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**MATHEMATICS**

**METHODS**

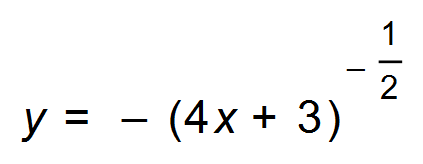
**UNIT 3**

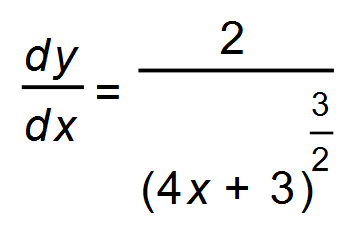
**Semester One**

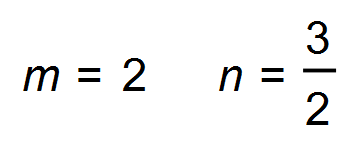
**2019**

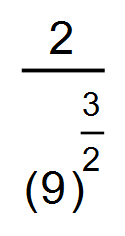
**SOLUTIONS**

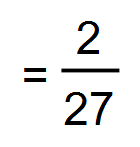
***Calculator−free Solutions***

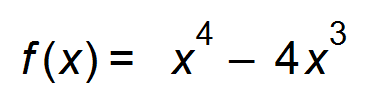
1. (a) 

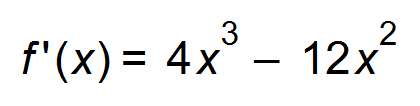
 ✓

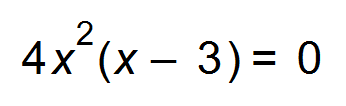
 ✓

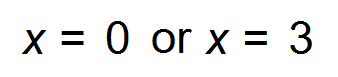
(b) 

 ✓ [3]

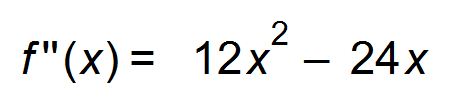
2. (a) 

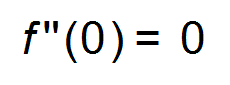


 ✓

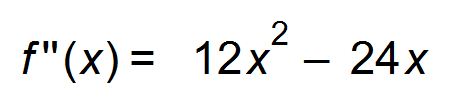
 ✓

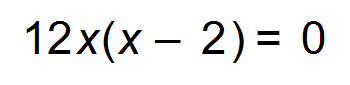
Stationary points (0, 0) and (3, 27) ✓

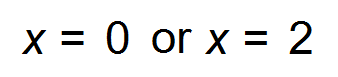
(b)  ✓

∴ horizontal point of inflection occurs at (0, 0) ✓

** (3, −27) ✓✓

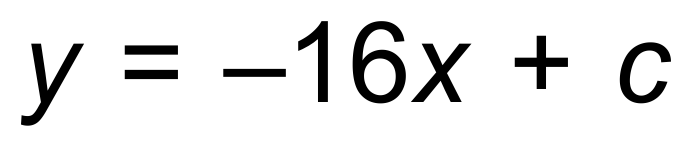
(c) (i) 

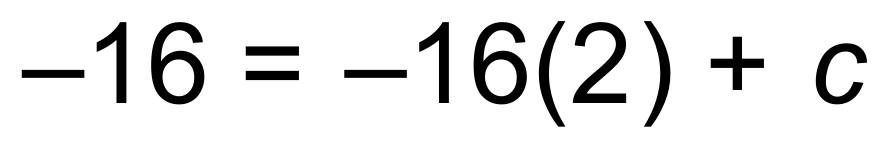


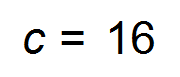
∴ ✓

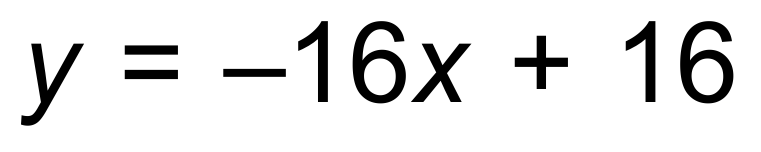
Point of oblique inflection at (2, 16) ✓

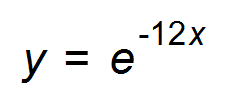
(ii) *m* = 16

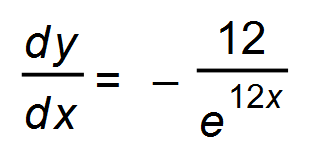
 ✓

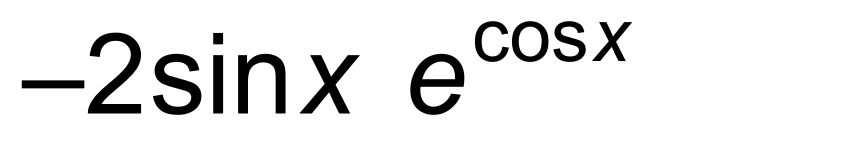




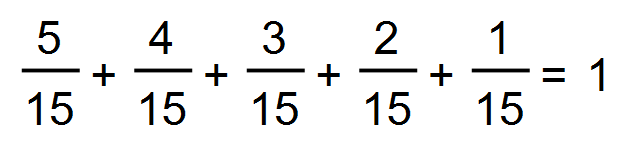
Tangent is  ✓ [11]

3. (a) 

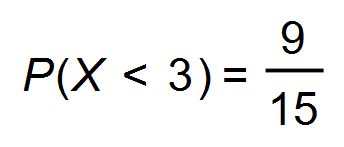
 ✓✓

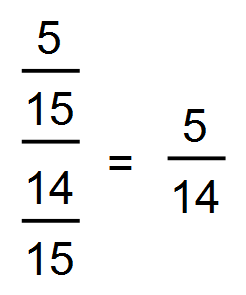
(b)  ✓✓ [4]

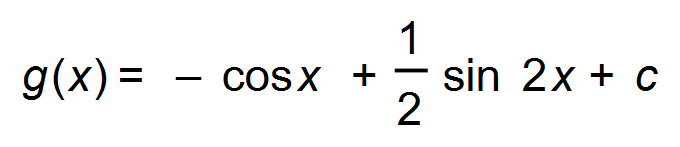
4. (a) The values of *f*(*x)* are all positive ✓

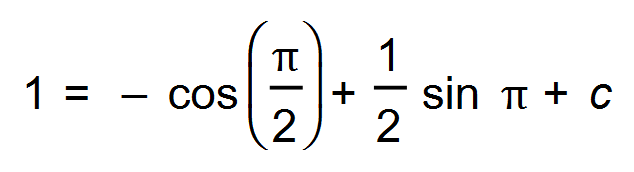
 ✓

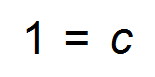
∴ Probability function

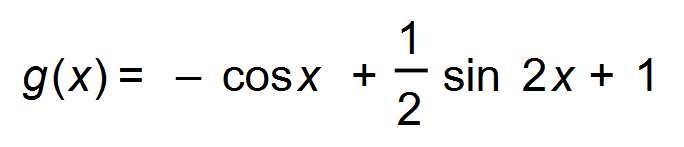
(b)  ✓

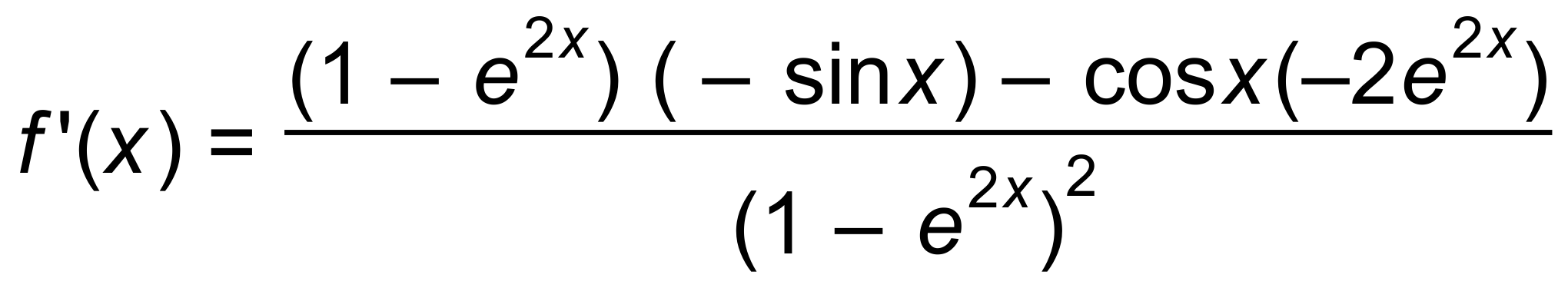
(c)  ✓✓ [5]

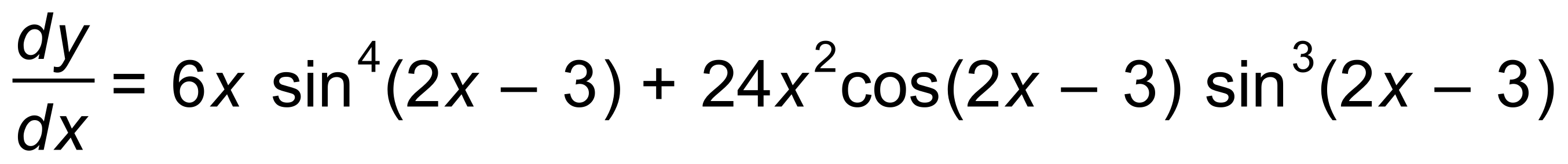
5.  ✓

**** ✓

****

 ✓ [3]

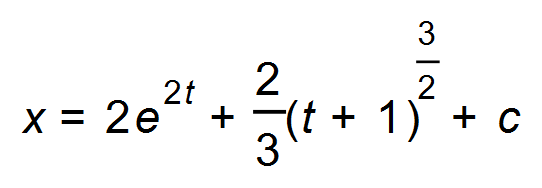
6. (a)  ✓✓

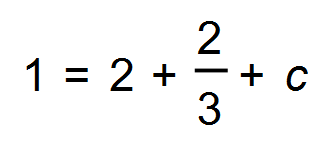
(b)  ✓✓ [4]

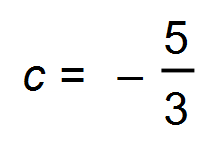
7. (a) (i)  ✓

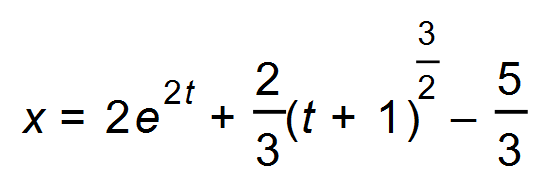
(ii) 62) = 4 ✓✓

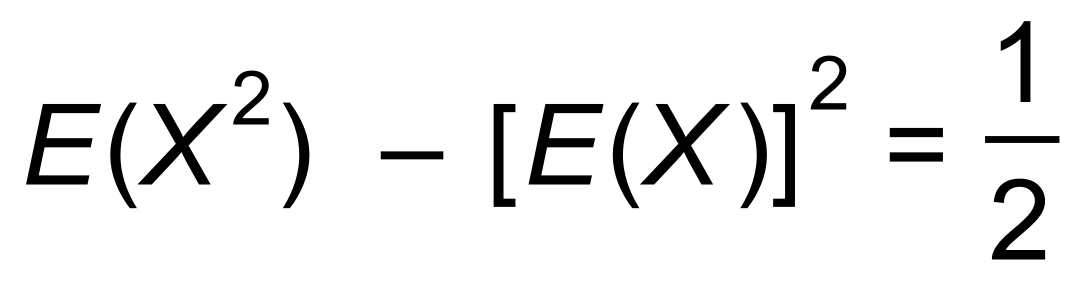
(iii) 5 units2 ✓✓

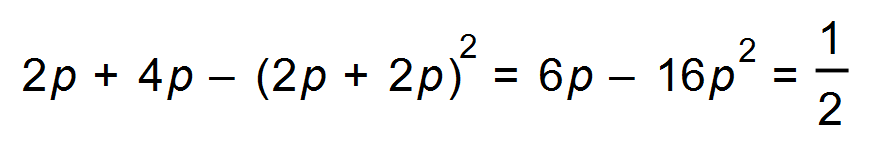
(b)  ✓

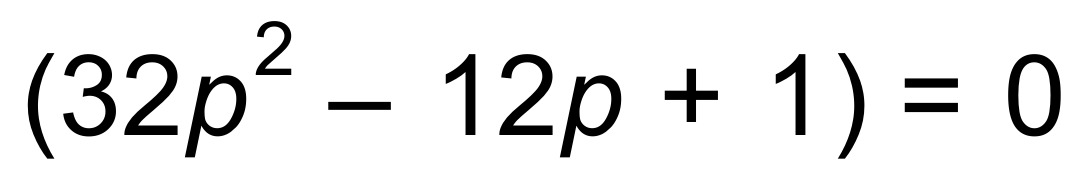
 ✓

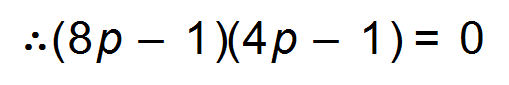


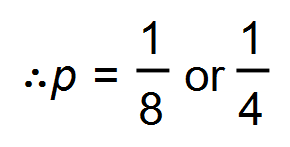
 ✓ [8]

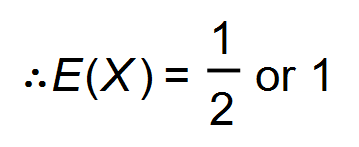
8. (a) 

 ✓





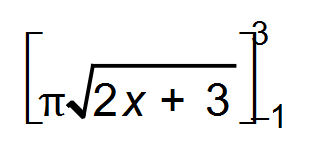
 ✓

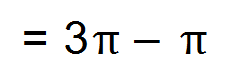
 ✓✓

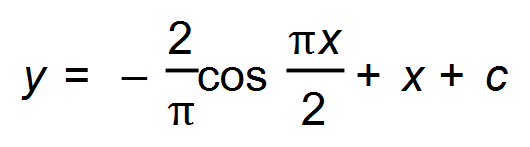
(b) (i) 21 ✓

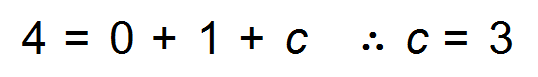
(ii) Standard deviation of *X* = 3

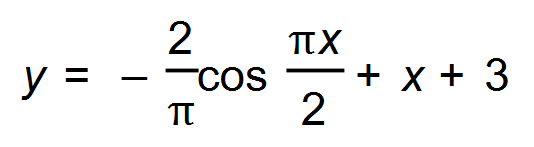
|2| x 3 = 6 ✓✓ [7]

9. (a)  ✓

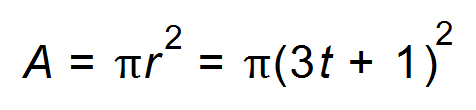
 = 2π✓

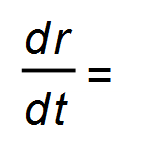
(b)  ✓

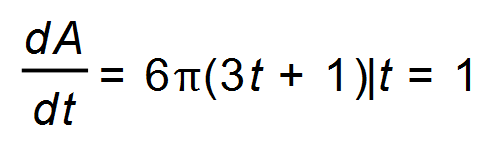
 ✓

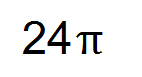
Its path is  ✓ [5]

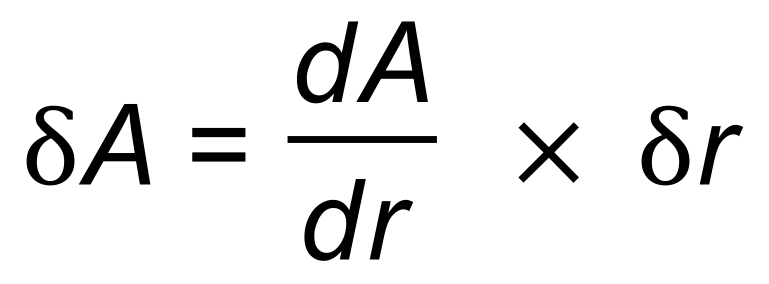
***Calculator−assumed Solutions***

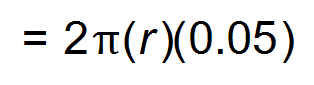
10. (a)  ✓

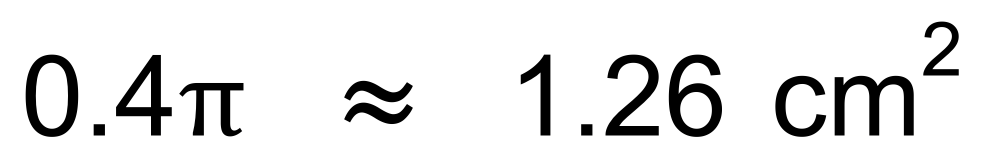
(b) 3 cm/s ✓

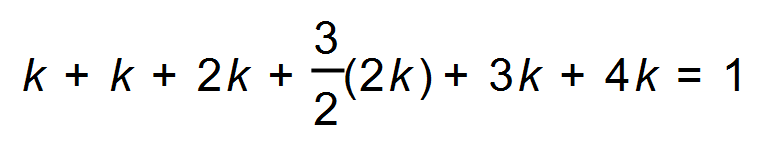
(c) 

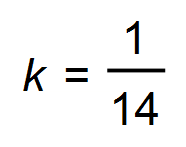
= cm2/s ✓

(d) 

 ✓✓

When *r =* 4 , = ✓ [6]

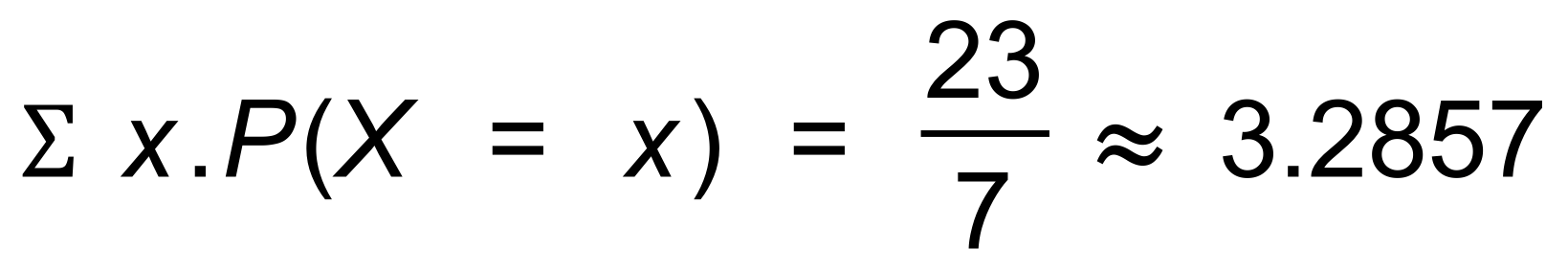
11. (a) Let P(*X* = 0) = *k* then 

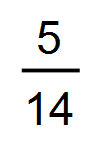
 ✓

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *X* | 0 | 1 | 2 | 3 | 4 | 5 |
| P(*X* = *x*) |  |  |  |  |  |  |
| Frequency | 23 | 23 | 46 | 69 | 69 | 92 |

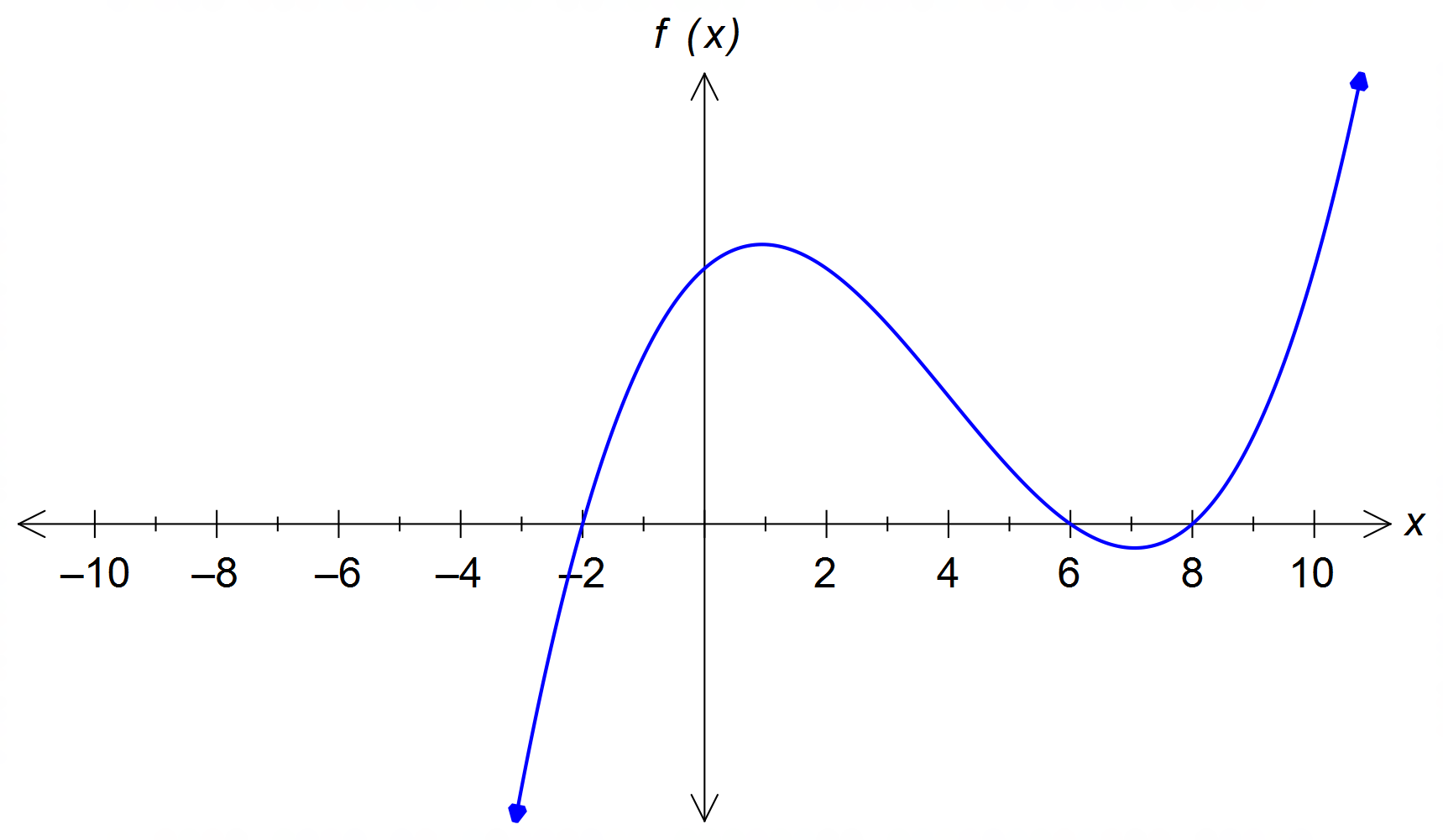
✓✓✓

(b) mode = 5 ✓

mean =  ✓

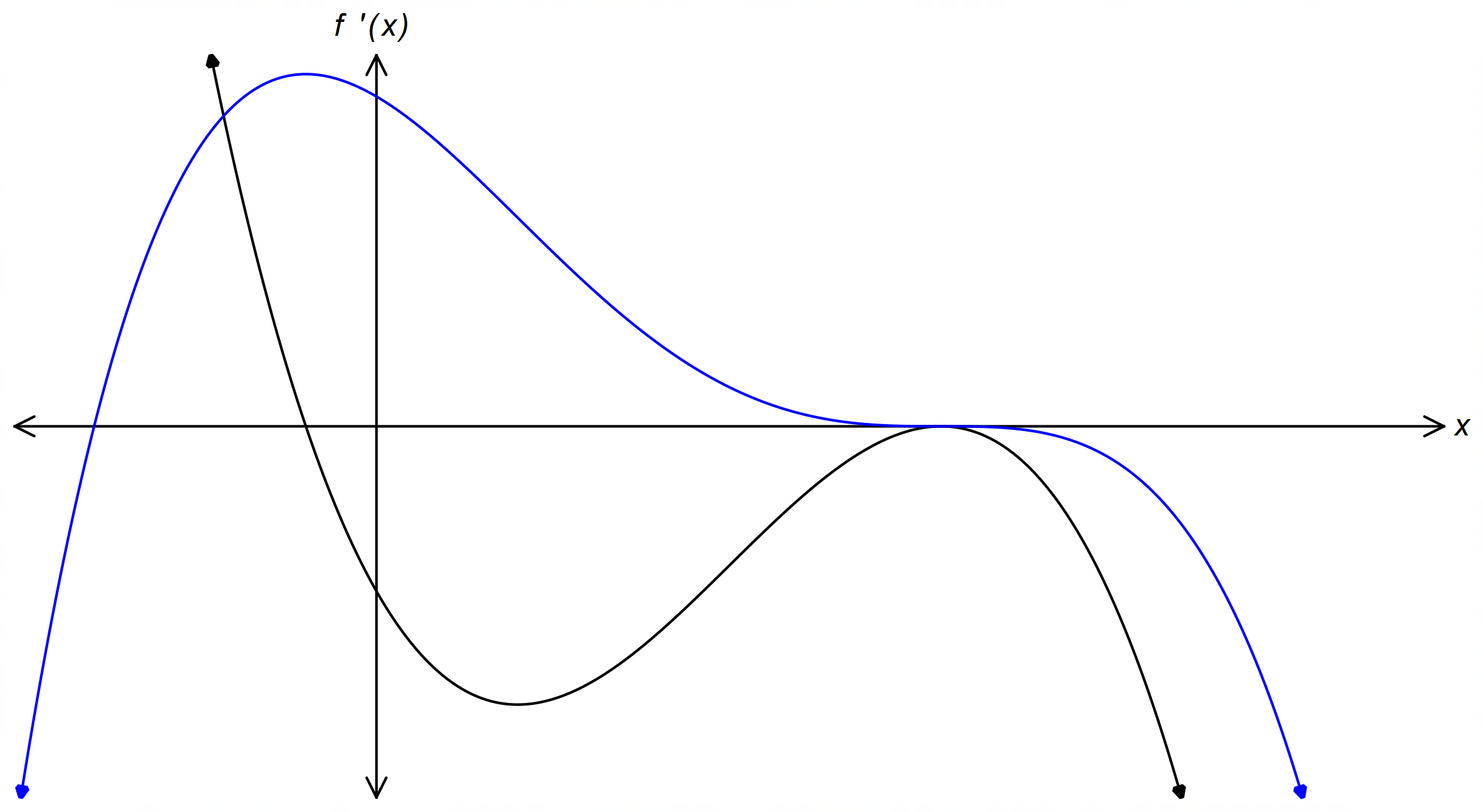
(c)  ✓ [7]

12. (a)

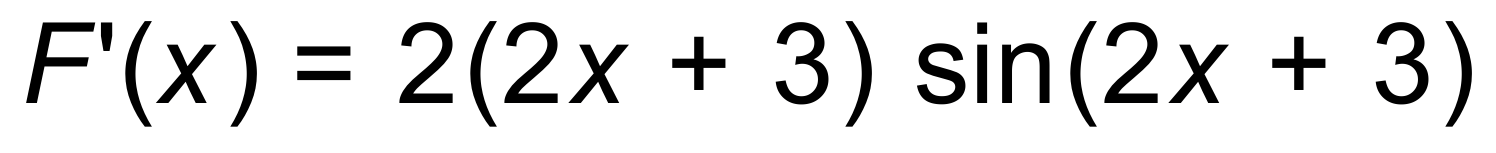


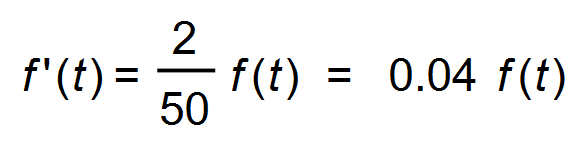
✓✓✓

(b)

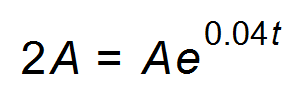


✓✓

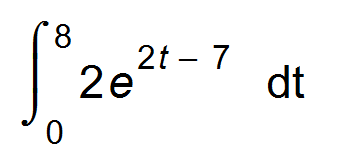
(c)  ✓ [6]

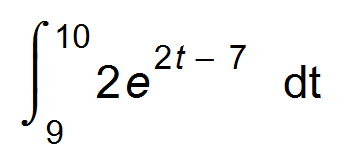
13. (a) 

 *k* = 0.04 ✓

 ✓

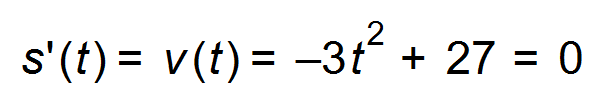
*t* = 17.3 days ✓

(b) (i) = 8103.083 m2 ✓

(ii)  = 382 539.25 m2  ✓

(iii) The exponential growth of the area becomes too large

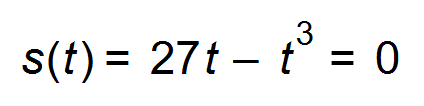
too quickly for the model to be realistic. ✓ [6]

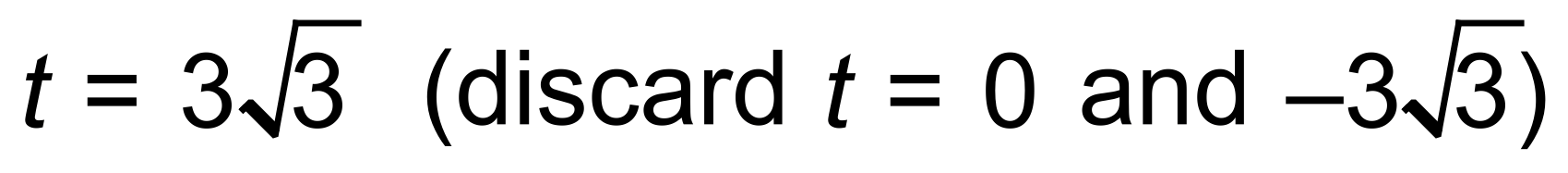
14. (a)  ✓

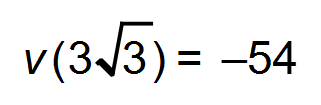
∴ ✓

The maximum distance from O occurs at *t* = 3 seconds and

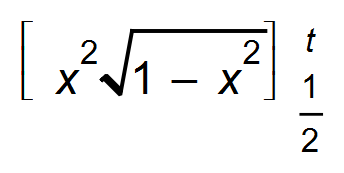
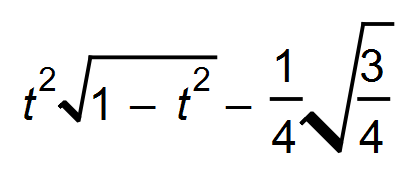
then the particle turns back towards O.

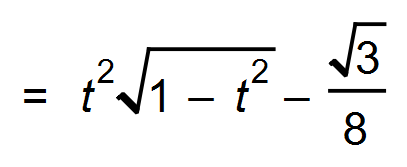
(b) 

∴  ✓

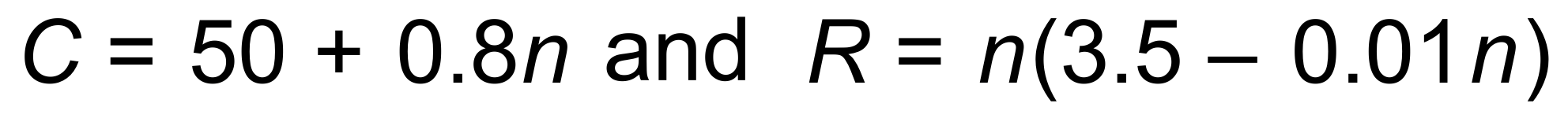
∴  ✓

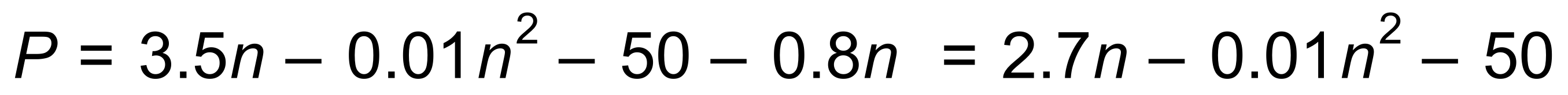
Therefore speed when the particle returns to O is 54 cm/s. ✓ [5]

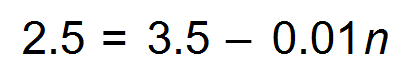
15.  =  ✓✓

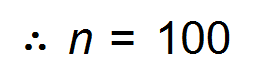
A(*t*) ✓ [3]

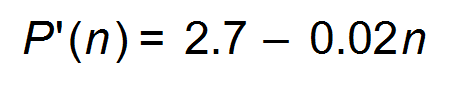
16. (a) Profit = Revenue Cost

 ✓

 ✓

(b)  ✓

 He will sell 100 figs ✓

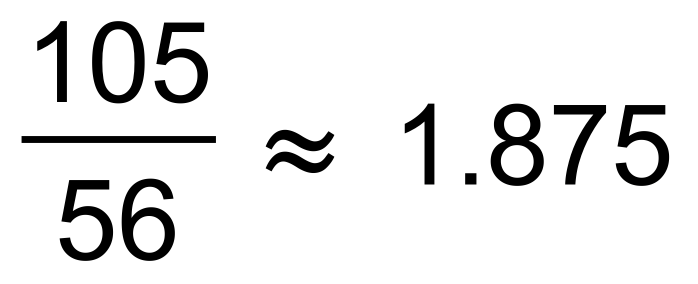
 where *n* =100 ✓

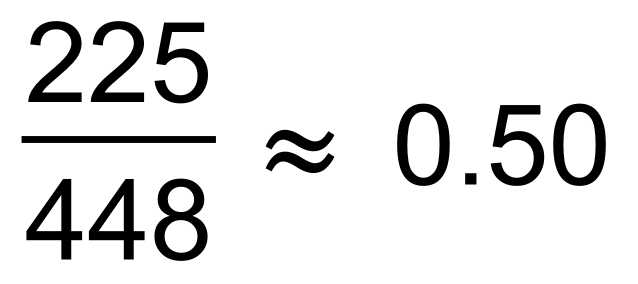
The marginal profit is 0.7 = 70 cents ✓ [6]

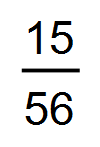
17. (a) (i)

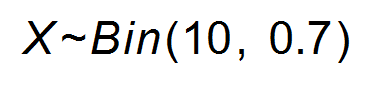
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Y | 0 | 1 | 2 | 3 |
| P(Y= *y*) |  |  |  |  |

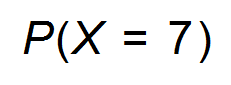
✓✓

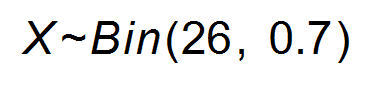
(ii) E(*Y*) =  ✓

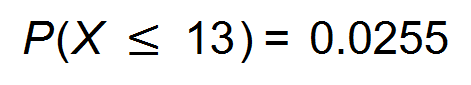
Var(*Y*) =  ✓

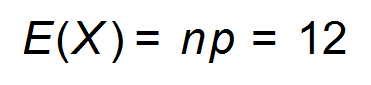
(iii)  ✓

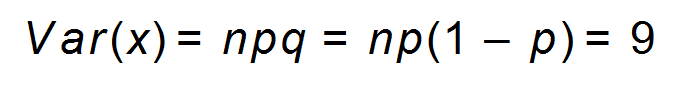
(b) (i) 

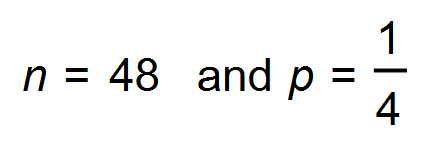
= 0.2668 ✓

(ii) 

 ✓

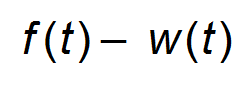
(c)  ✓

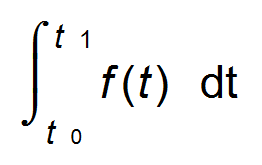
 ✓

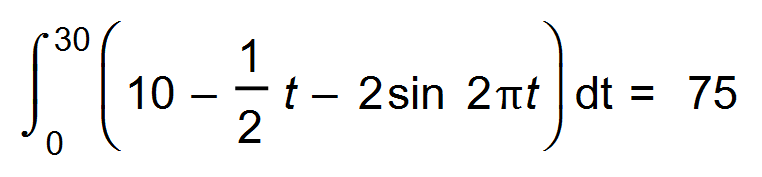
 ✓ [10]

18. (a) The amount of water cannot be a negative amount.

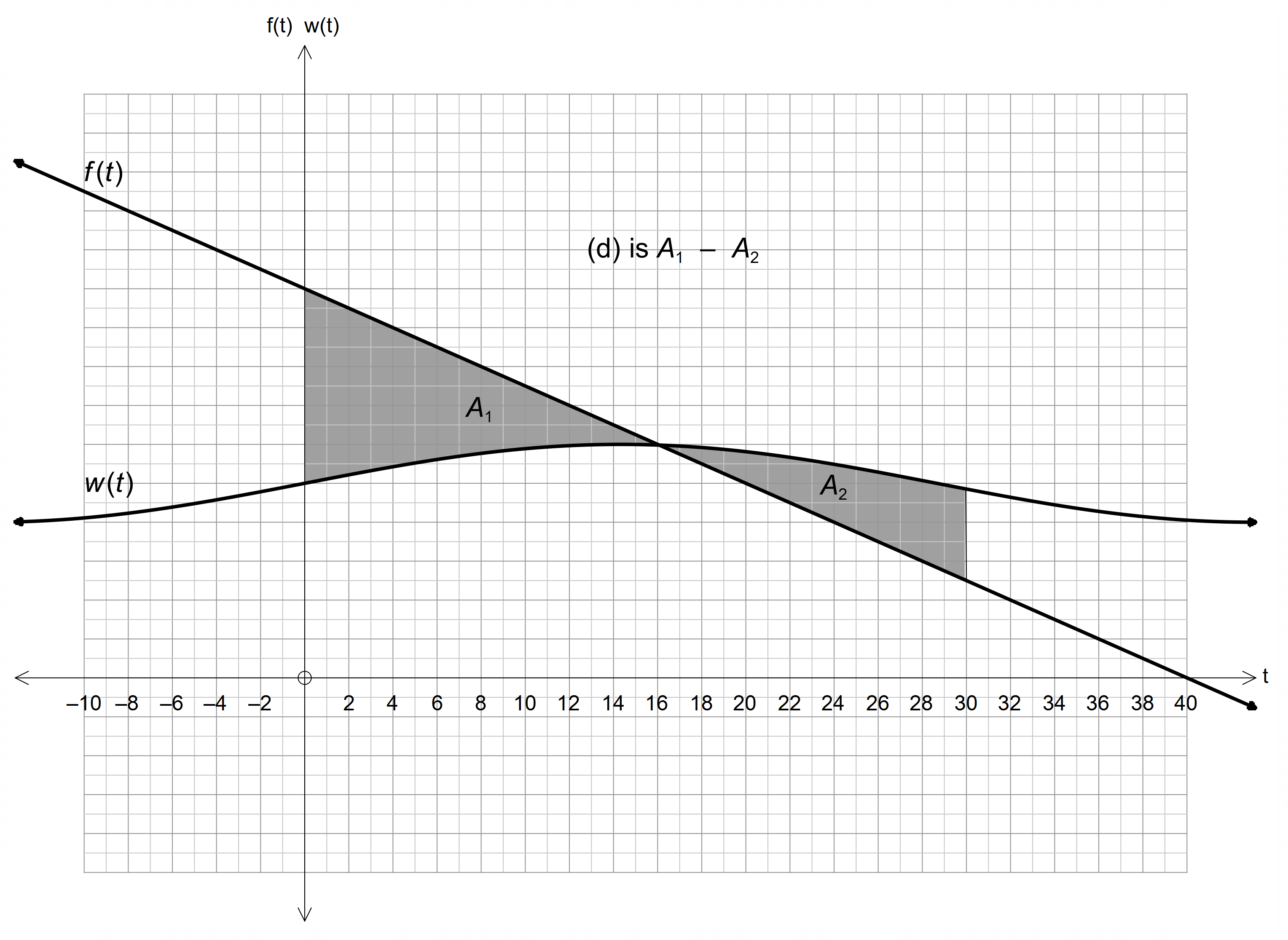
If no water flows in or out the functions can equal zero. ✓✓

(b)  megalitres ✓

(c)  ✓

(d)  ✓

75 megalitres of water. ✓



(e)

✓✓ [8]

19. (a) (i) Each washing machine is an independent trial. ✓

There are two outcomes: Success (a washing machine works)

and Failure (a washing machine is broken.) ✓

(ii) E(*X*) = *p* = 0.2 ✓

Var (*X*) = *p*(1 *p*) = 0.2 x 0.8 = 0.16

Standard deviation = 0.4 ✓

(b) (i) This means that the first mobile phone was selected and found to be defective. (0 non-defective mobile phones were found) ✓

P(*X* = 0) = 0.03 ✓

(ii) This means that the first two mobile phones selected

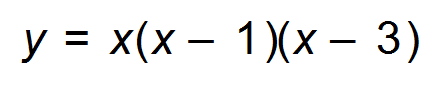
were found to be non-defective but the third mobile phone

selected was defective. ✓

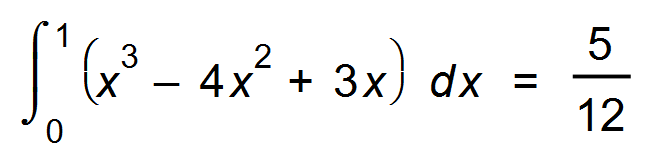
P(*X* = 2) = 0.97 x 0.97 x 0.03 = 0.028227 ✓

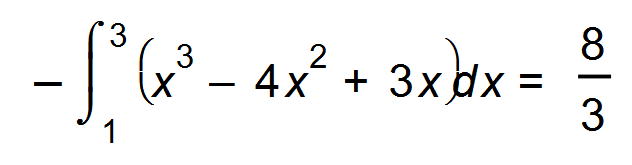
(iii) 0.975 x 0.03 = 0.02576 ✓✓

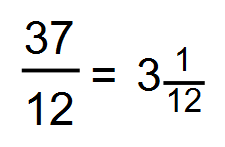
(iv) 1 − [P(0) + P(1) + P(2)] = 0.91267 ✓✓ [12]

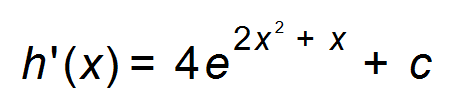
20. (a) 

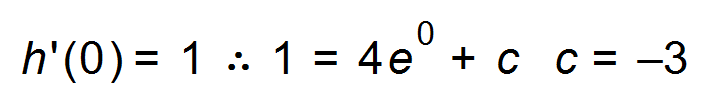
Graph cuts the *x-* axis at 0, 1 and 3. ✓

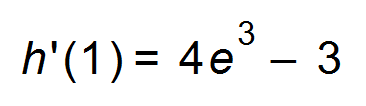
 ✓

 ✓

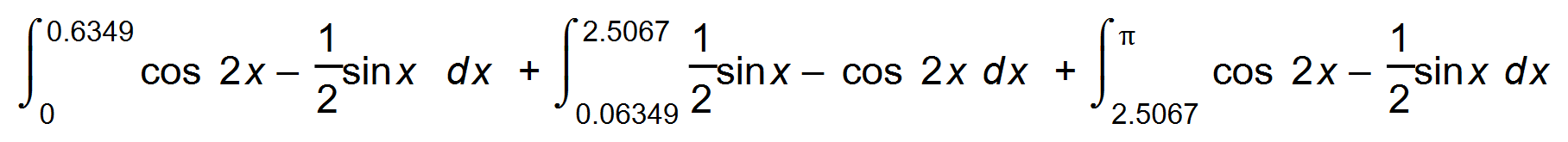
Area = 

(b)  ✓

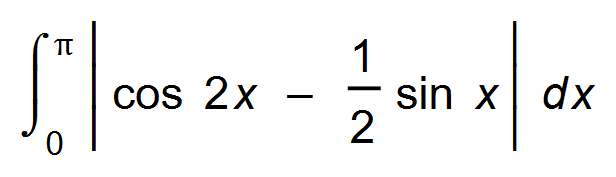
 ✓

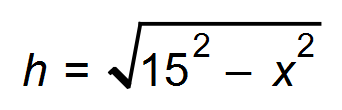
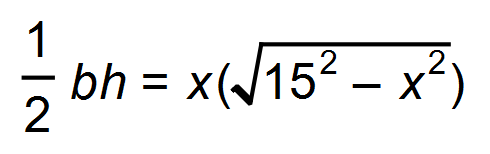
 which is the gradient at *x* = 1 ✓

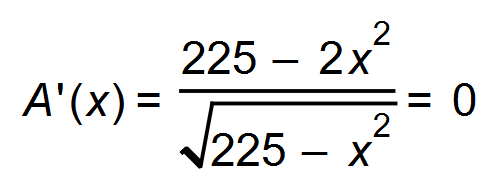
(c) Graphs intersect at *x* = 0.6349, 2.5067 ✓

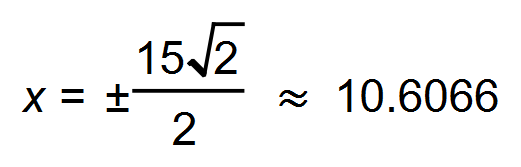


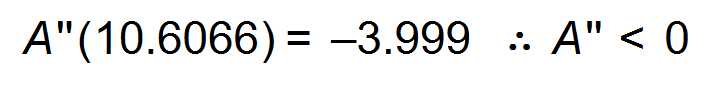
= 2.5203 units2 ✓✓ [9]

Or: = 2.5203 units2

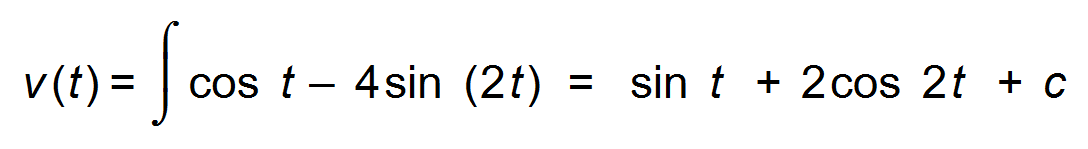
21. In triangle therefore A= ✓

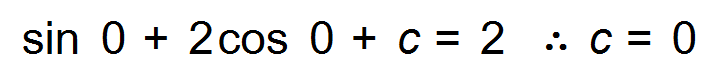
 ✓

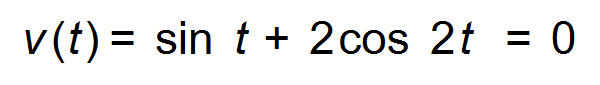
 (Discard negative value for *x.*) ✓

 therefore maximum ✓

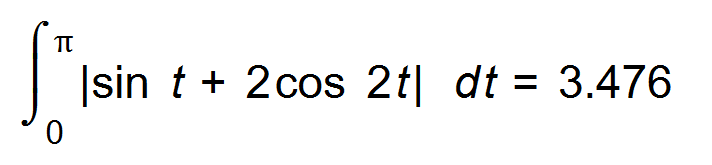
Maximum area is 112.5 cm2  ✓ [5]

22. (a)  ✓



 ✓

The particle changes direction when *t =* 1.003 s or *t* = 2.139 s ✓

(b) m2 ✓✓ [5]

23. (a)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *g*(0) | *g*(0.2) | *g*(0.4) | *g*(0.6) | *g*(0.8) | *g*(1) |
| 1 | 0.96 | 0.85 | 0.70 | 0.53 | 0.37 |

✓

Area from left = 0.2 (1 + 0.96 + 0.85 + 0.70 + 0.53) = 0.808 ✓

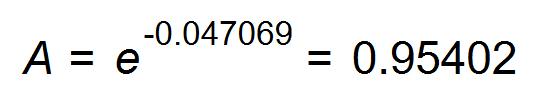
Area from right = 0.2 (0.96 + 0.85 + 0.70 + 0.53 + 0.37) = 0.682 ✓

Average = 0.745 = 0.75 units2 ✓

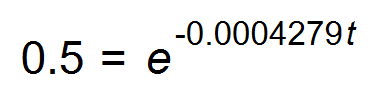
(b) As the width of the rectangle tends to 0,

the more accurate will be the area. ✓ [5]

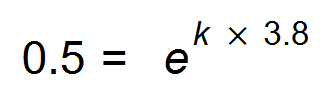
24. (a) *t* = 110 years

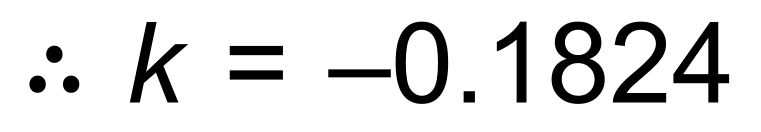
grams ✓

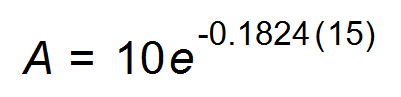
Therefore 4.598 % has decayed. ✓

(b)  ✓

*t* = 1619.88 1620 years ✓

(c) 

 ✓

 ✓

0.648 mg of radon remains ✓ [7]

**END OF QUESTIONS**