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**SEMESTER TWO**

**MATHEMATICS**

**SPECIALIST**

**UNITS 3 & 4**

**2019**

**SOLUTIONS**

**Calculator−Free Solutions**

1. ✓✓

i.e.

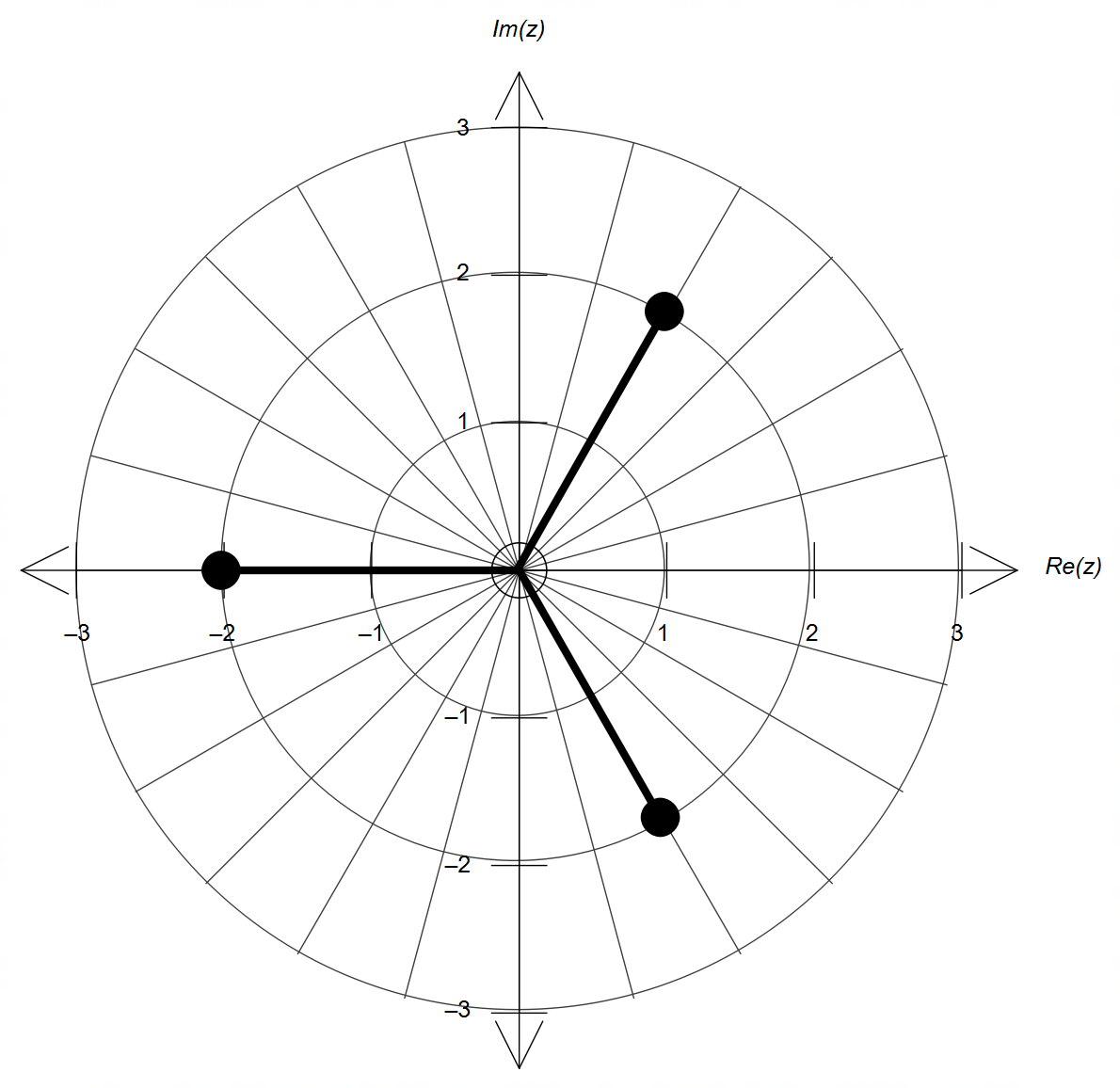
i.e. the complex number lies on the line ✓

✓✓ [5]

2. (a)

✓

✓✓



(b)

✓ magnitude = 2

✓ radians apart

(c)

expanding with gives:

and therefore and ✓

(division of polynomials is also possible)

Hence, ✓

(d) ✓

✓✓ [10]

3. (a) ✓

✓

✓

(b) Using the substitution recommended in (a):

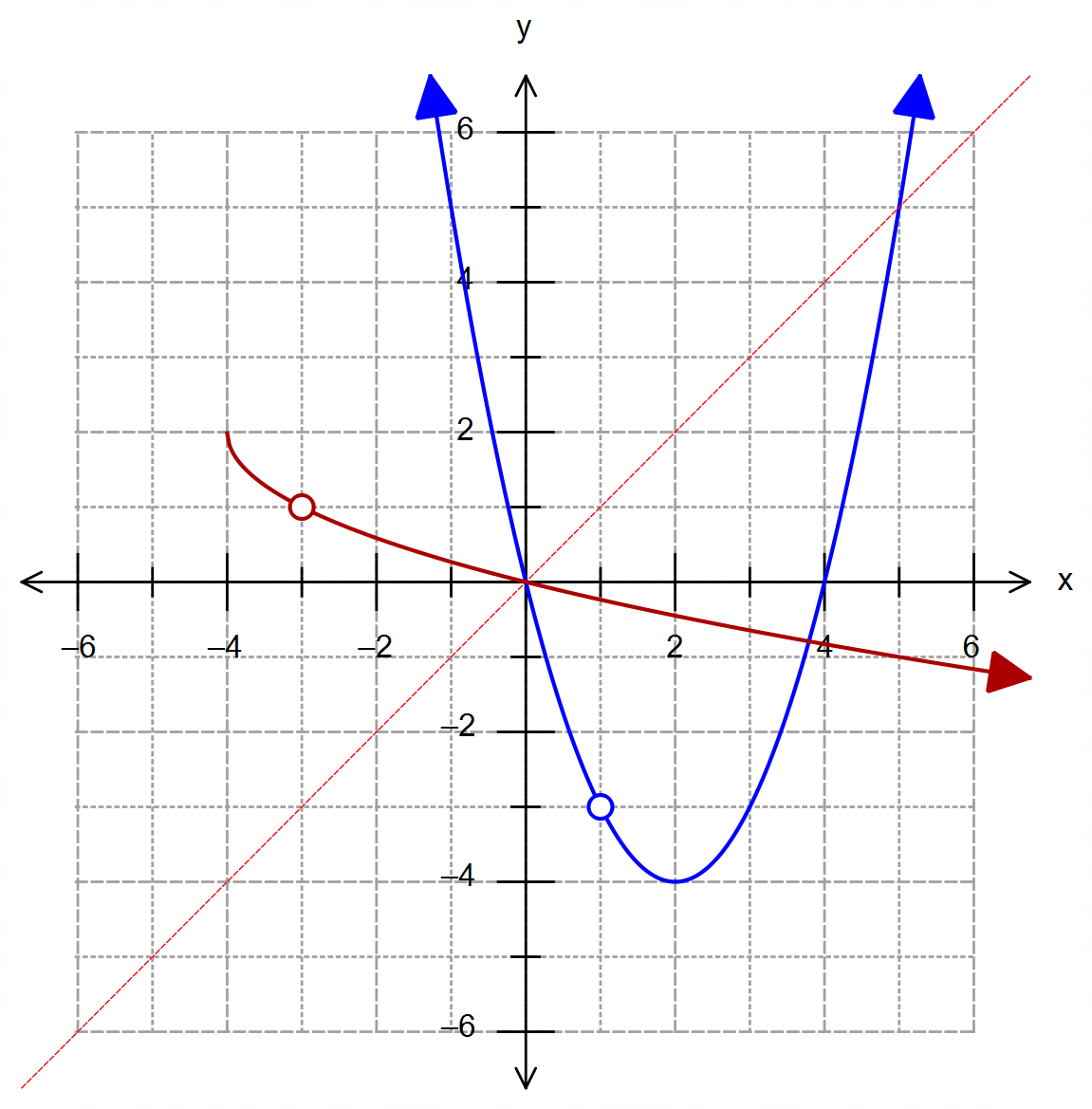
✓✓ [4]

(other method is possible by setting )

4. (a) provided ✓

✓

✓✓



(b)

(b)

✓ parabola with roots at x=0 and 4, with tp at (2,-4)

✓ discontinuity at (1,-3)

(d)

✓ square root function

with tp at (-4,2)

✓ discontinuity at (-3,1)

4. (c) Turning point at ✓

Algebraically by rearranging to make the subject

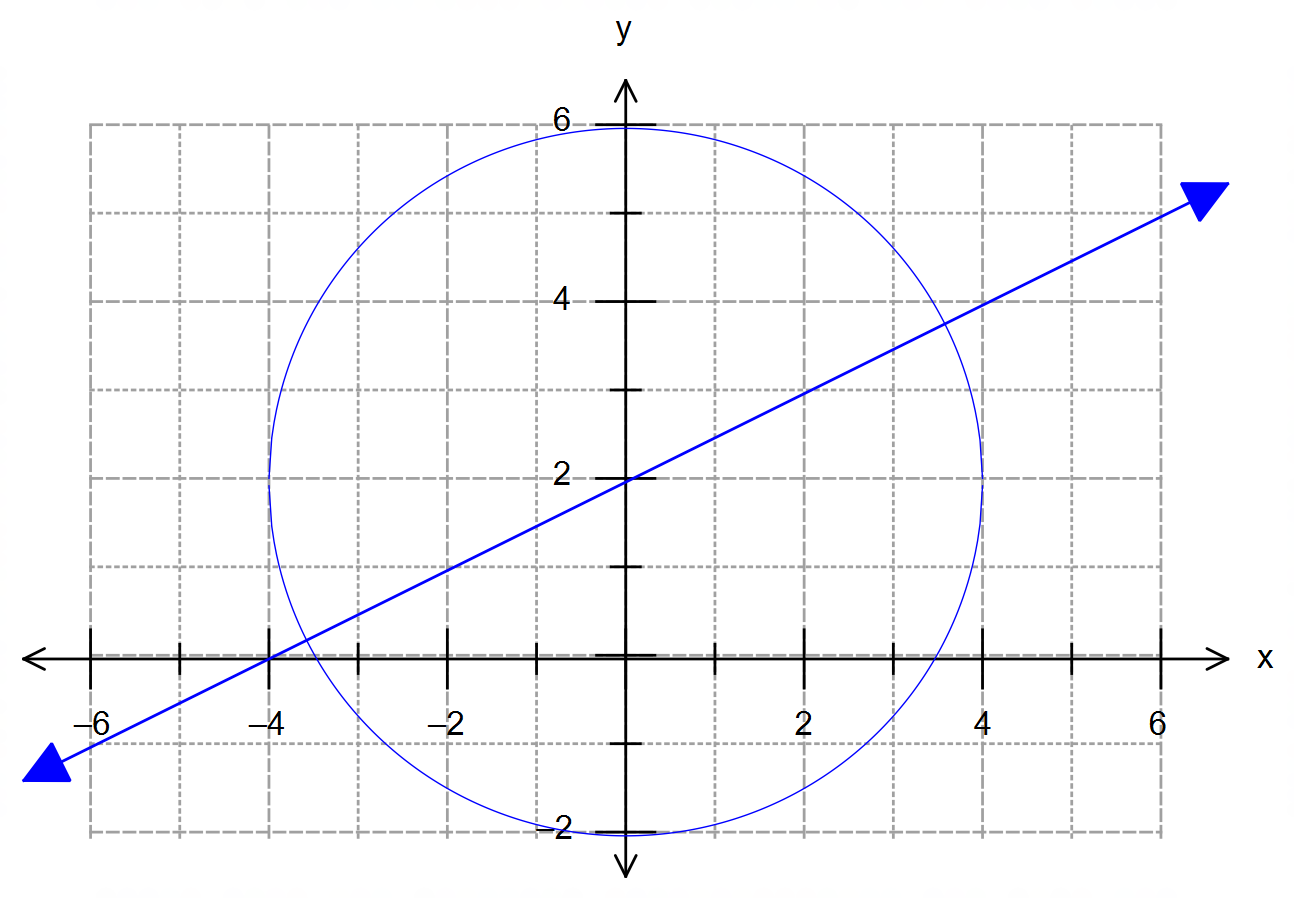
gives ✓

(d) Shown on the graph in (b). ✓✓ [10]

5. (a) ✓

(b) The line can be obtained from two points, by choosing

any two different values of .



✓✓ line

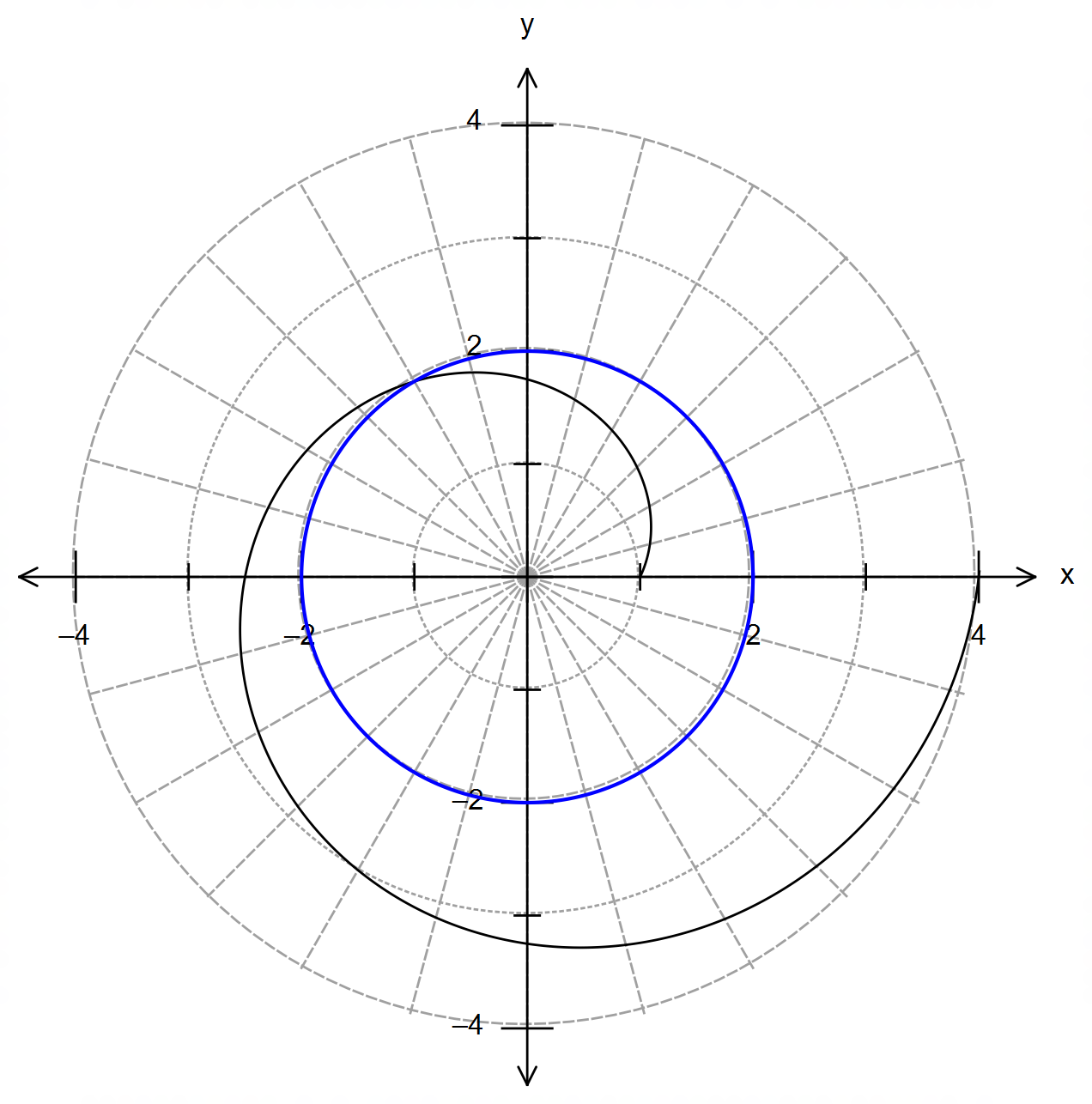
✓

✓

✓ [6]

6. (a) Choosing the polar point :

✓

 (b)

✓ circle cented at O

with radius 2

(c) Using :

✓✓

✓✓ [6]

7. (a) Area of a segment:

✓

(b) ✓

(c) ✓

✓

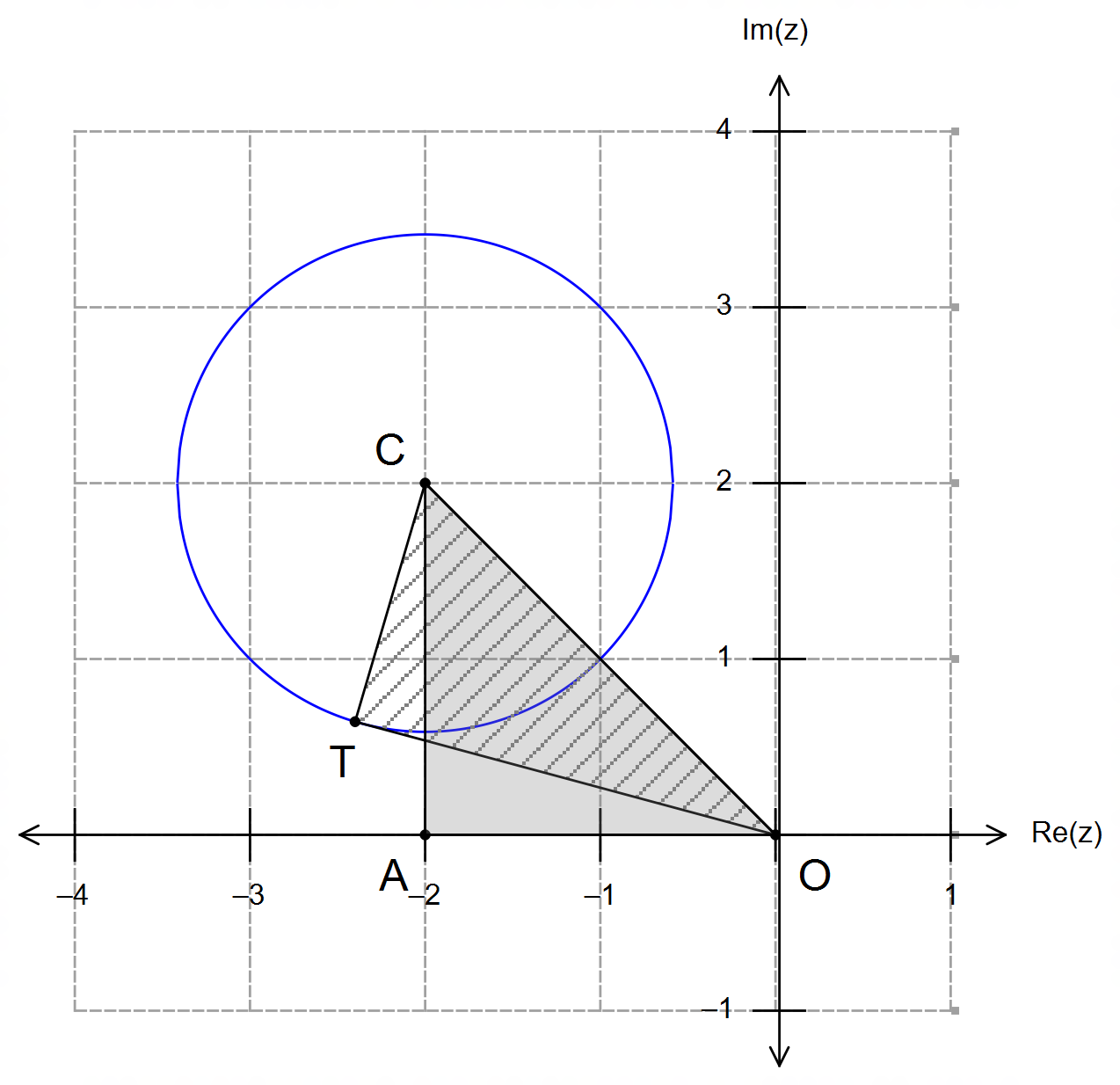
✓

(d)

✓

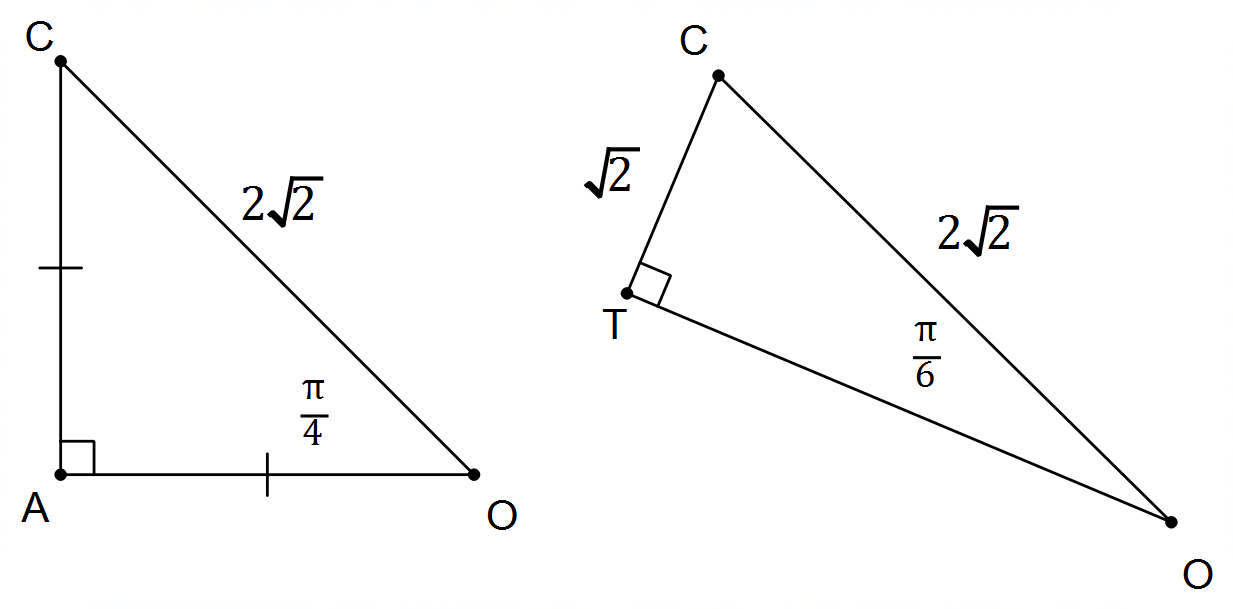
when m we obtain ✓

✓ [8]

**Calculator−assumed Solutions**

8. From the diagram we obtain two

right angled triangles:



And therefore we have:

✓

✓

✓✓

✓ [5]

9. (a) ✓

✓

(2dp.) ✓

(b)

✓ Normal distribution

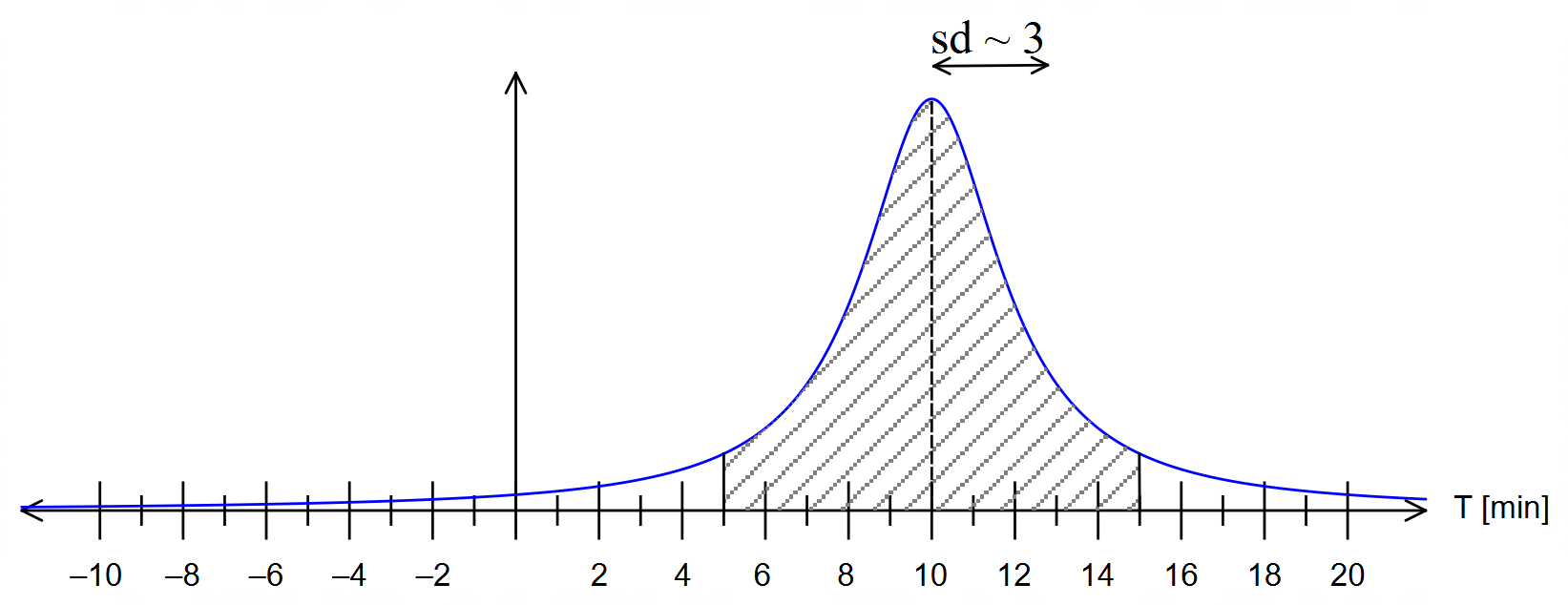
centred at

✓ Indicates a standard

deviation of approx. 3 min

✓ Refers to (a) with area

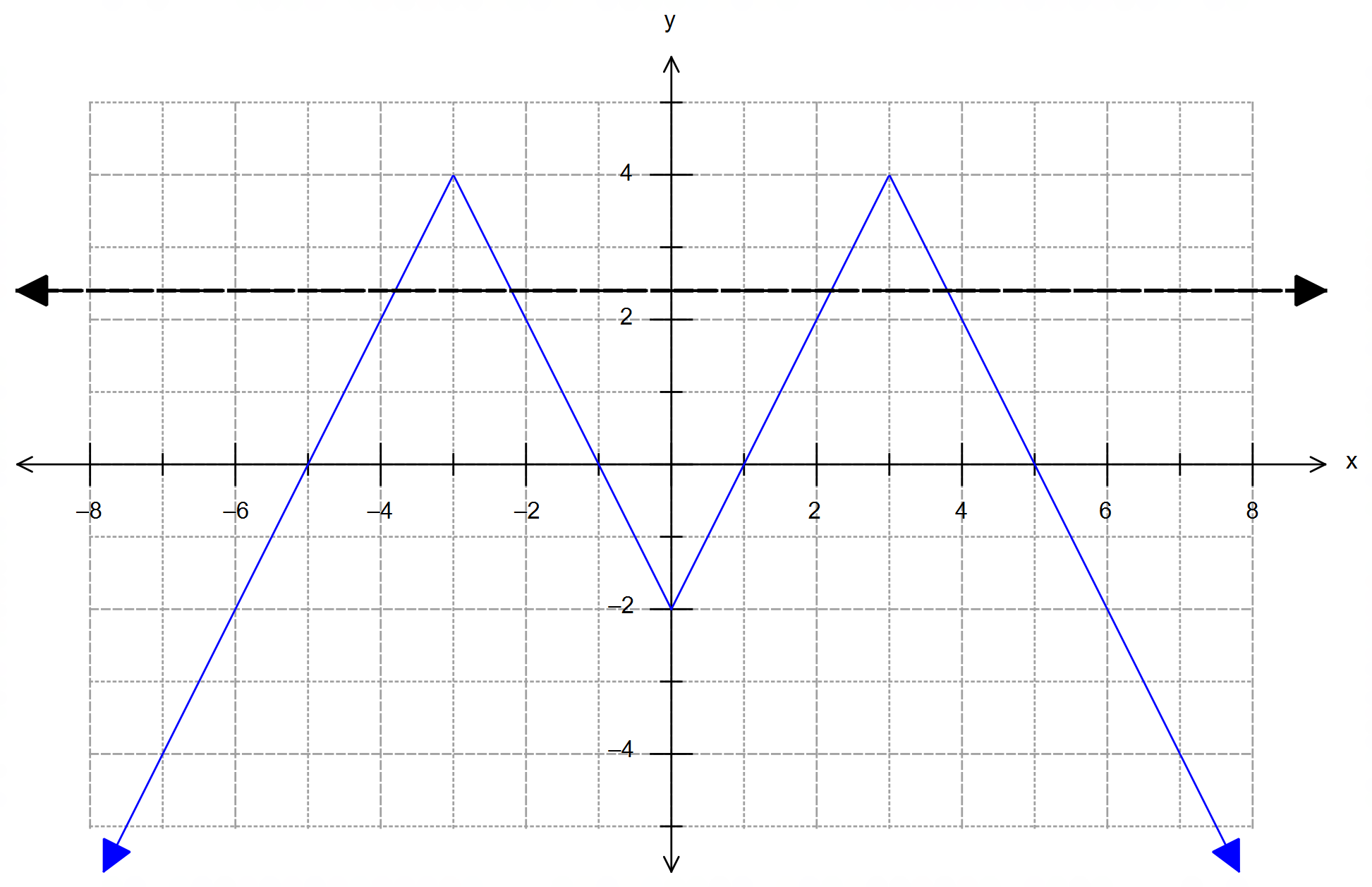
shaded



[6]

10. (a)

✓✓✓

 (b) The diagram below shows :

Thefore, a horizontal line would intersect the graph

for . ✓✓✓ [6]

(graphical explanation can be accepted)

11. (a) location of ground collision ✓

seconds ✓

✓

and from O ✓

(b) point 10 km above ground

sec from detection time ✓

✓

displacement vector for ABM ✓

✓

11. (c) (Using the conditions for collision will show that they do

not collide. If no other work is shown then award two marks for this attempt)

Using closest-approach method with CAS: fmin

and

✓✓

✓

CAS:fmin for ✓✓ [13]

12. (a) ✓✓

(b) The slope is undefined at ✓

(c)

✓

✓

✓ [7]

13. (a) is approximately normally distributed as the sample

size

✓✓

i.e. ✓

(b) ✓✓

(c) No, there is no change. ✓

Because the sample size provides a normal

distribution for the sample means, despite the shape

of the parent distribution. ✓

13. (d) ✓

and , i.e.

If ✓

✓✓ [11]

14. (a) (i) ✓

(ii)

✓

✓

(b)

Let

then:

for ✓

for ✓

✓

[8]

15. (a)

✓

✓

15. (b) ✓

✓

Since exponential decay never crosses the x-axis, we must

choose the first value that would round to zero.

i.e. (other values less than 100.5 are acceptable)

✓

✓ [7]

16. (a) from formula sheet ✓

(b) from formula sheet, with 5000 as limit ✓✓

and

solving simultaneously: CAS ✓✓

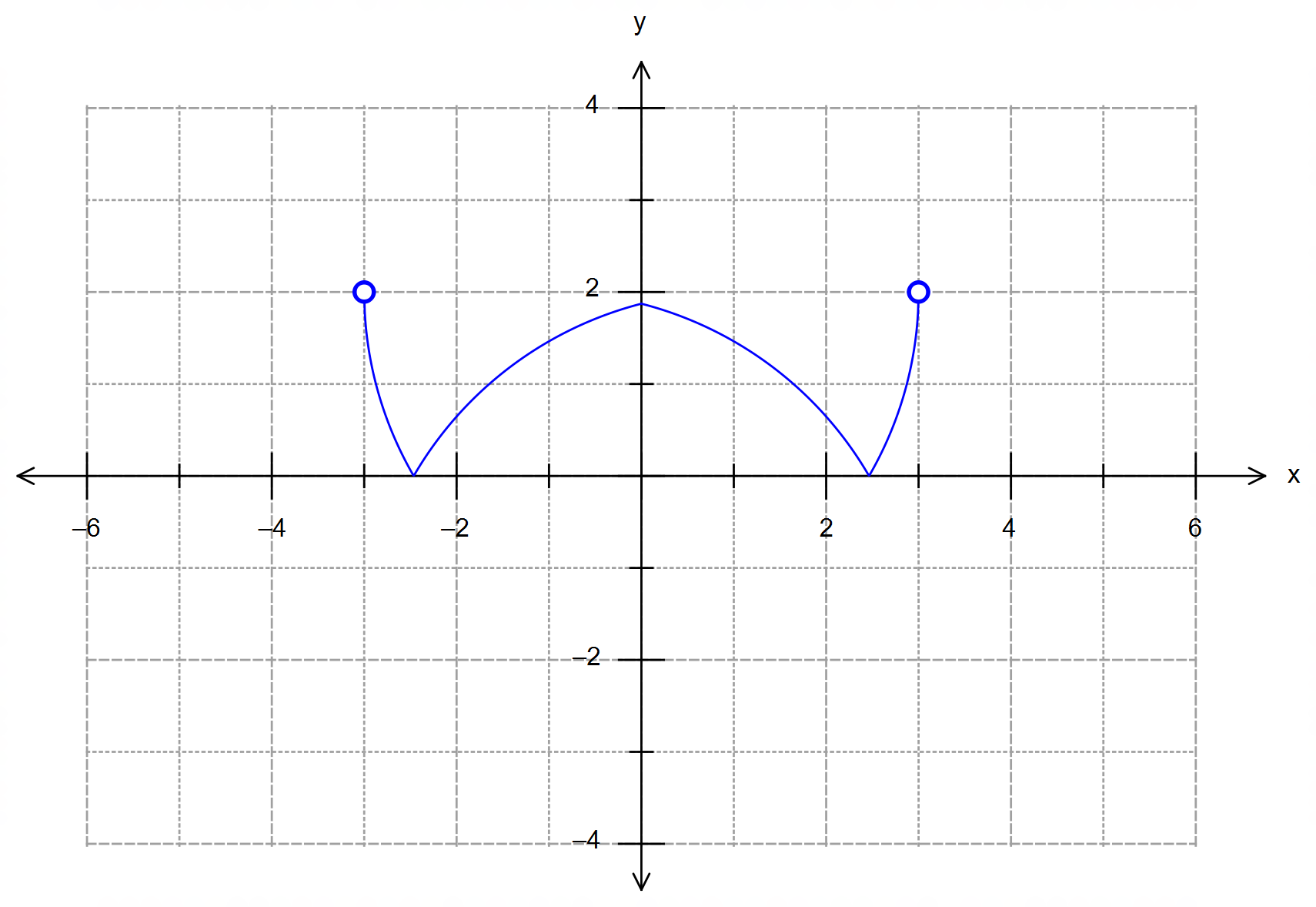
(c) Since the line is the upper asymptote, it will never

actually reach 5000. Therefore we must choose the first value

that would round to 5000:

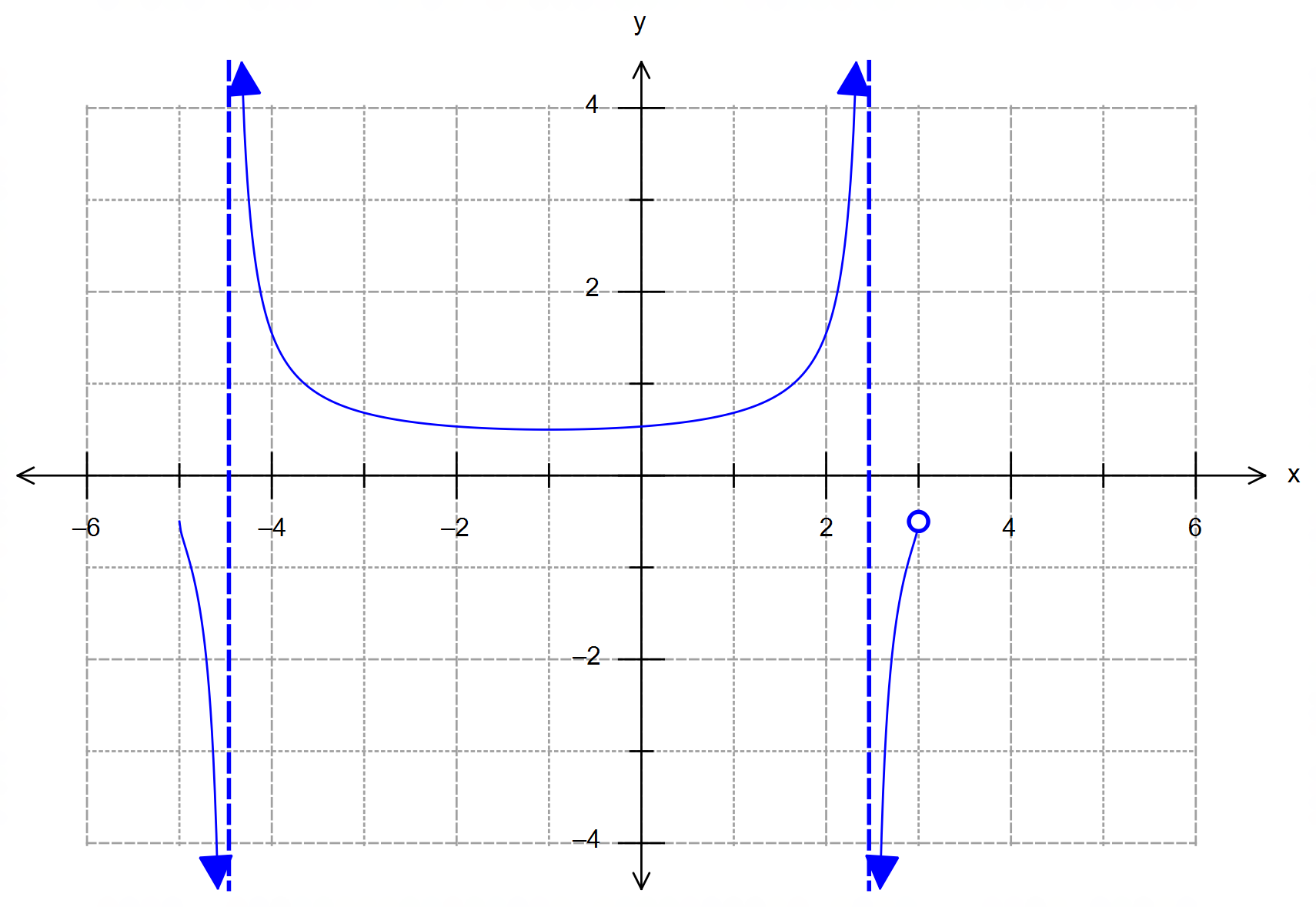
✓

CAS ✓ [7]

17. (a) (i)

✓ reflection over x axis

✓ reflection over y axis

17. (a) (ii)

✓ vertical asymptotes

at the roots of the circle

✓ crosses the original

function at points

✓ behaviour on either side

of the asymptotes

(b) (i) ✓

(ii) For :

✓

Domain of ✓

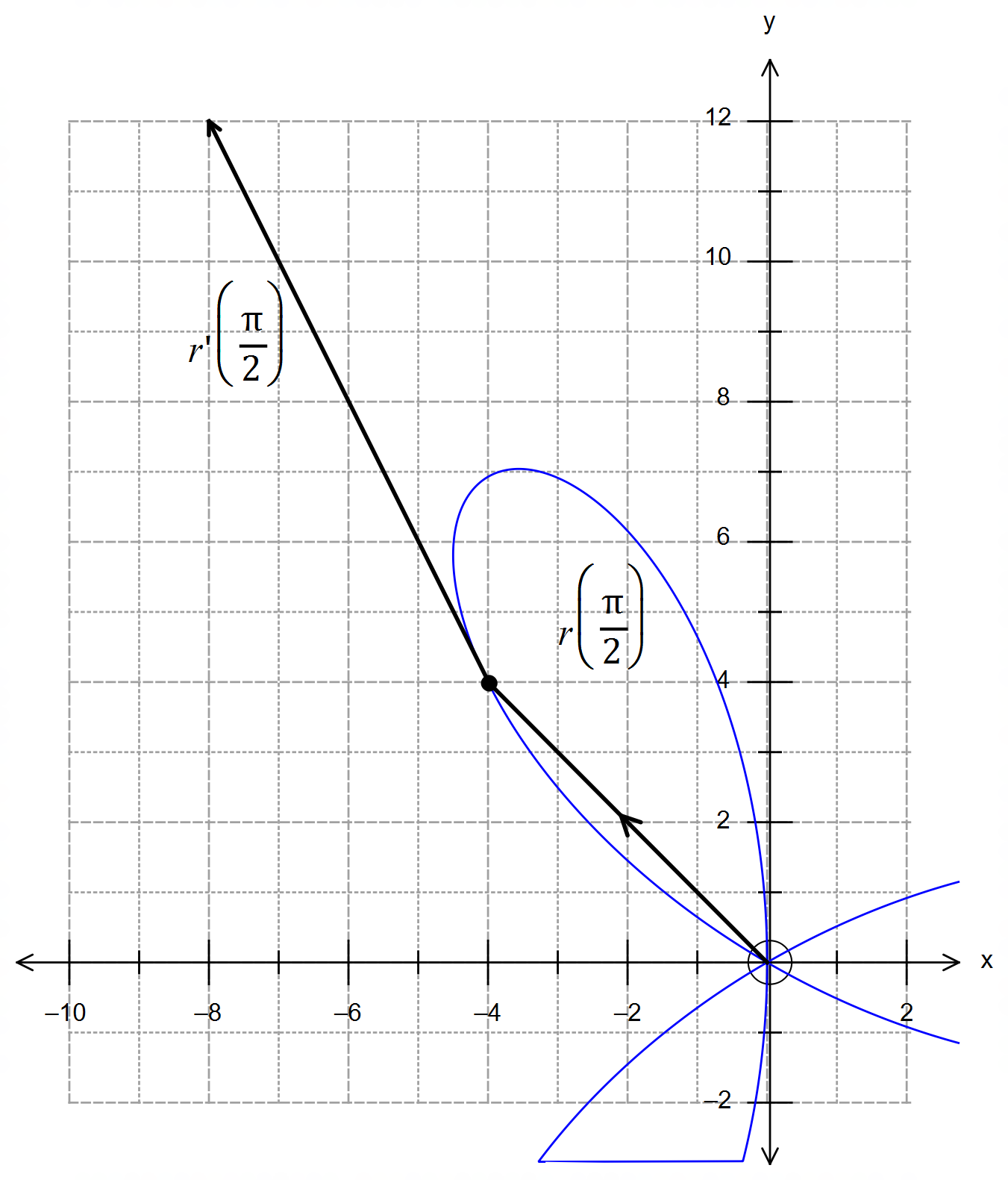
Range of ✓ [9]

18. (a) seconds ✓

(b)  [m] from O ✓

✓

[m/s] ✓

18. (b) Continued.

✓ position vector (-4, 4)

drawn from O.

✓ velocity vector (-4, 8)

relative to (-4,4)

[i.e. drawn from (-4 ,4)]

(c) m/s ✓

for ✓

✓ [9]

19. (a) the apparent “root” is in fact a discontinuity which

occurs at ✓

✓

✓

(b)

✓✓ [9]