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**MATHEMATICS**

**SPECIALIST**

**UNIT 3**

**Semester One**

**2020**

**SOLUTIONS**

***Calculator−free Solutions***

1. (a) ✓

(b) ✓✓

✓✓

(c) No, because does not exist for . ✓✓ [7]

2. (a) and given, then:

✓✓

✓✓

(b) ✓

answers must be parallel to ✓

✓

✓✓ [9]

3. (a) (i) ✓✓✓

(ii) ✓

✓

✓

(b) (i) is a root of

✓

✓

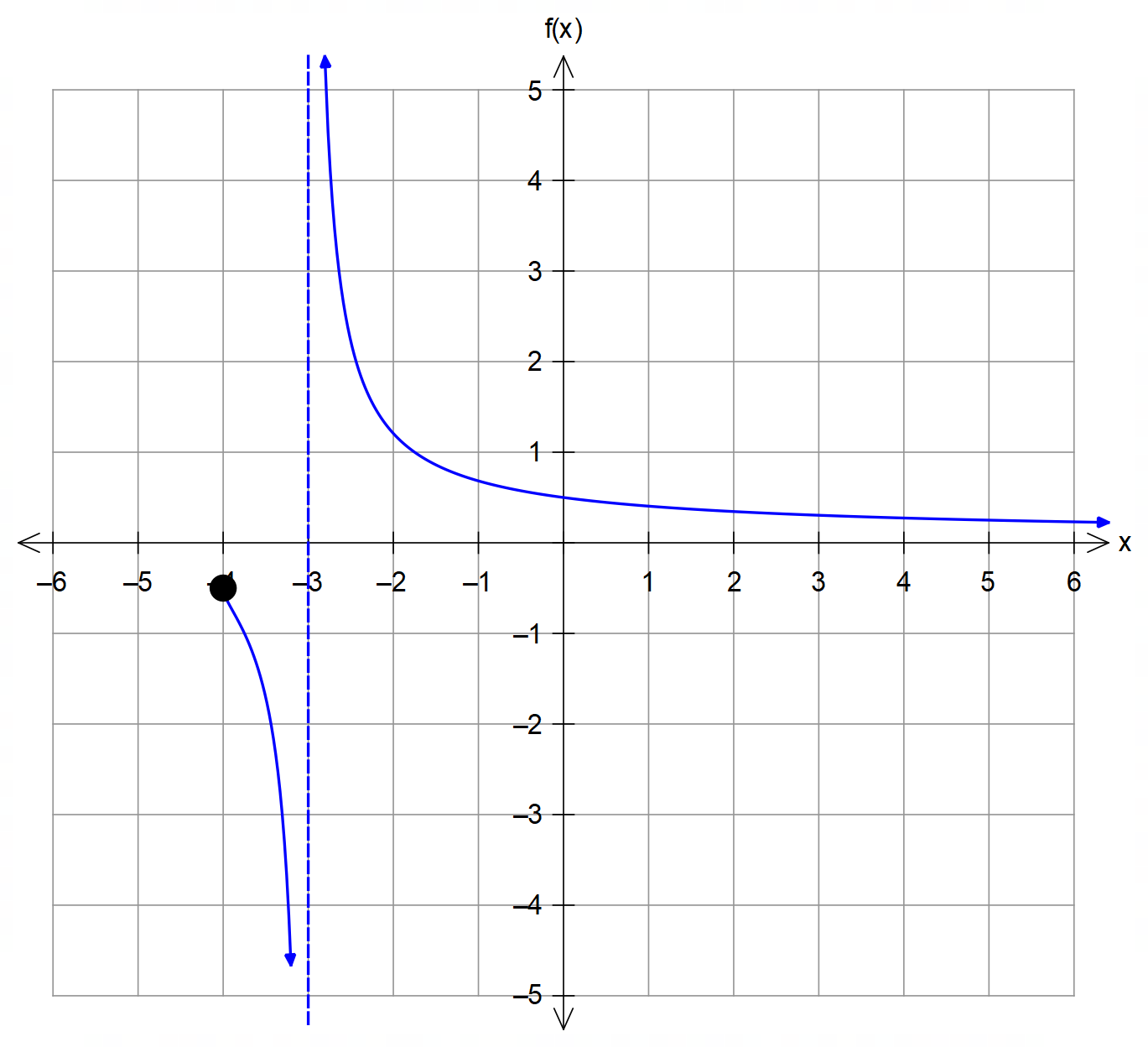
is a root of as per the factor theorem.

(ii) Since the coefficients of are real, then is

also as root. ✓

✓

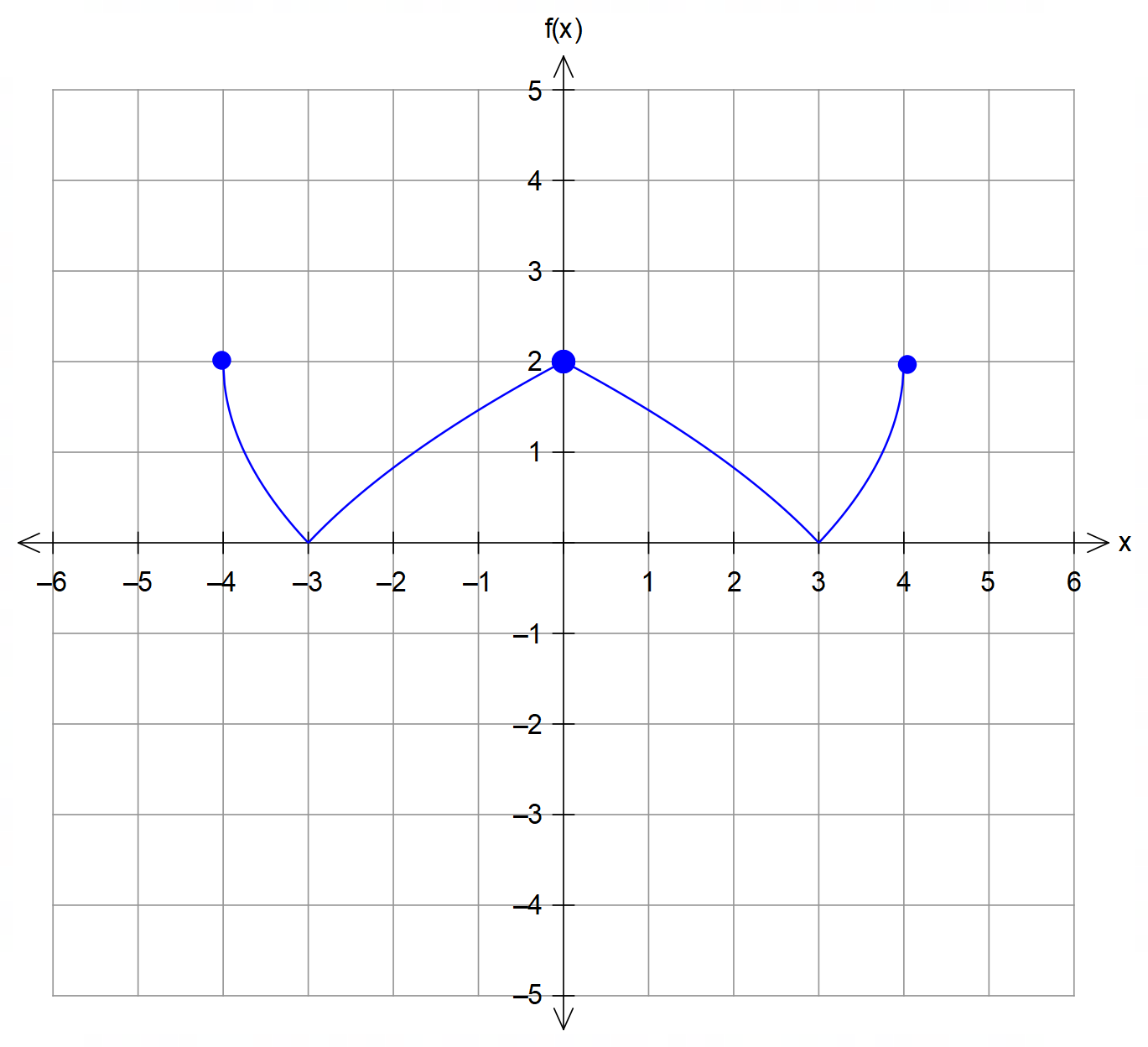
Solutions are ✓✓ [12]

4. (a)

✓ asymptote y = 0

and a pole x=-3

✓✓ behaviour on either side of the pole.



(b)

✓ roots

y-intercept y=2

✓✓ symmetry and

curvature

(c) ✓

✓

✓ [9]

5. (a) ✓✓✓

(any algebraic method or matrix method accepted)

5. (b) The normal vectors to the three planes are and

Solutions do not exist for ✓

which is when the three planes are non-parallel but do not

intersect at a single point in space. ✓

Solutions exist for ✓ [6]

6. (a) ✓

(b) ✓✓

(c) centre = midpoint ✓

radius ✓

✓ [6]

7. Solutions must satisfy:

✓

✓

from symmetry, the roots must be equally spaced at intervals

of therefore ✓✓ [4]

(it must be an odd multiple of 3)

(any explanation based on symmetry is acceptable)

***Calculator−Assumed Solutions***

8. Discontinuities at ✓✓

Oblique asymptote is given by

✓✓

using the point given:

✓ [5]

9. (a) and ✓✓

CAS ✓

(b) Let ✓

(Other solutions exist)

(c) (i) ✓✓

as required

(ii) Normal equation of the plane needed:

✓

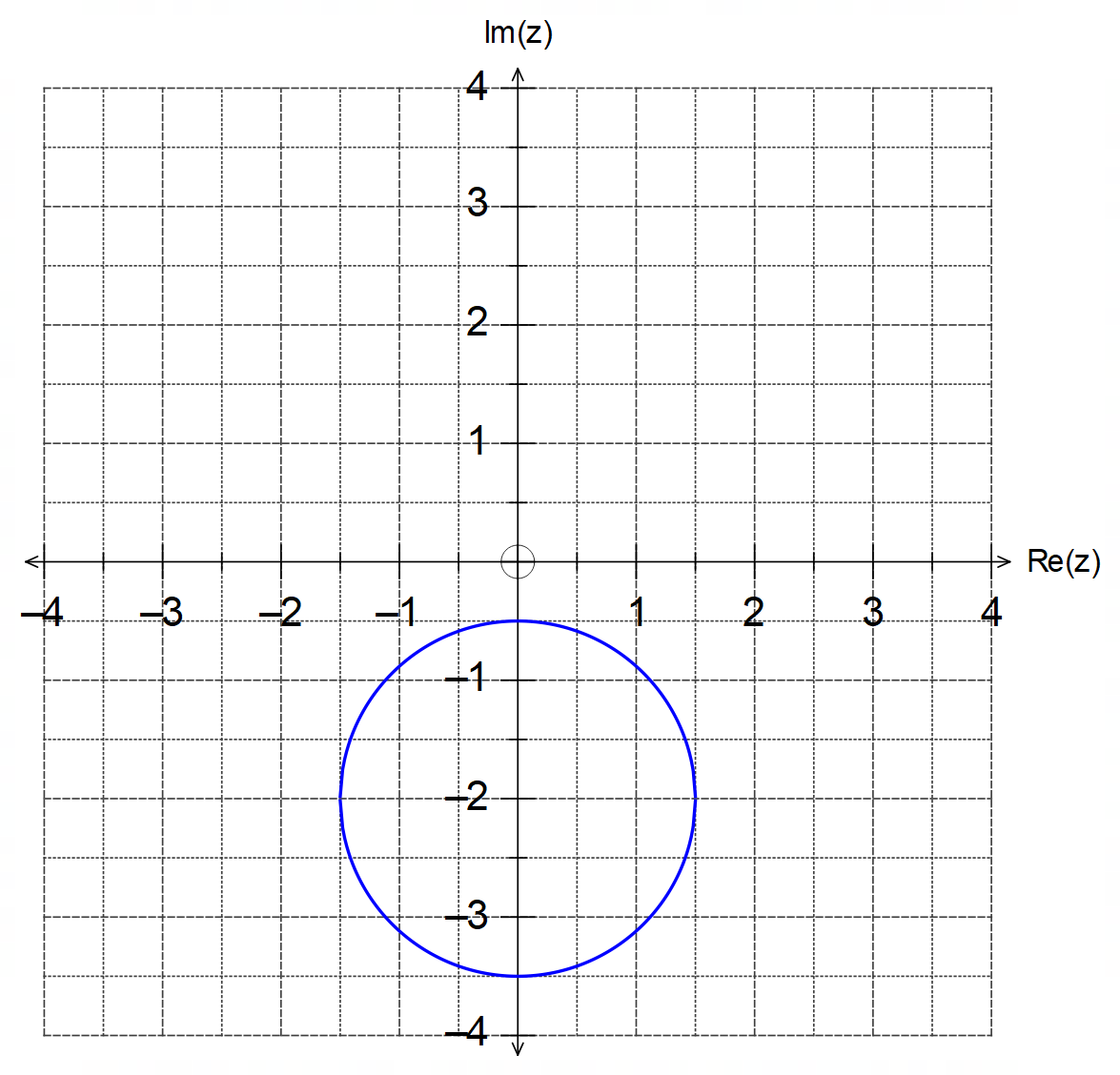
✓

✓

(d) Since L in (c)(ii) passes through the origin, then is

the position vector of the point of shortest distance from O.

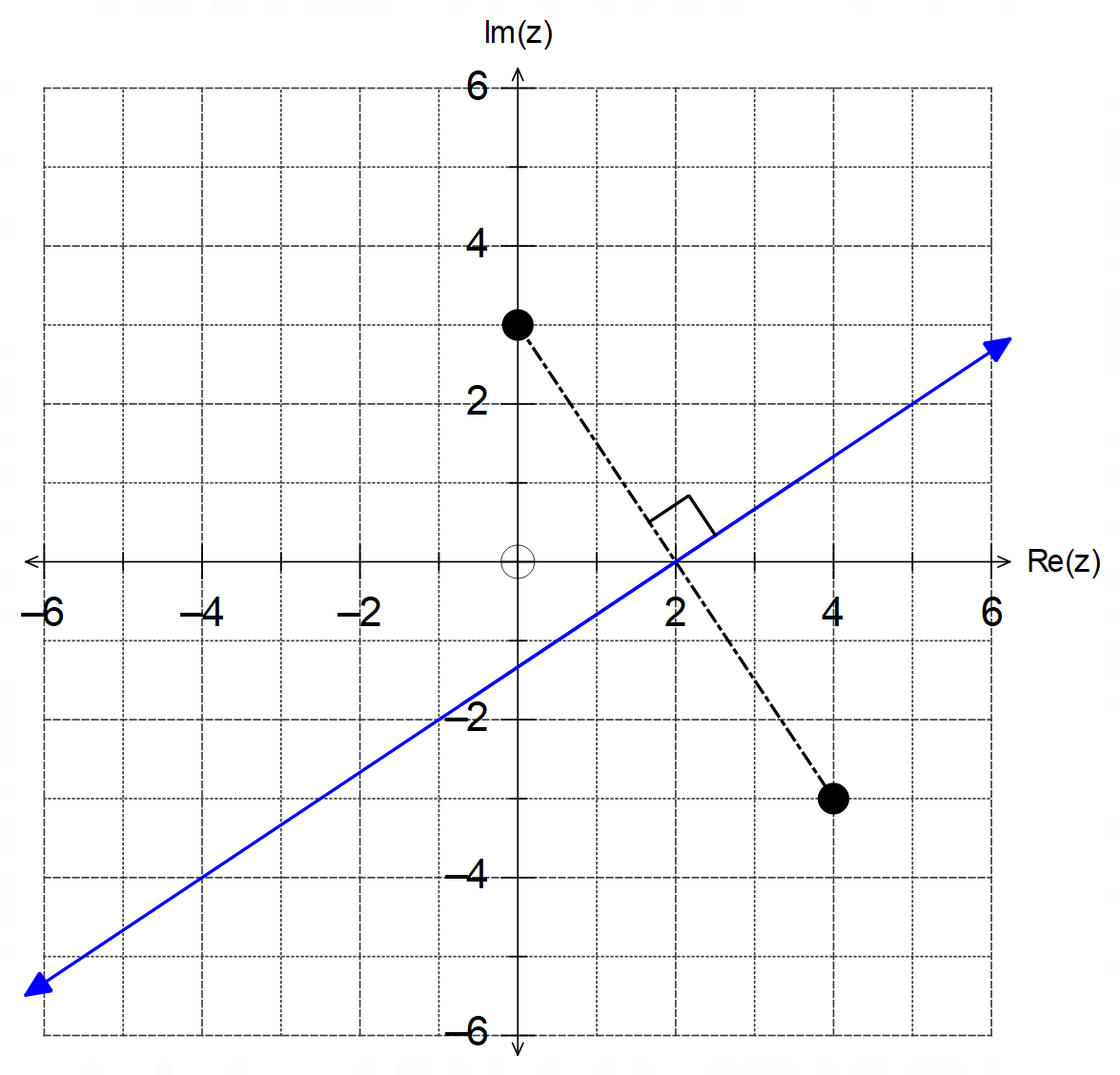
✓ [10]

10. (a) (i)

✓ circle

✓centred at (0,-2)

✓radius of 1.5 units



(ii)

✓ line

or passes through

the points (2,0)

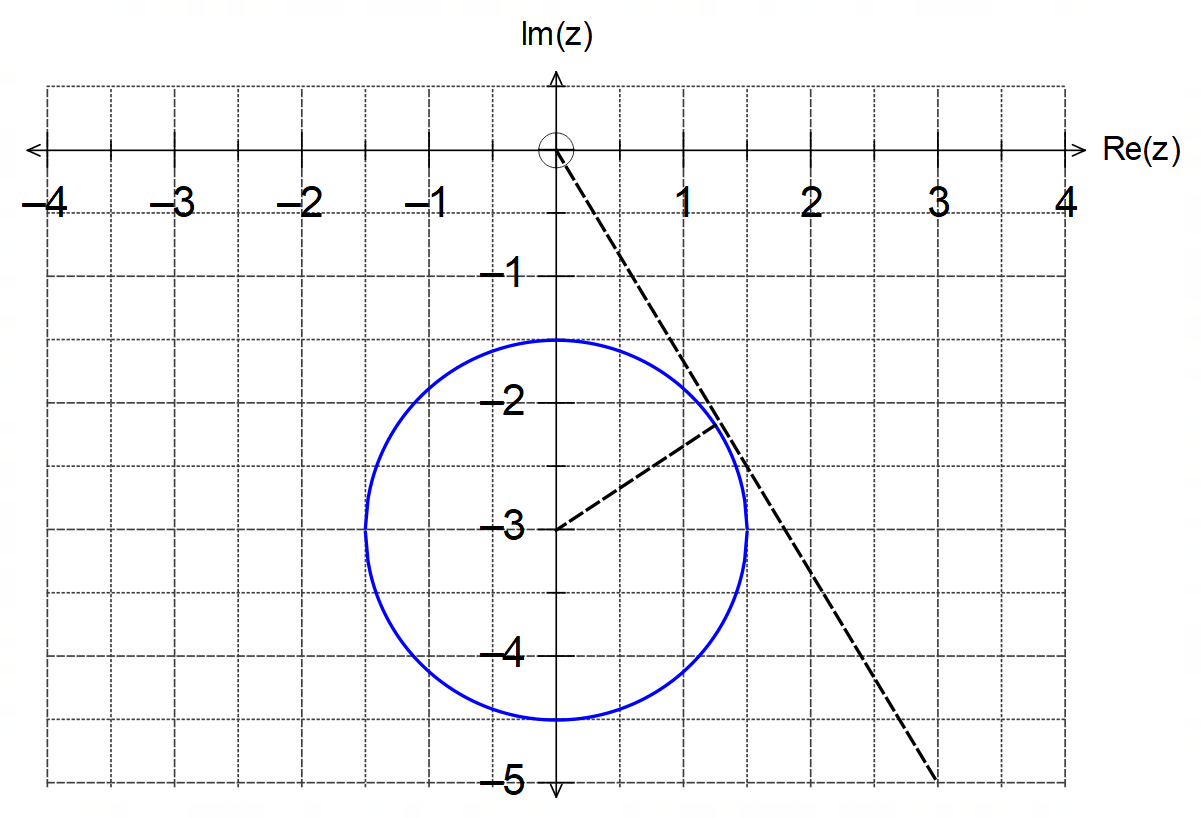
and (-1, -2)

✓✓ perpendicular

bisector between

points given

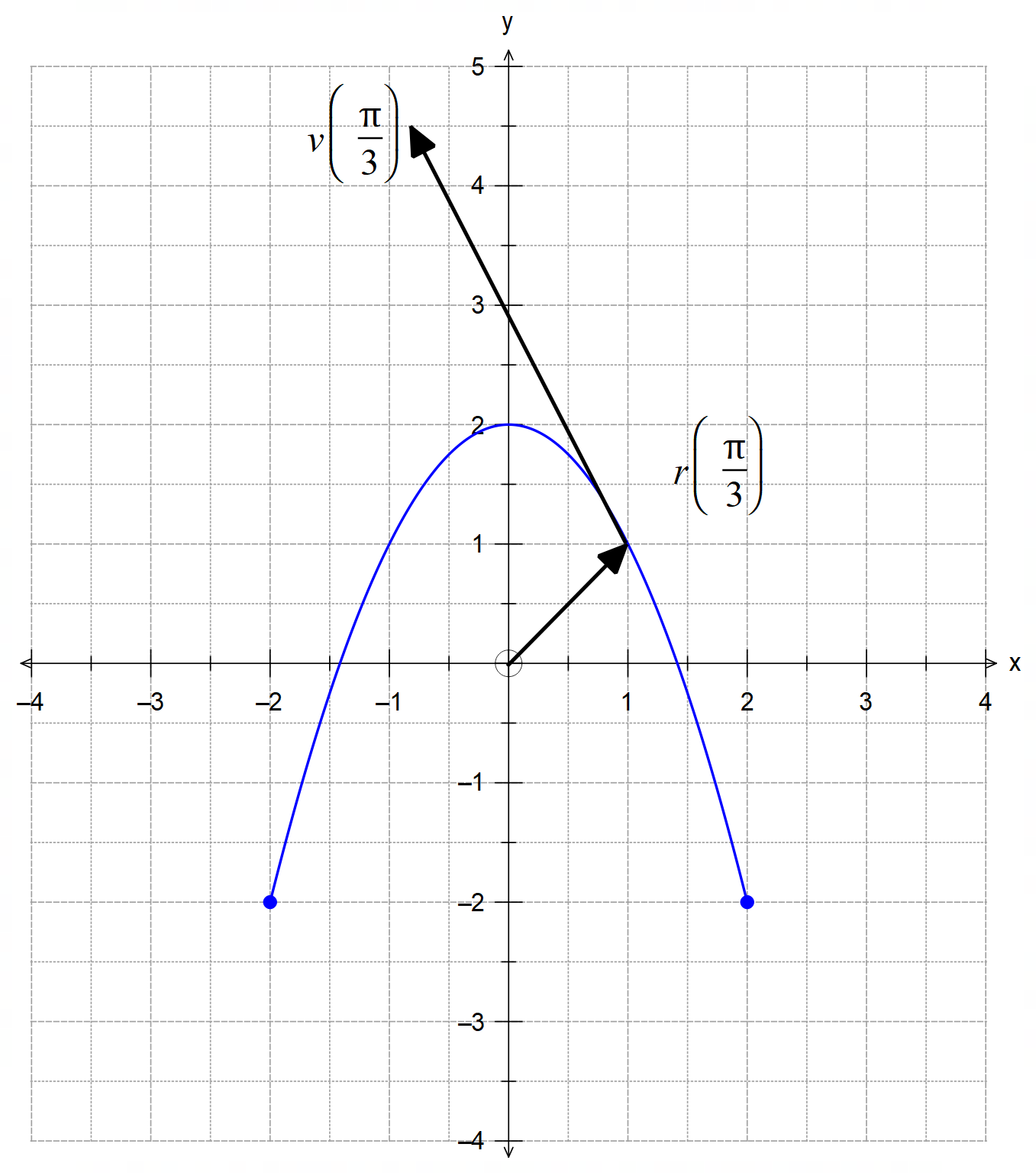
(b) is a translation of 1 unit down. ✓



From diagram: ✓

and occurs in 4th quadrant:

✓✓ [10]

11. (a)

(a)

✓✓ parabola

✓ restricted domain

(c)

✓ position vector

✓ velocity vector

from (1,1)

(b) ✓

(c) ✓

✓

✓✓

(d)

✓

✓

(e) ✓

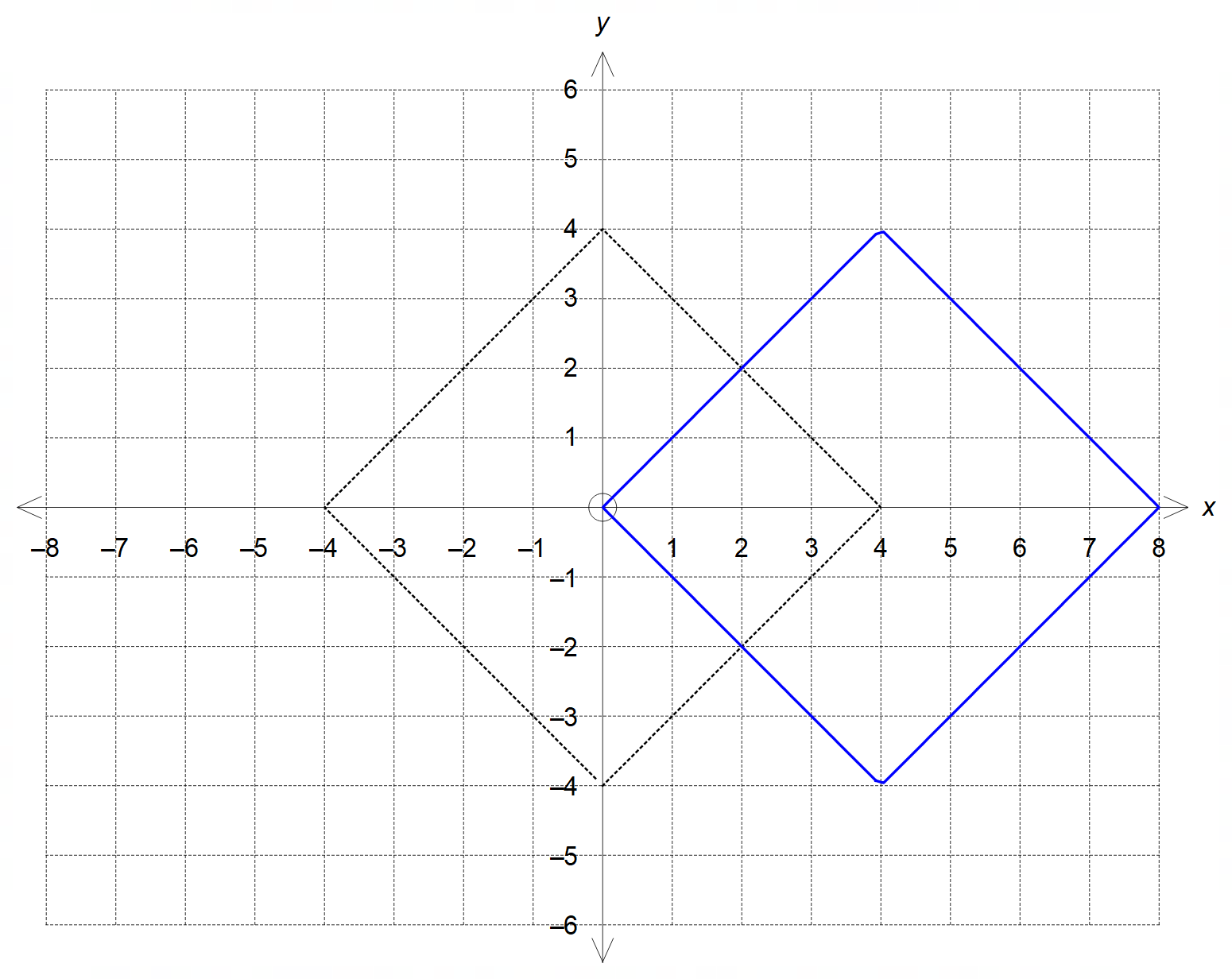
✓

as required.

(f) ✓

✓

with ✓ [17]

12. (a)

✓shape/accuracy

✓ location

(b) is a circle and can intersect the square four times at

either its vertices, or use its sides as tangents.

✓✓

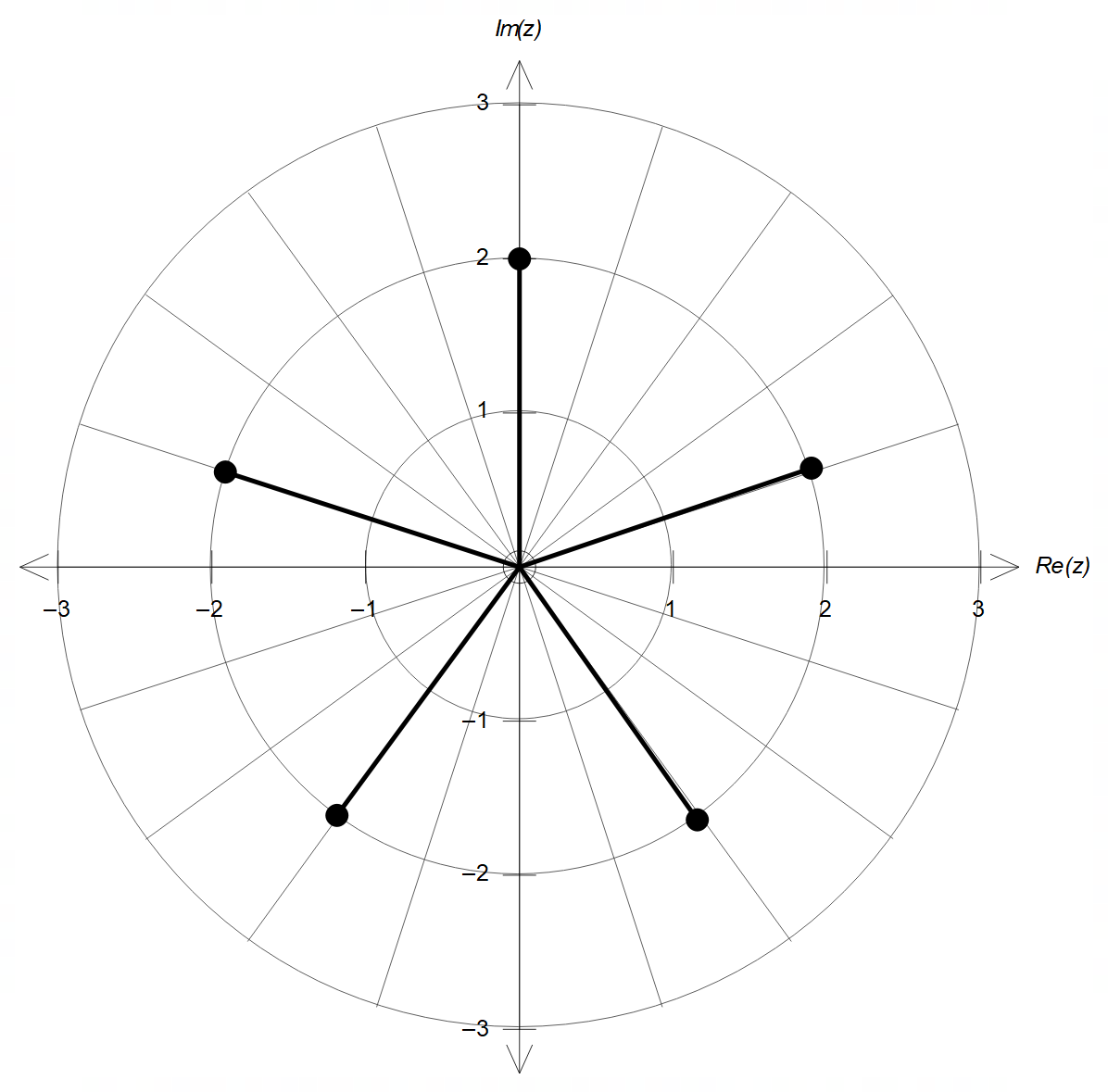
(c) ✓✓ [6]

13. (a) Solution given is ✓

✓✓

Other solutions can be graphed and then listed:

✓✓



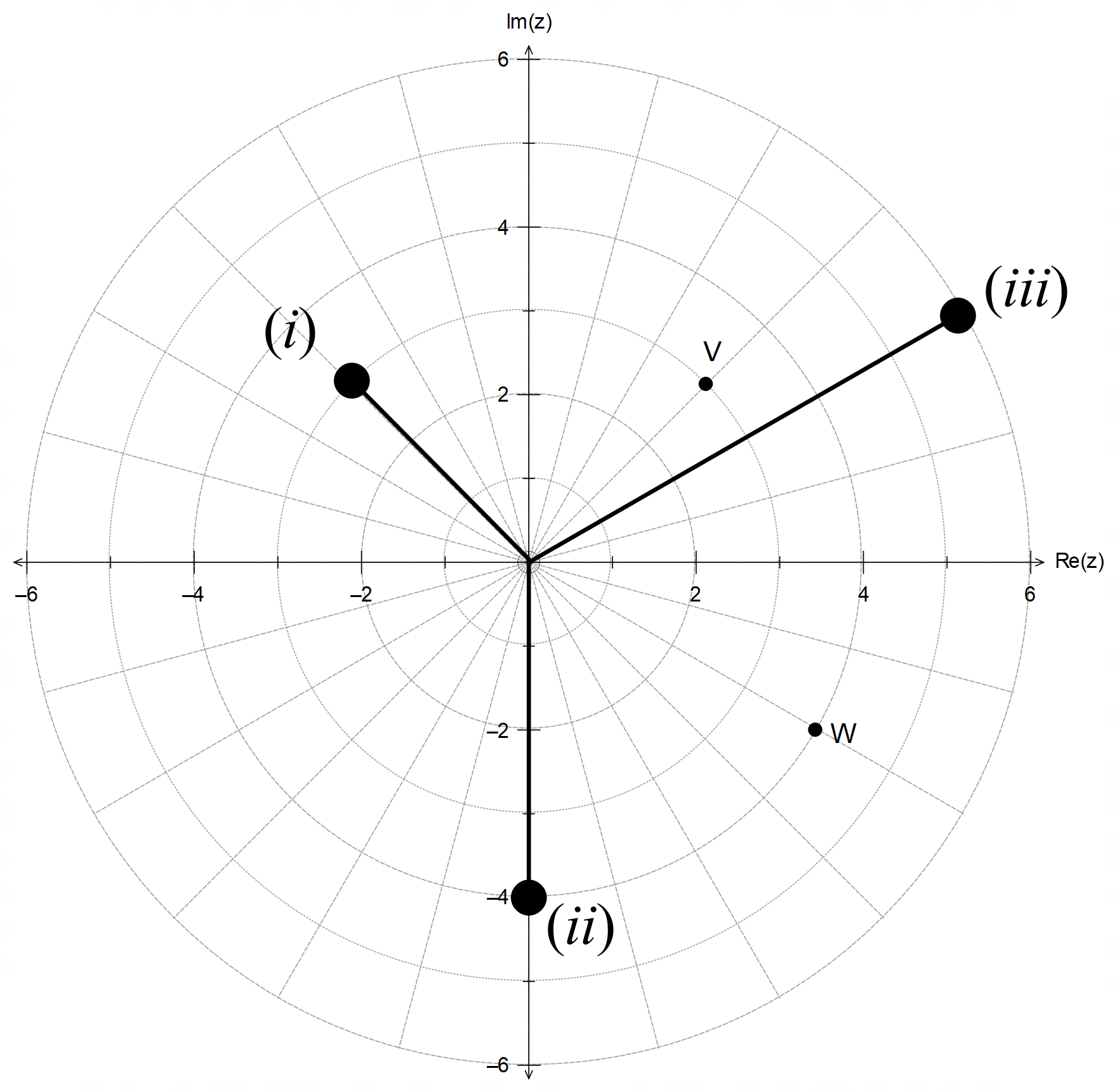
✓ magnitude of 2

✓ apart (4 div)

13. (b) (i)

(ii)

(iii)



✓ magnitude

✓ argument

(each)

[13]

14. (a) Location of collision:

✓

✓✓

✓

(b) Resetting timer/position for particle A;

✓✓

14. (c) from (b)

✓

and

✓

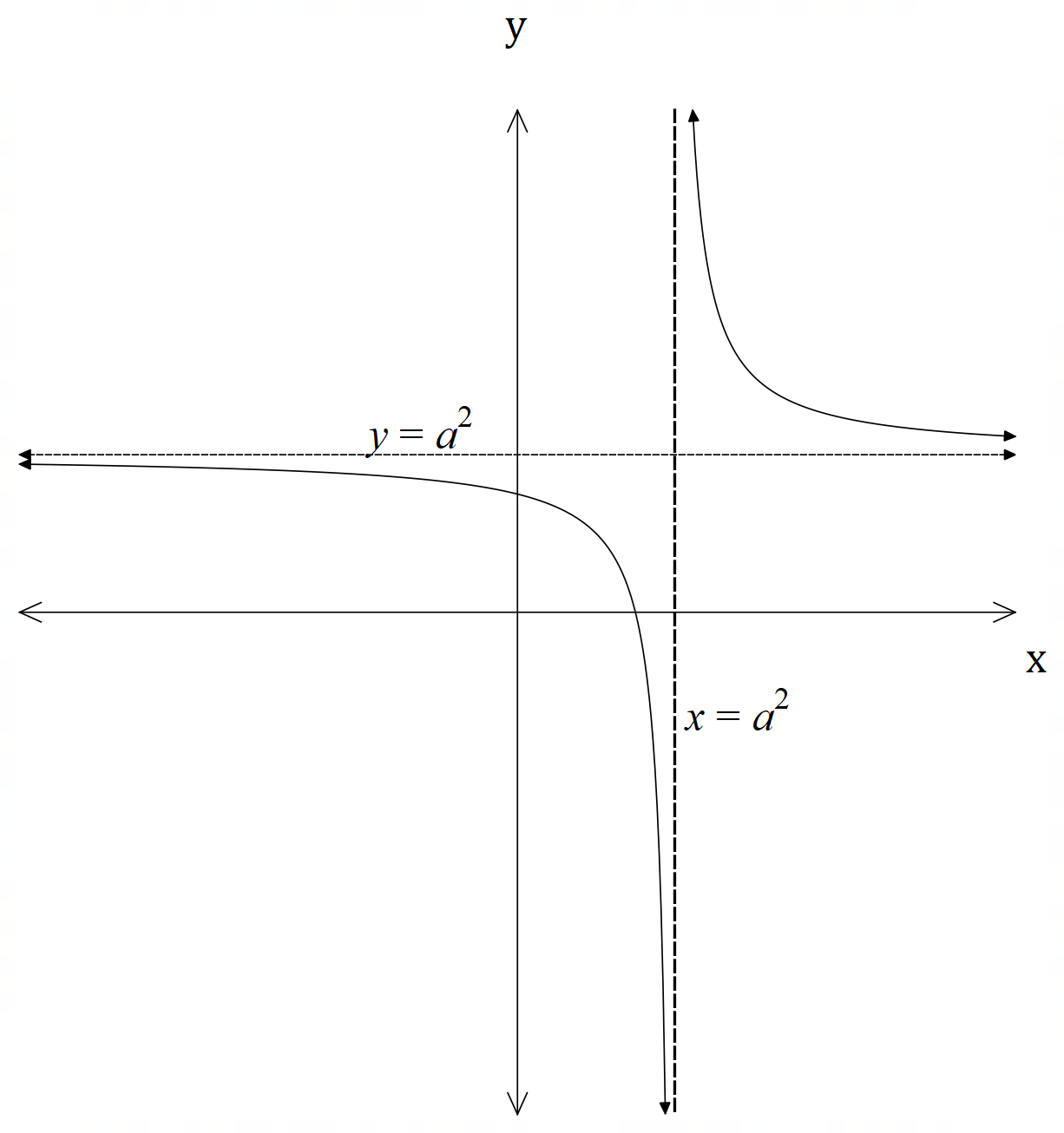
CAS ✓

✓

✓ [11]

15. (a) ✓

✓✓

 (b)

✓ asymptote

✓ pole

✓ positive rectangular

hyperbola

(c) (i) ✓✓

(ii) is an involution and hence it is its own inverse.

The graphs of and are symmetrical over the line .

They have the same set for both its domain and range: .

They have the same asymptote .

They have the same pole ✓✓✓✓ [12]

(any four of these)

16. (a) from De Moivre’s theorem ✓

CAS ✓

✓

✓

(b) Let

from (a) ✓

✓

✓ [7]

17. ✓

✓

and ✓

✓

✓

✓ [6]