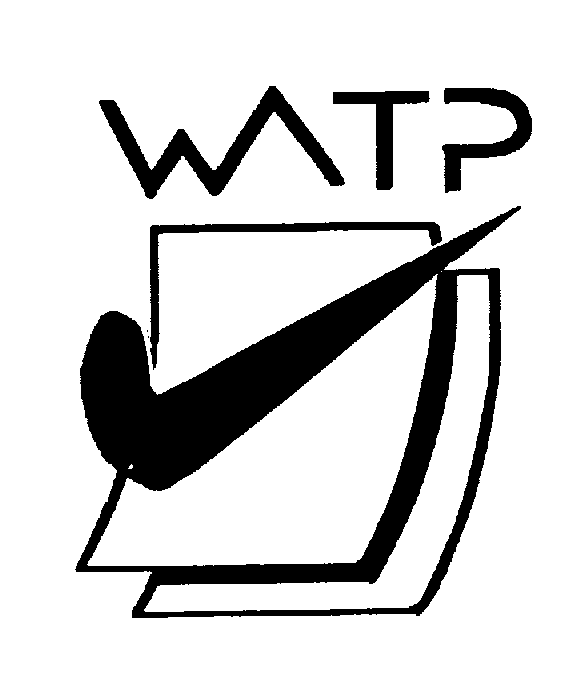
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**SEMESTER TWO**

**MATHEMATICS**

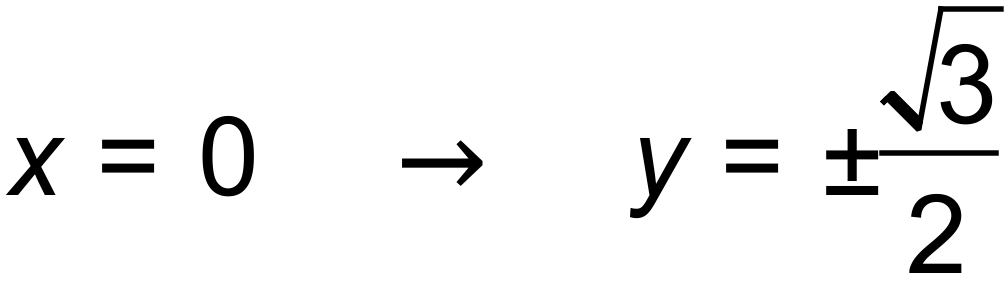
**SPECIALIST**

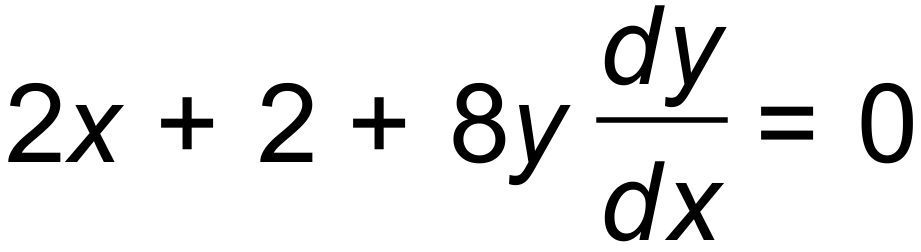
**UNITS 3 & 4**

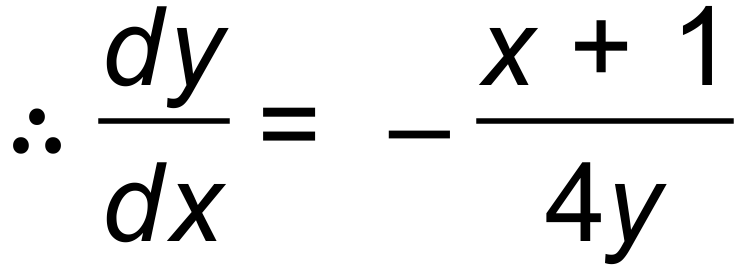
**2016**

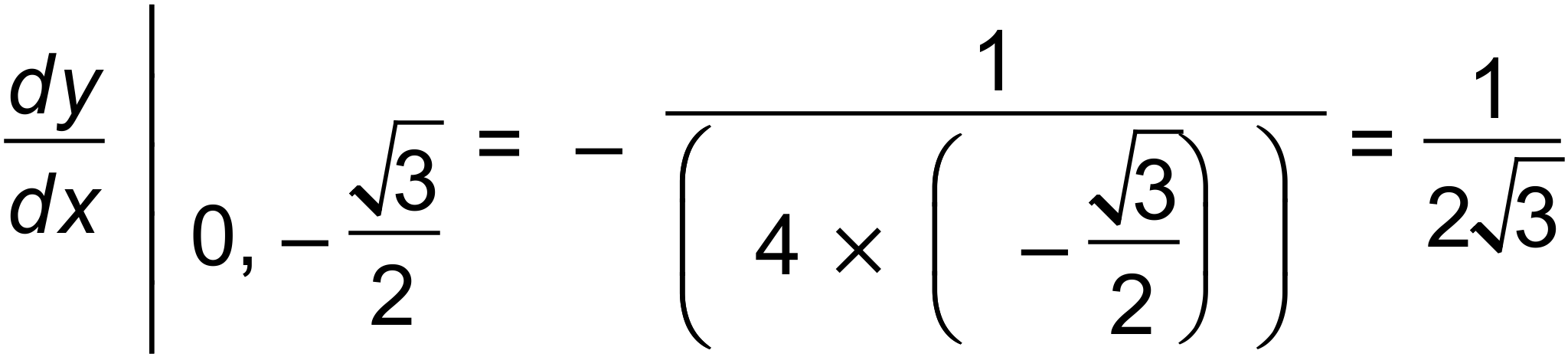
**SOLUTIONS**

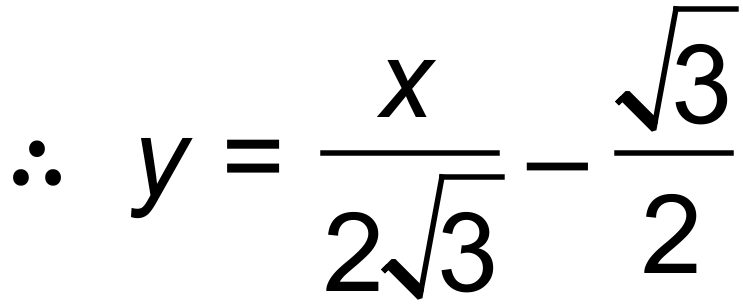
***Calculator−free Solutions***

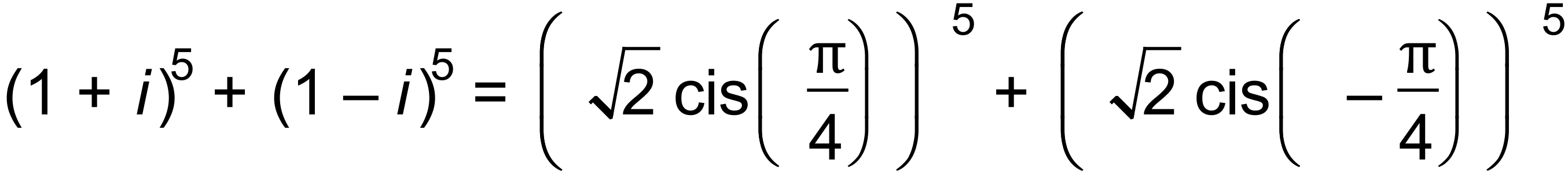
1.  ✓

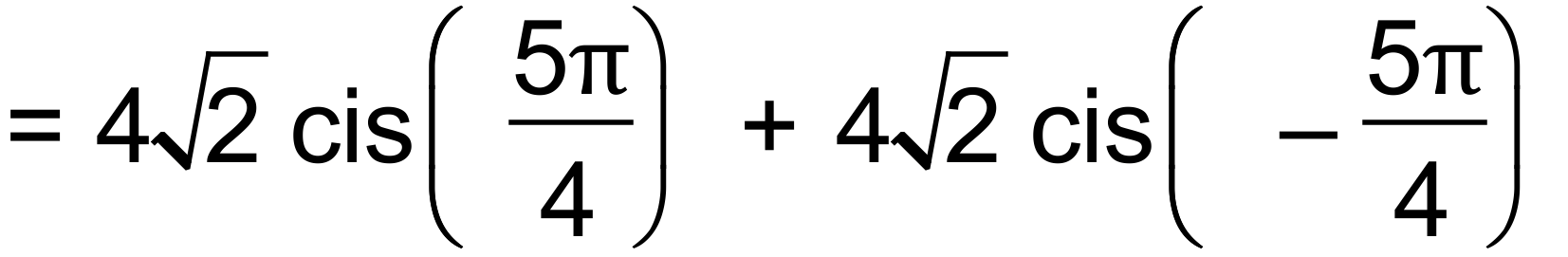
 ✓✓

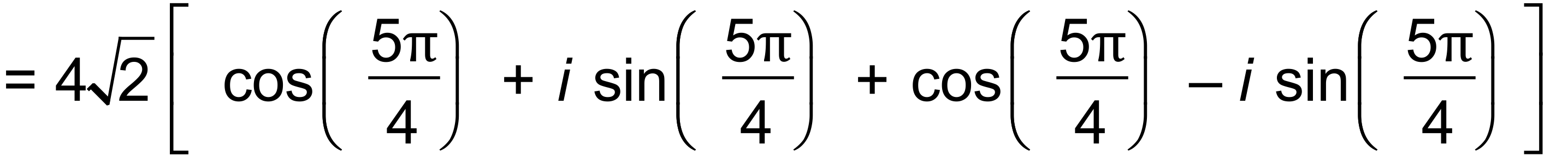


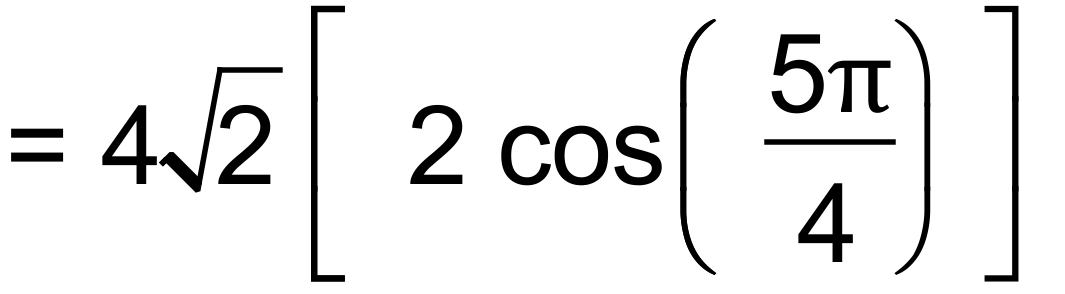
 ✓

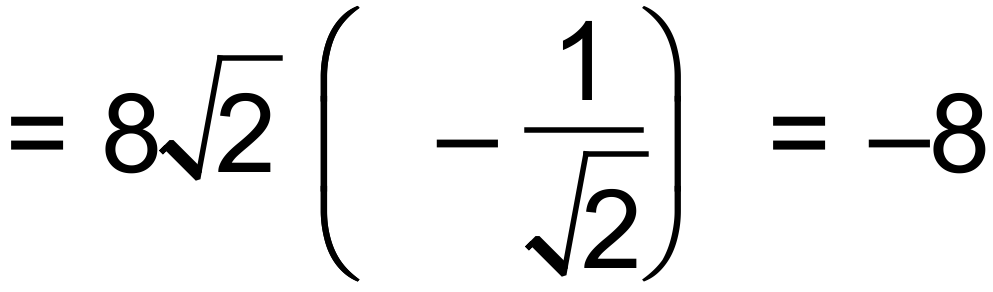
 ✓ [5]

2. (a)  ✓

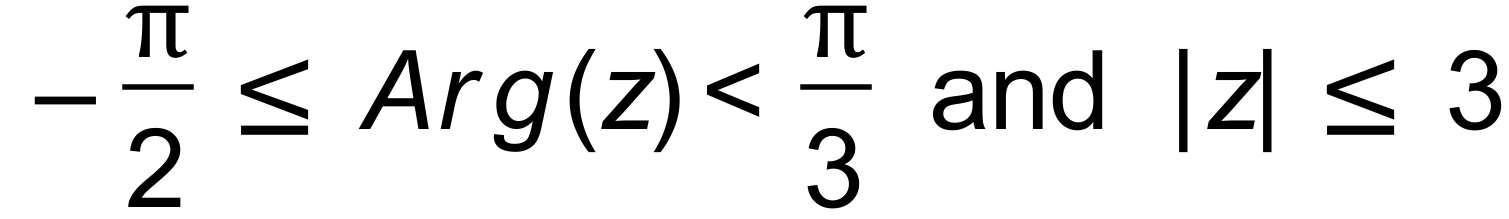
 ✓

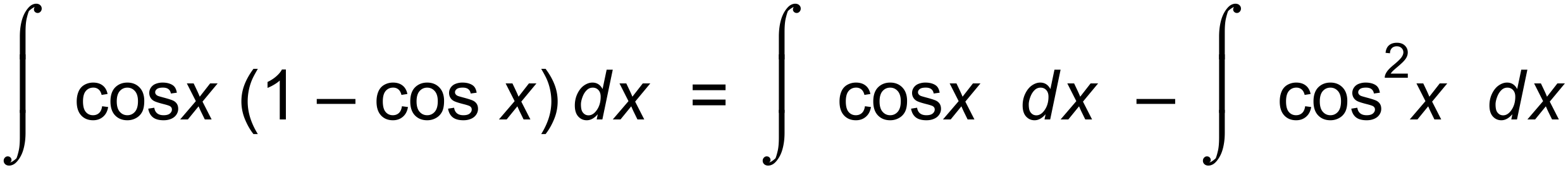
 ✓

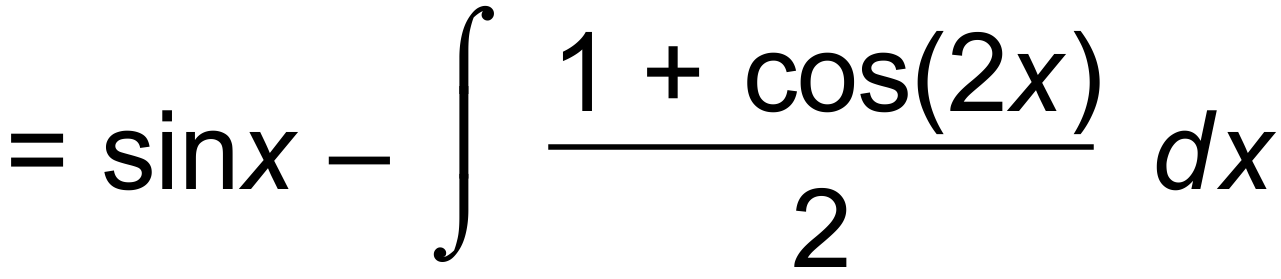


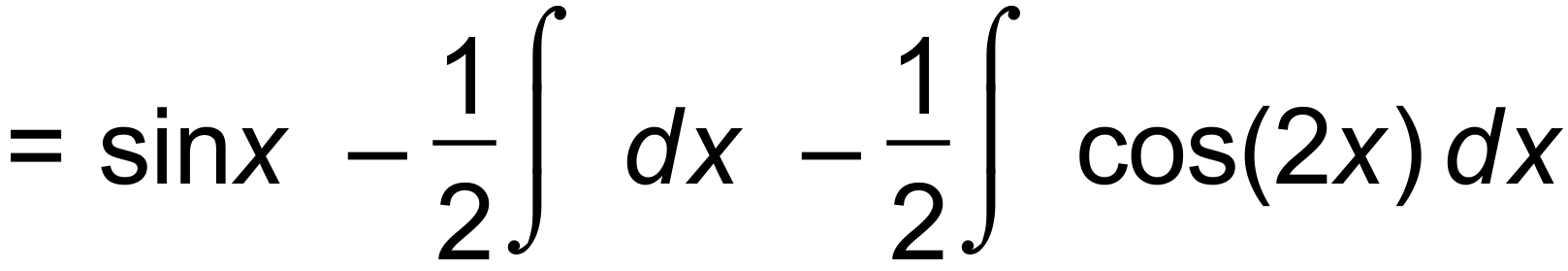
 ✓✓

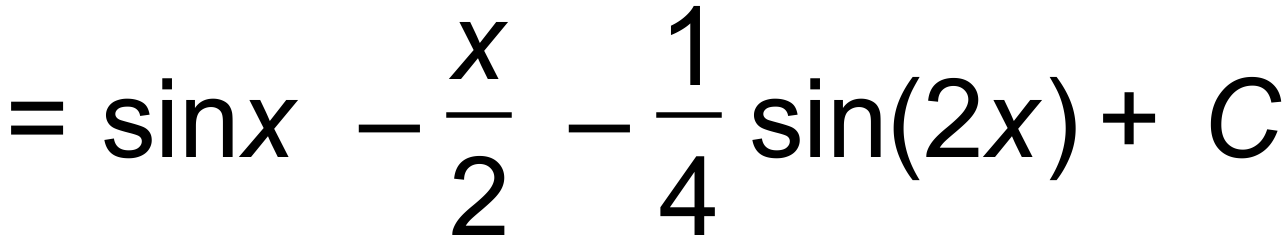
(b) (i)  ✓✓

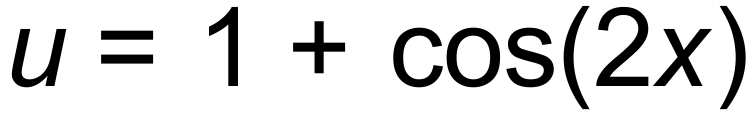
(ii)  ✓✓✓ [10]

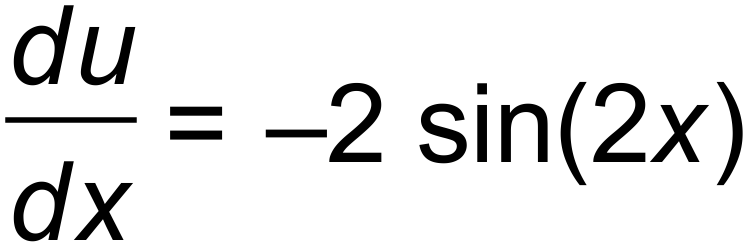
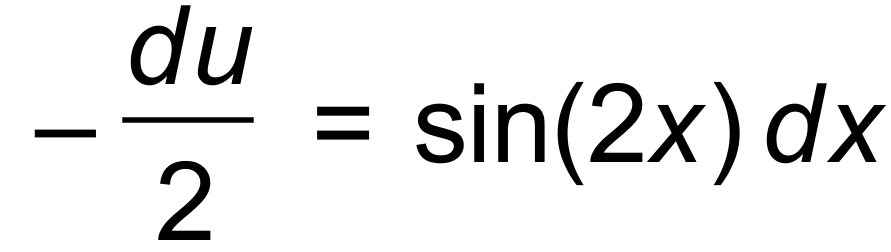
3. (a) 

 ✓✓

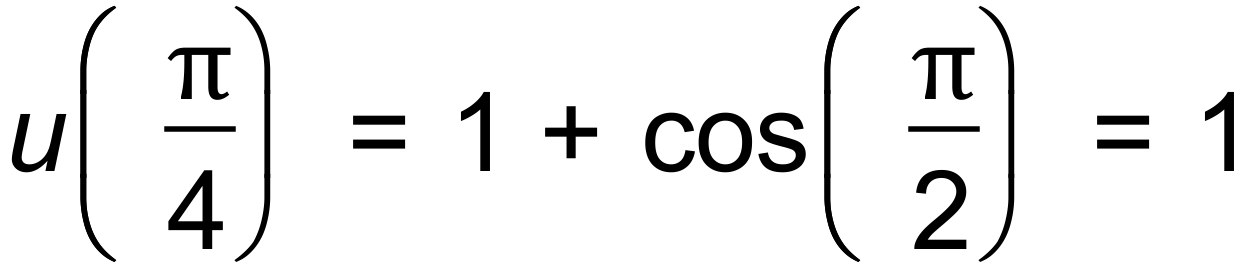


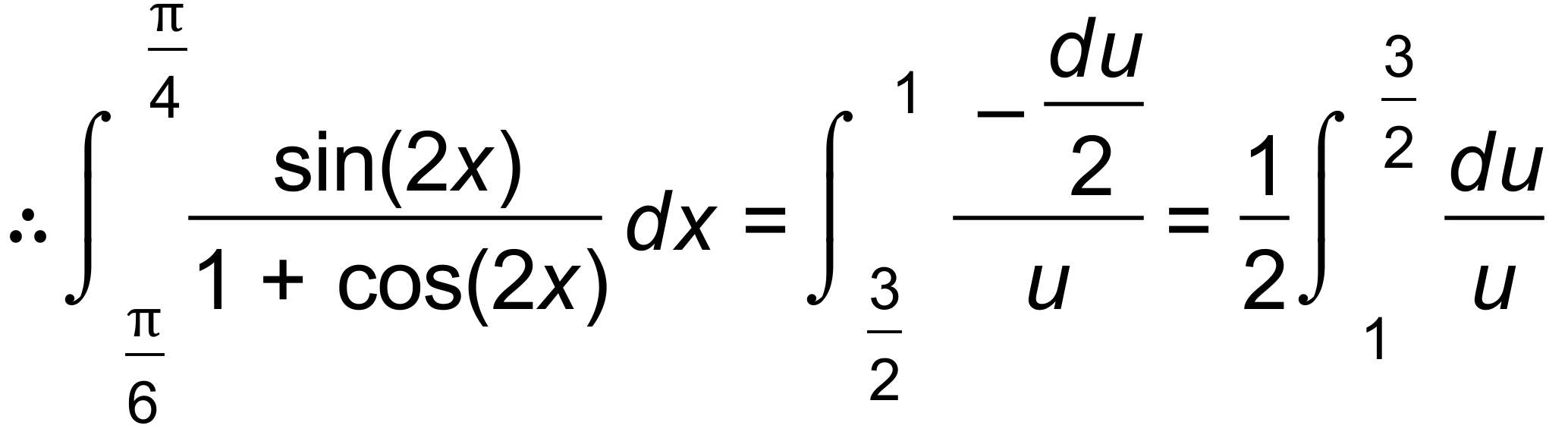
 ✓✓

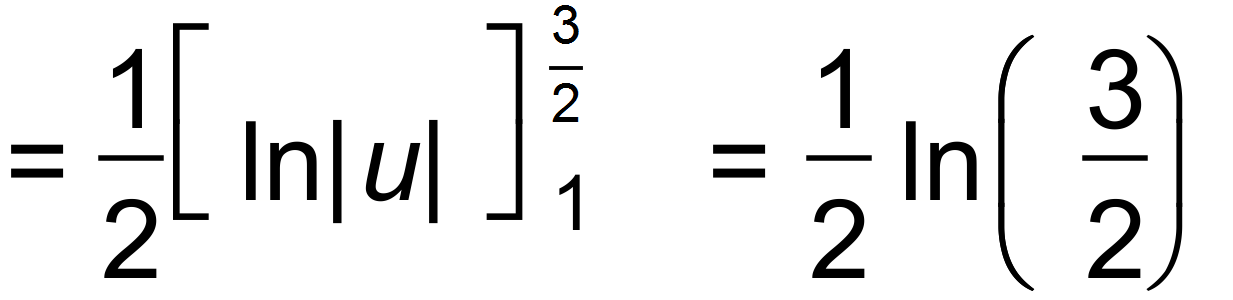
3. (b) Let  ✓

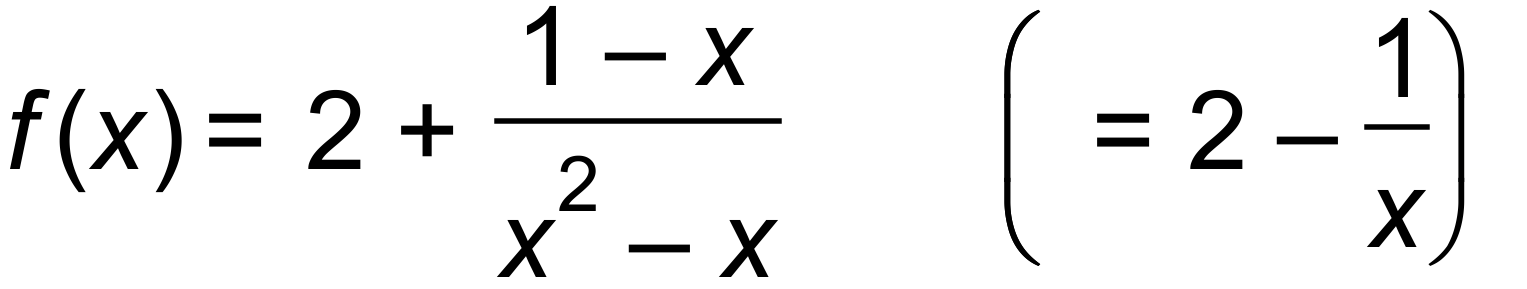
Then  and hence  ✓

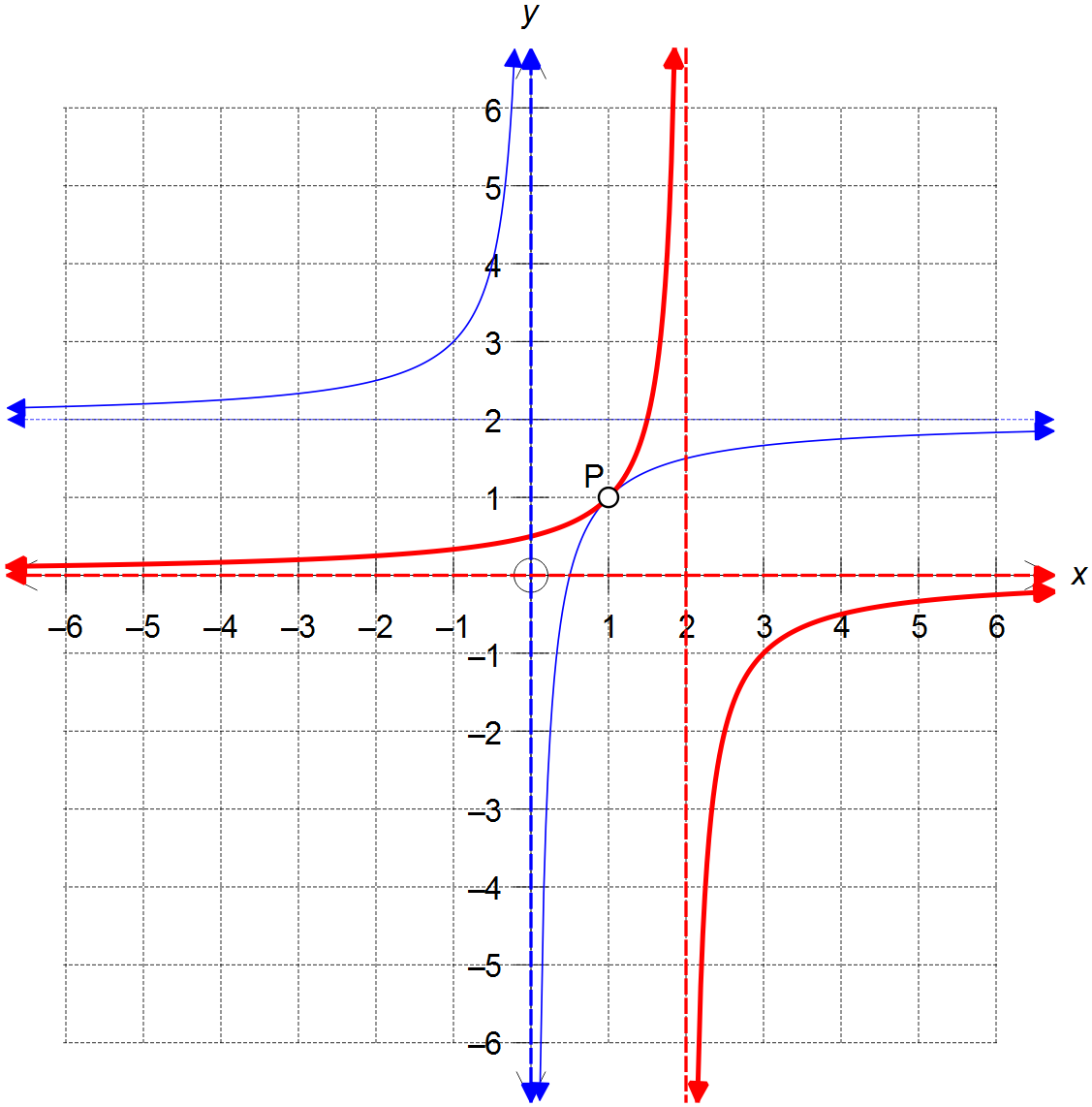
Also, 

and  ✓

 ✓

 ✓ [9]

4. (a)  ✓✓✓



(b) (e)

(b)

✓ Reciprocal Curve

✓ Marks undefined point P

✓ Vertical asymptote at x=0

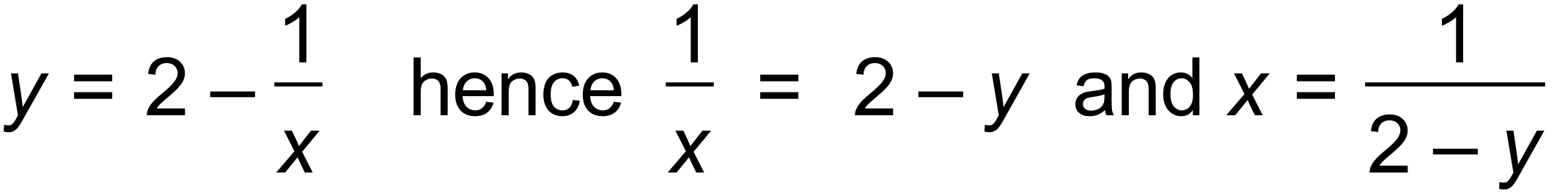
✓ Horizontal asymptote at y=2

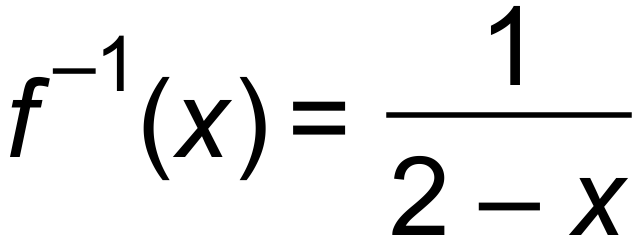
(e) (in bold)

✓ Asymptotes x=2 and y=0

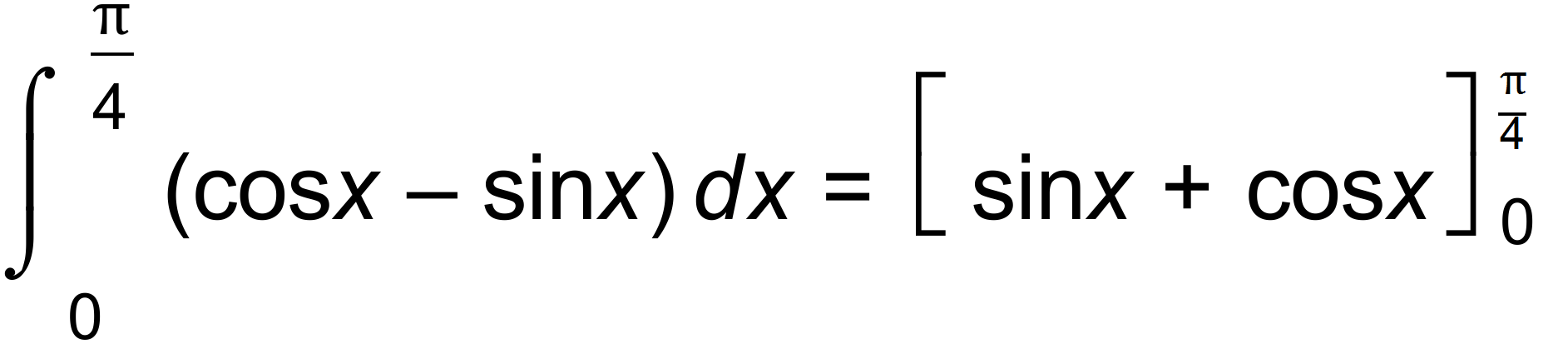
✓ Marks undefined point P

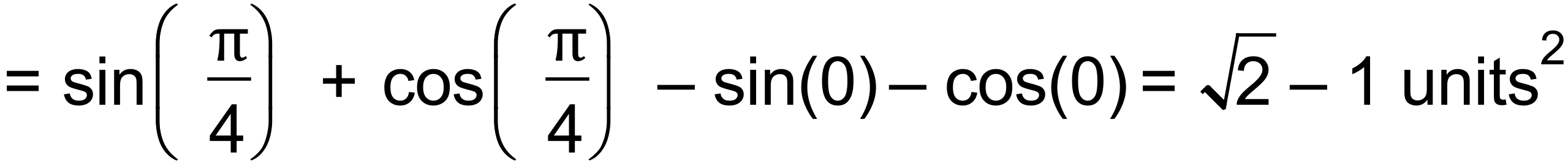
(c) Range =  ✓

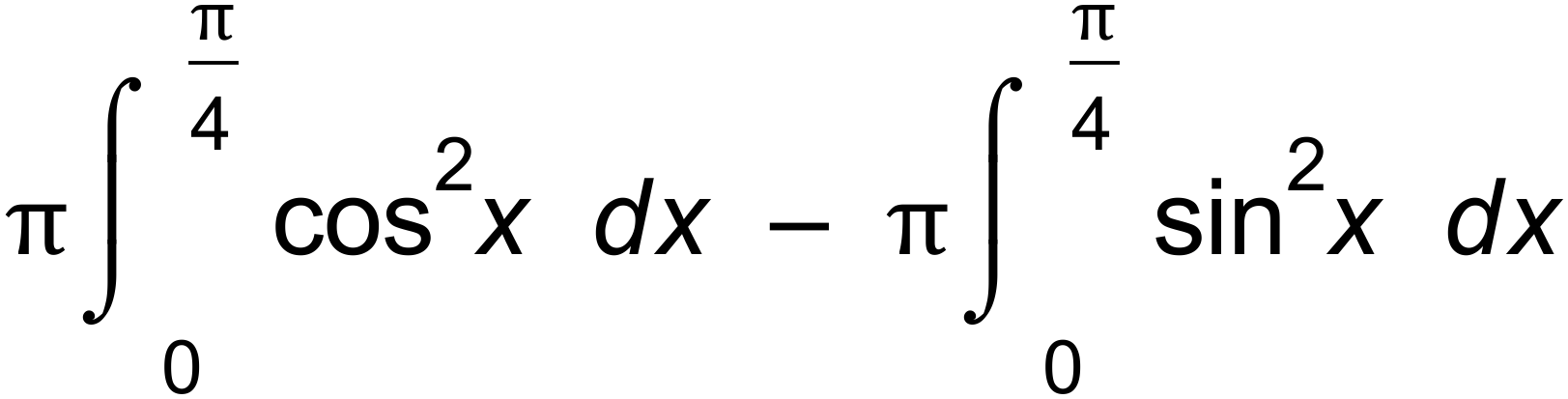
(d)  ✓

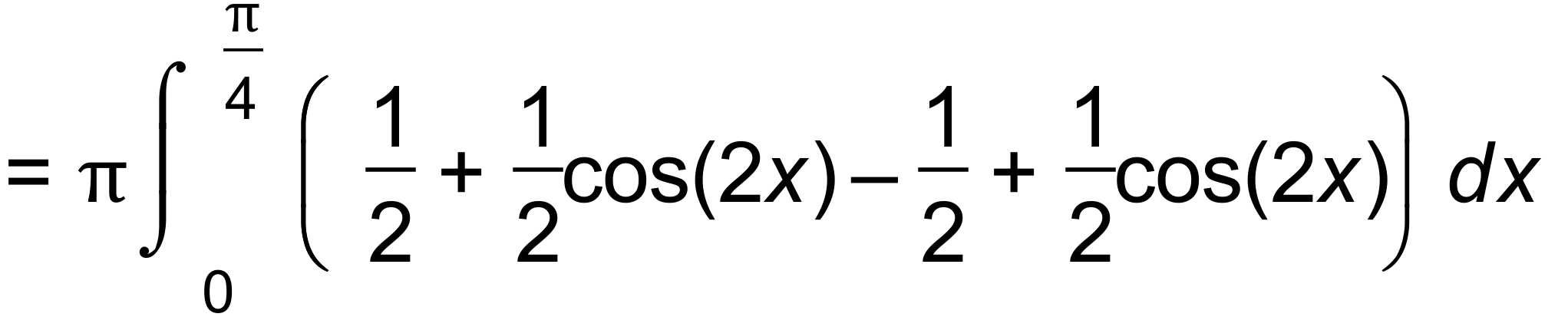
therefore  as required

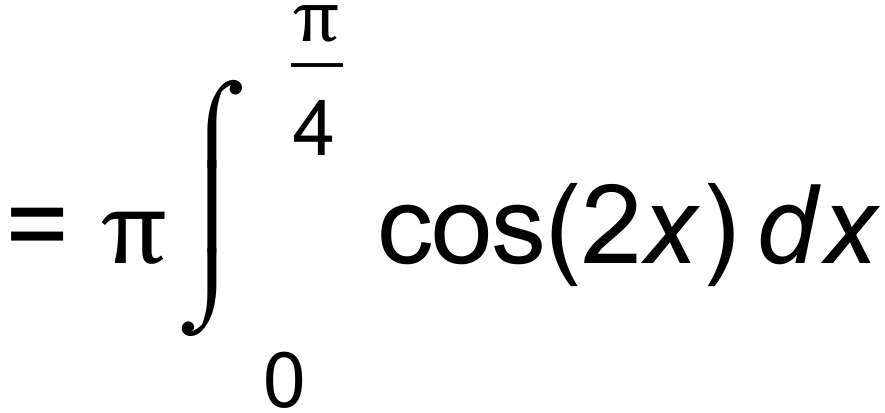
domain =  ✓ [12]

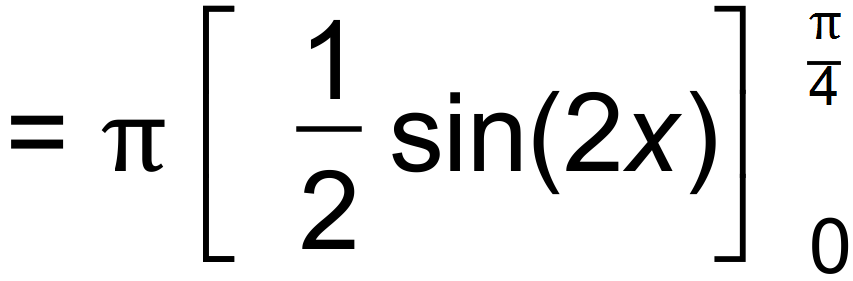
5. (a)  ✓

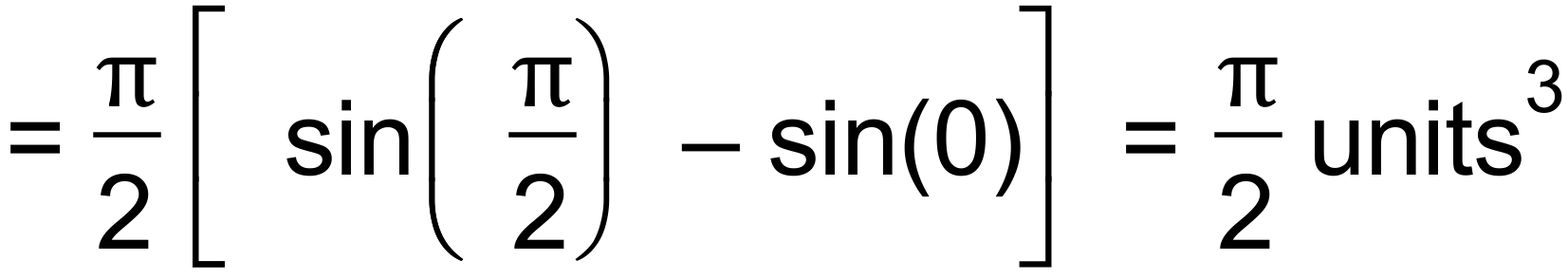
 ✓

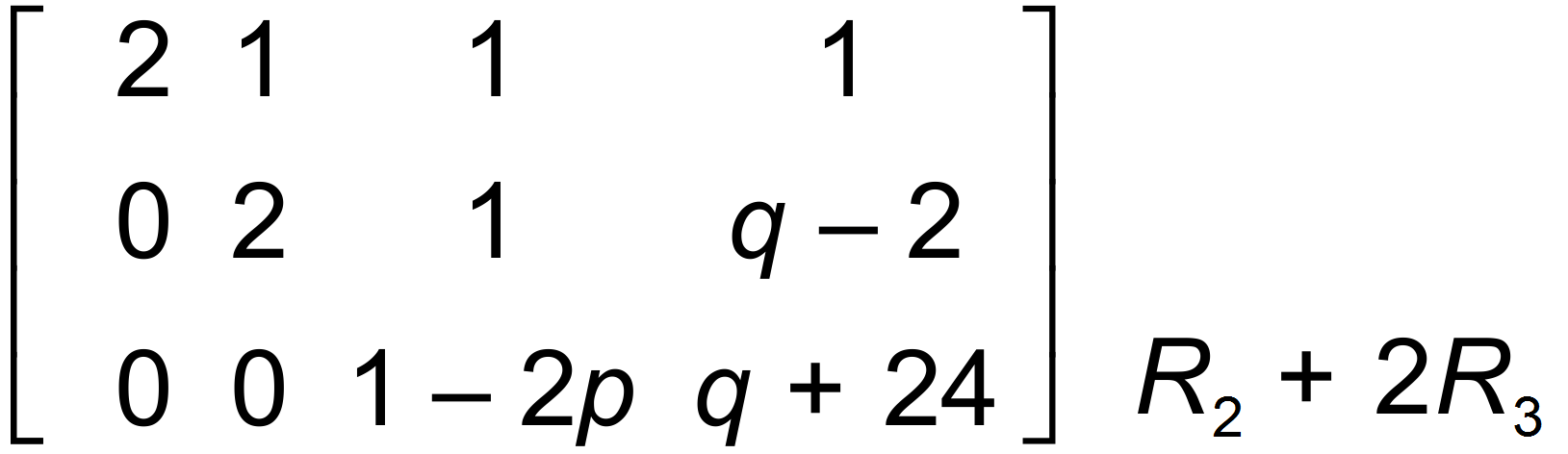
(b)  ✓

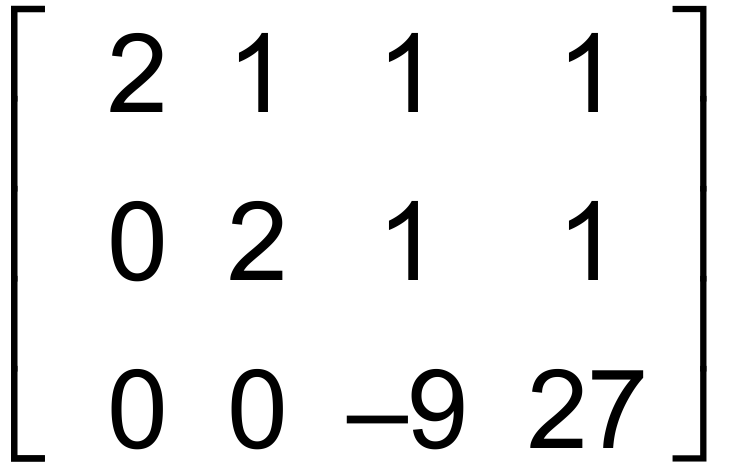
 ✓

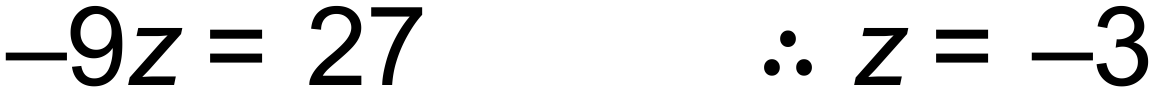
 ✓

 ✓

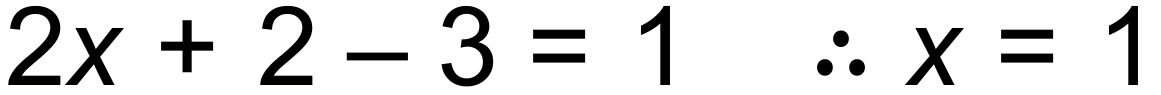
 ✓ [7]

6. (a)  ✓✓

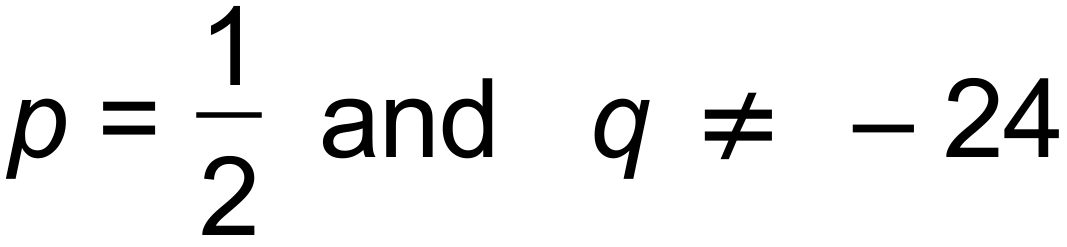
(b) 

 ✓

 ✓

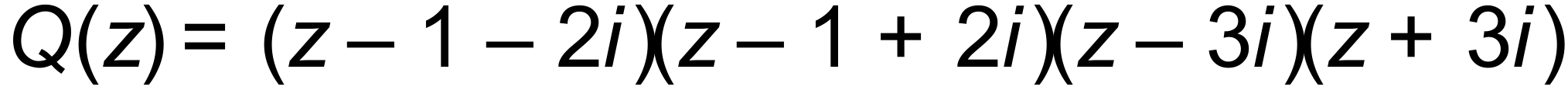
 ✓

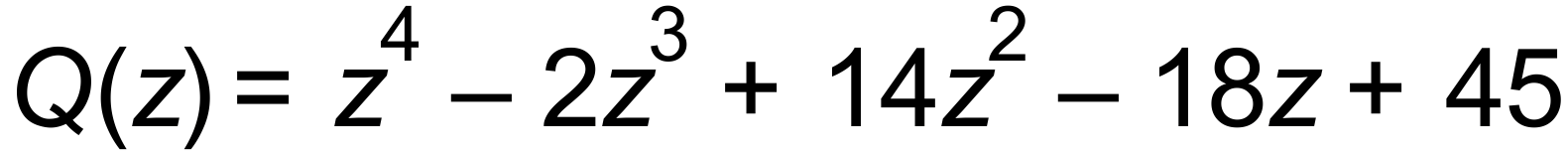
(c) (i)  ✓

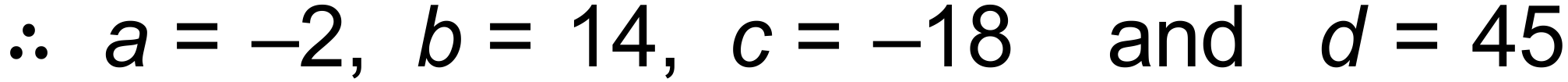
(ii)  ✓ [7]

***Calculator−assumed Solutions***

7. (a)  ✓✓

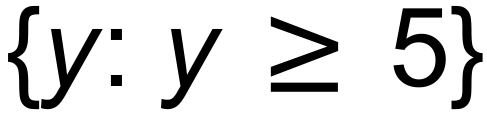
(b)  ✓

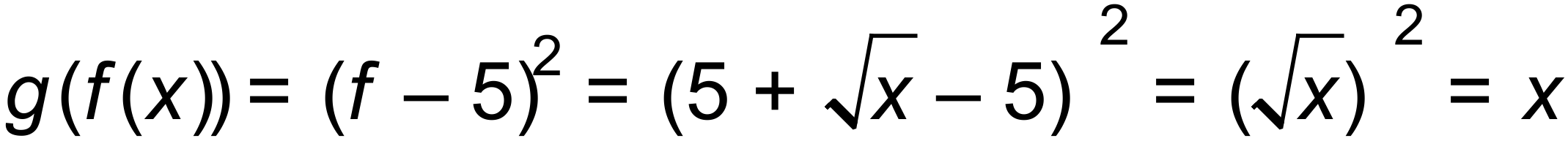
(c) CAS → 

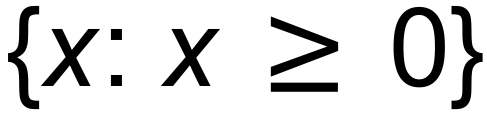
 ✓✓ [5]

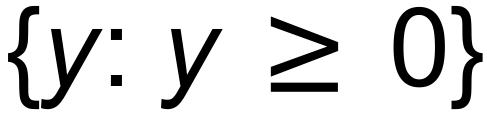
8. (a)  ✓

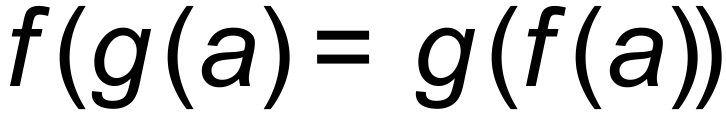
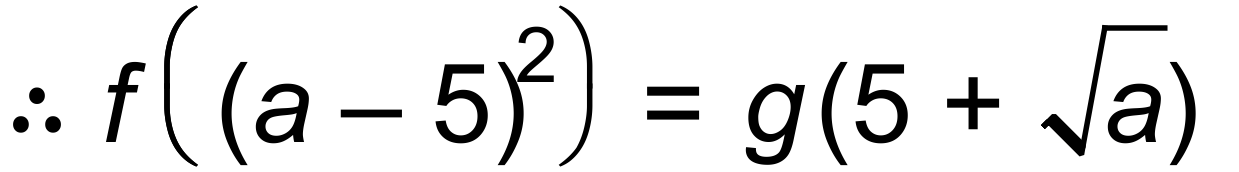
Domain =  ✓

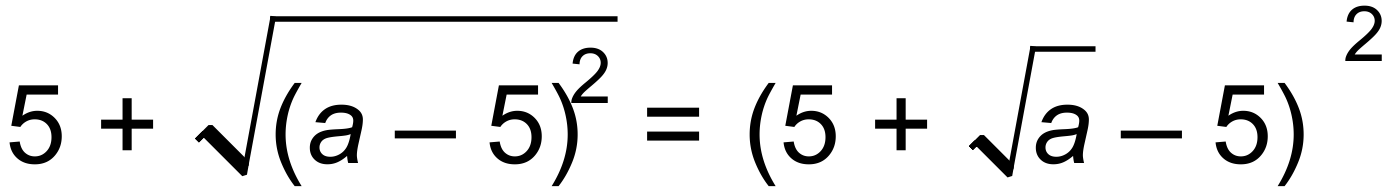
Range =  ✓

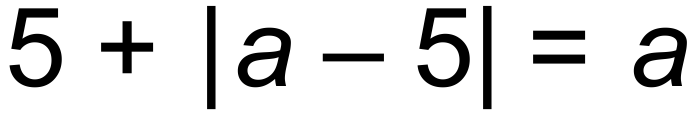
 ✓

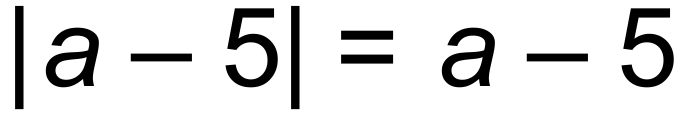
Domain =  ✓

Range =  ✓

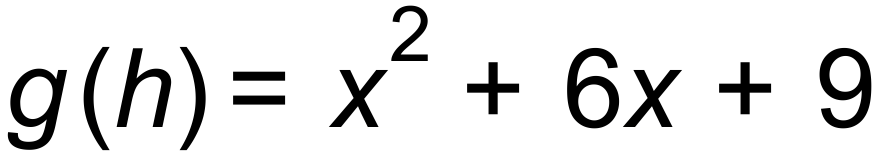
(b)  

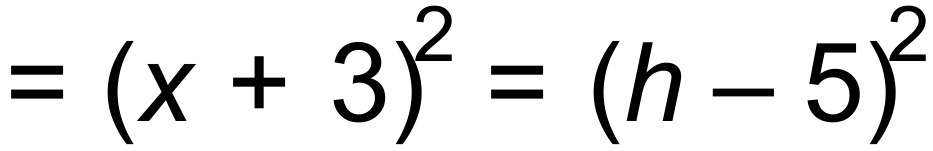
 ✓

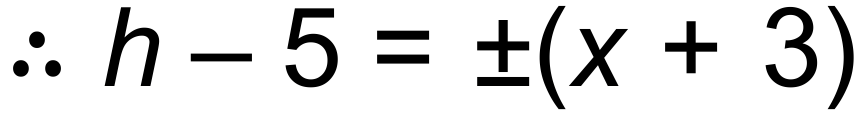




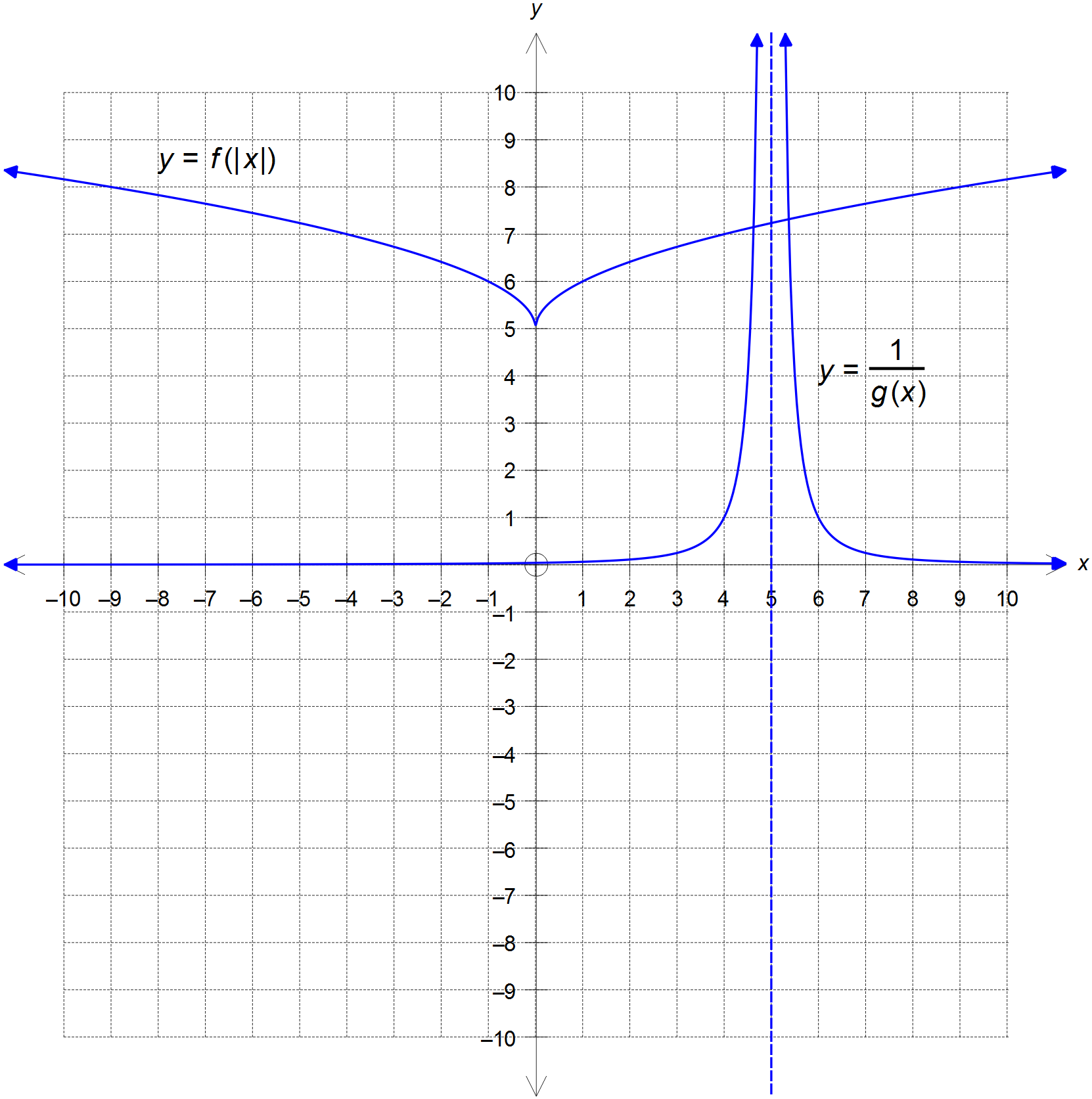
 ✓

(c) 

 ✓

 hence ✓





(d)

✓ point of reflection

✓ mirror shape on 2nd quadrant

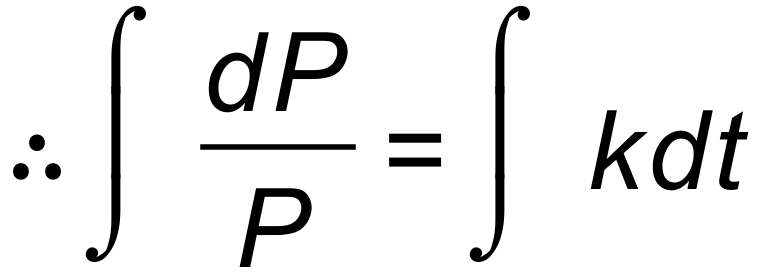
✓ Vertical asymptote at x=5

✓ Horizontal asymptote at y=0

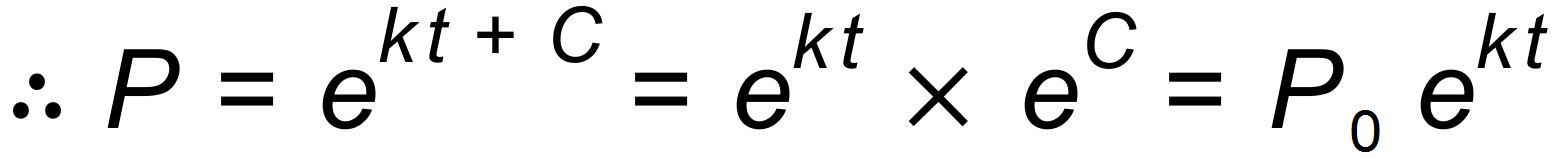
✓ Shape and accuracy

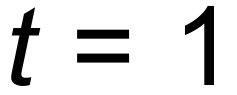
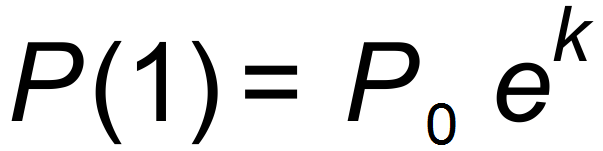
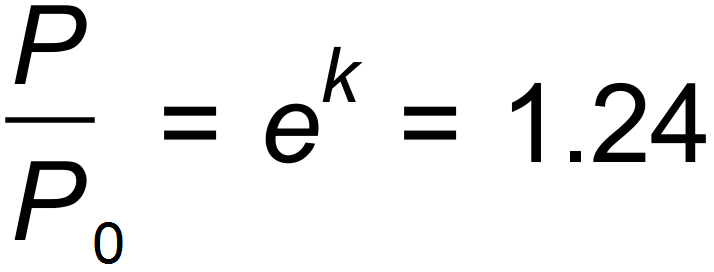
[15]

9. (a) 

 ✓

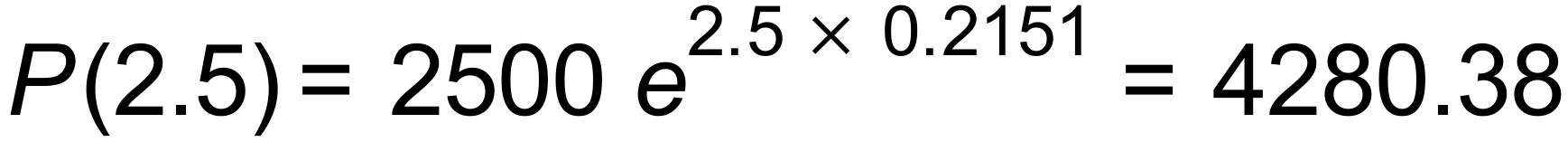
 ✓

 ✓

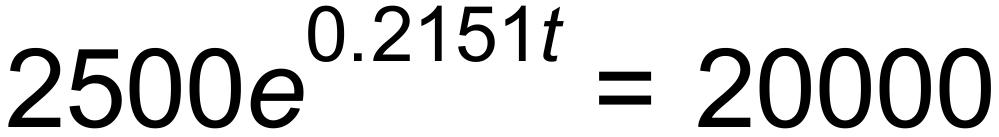
(b) (i) At ,  thus  ✓

 ✓

therefore, 

and 

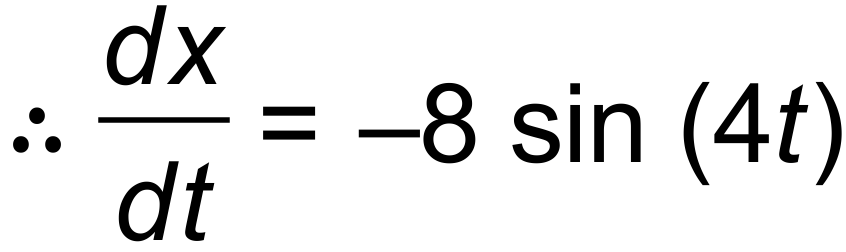
~ 4280 fish ✓

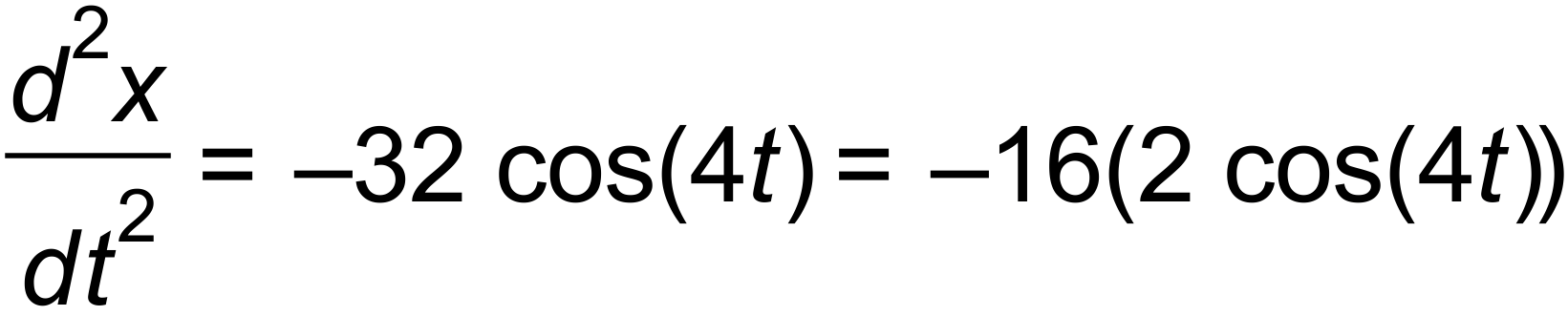
(ii)  ✓

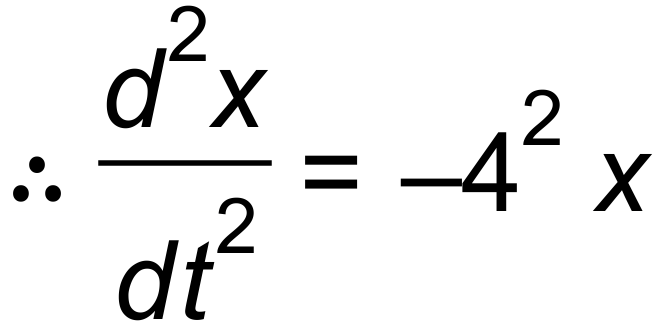
 ✓ [8]

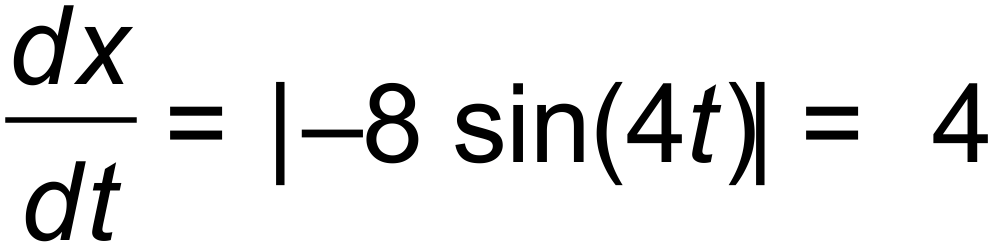
10. (a) Point of reference is P(5, 0). From P:

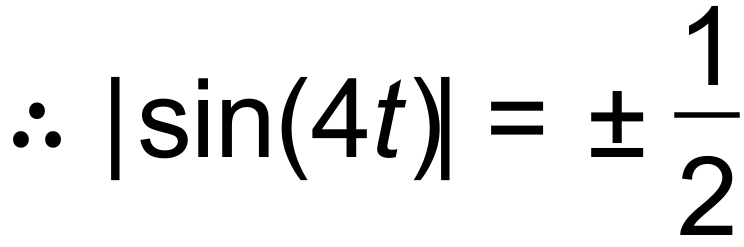
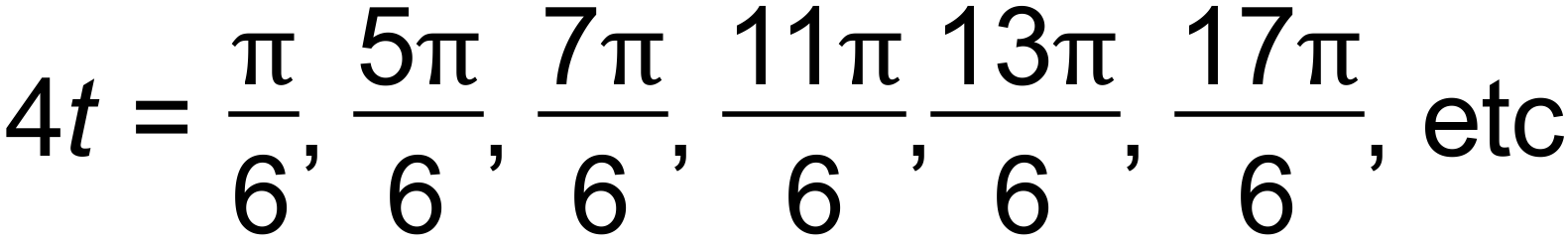


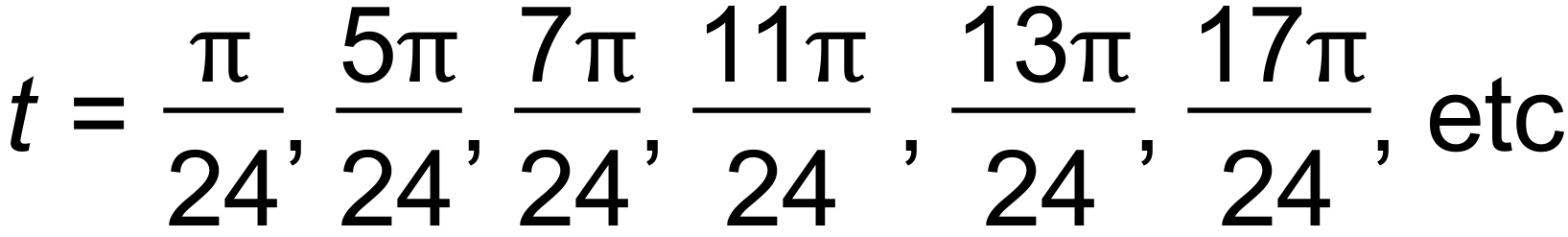
 ✓

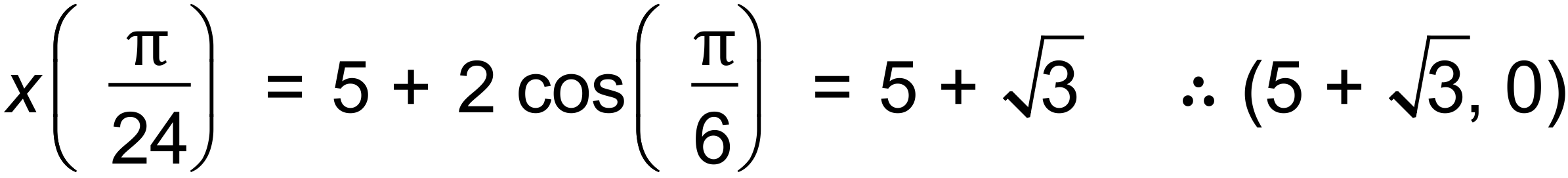
and  ✓

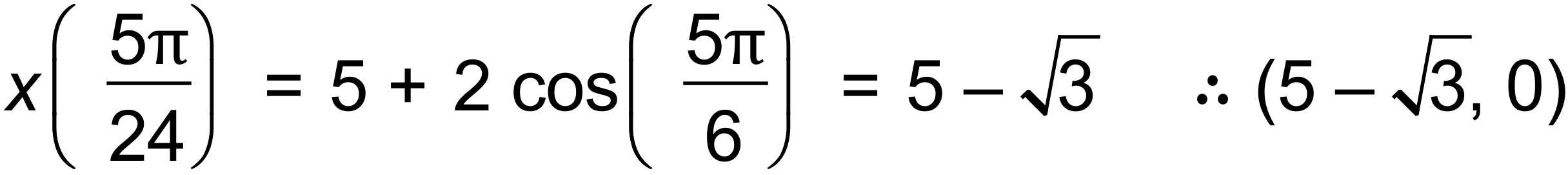
 which is the condition for SHM ✓

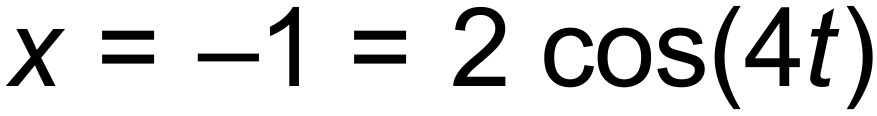
(b) 

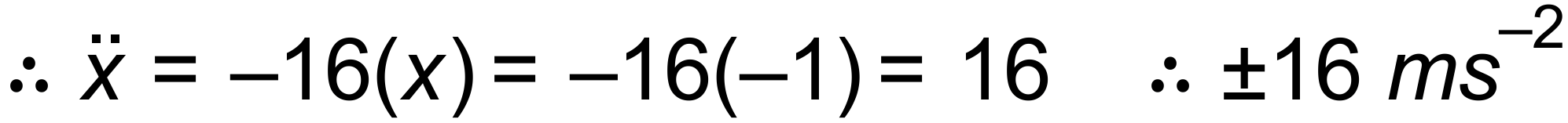
 and hence  ✓

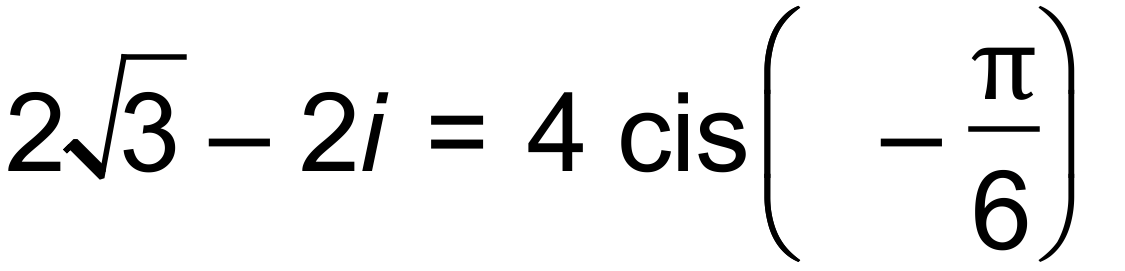
and 

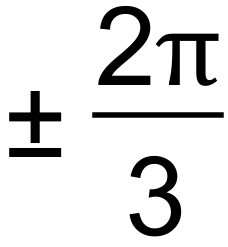
 ✓

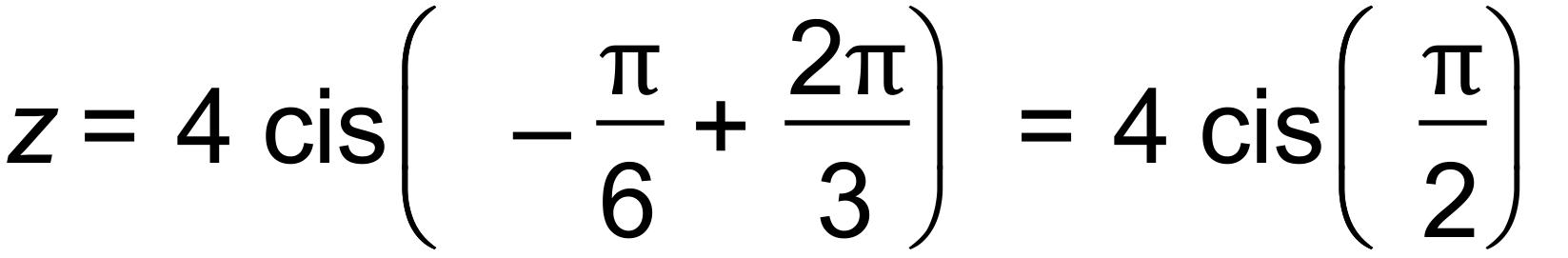
 ✓

(c) 

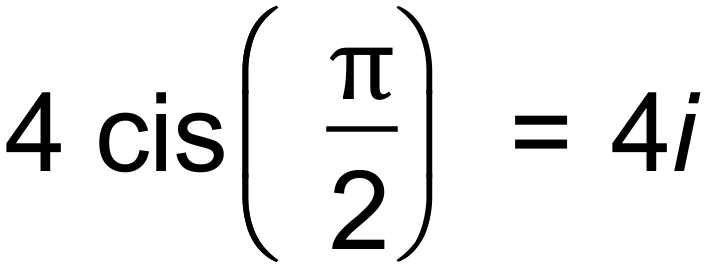
 ✓ [7]

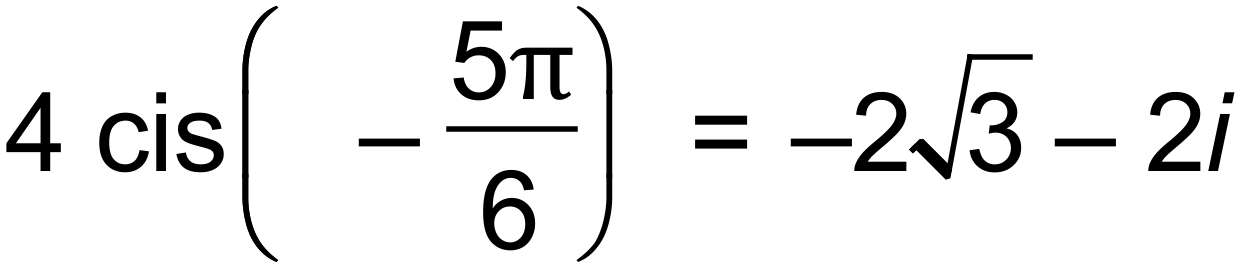
11. (a) (i)  ✓

Other roots are  apart, hence

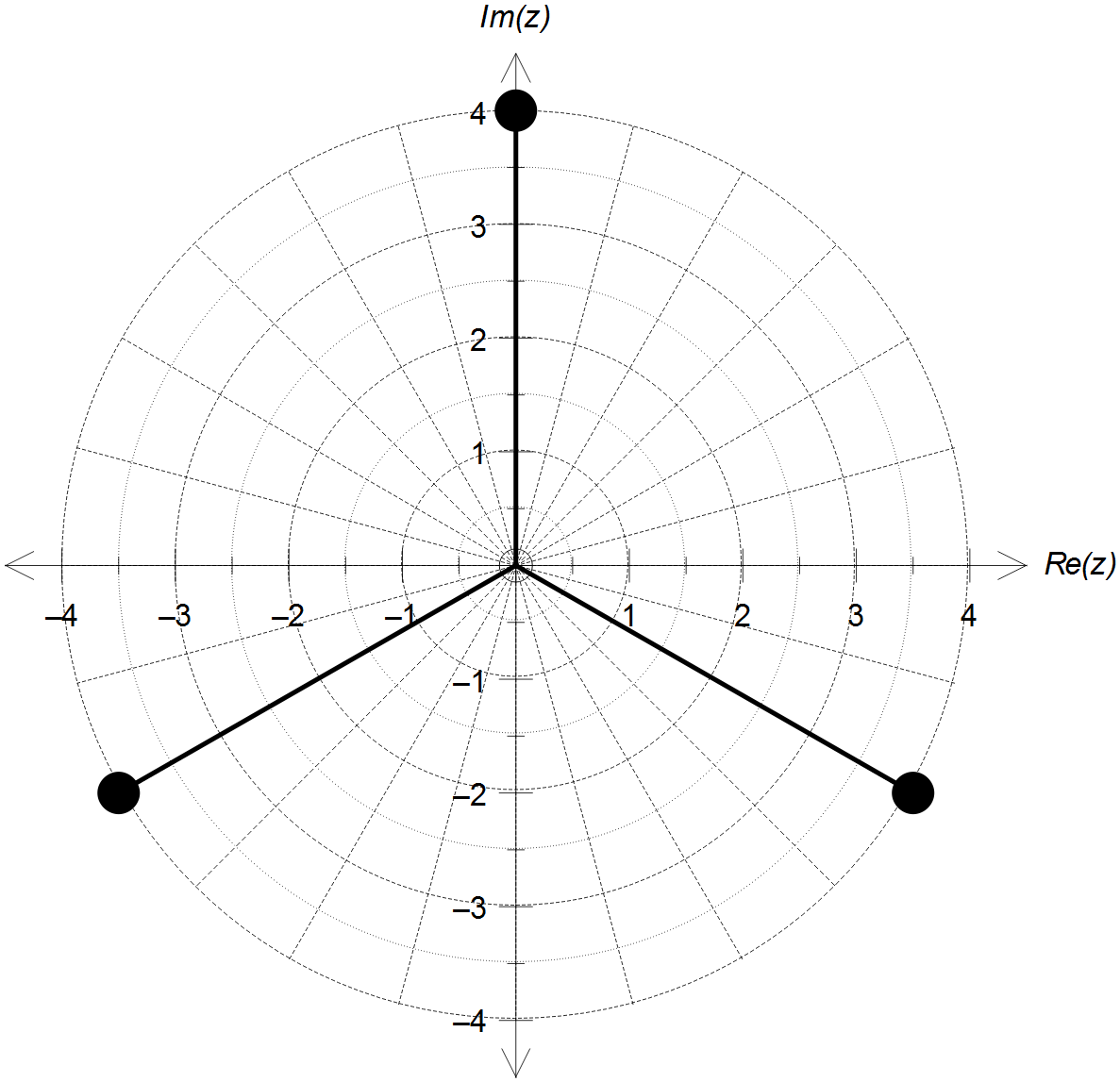
 ✓

 ✓

(ii)  ✓

 ✓

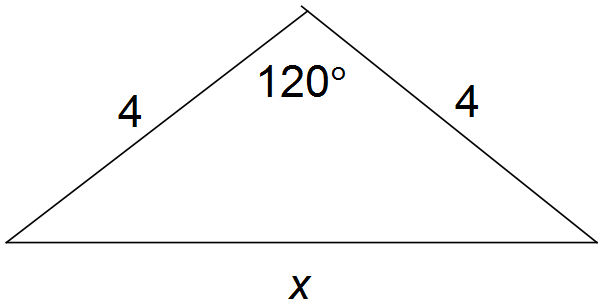
(b)

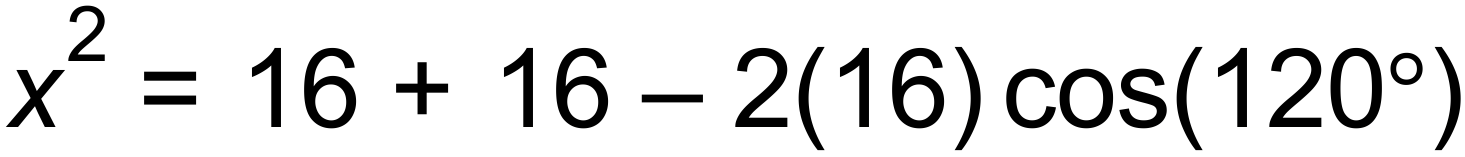


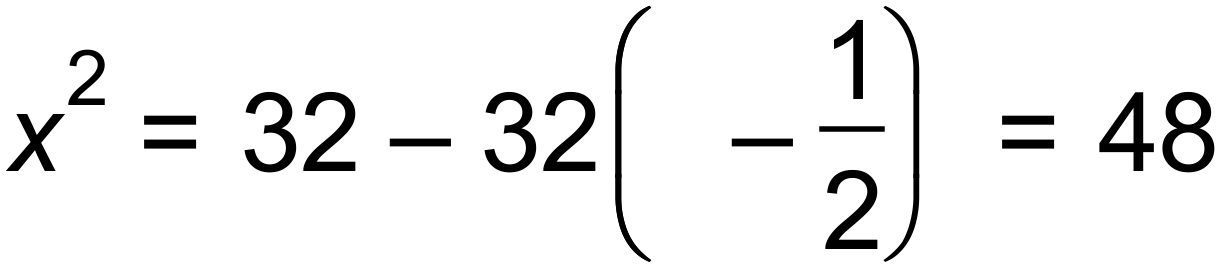
✓ Same magnitude

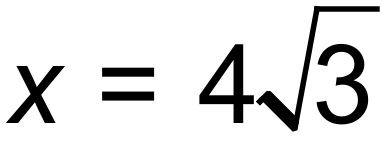
✓ Equally spaced 120° apart

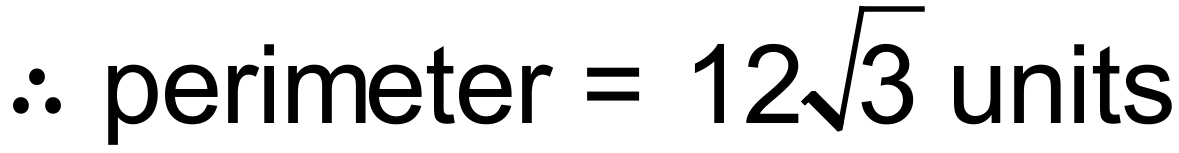
(c)

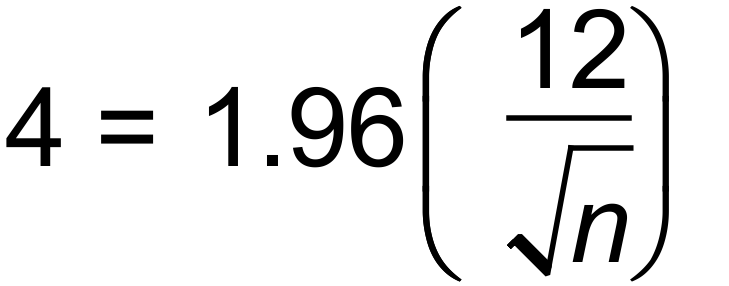


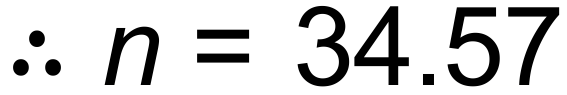
 ✓

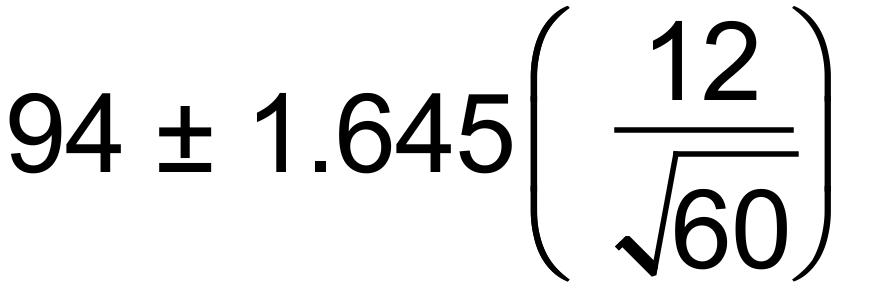


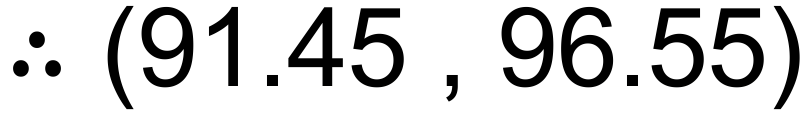
 ✓

 ✓ [10]

12. (a)  ✓✓

 i.e. 35 calculators are needed ✓

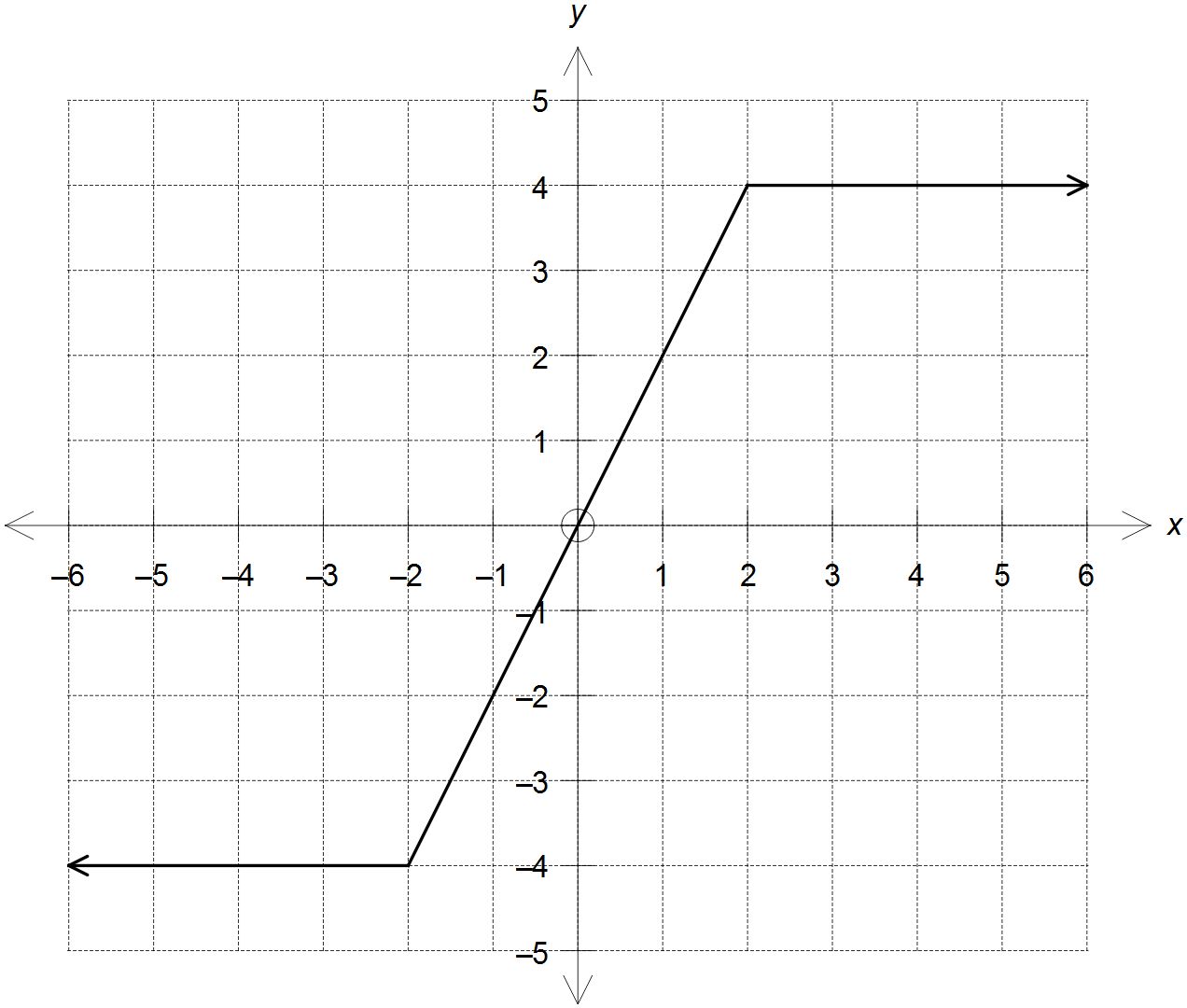
(b)  ✓✓

 ✓

(c) No, as the 90% interval does not contain the

100hr claimed. ✓✓ [8]

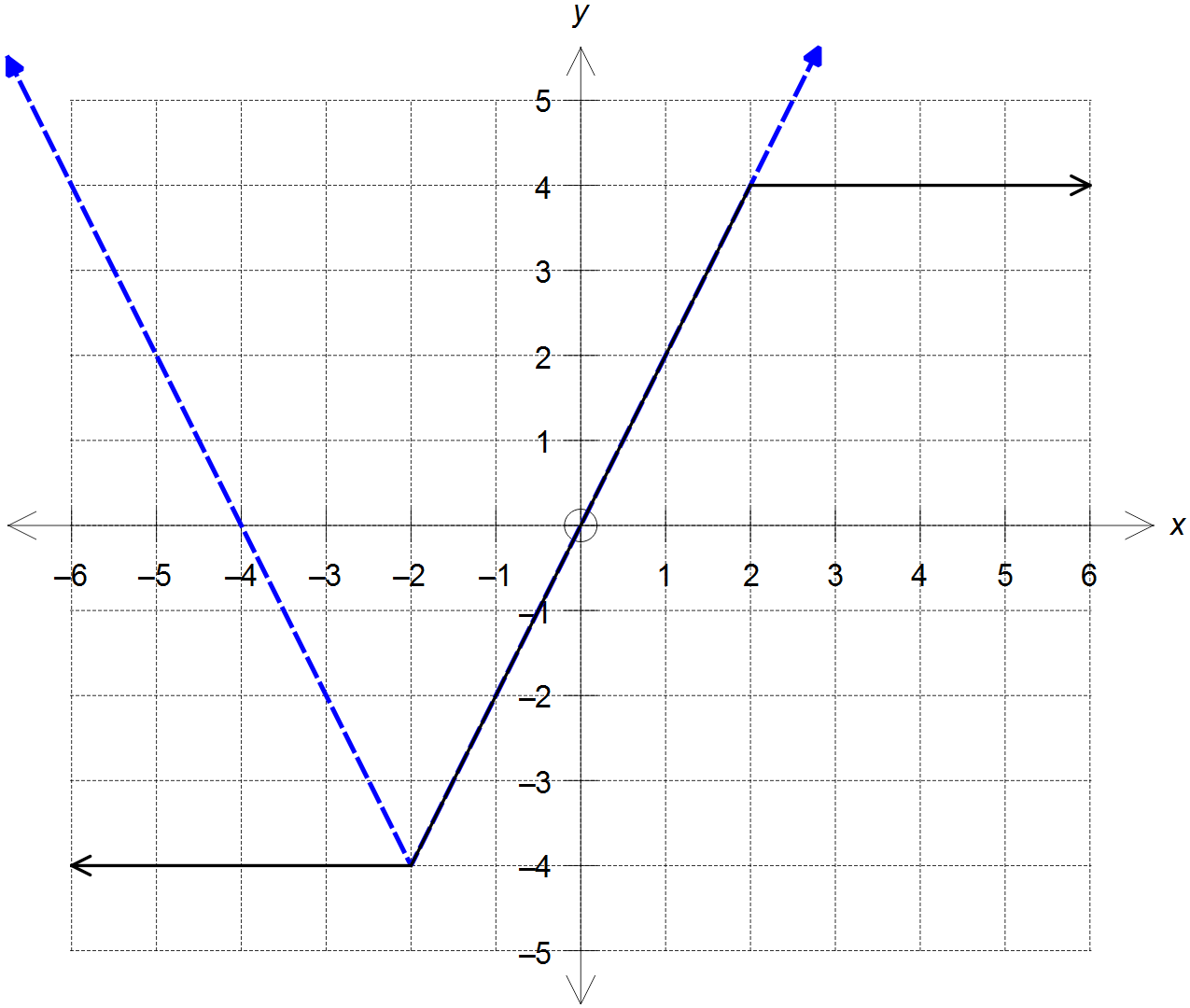
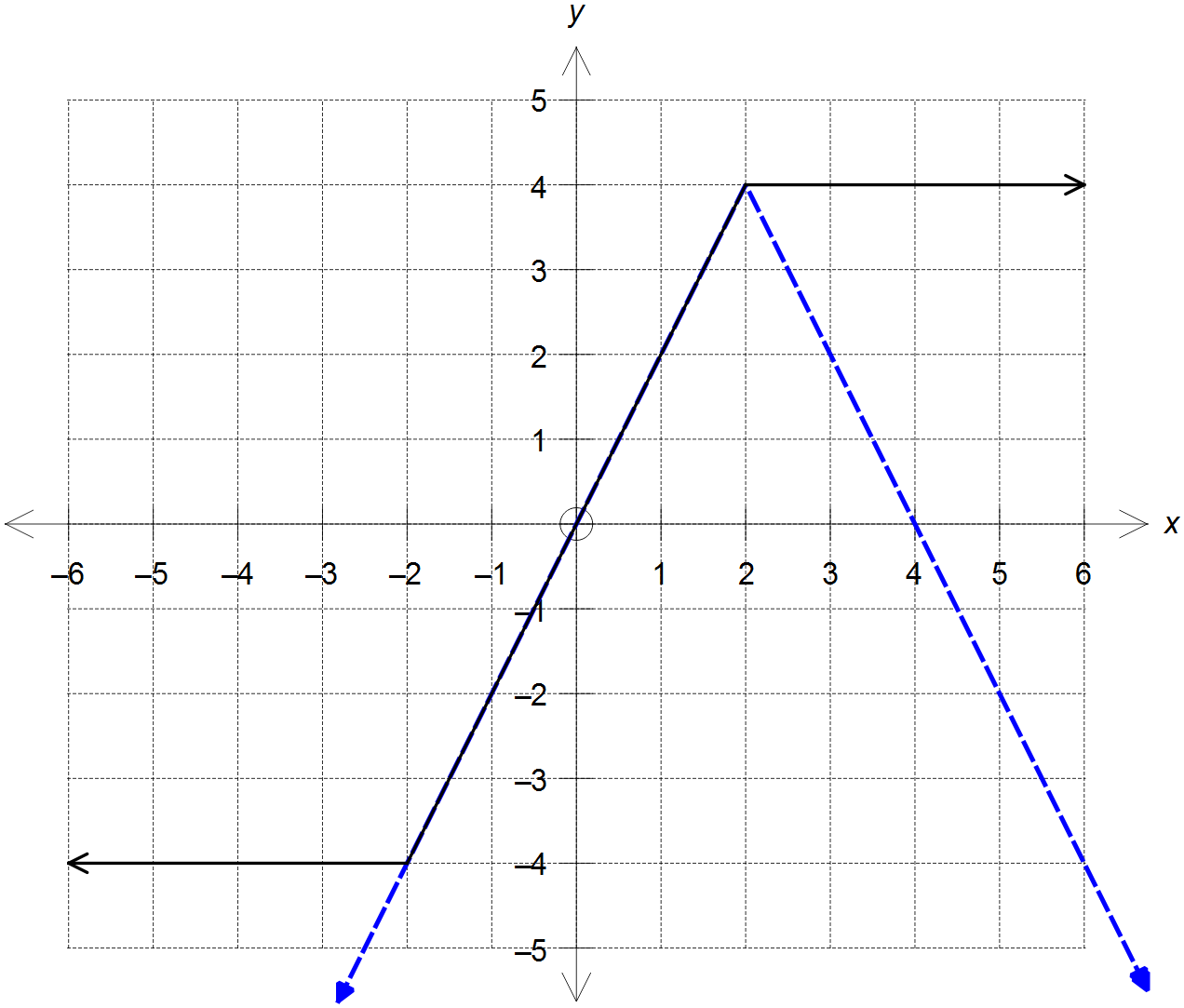
13. (a)



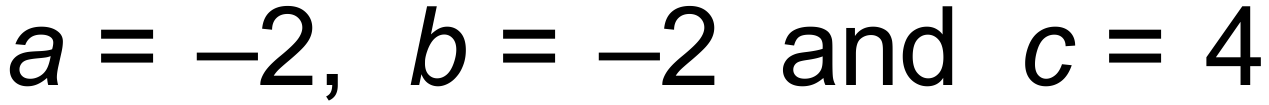
✓ line y = 2x

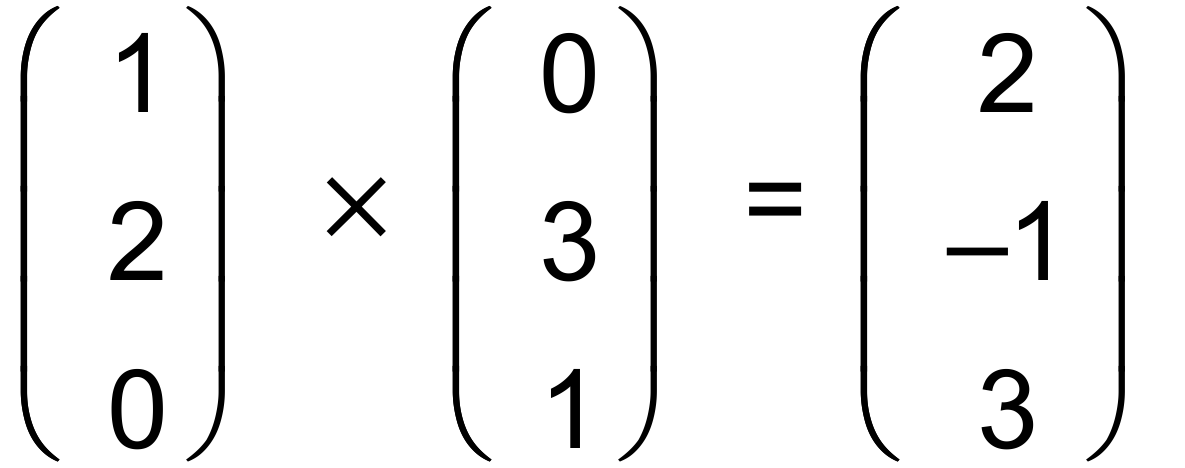
✓ lines y = 2 and y = –2

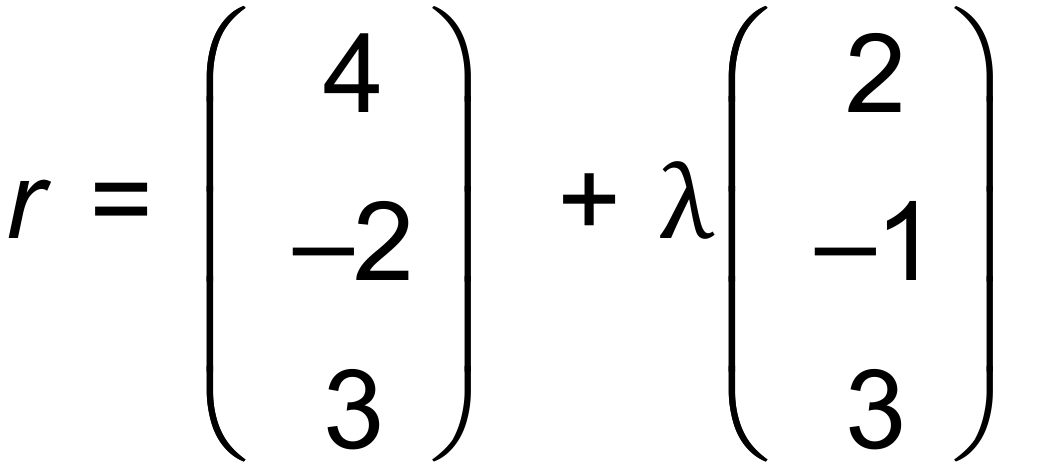
(b) Two possible solutions:

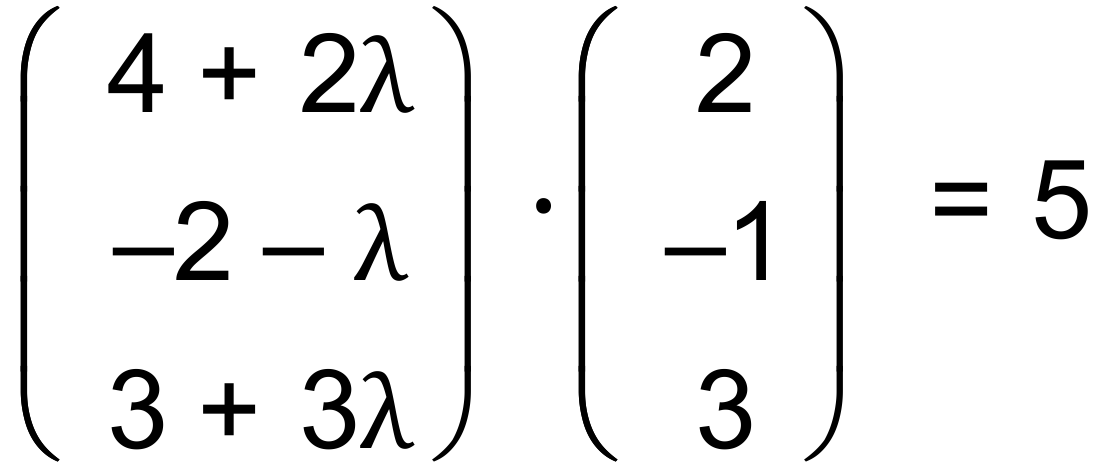


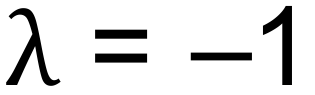
hence,  ✓✓✓

or  ✓ [6]

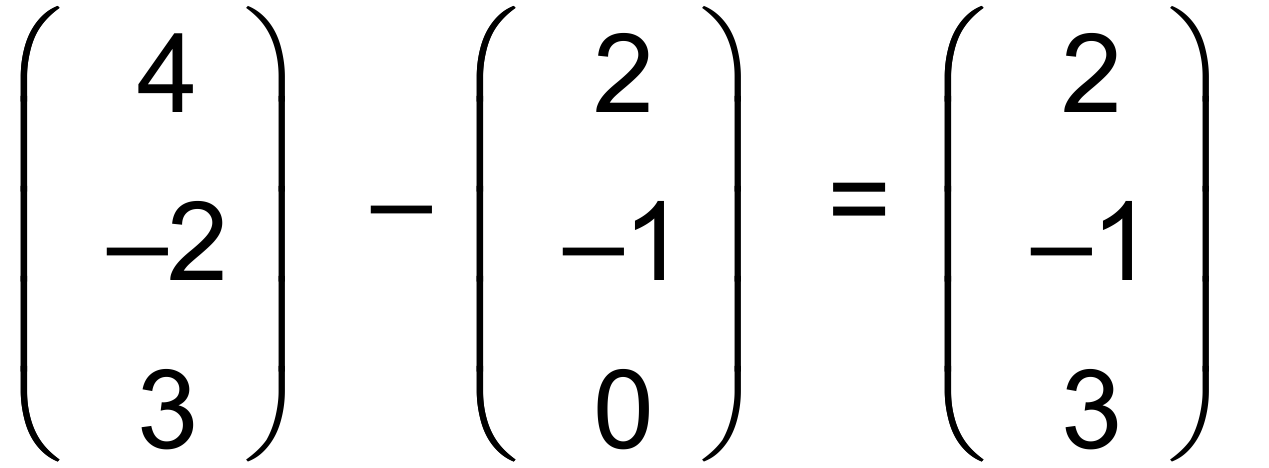
14. (a)  ✓

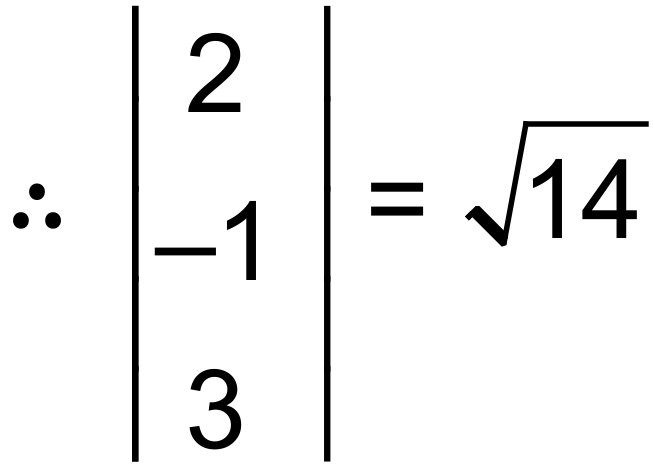
 ✓

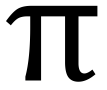
(b)  ✓

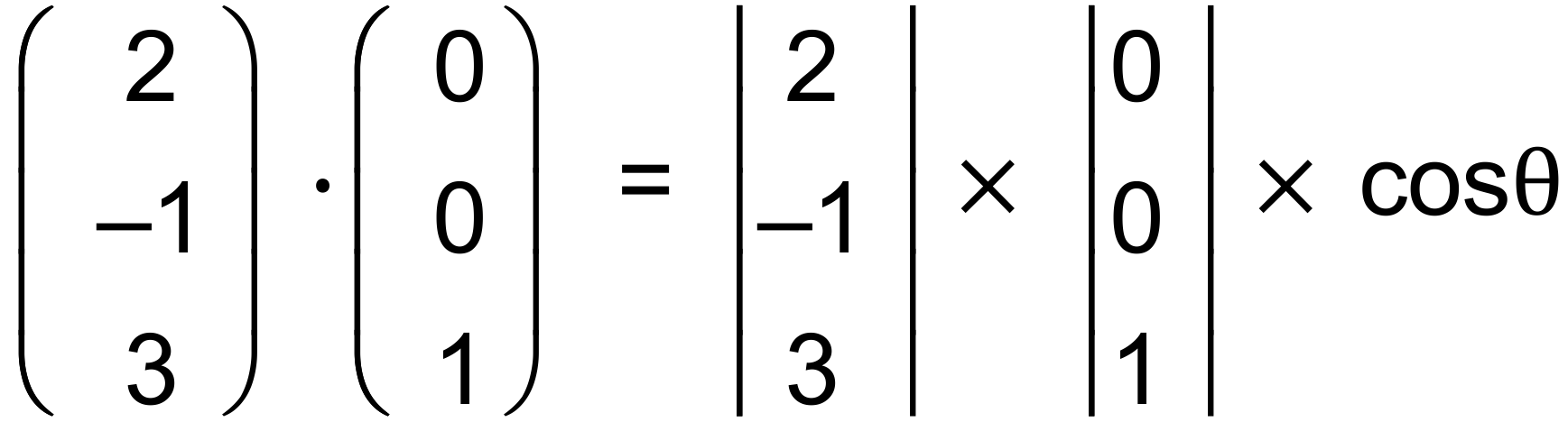
CAS →  ✓

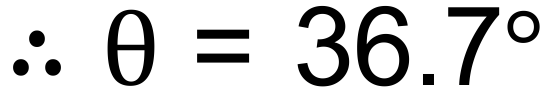
 ✓

(c)  ✓

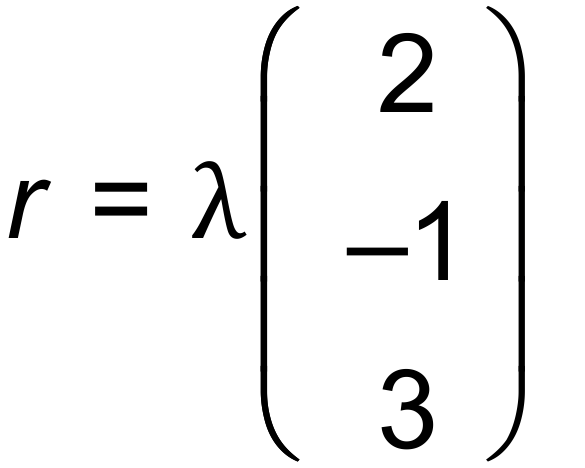
 units ✓

(d) Use the normal to the xy plane and the normal to the plane  : ✓

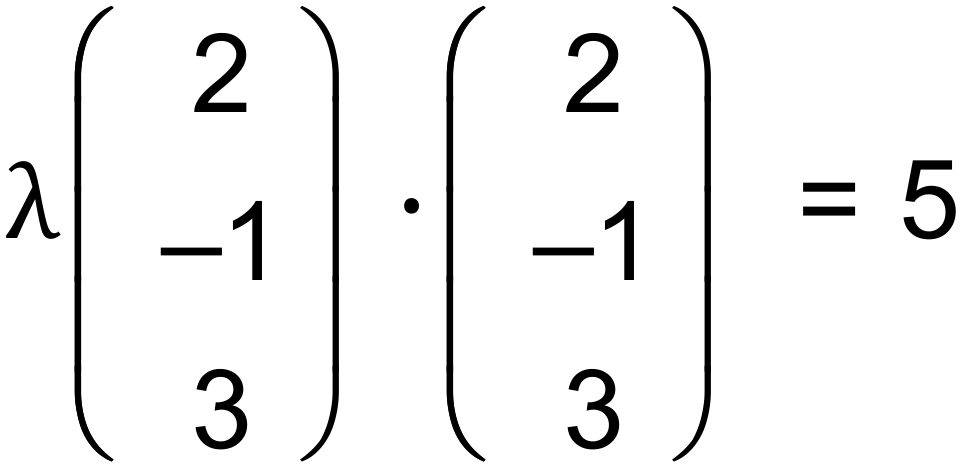
 ✓

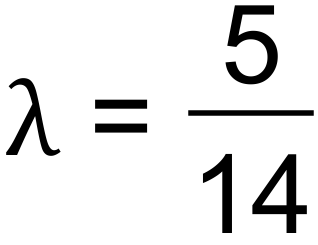
 ✓

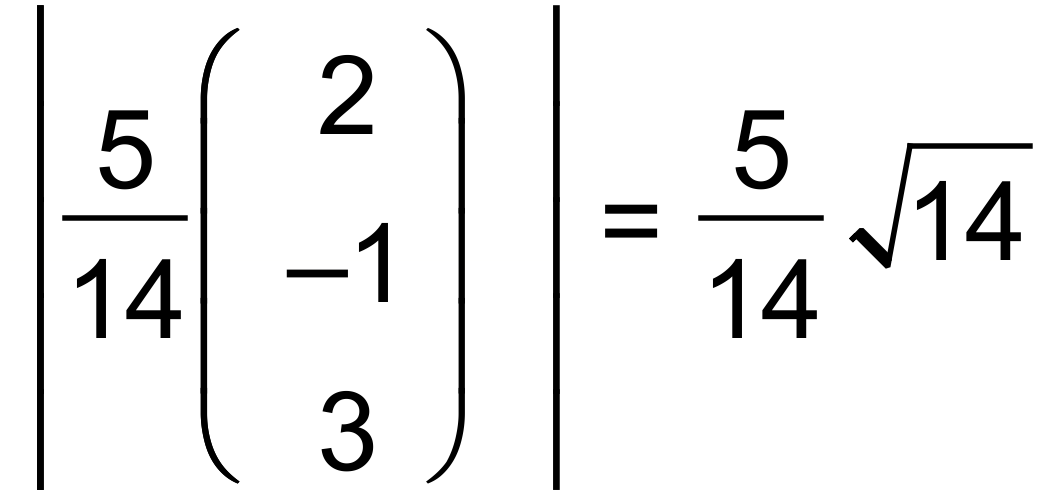
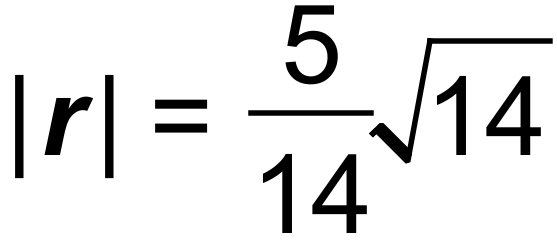
(e) Create a line perpendicular to the plane that passes through O:

Let 

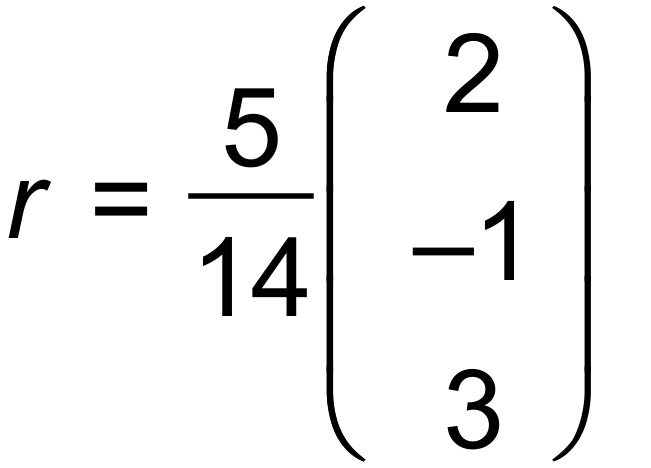
Find the point of intersection of this line and the plane:

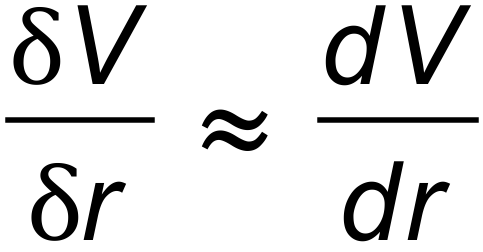
 ✓

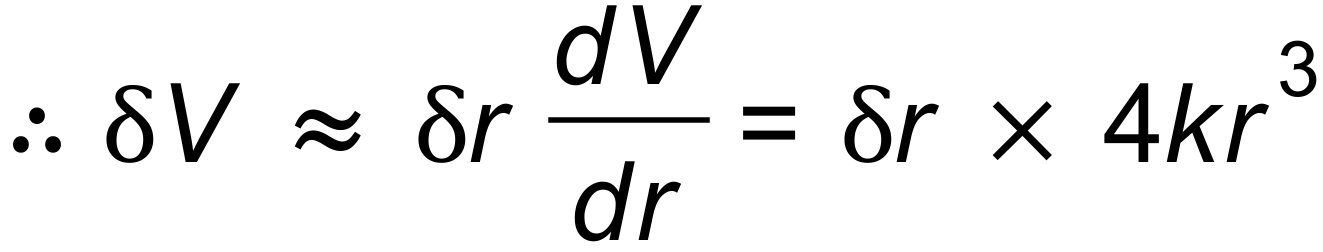
CAS →  ✓

Hence,  , so equation is  ✓

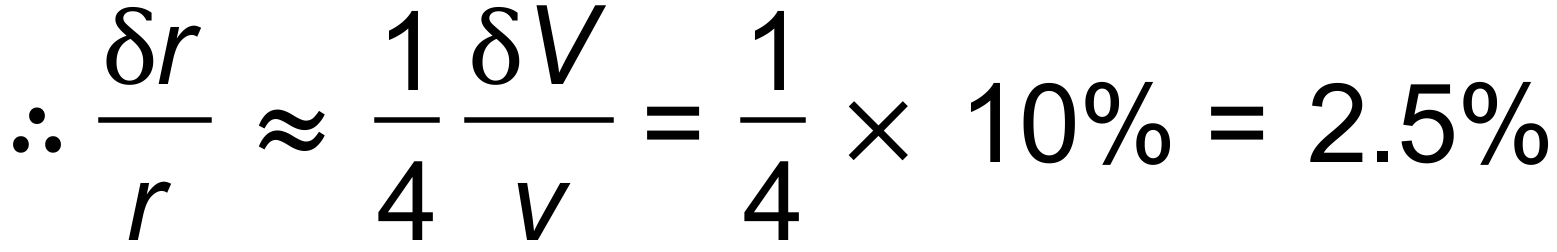
And the point of tangency is:

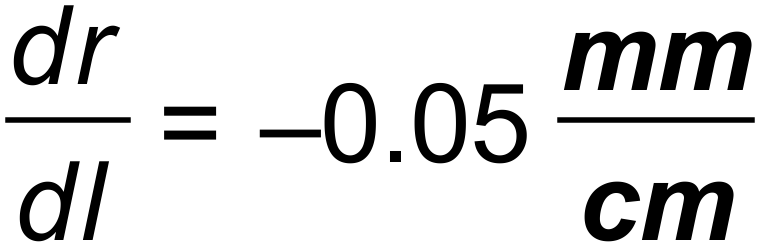
 ✓ [14]

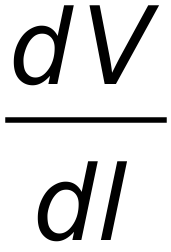
15. (a) 

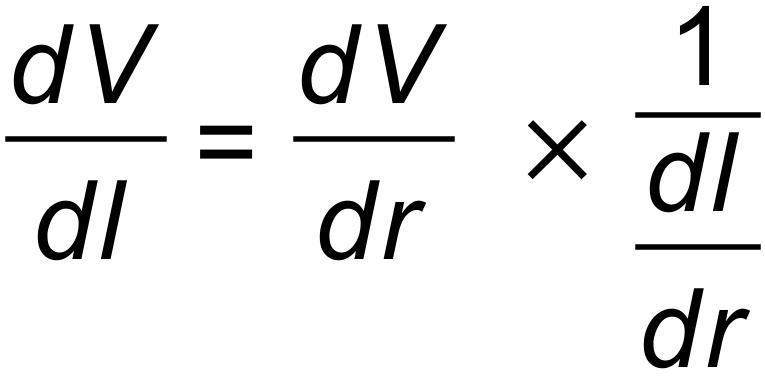
 ✓

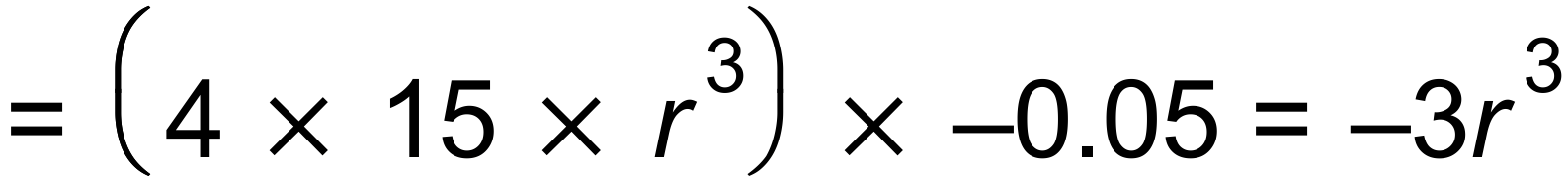
 ✓

 ✓

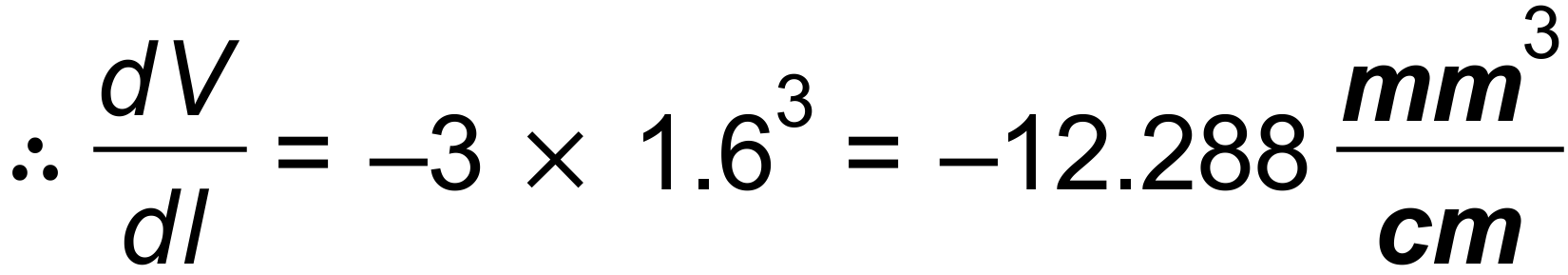
(b) rate given: 

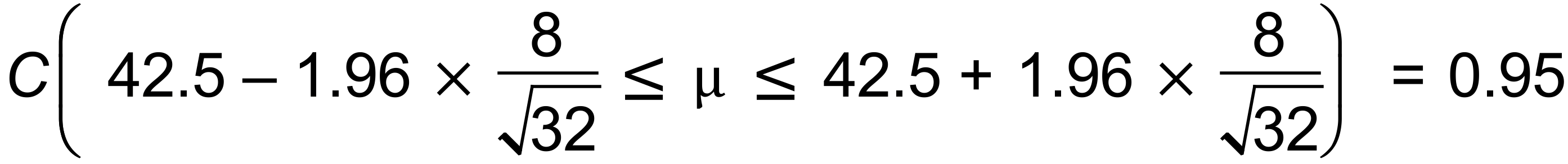
rate needed: 

hence,  ✓

 ✓

 ✓

 ✓ [7]

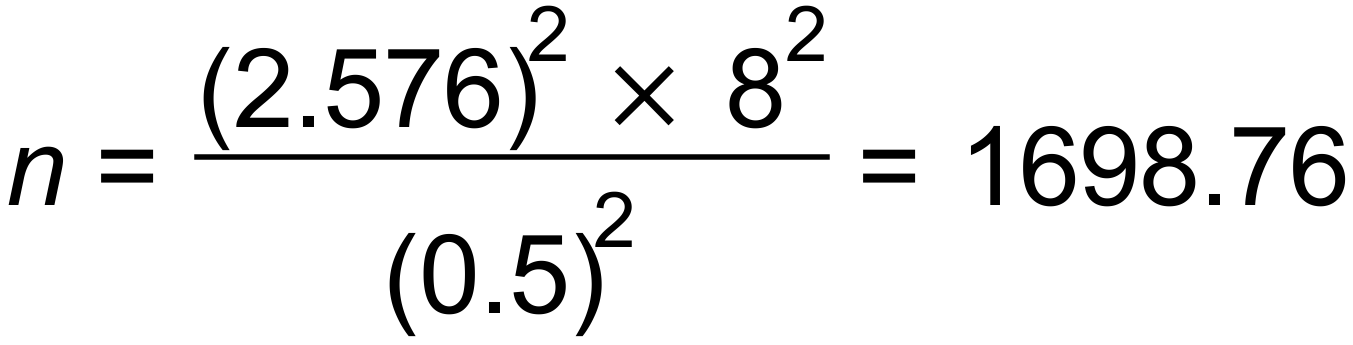
16. (a)  ✓

 ✓✓

The engineers can be 95% confident that the mean operating

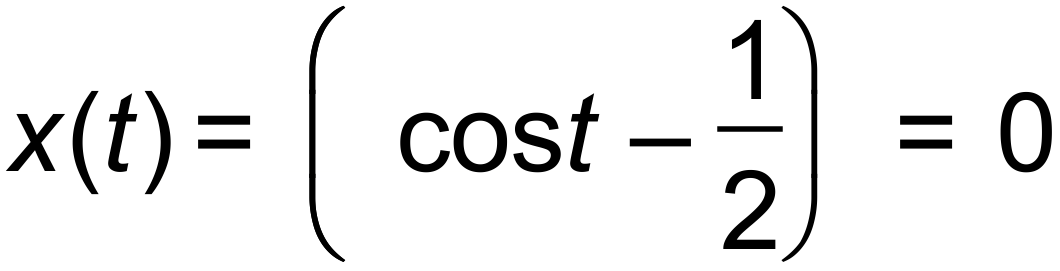
temperature of the lithium-ion batteries is somewhere between

39.73°C and 45.27°C. ✓

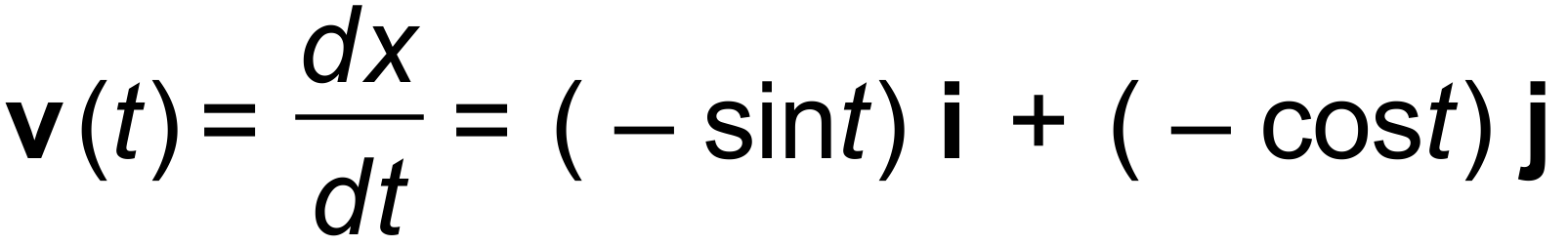
(b)  ✓✓

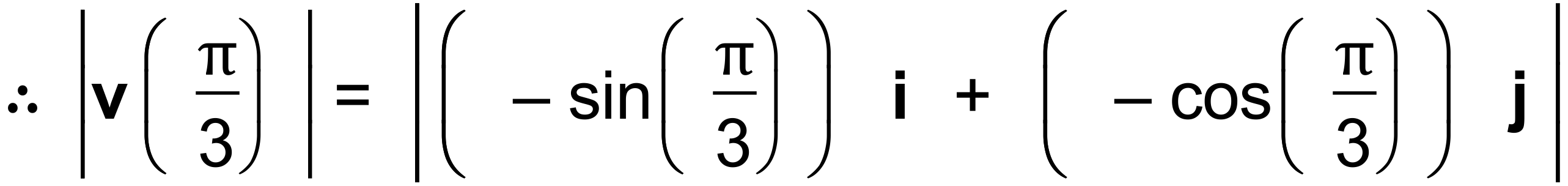
They will need 1699 batteries to be within 0.5°C of the

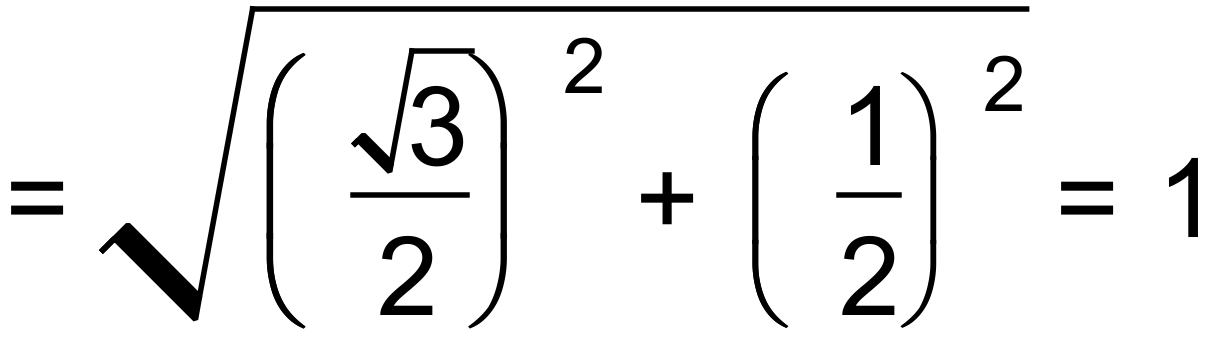
true mean. ✓ [7]

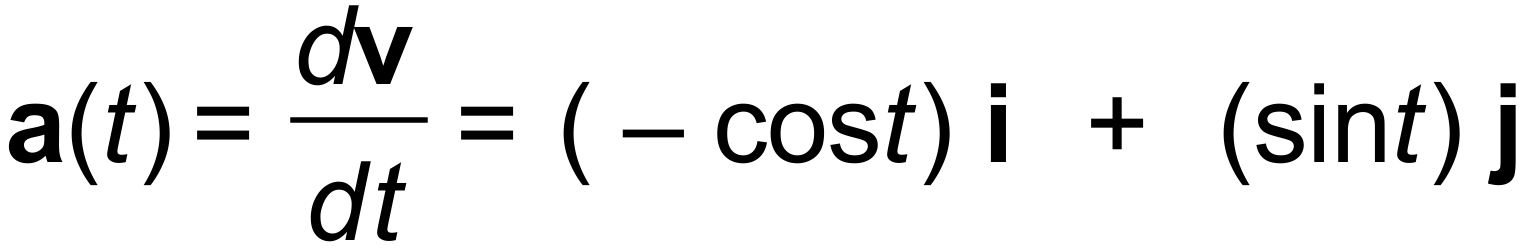
17. (a) 

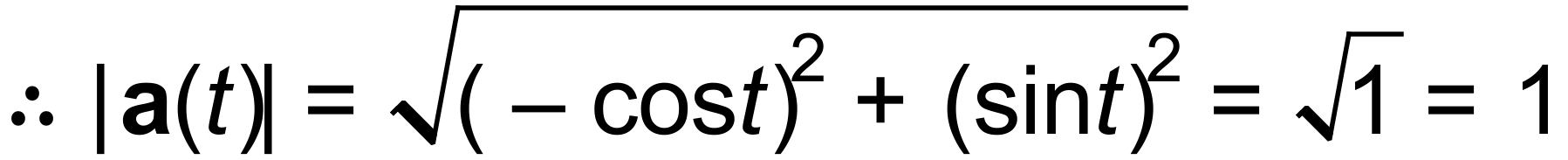
 ✓

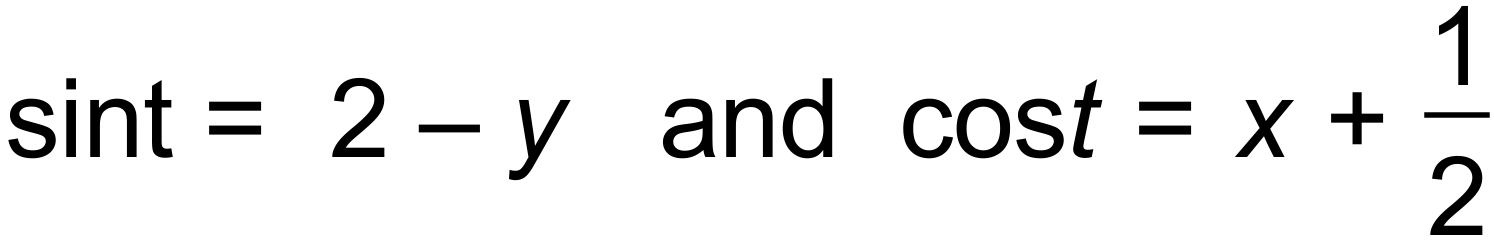
 ✓

 ✓

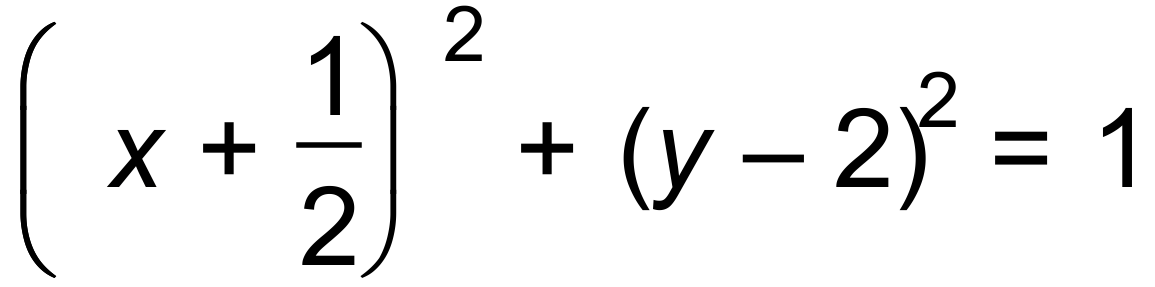
 units/s ✓

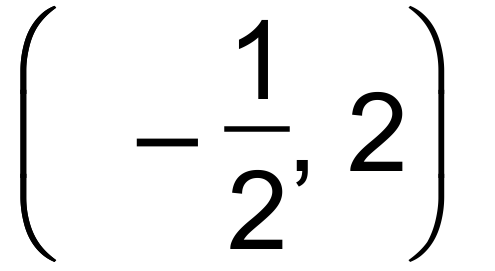
(b)  ✓

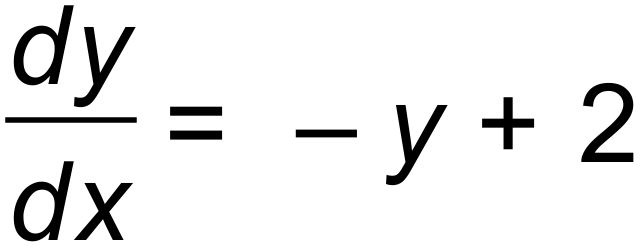
 unit/s2 ✓

(c) 

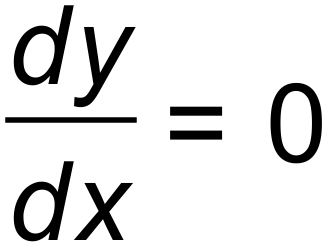
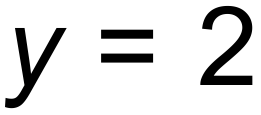
since 

then  ✓

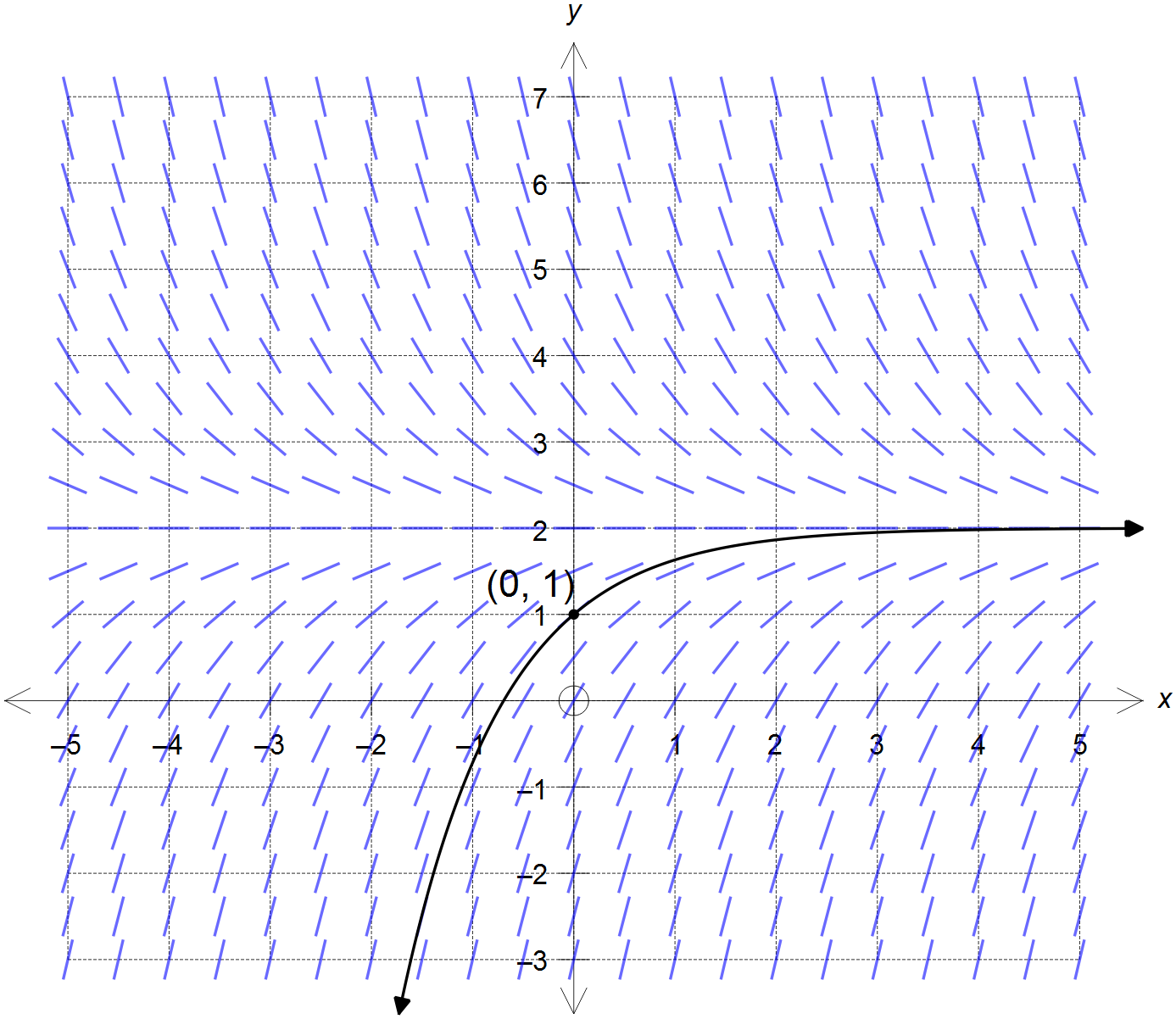
the path is a circle centred at  of radius = 1 unit ✓ [8]

18. (a)  ✓✓

Reasons: (at least 1) ✓

* when  the isoclines follow the line 
* the isoclines describe exponential solutions
* the isoclines follow exponential decay, hence “-y”

(b)



✓ exponential curve that

follows the isoclines

✓ passes through the point

(0, 1)

[5]