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**SEMESTER ONE**

**MATHEMATICS**

**SPECIALIST**

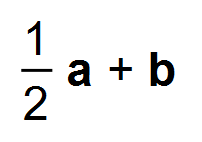
**UNIT 1**

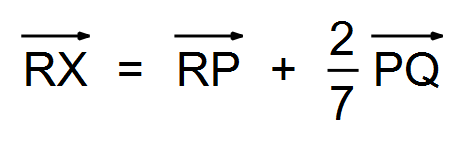
**2020**

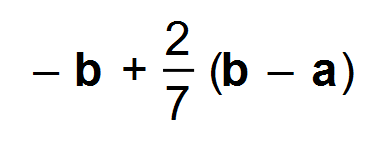
**SOLUTIONS**

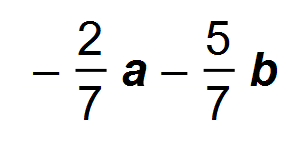
**Calculator−free Solutions**

1. (a) (i) −**b** ✓

(ii)  ✓

(b)  ✓

=  ✓

=  ✓ [5]

2. (a) (i) 5 ✓

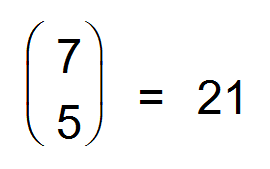
(ii) 21 ✓

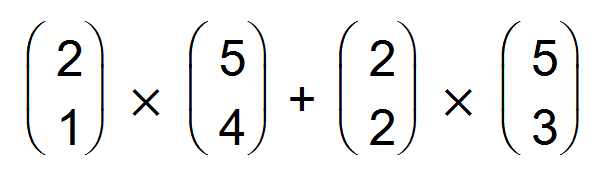
(b) (i) *x =* 3 ✓

(ii) *x =* 4 ✓

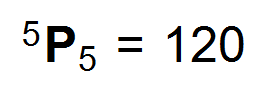
(iii) *x =* 7 ✓

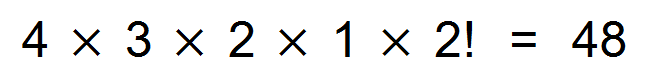
(iv) *x =* 2 ✓

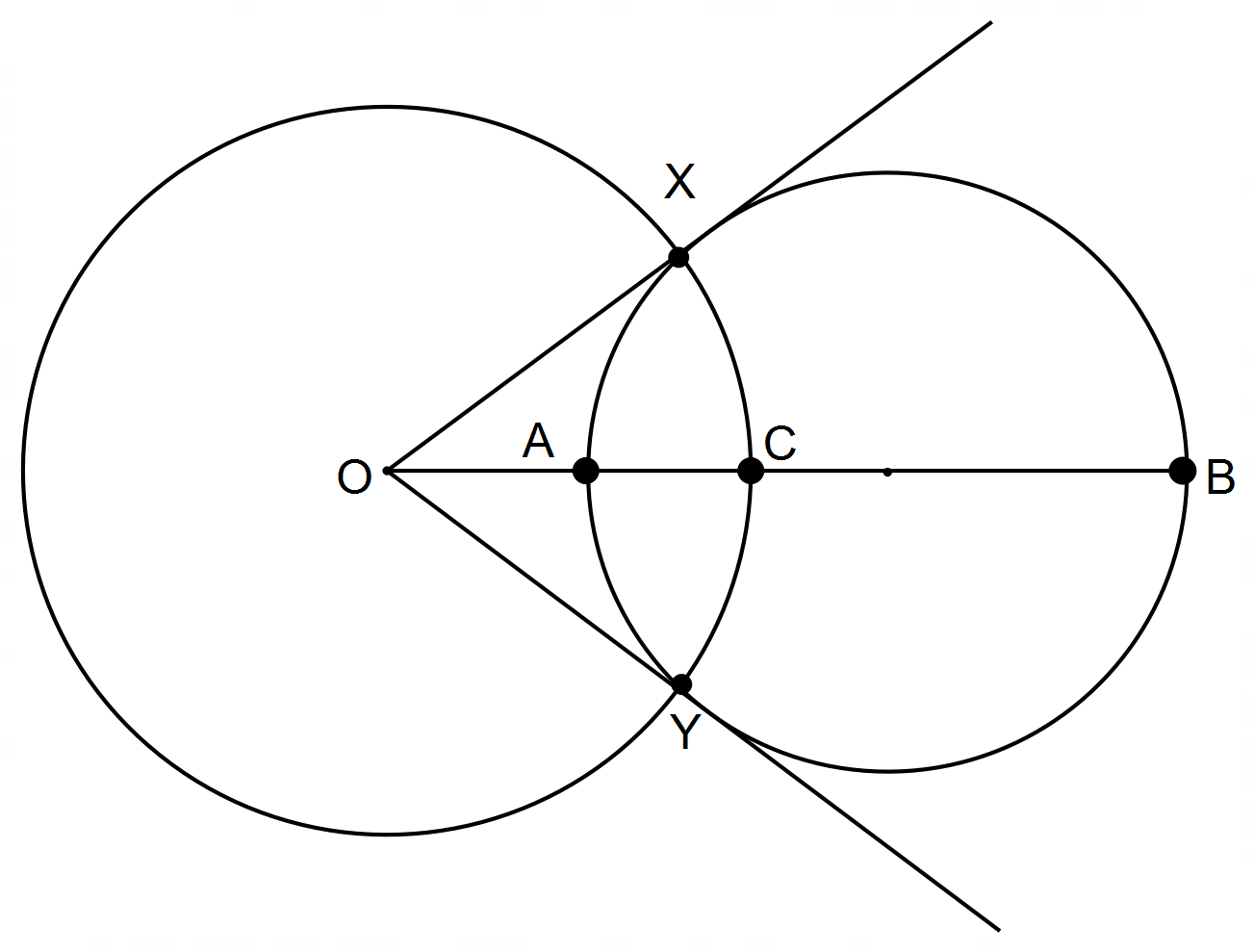
(c) (i)  ✓

(ii)  ✓

= 20 ✓

(d) (i)  ✓

(ii)  ✓✓ [12]

3. (a) (i)

✓

(ii) OA x OB = OC2

But OC = OX

∴ OA x OB = OX2 ✓

This is the converse of the secant/tangent theorem

∴ OX is a tangent ✓

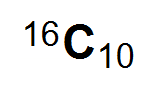
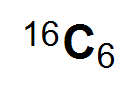
OA x OB = OC2

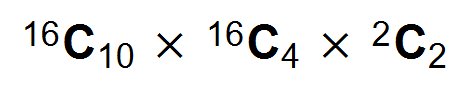
But OC = OY

∴ OA x OB = OY2 ✓

This is the converse of the secant/tangent theorem

∴ OY is a tangent ✓

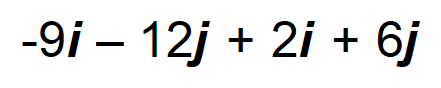
(b)  or  ✓✓

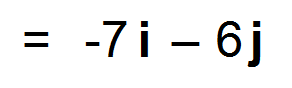
(c) (i)  ✓✓

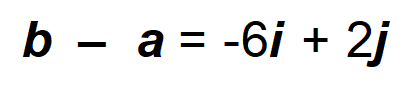
(ii) 3! = 6 ways ✓ [10]

4. (a) (i) −**i** − 13**j** ✓

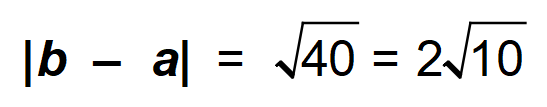
(ii) 5 ✓

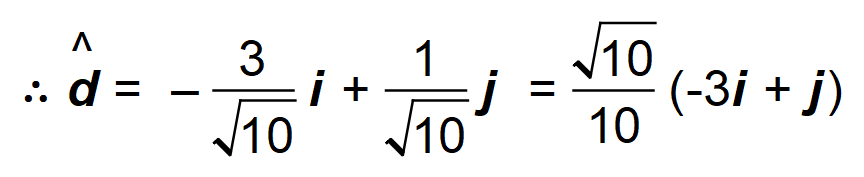
(iii)  ✓

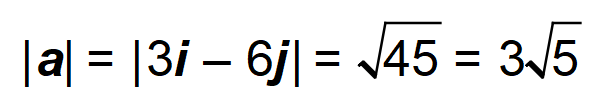
 ✓

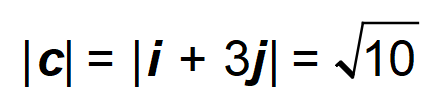
(iv)  ✓

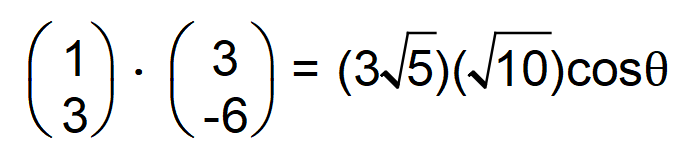


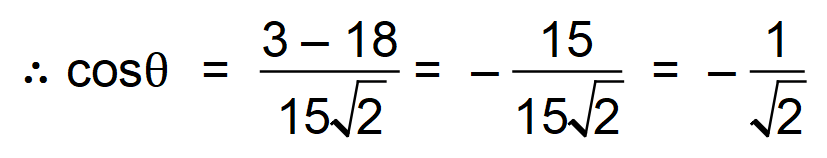
 ✓

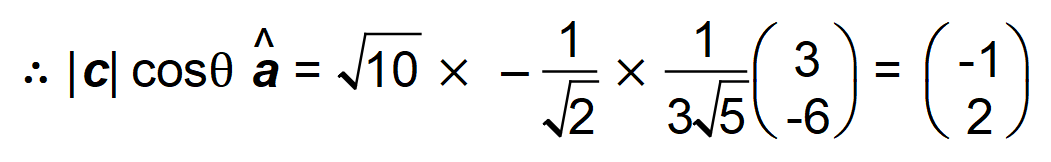
 ✓

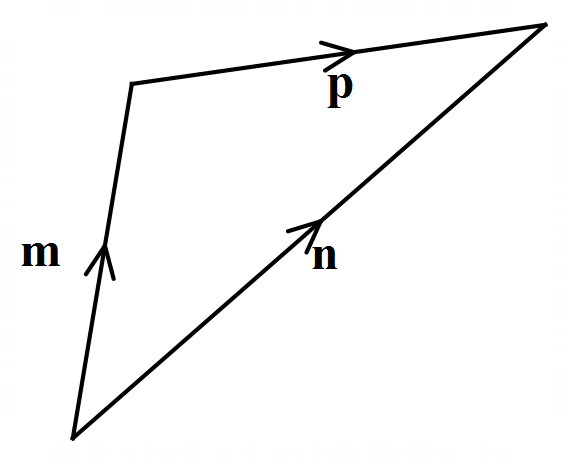
(b) 



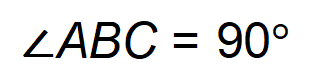
 ✓

 ✓

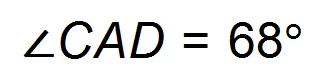
 ✓✓

 (c)

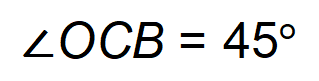
✓ [12]

5. (a)  ✓

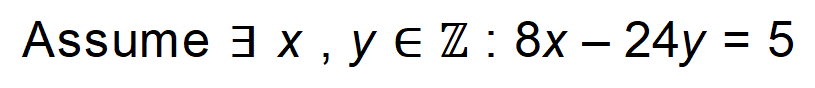
Thale’s Theorem ✓

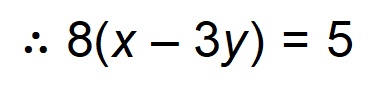
(b)  ✓

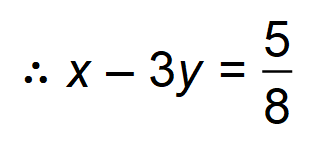
Revolution equal to 360 degrees ✓

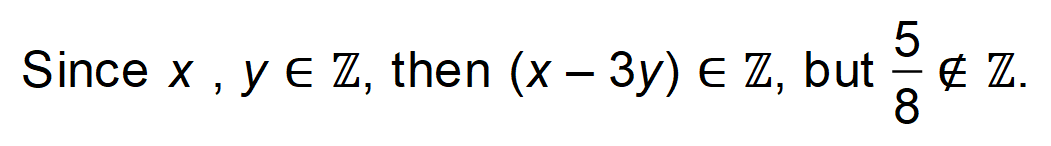
(c)  ✓

Equal angles at base of isosceles triangle ✓ [6]

6.  ✓



 ✓

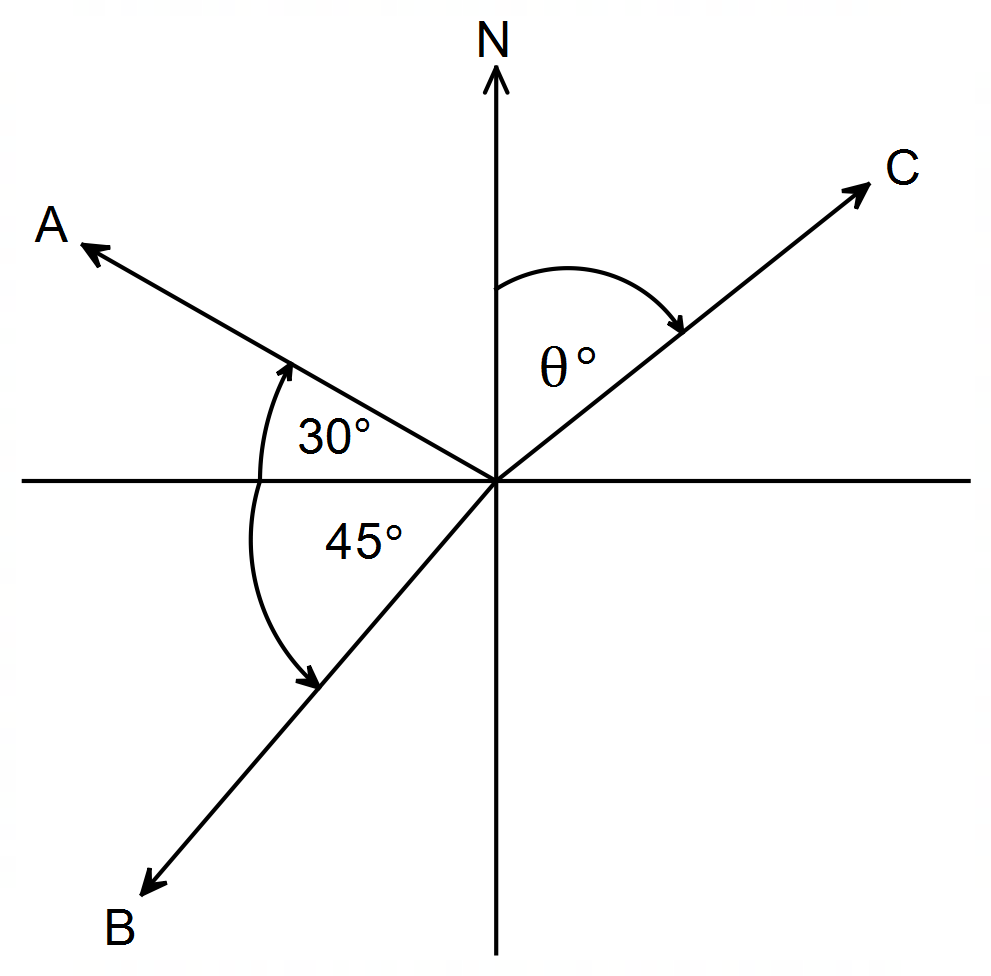
 ✓

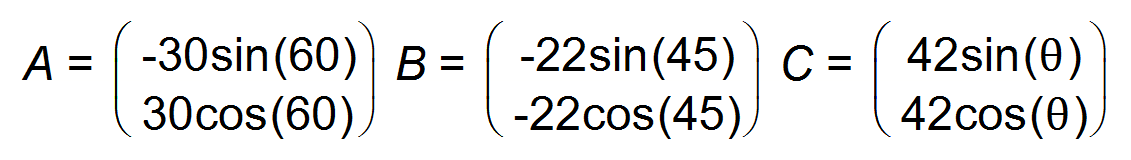
This is a contradiction as (*x – 3y*) cannot both belong and not belong

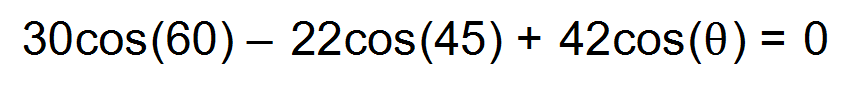
to the integer set. ✓

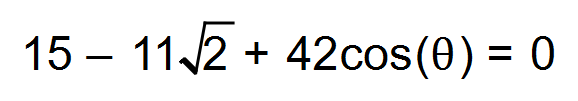
:. False, there are no integers for which this statement is true. ✓ [5]

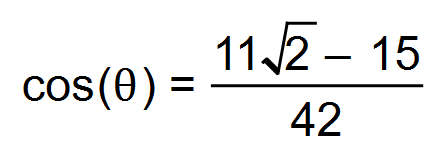
**Calculator−Assumed Solutions**

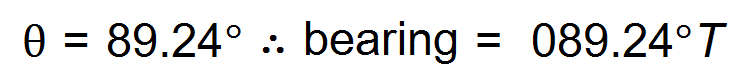
7.

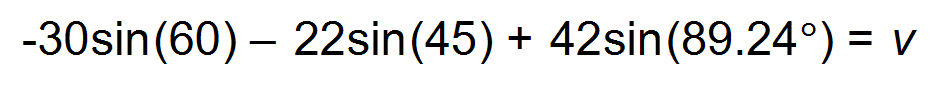
 ✓✓

 ✓



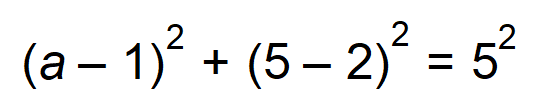


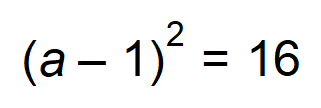
 ✓

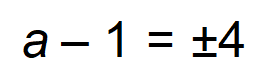
 ✓

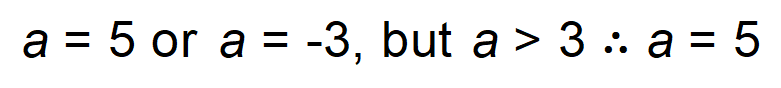
*v =* 0.46 km/h ✓ [6]

8. (a) (i) **LM** parallel to *x*–axis so *b* = 5 ✓

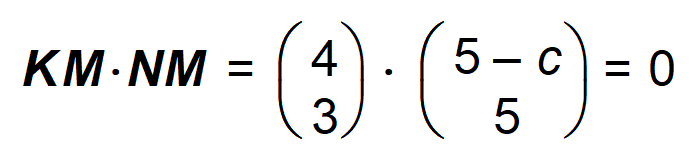
 ✓

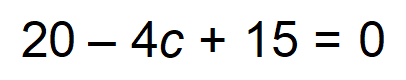


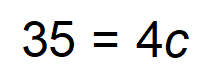


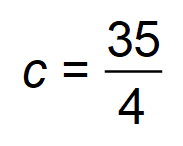
 ✓

M = (5, 5)

(ii) **** ✓

****



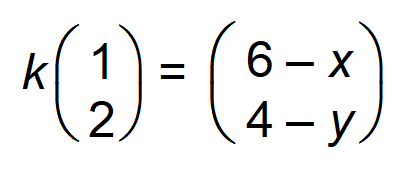
 ✓

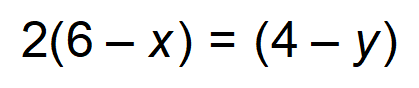
(b) (i) *x* = 5 ✓

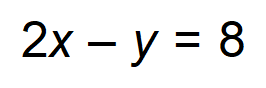
*y* = 2 ✓

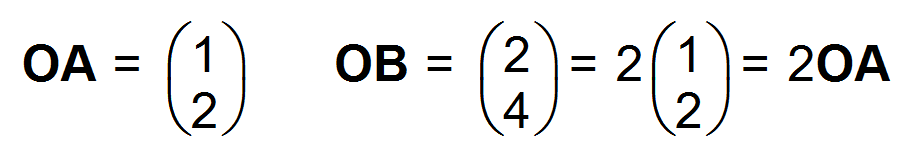
(ii) If *y* = 2 & *x* ≥ 6, then ***BC* *// AD*** ✓

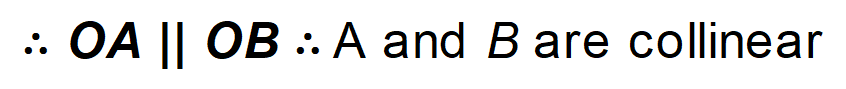
If ***AB* *// DC*** ✓

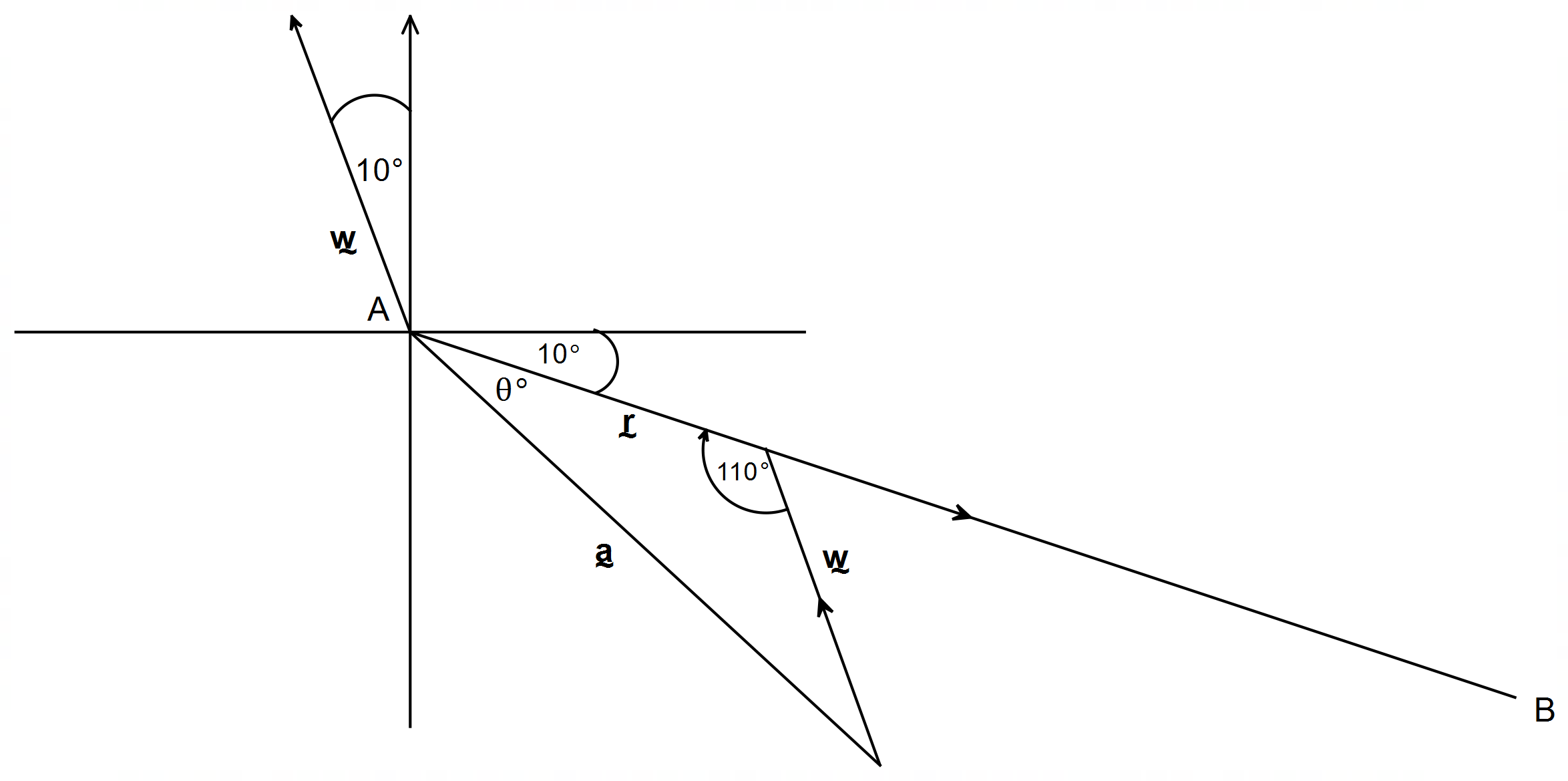
 ✓



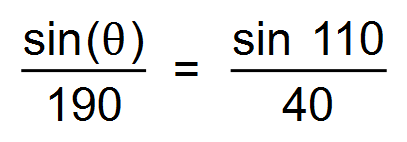
 ✓

(iii)  ✓

 ✓ [13]

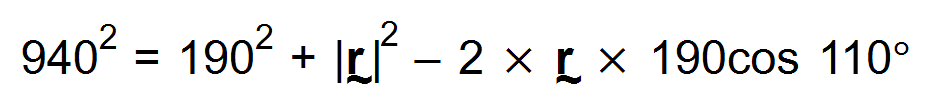
9. (a)

✓✓

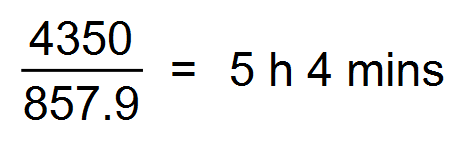
(b) 

∴  ✓

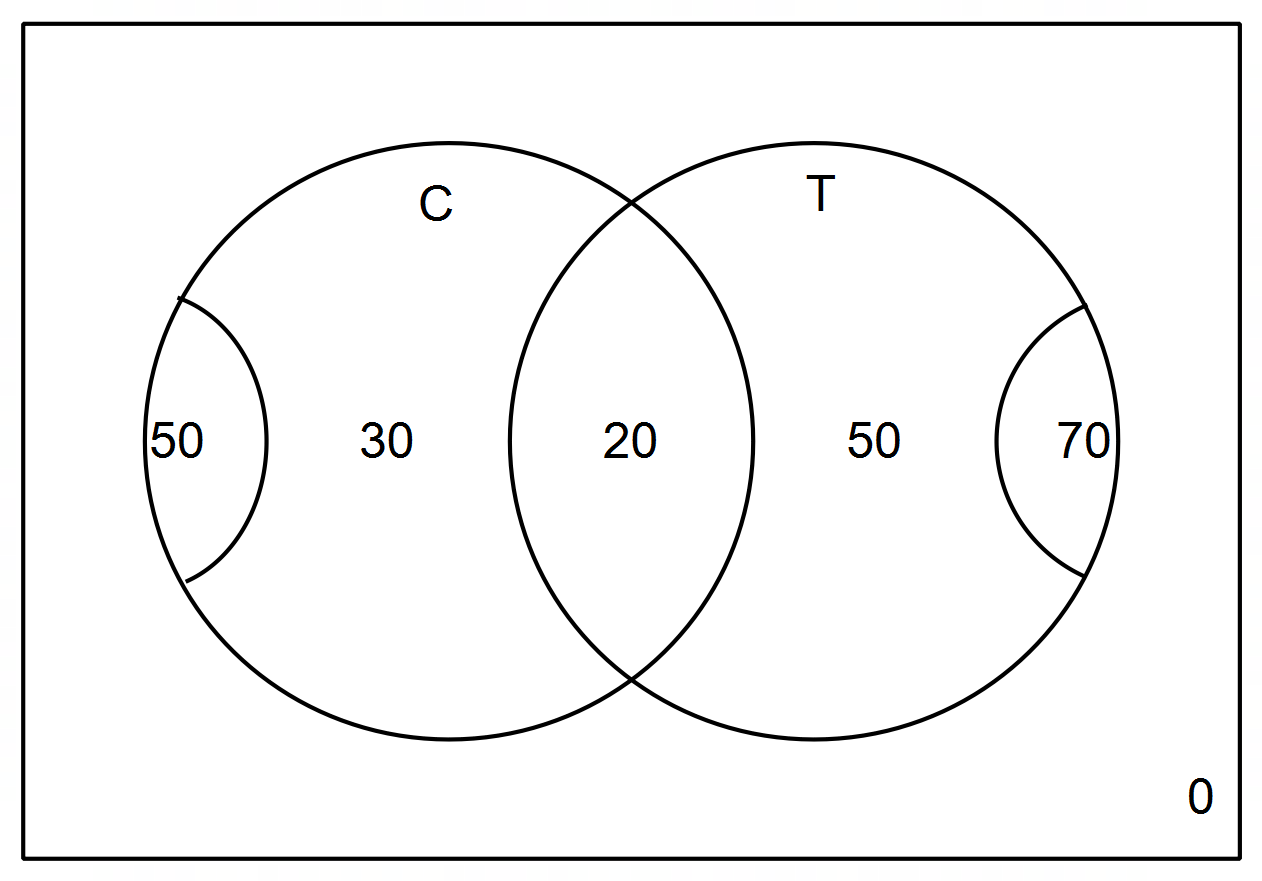
∴ Bearing = 110°T ✓

(c)  ✓

∴  ✓

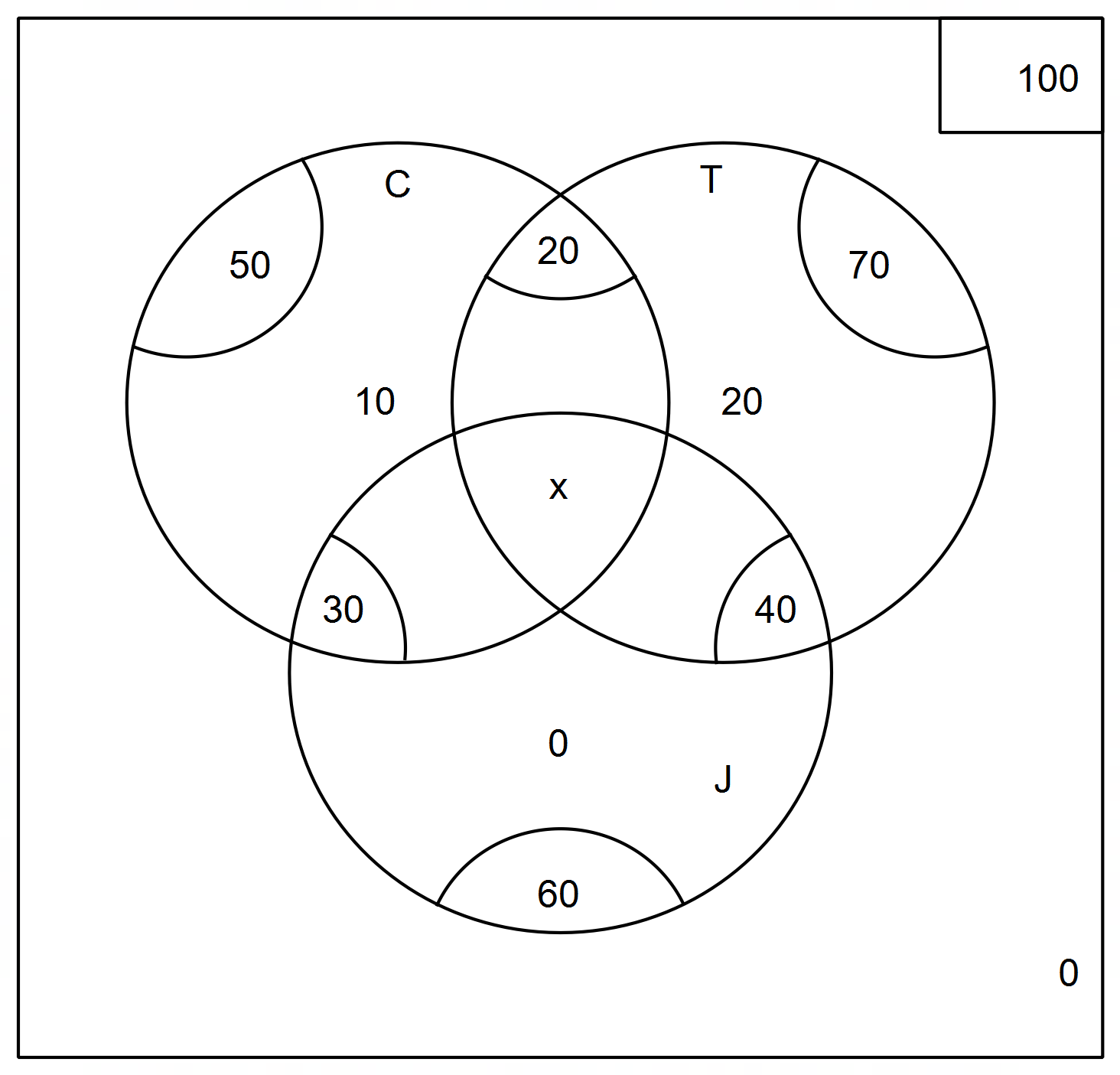
∴ Time taken =  ✓ [7]

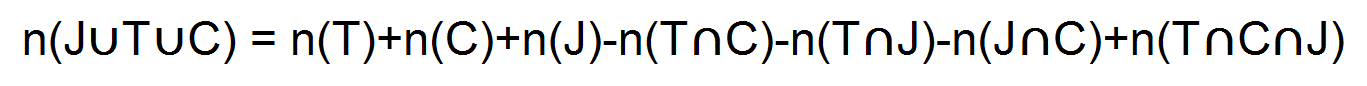
10. (a)



∴ 50 like tea only ✓

(b) None like neither ✓

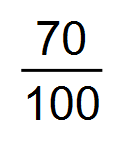
 (c)

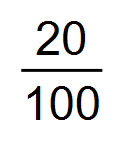


∴ 100 = 70 + 50 + 60 − 20 − 40 − 30 + *x* ✓

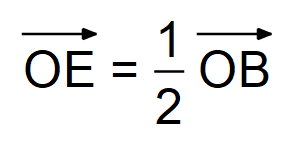
∴ = 90 + *x* ✓

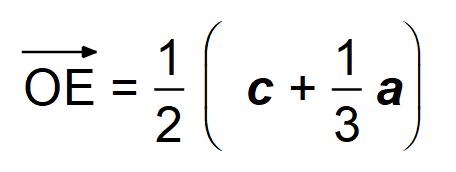
∴ *x* = 10 ✓

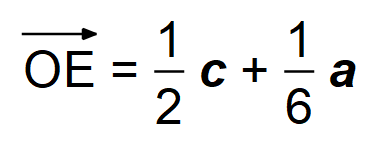
(d) (i)  ✓

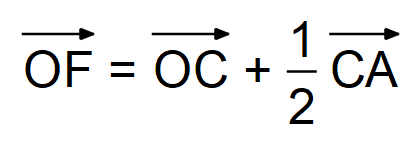
(ii)  ✓

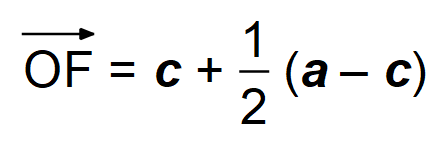
(e) 41 ✓ [8]

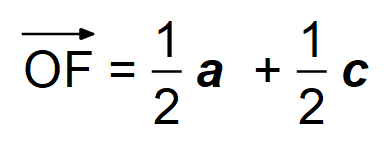
11. (a)  ✓

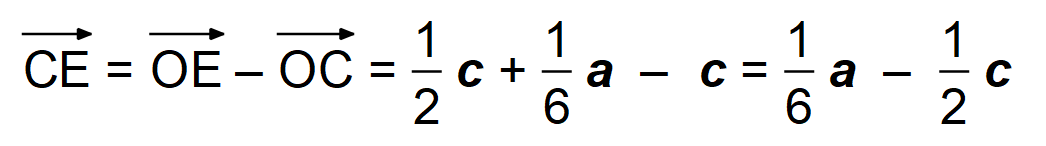


 ✓

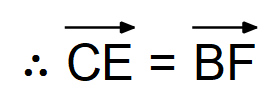
 ✓

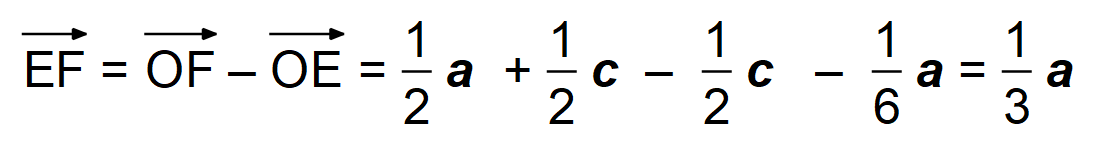


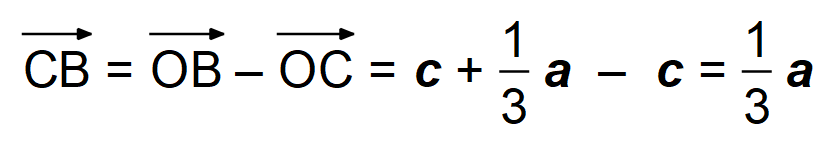
 ✓

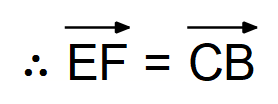
(b)  ✓

 ✓



 ✓

 ✓ [8]



12. (a) 3 > 2 but −3 < −2 is false ✓

(b) “If the triangle is not isosceles, then the triangle does not

have two equal sides.” ✓

Yes is it always true since the original implication is always

true by definition of isosceles triangles. ✓

(c) “If n is divisible by 4, then n is divisible by 8”. ✓

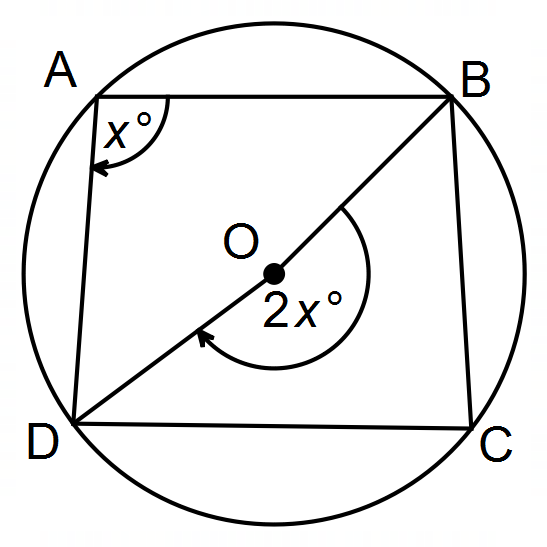
The converse is not always true, as shown by the

counter-example where n = 12 ✓

(d) FOR ALL natural numbers p, EXISTS a real number q,

such that q is one less than p. ✓✓ [7]

13. (a)



Let ∠BAD = *x*°

∴ reflex ∠BOD = 2*x*° Angle at the centre theorem ✓

Similarly let ∠BCD = *y*°

∴ ∠BOD = 2*y*° Angle at the centre teorem ✓

Since 2*x* + 2*y* = 360

then *x* + *y* = 180° ✓

Hence ∠BAD + ∠BCD = 180° ✓

QED

(b) ∠EAG + ∠BCD = 180° Cyclic quadrilateral

∴ ∠EAG ≡ ∠ECF ✓

In ΔEAG and ΔECF

∠AEG ≡ ∠CEF Bisector ✓

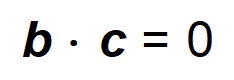
∠EAG ≡ ∠ECF Proven ✓

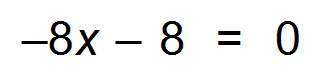
∴ ∠CFE ≡ ∠BFG Vertically Opposite

∴ ∠AGF ≡ ∠BFG QED ✓

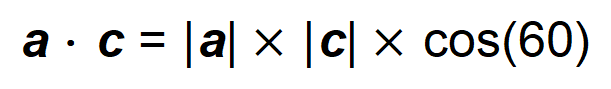
(c) (i) Converse ✓

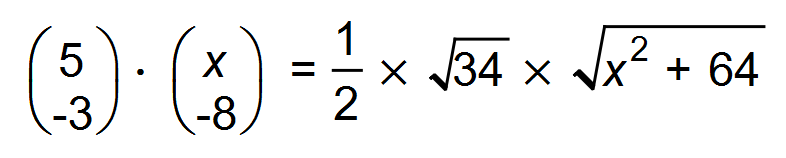
(ii) Yes ✓ [10]

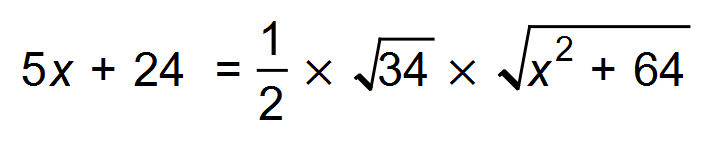
14. (a) (i) 

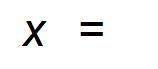
∴  ✓

* *x* = −1 ✓

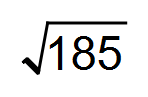
(ii)  ✓

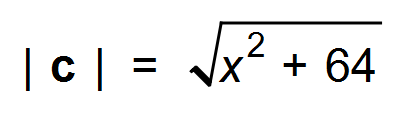
∴  ✓

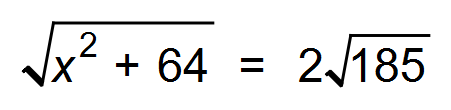
∴ 

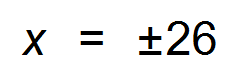
∴  −0.13 ✓

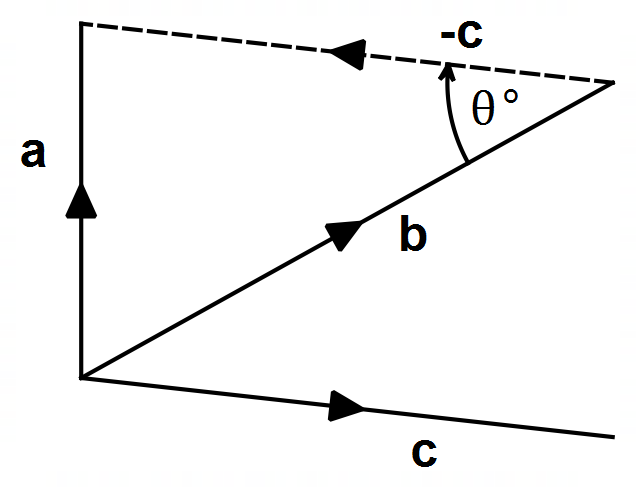
(iii) **a** − **b** = 13**i** − 4**j** ✓

∴ | **a** − **b** | = 

∴ 

∴  ✓

∴  ✓

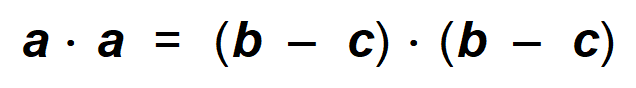
(b) (i)

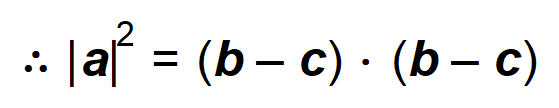
✓✓

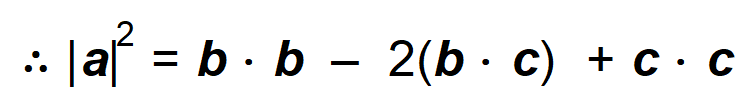
(ii) cos(0) = 1 ✓

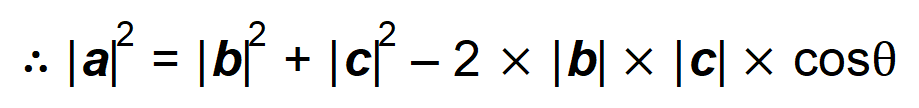
So, the dot product of a vector with itself is its magnitude

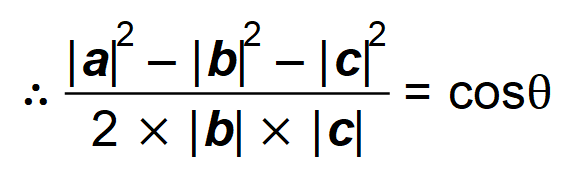
squared multiplied by 1.

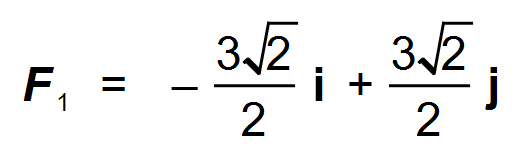
(iii) 

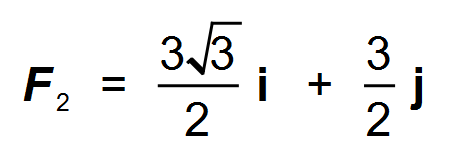


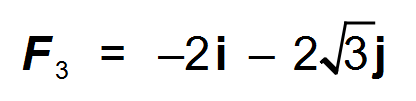
 ✓

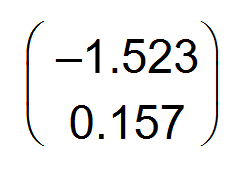
 ✓

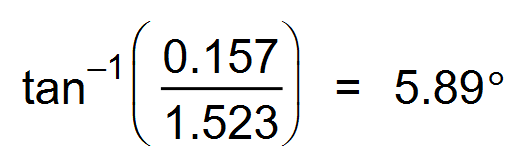
 ✓ [14]

15. (a)  ✓

 ✓

 ✓

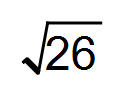
∴ ***F***1 + ***F***2 + ***F***3 =  ✓

∴  ✓

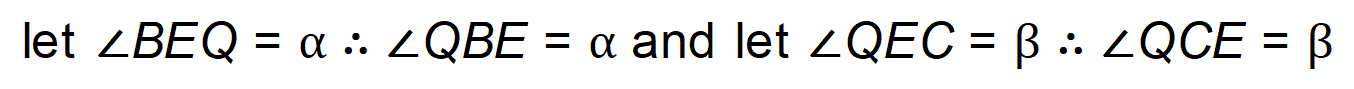
∴ 276°T ✓

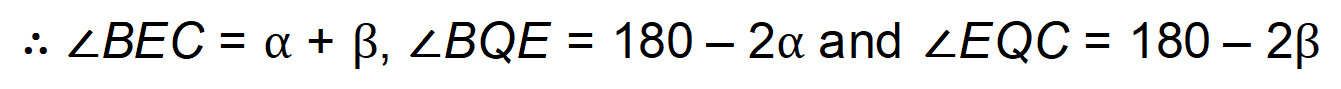
(b) **a** + **b** = −5**i** + **j** ✓

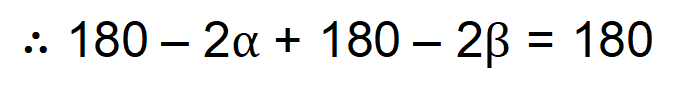
**c** = 5**i** − **j** ✓

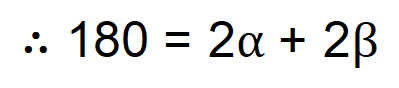
**| c | = ** ✓

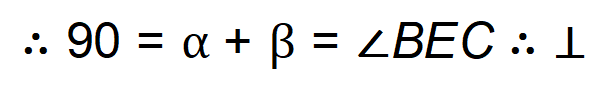
Direction = 101°T ✓ [10]

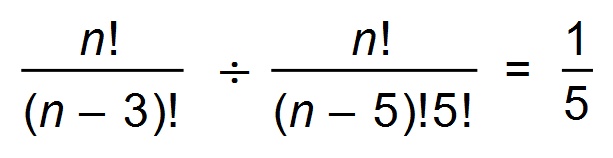
16.  ✓

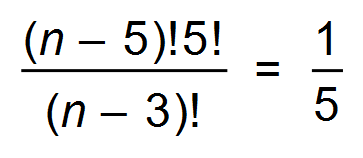
 ✓

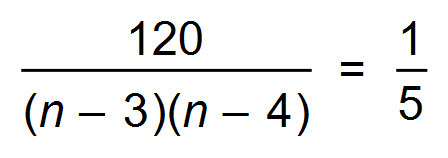
 ✓

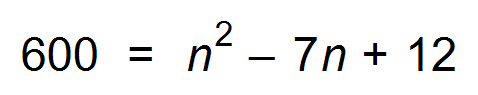


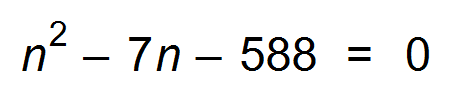
 ✓ [4]

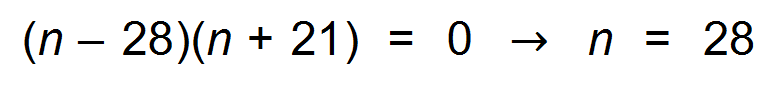
17.  ✓

∴ 

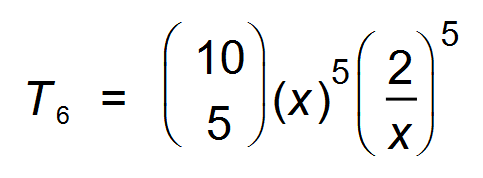
∴  ✓

∴  ✓

∴  ✓

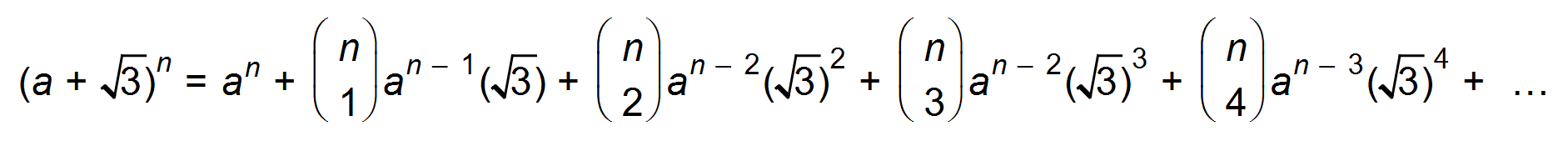
∴  ✓ [5]

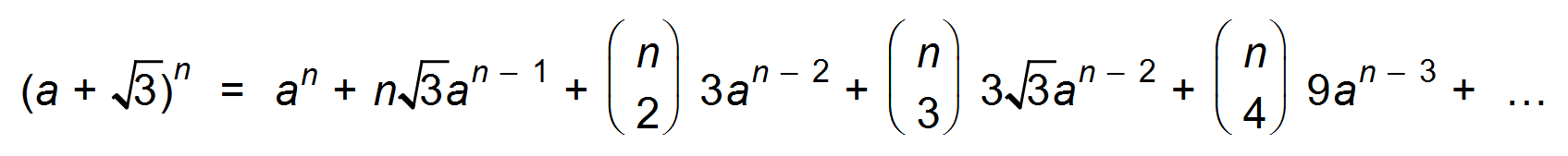
18. (a) Independent term is the middle term. ✓

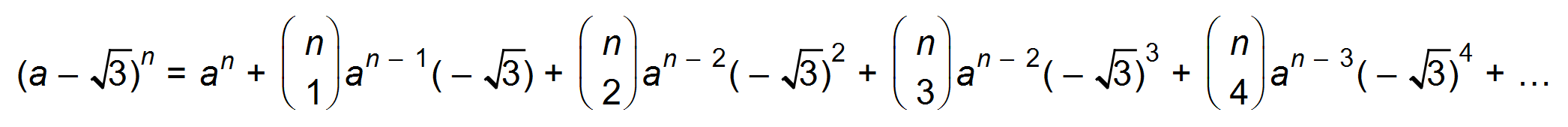
∴  ✓

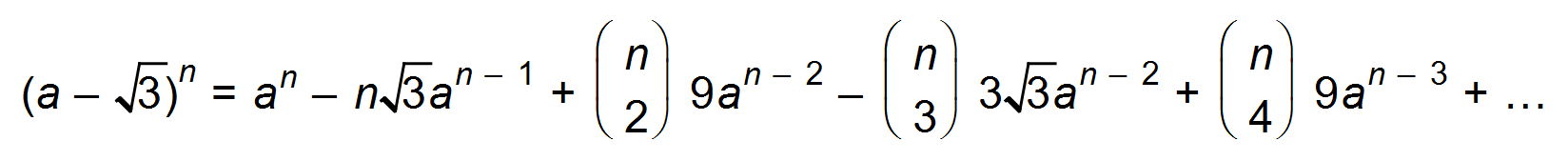
∴ 8064 ✓

(b)

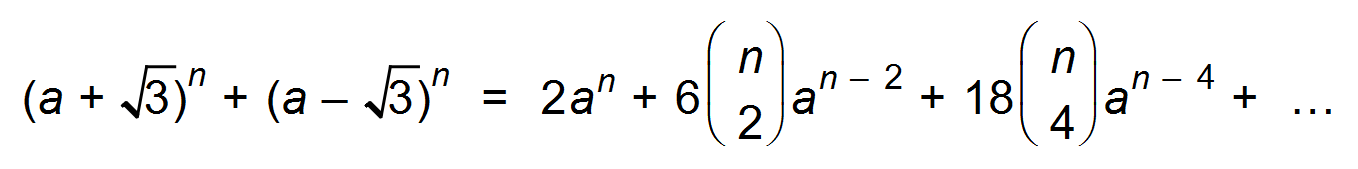


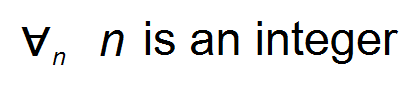
✓



✓

Hence,

 ✓✓

∴  ✓ [8]