing of 070° before stopping for a rest. She then continues on for another 6 km on a bearing of 340° followed by the last 1.2 km on a bearing of 300° .

Draw a diagram illustrating the situation. Find the distance and bearing of her final position from her initial position.

$$\tan \theta = \frac{3.8}{6}$$

$$\theta = 32.3$$

$$360 - 160 - 32.3 = 107.7$$

$$b = \sqrt{3.8^2 + 6^2} = 7.102 \text{ km}$$

$$x^2 = 1.2^2 + 7.102^2 - 2(1.2)(7.102)\cos 107.7$$

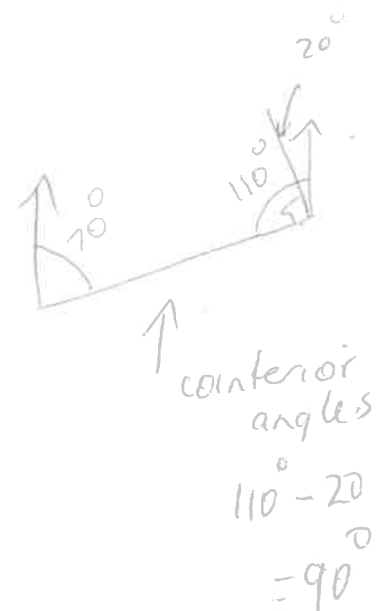
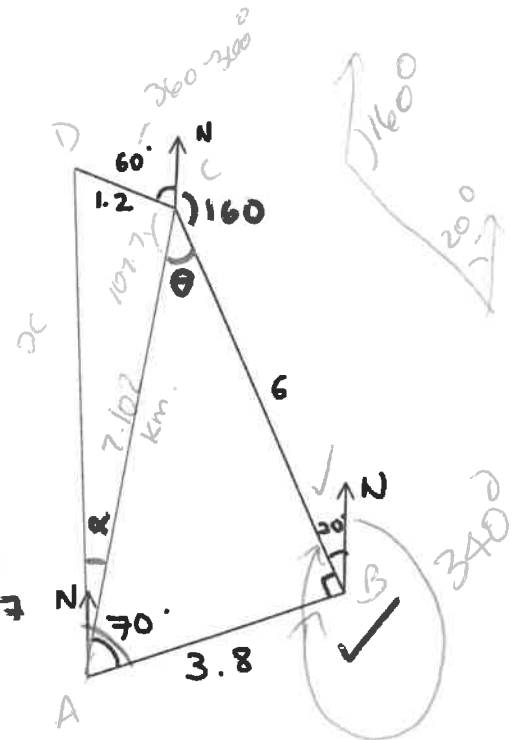
$$x = 7.55$$

$$\frac{7.55}{\sin 107.7} = \frac{1.2}{\sin \alpha}$$

$$\alpha = 8.71$$

$$70 - [8.71 + (90 - 32.3)] = 3.6$$

$$\therefore \text{Distance} = 7.55 \text{ km, bearing} = 004^\circ$$

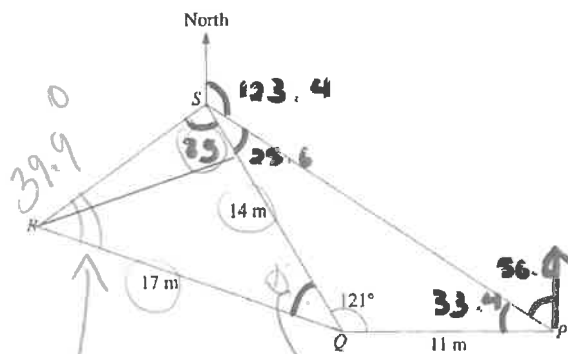


Question 6

[2, 2, 3, 2 = 9 marks]

P , Q , R , and S are four points on ground level. P is due East of Q . The bearing of R from S is 234° .

Given that $\angle PQS = 121^\circ$, $PQ = 11$ m, $QR = 17$ m and $QS = 14$ m, calculate



a) PS

$$PS^2 = 11^2 + 14^2 - 2(11)(14) \cos 121$$

$$PS = 21.8 \text{ m}$$

b) $\angle SPQ$

$$\frac{\sin \angle SPQ}{14} = \frac{\sin 121}{21.8}$$

$$\angle SPQ = 33.4^\circ$$

c) $\angle RQS$

$$\frac{17}{\sin 85} = \frac{14}{\sin \angle RQS}$$

$$\angle RQS = 55.1^\circ$$

$$180 - 55.1 - 85 = 39.9$$

d) The shortest distance from R to QS

$$\sin 39.9 = \frac{x}{17}$$

$$x = 10.9 \text{ m}$$

Question 7

[2, 3, 2, 2, 2 = 11 marks]

A, B, C and D are four towns. B, C and D lie on a straight line with C between B and D. B is 3.7 km due South of A. The bearing of C from B is 042° . AC = 2.8 km and CD = 3.3 km.

Find

- a) The bearing of B from C

$$180 + 42 = 222^\circ$$

Corresponding angles

- b) The obtuse $\angle ACD$

$$\frac{2.8}{\sin 42} = \frac{3.7}{\sin \theta}$$

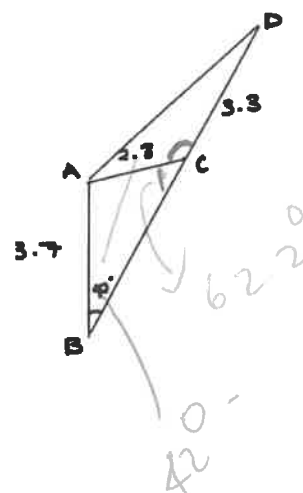
$$\theta = 62.2^\circ$$

$$180 - 62.2 = 117.8^\circ$$

- c) The distance AD

$$AD^2 = 2.8^2 + 3.3^2 - 2(2.8)(3.3)\cos 117.8$$

$$AD = 5.23 \text{ km}$$



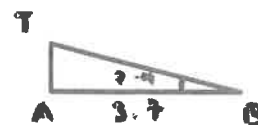
A vertical tower, AT, has its base at A. Given that the angle of elevation of T from B is 2.4° , calculate

- d) The height of the tower AT, giving your answer to the nearest metre

$$\tan 2.4 = \frac{AT}{3.7}$$

$$AT = 1.551$$

$$\approx 155 \text{ m}$$



- e) The angle of depression of C from T

$$\tan \alpha = \frac{1.551}{2.8}$$

$$\alpha = 3.17^\circ$$

