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**MATHEMATICS**

**METHODS**

**UNIT 3**

**Semester One**

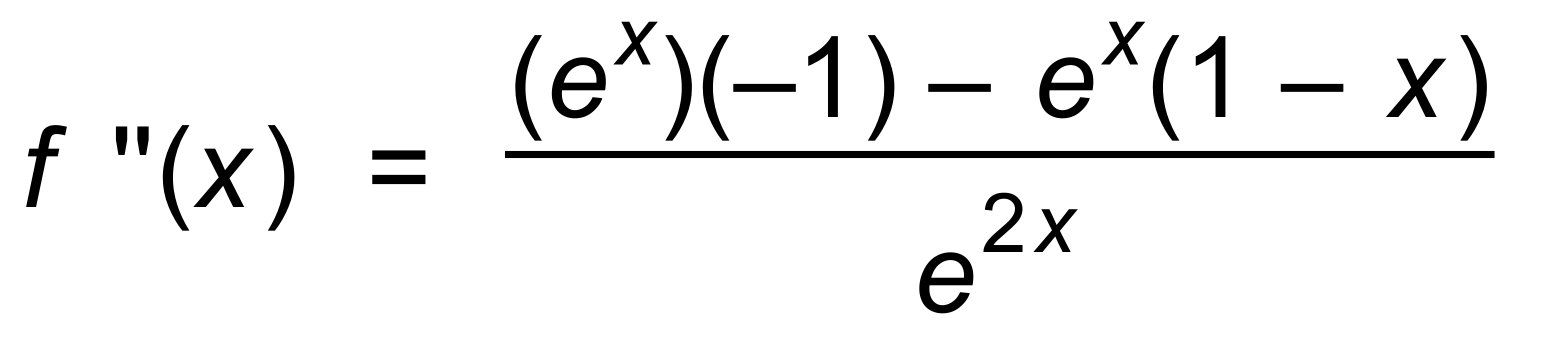
**2018**

**SOLUTIONS**

***Calculator−free Solutions***

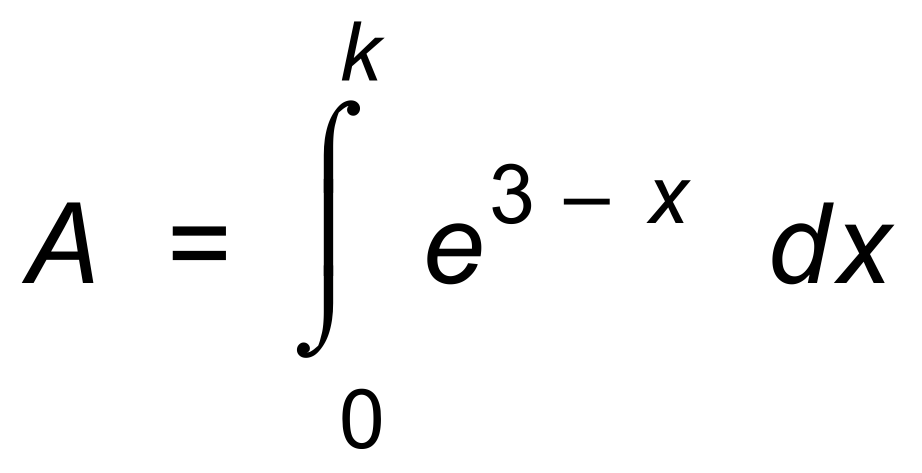
1..  ✓

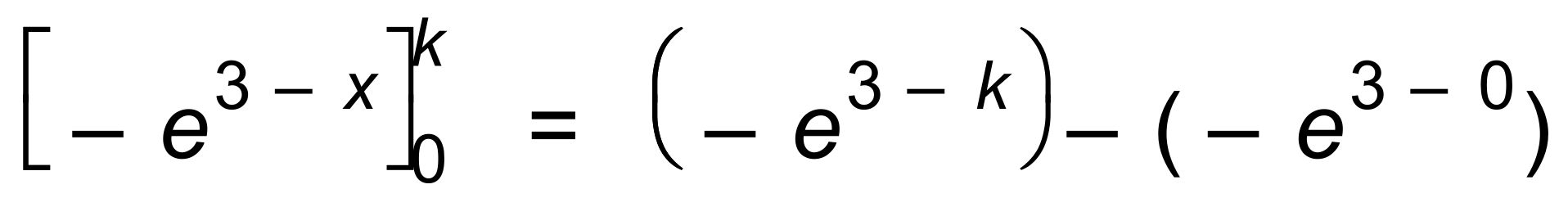
∴ x = 1 ✓

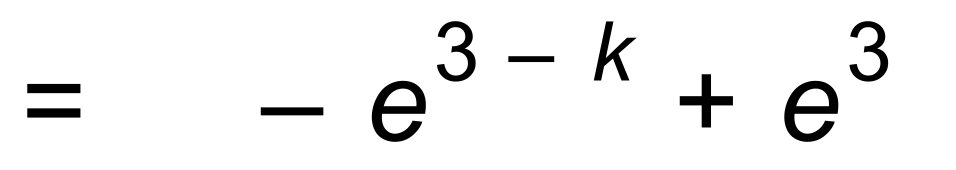
 ✓

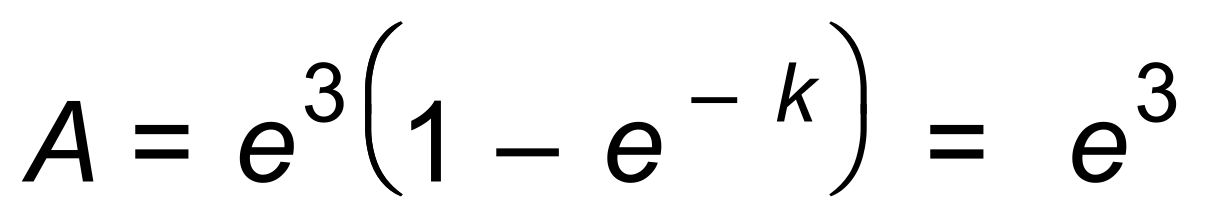
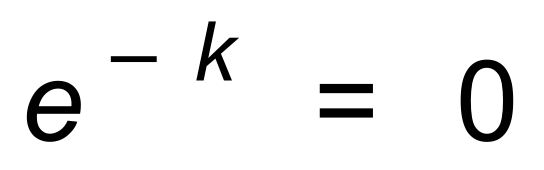
Since f ′′(1) < 0, then maximum ✓

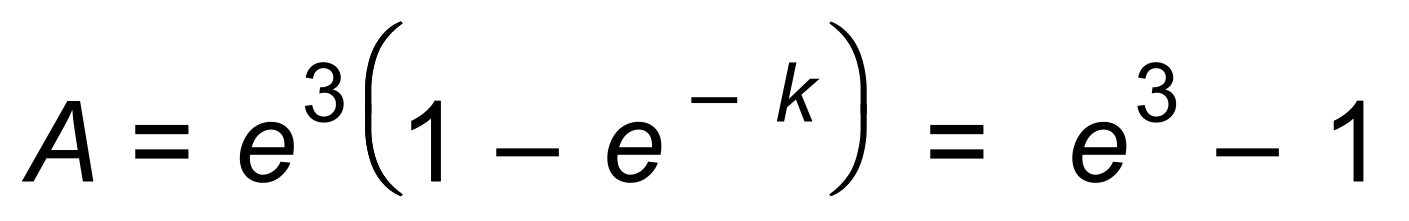
[4]

2.  ✓

∴  ✓

 ✓

If  then , which is impossible. ✓

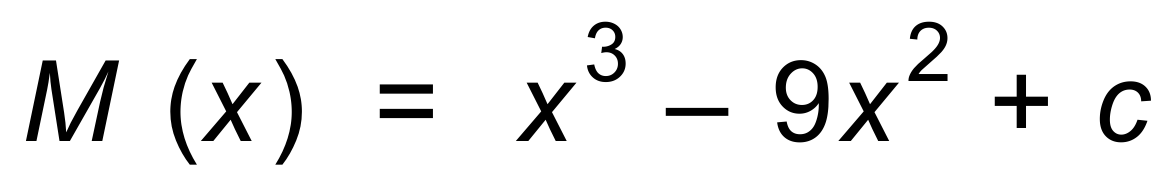
If  ✓

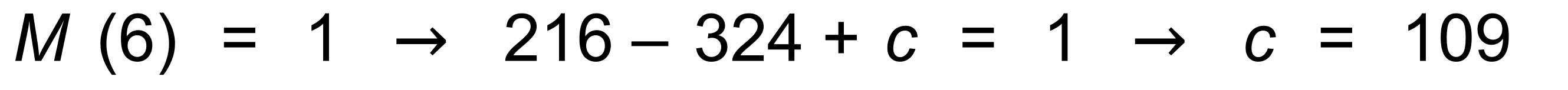
∴ k = 3 ✓ [6]

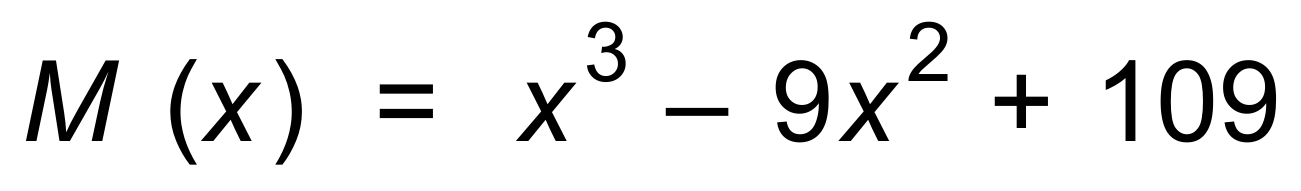
3. (a) Stationary point occurs when 

∴  ✓

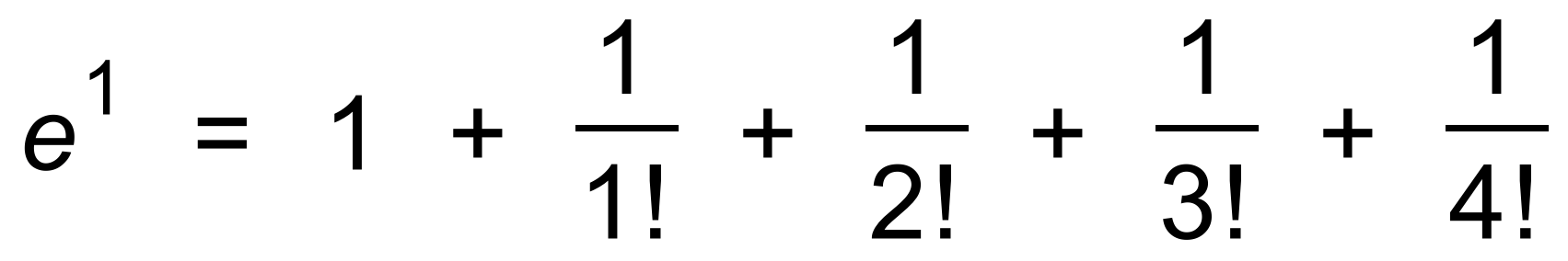
∴ k = 18 ✓

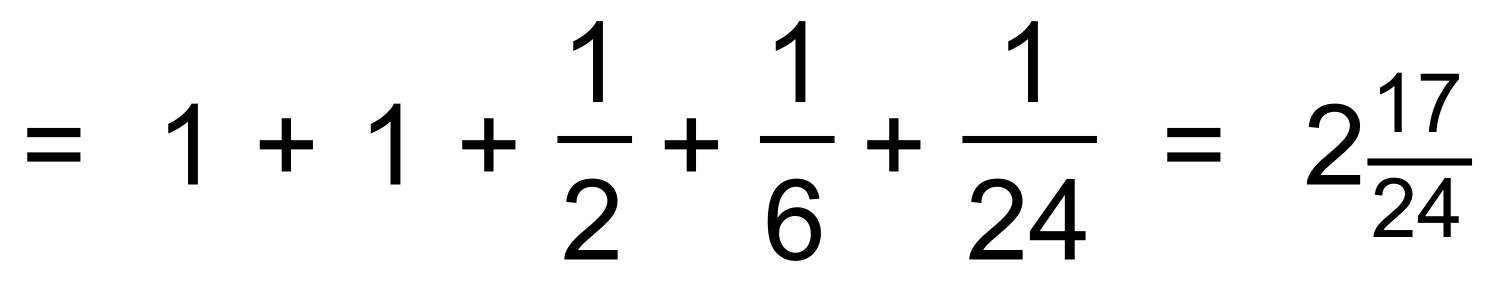
(b)  ✓

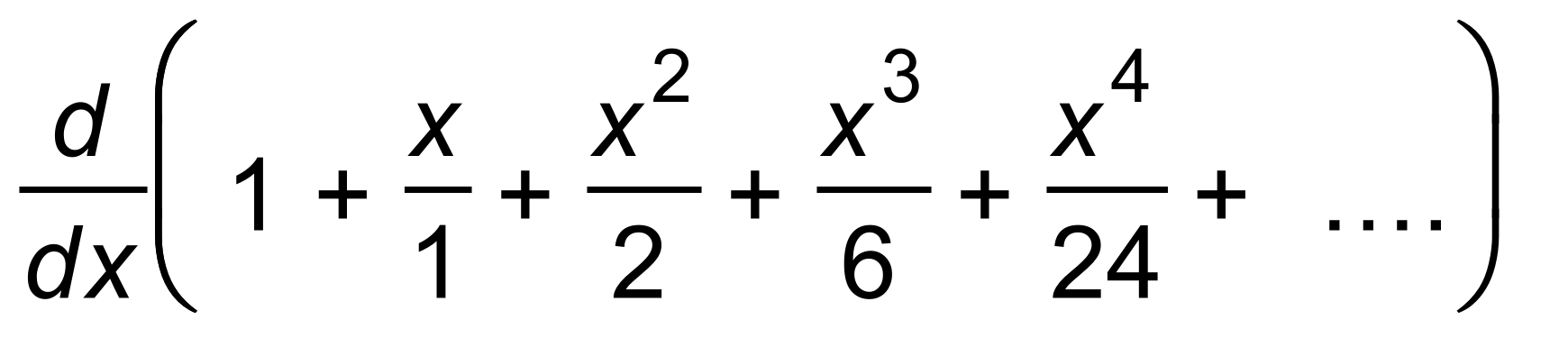
Since  ✓

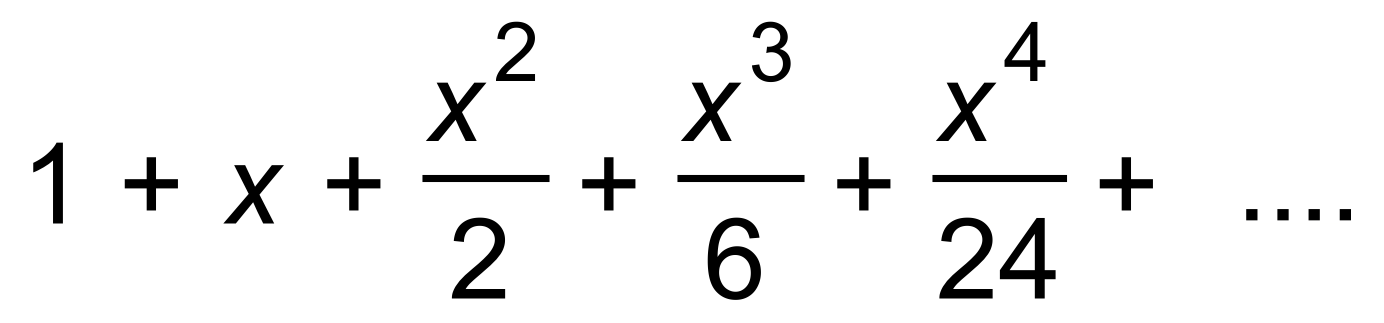
∴  ✓

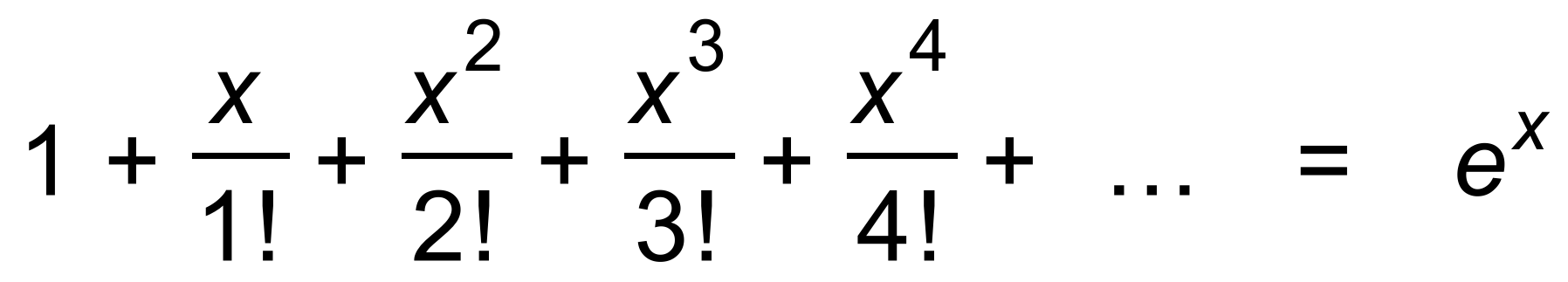
∴ Vertical intercept = 109 ✓ [6]

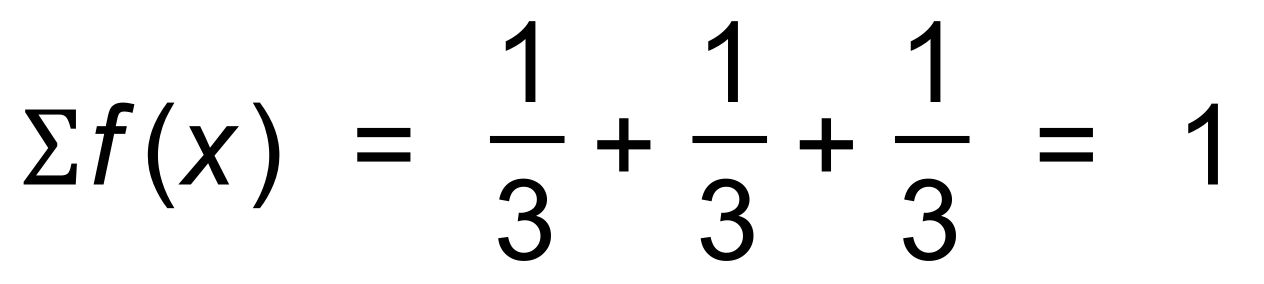
4. (a)  ✓

 ✓

(b) 

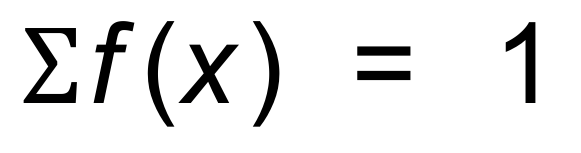
=  ✓

=  ✓ [4]

5. (a)  ✓

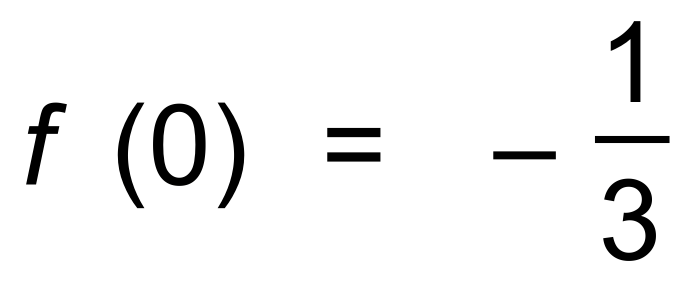
and 0  f (x) 0 for all x ✓

∴ PDF

(b)  ✓

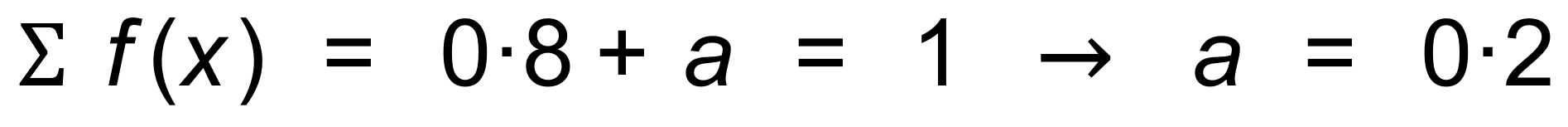
and 0  f (x) 0 for all x ✓

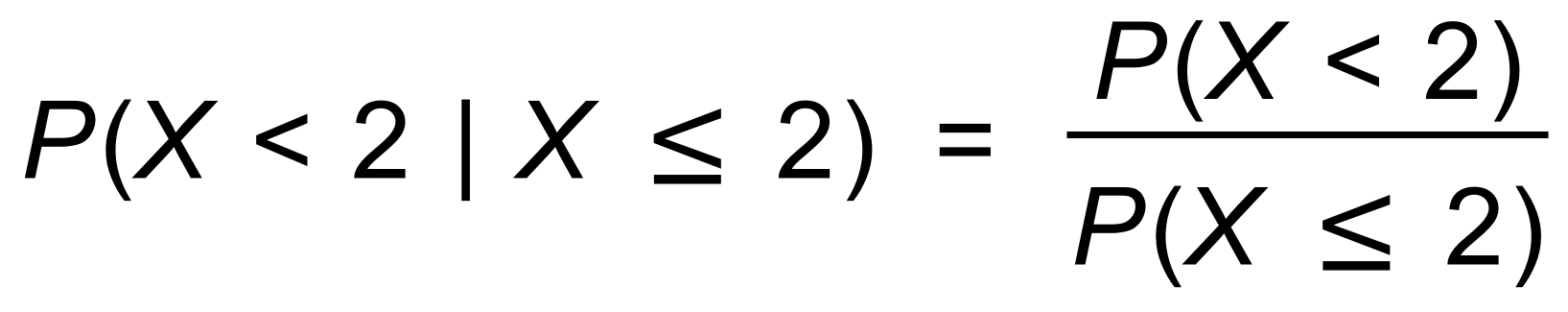
∴ PDF

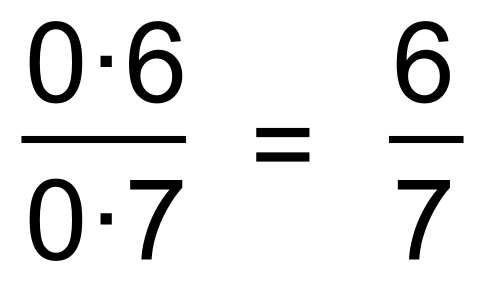
(c) Since 

f (x) is not greater than or equal to 0 for all x ✓

∴ Not PDF ✓ [6]

6. (a) Since PDF  ✓

(b)  ✓

=  ✓

(c) E(X) = 0 + 0.1 + 0.2 + 0.3 + 0.8 = 1.4 ✓✓

(d) Variance = (0 + 1 x 0.1 + 4 x 0.1 + 9 x 0.1 + 16 x 0.2) − 1.42 ✓✓

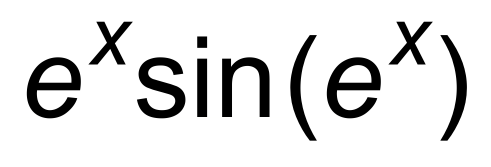
= 0.1 + 0.4 + 0.9 + 3.2 − 1.96 = 2.64 ✓ [8]

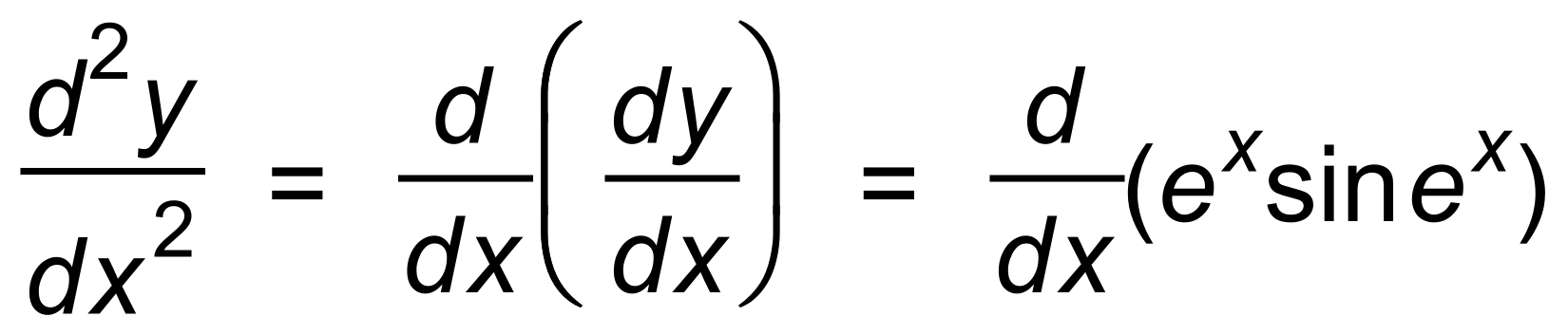
7. E(Y) = 2E(X) + 3 = 8

∴ m = 2.5 ✓

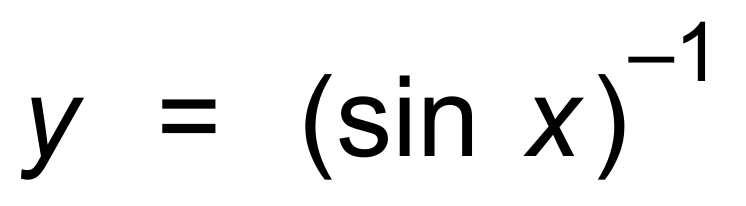
VAR(Y) = 4VAR(X) = 20

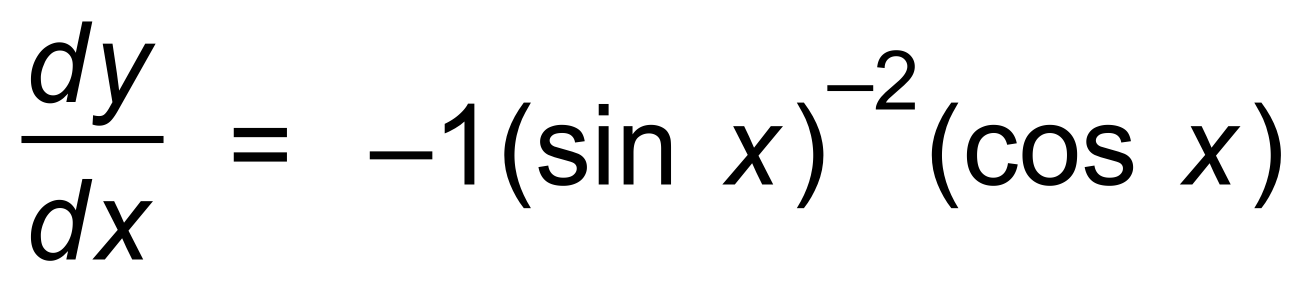
∴ v = 5 ✓✓ [3]

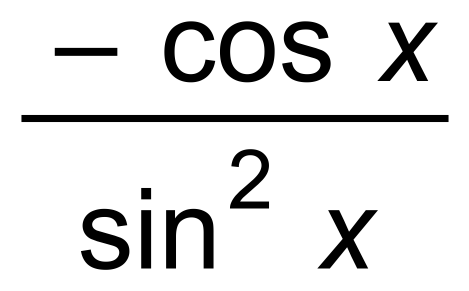
8. (a)  ✓✓

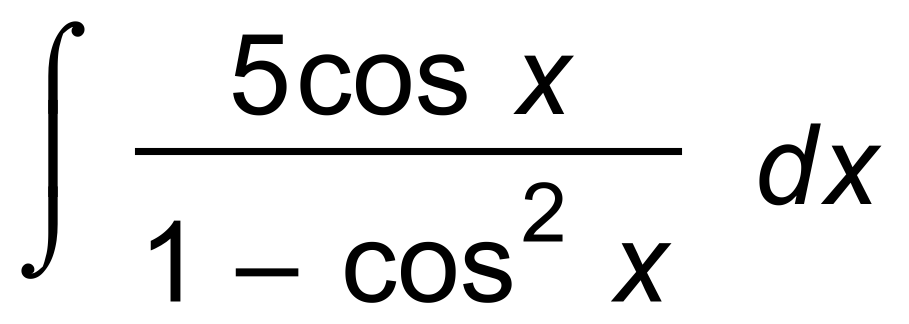
(b)  ✓

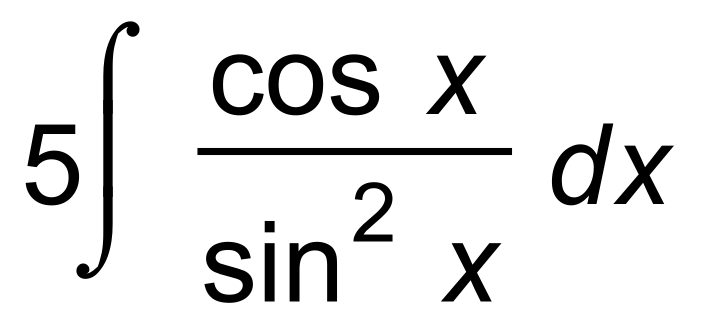
=  ✓✓ [5]

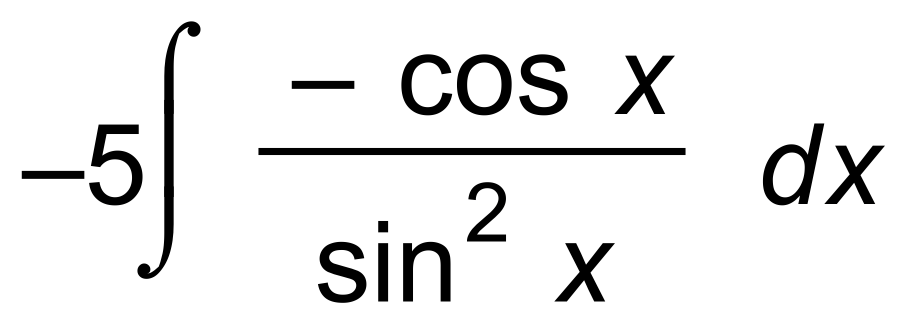
9. (a) 

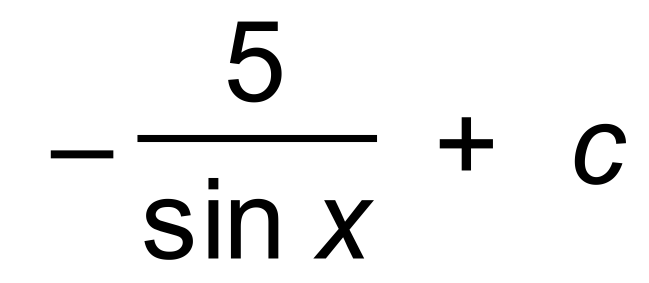
 ✓

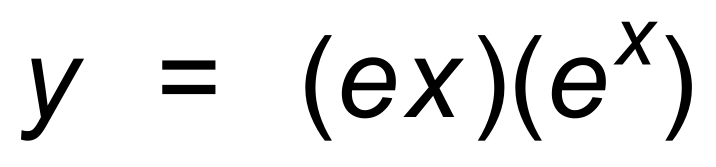
=  ✓

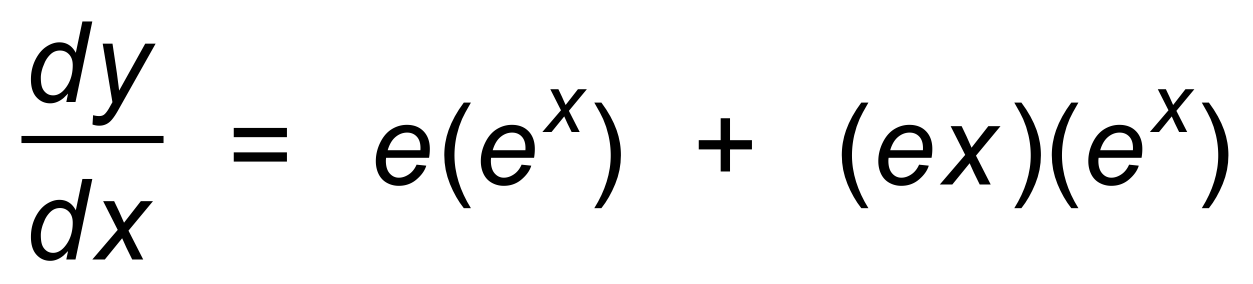
(b) 

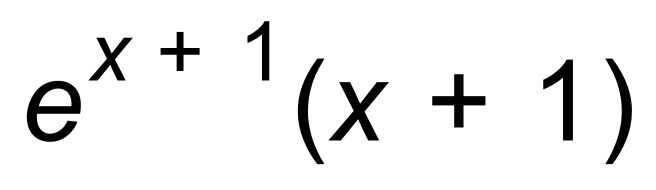
=  ✓

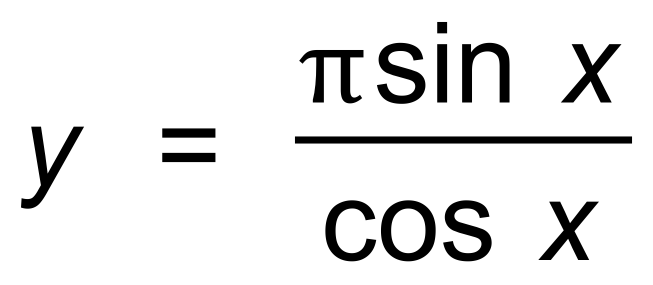
=  ✓

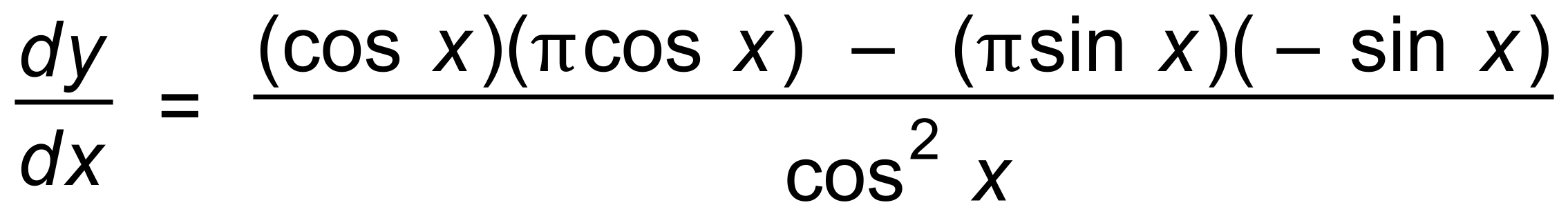
=  ✓ [5]

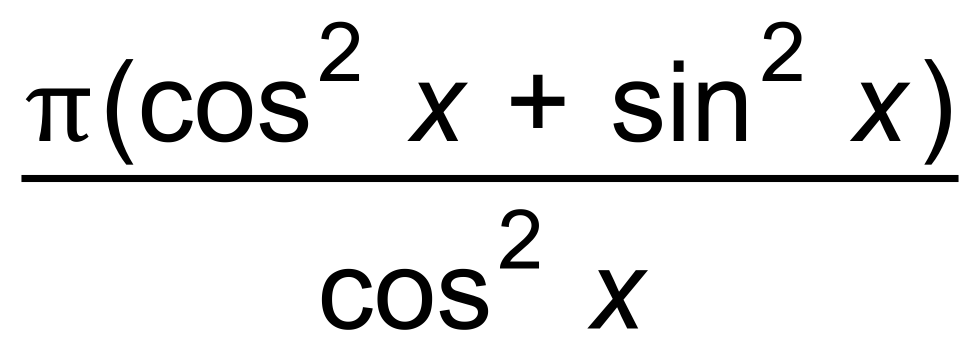
10. (a) 

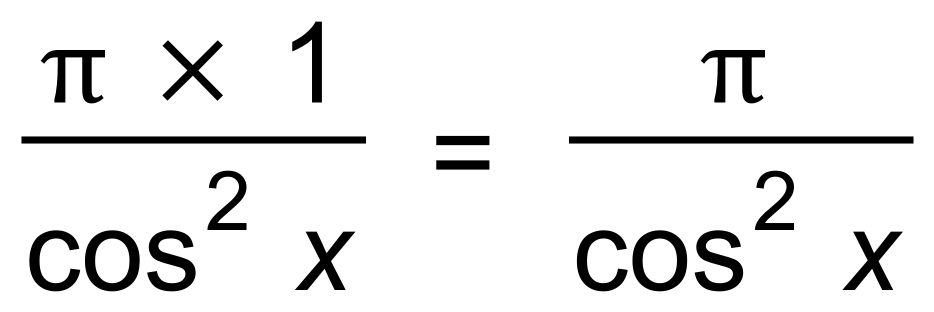
∴  ✓

∴ =  ✓

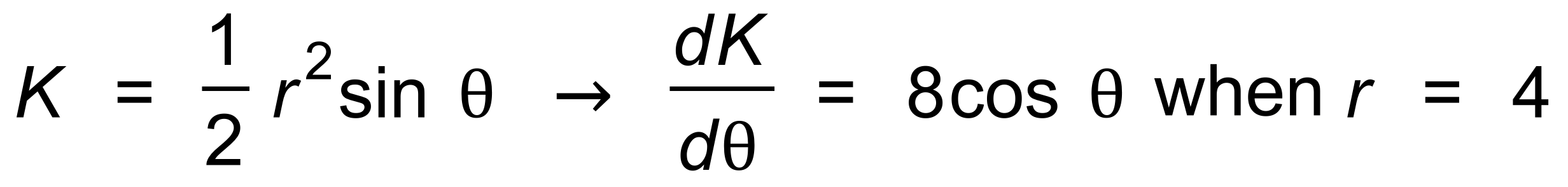
(b) 

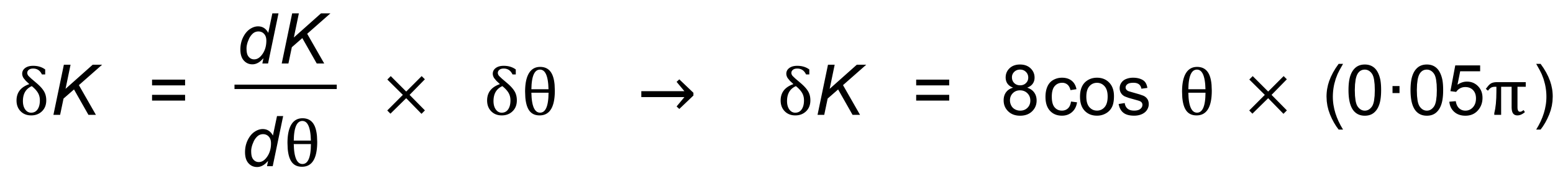
∴  ✓

=  ✓

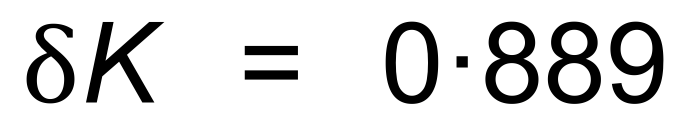
=  ✓ [5]

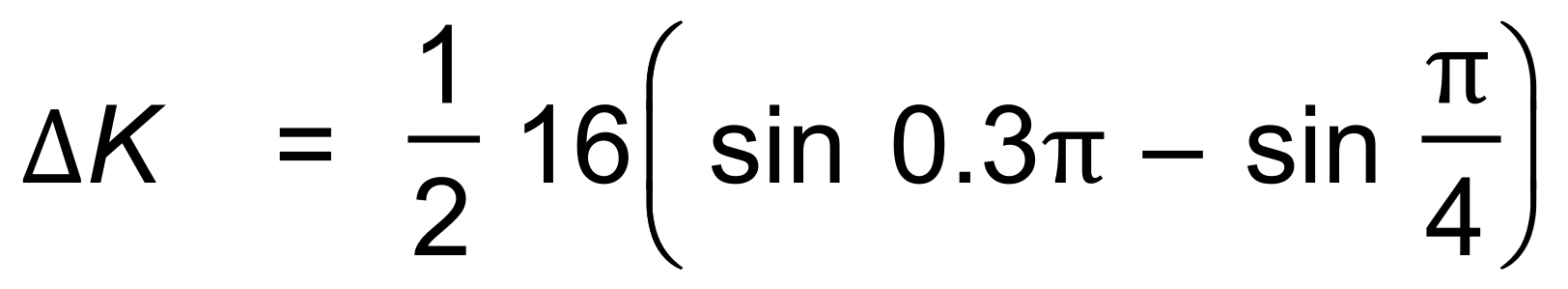
***Calculator−assumed Solutions***

11. (a)  ✓

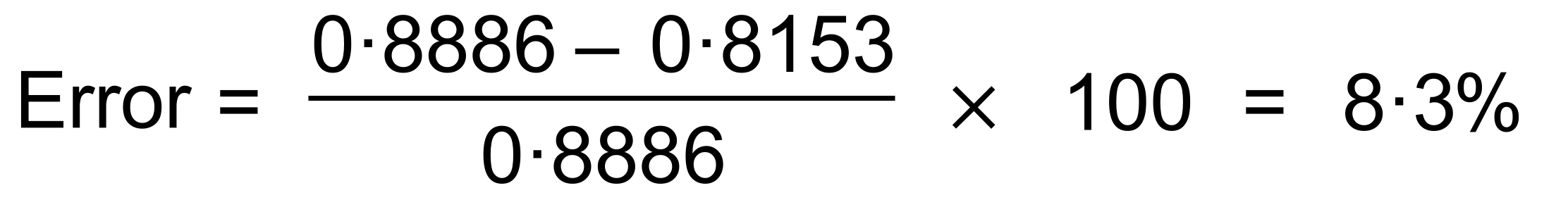
 ✓

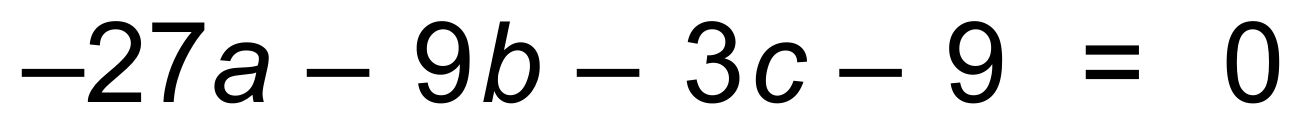
∴ 

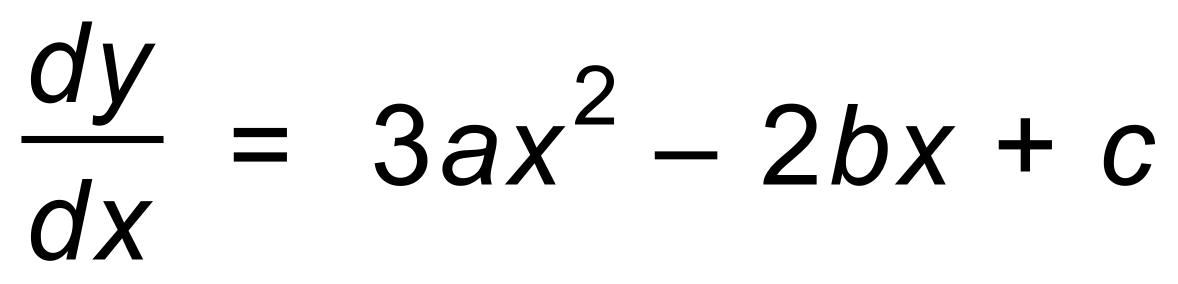
∴  ✓

(b) 

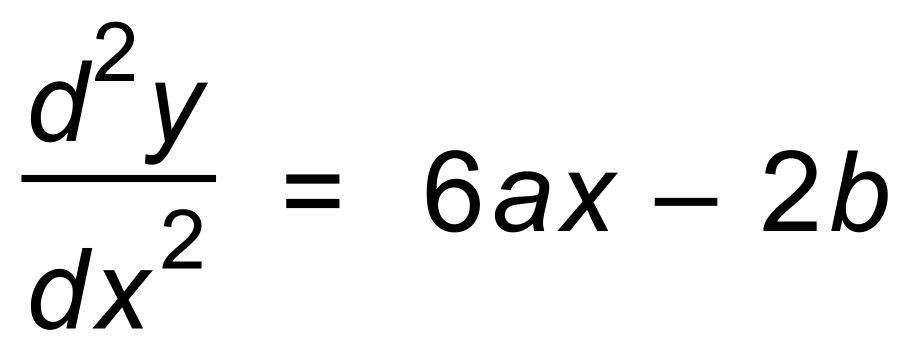
∴  ✓

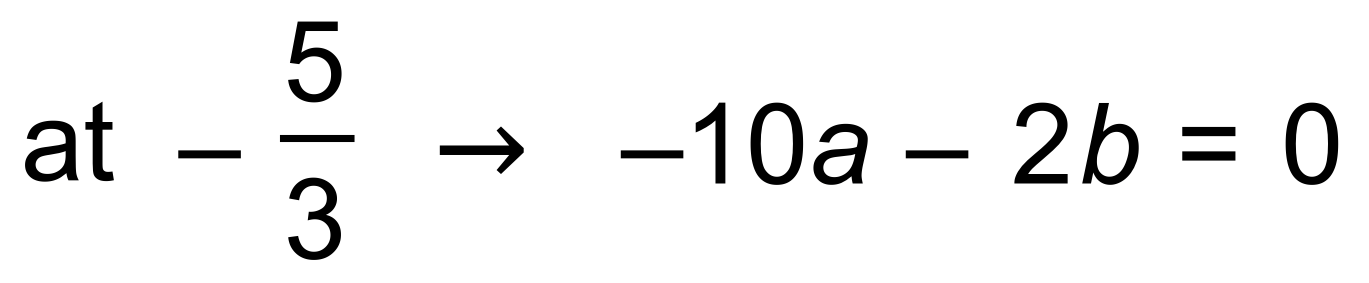
∴  ✓ [5]

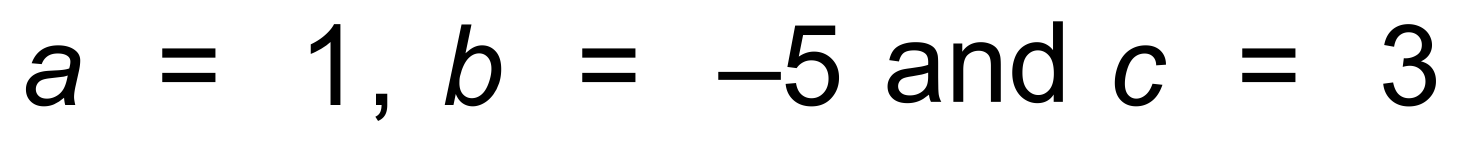
12. (−3, 0) →  ✓

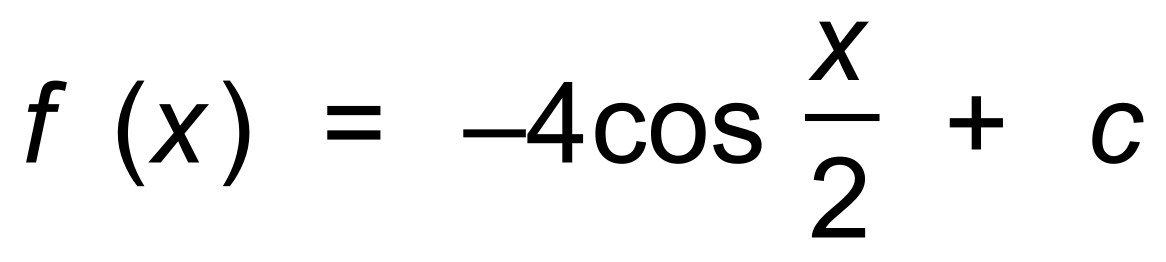
 ✓

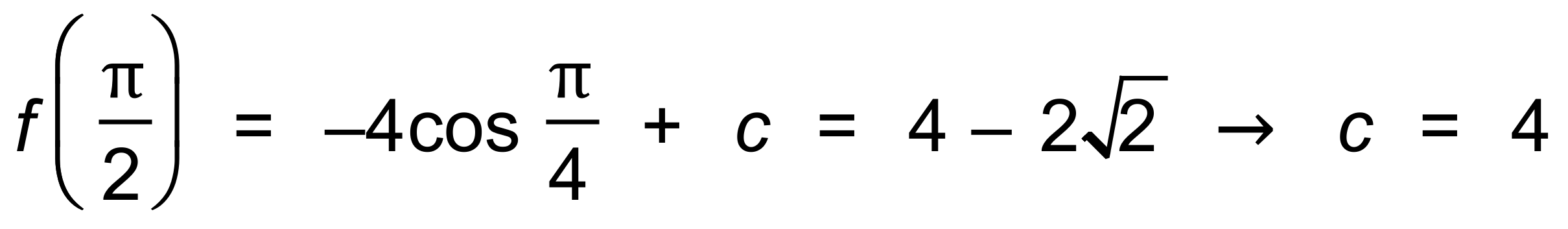
 ✓

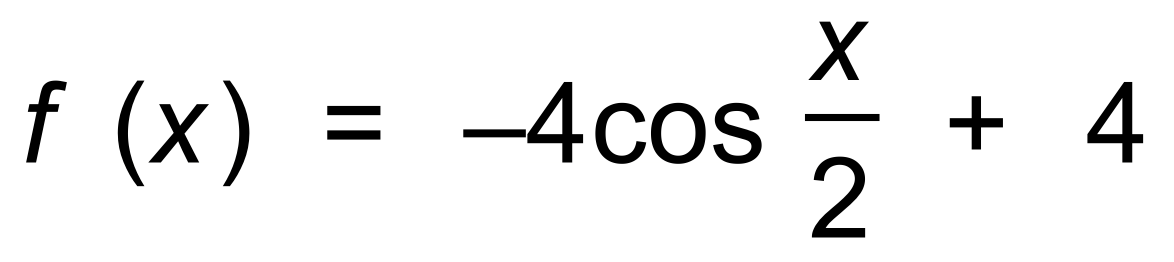
 ✓

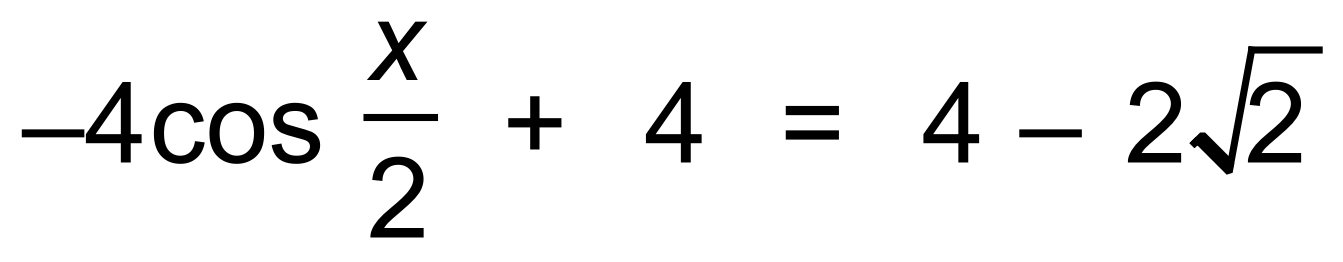
POI  ✓

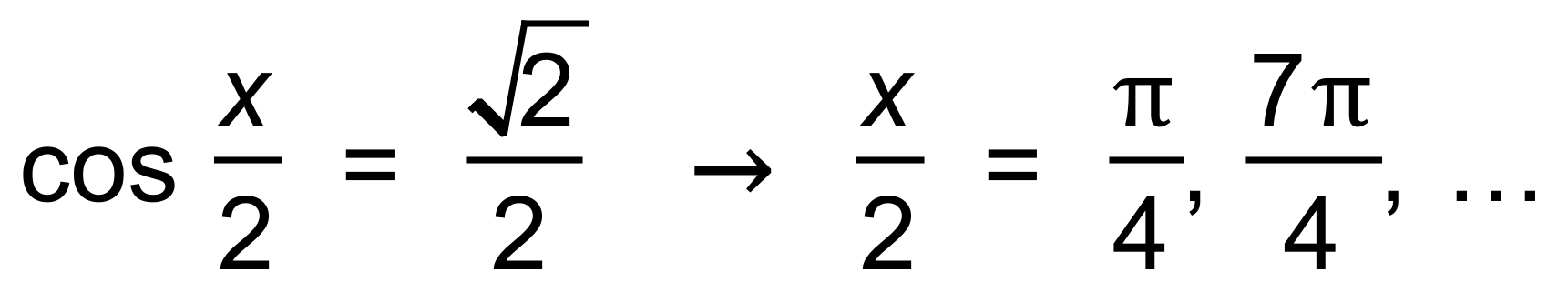
∴ Using calc  ✓✓ [7]

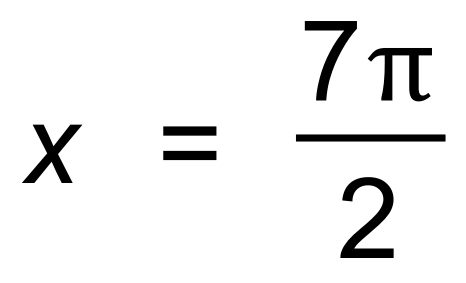
13. (a)  ✓

∴  ✓

∴  ✓

(b) 

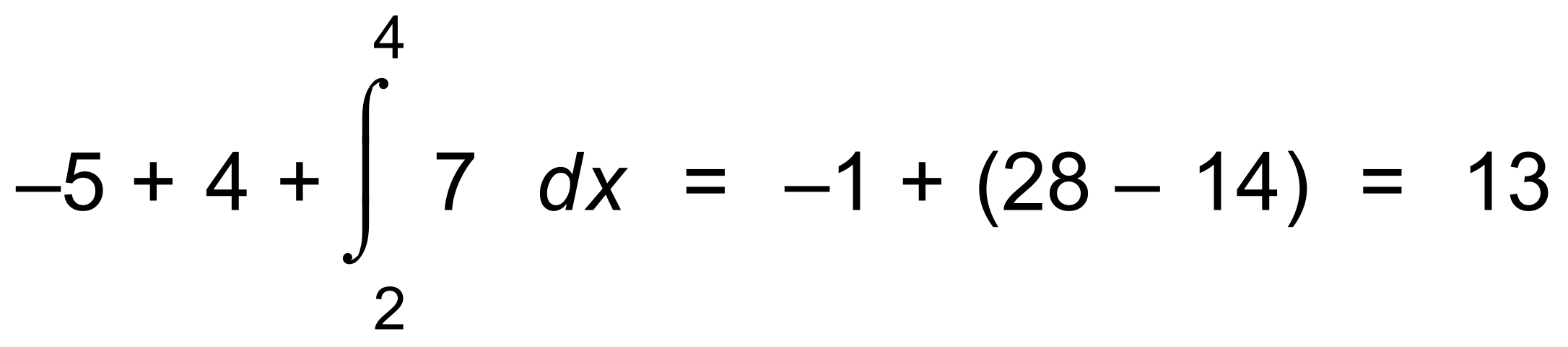
∴  ✓✓

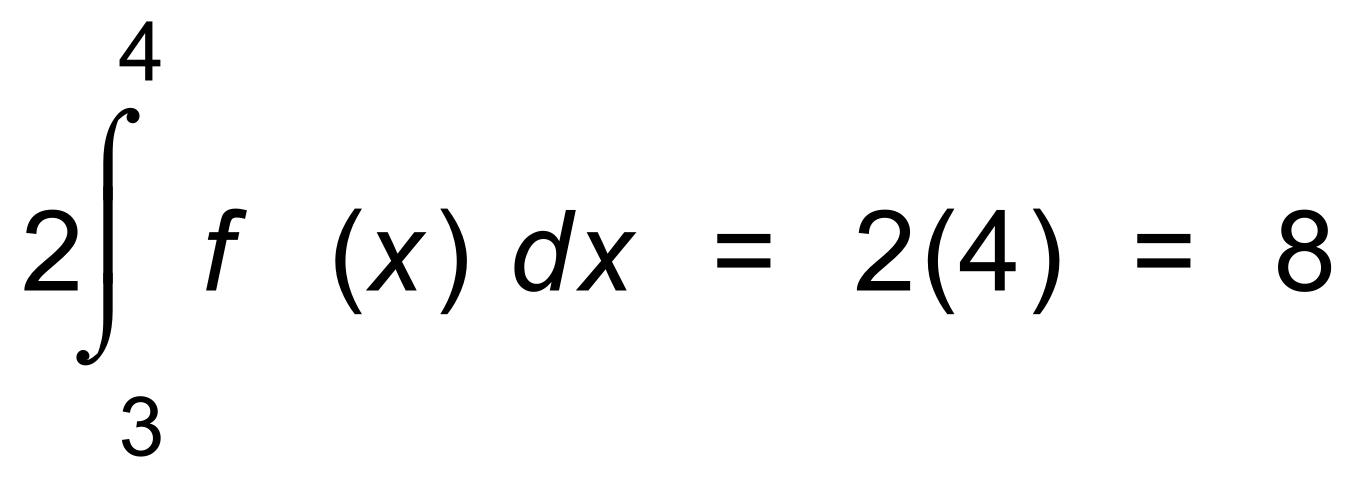
∴ Next time is  ✓ [6]

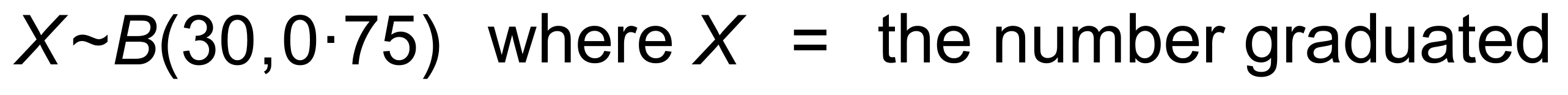
14. (a) (i) 0 + 1 + (−5) + 4 = 0 ✓✓

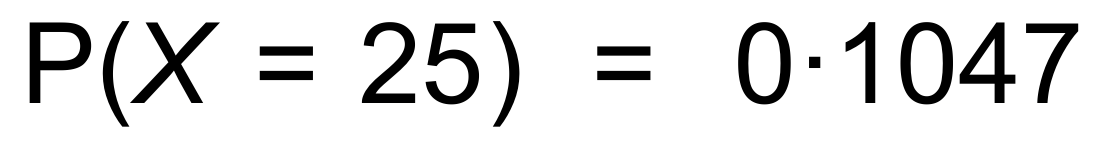
(ii) −3 + 1 + (−5) + 4 = −3 ✓✓

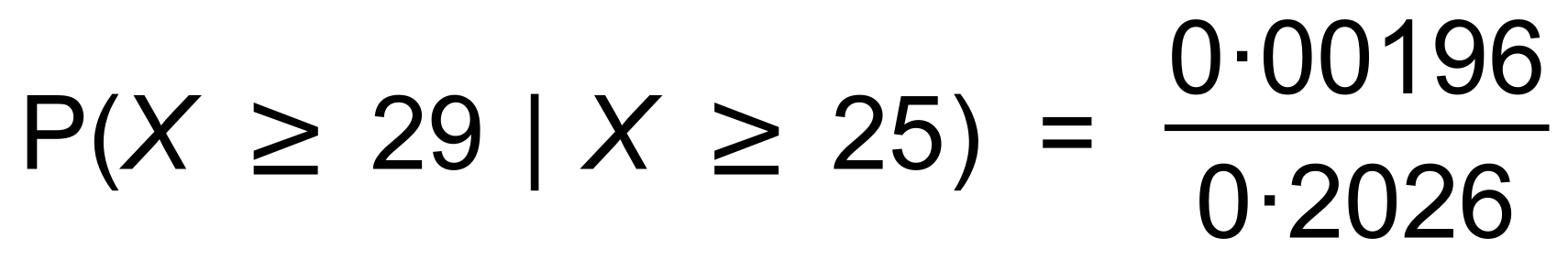
(iii) 1 + 5 + 4 = 10 ✓✓

(b) (i)  ✓✓

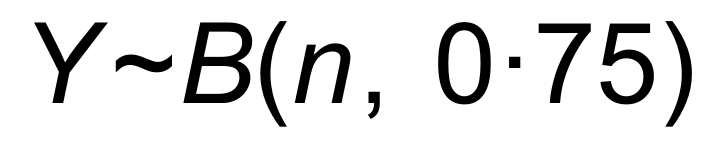
(ii)  ✓✓[10]

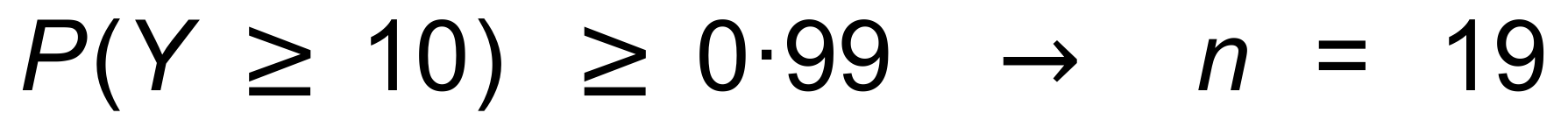
15. (a) (i)  ✓

∴  ✓✓

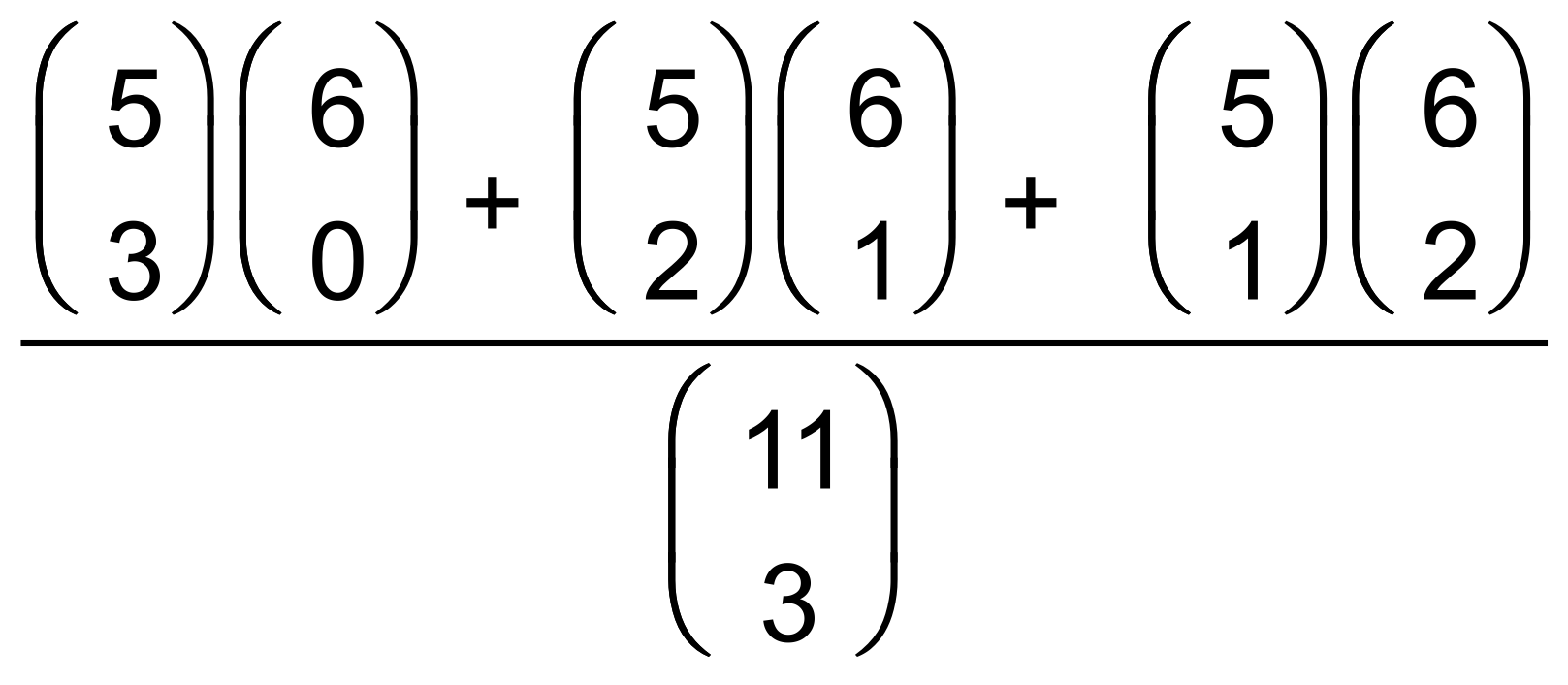
(ii)  ✓✓

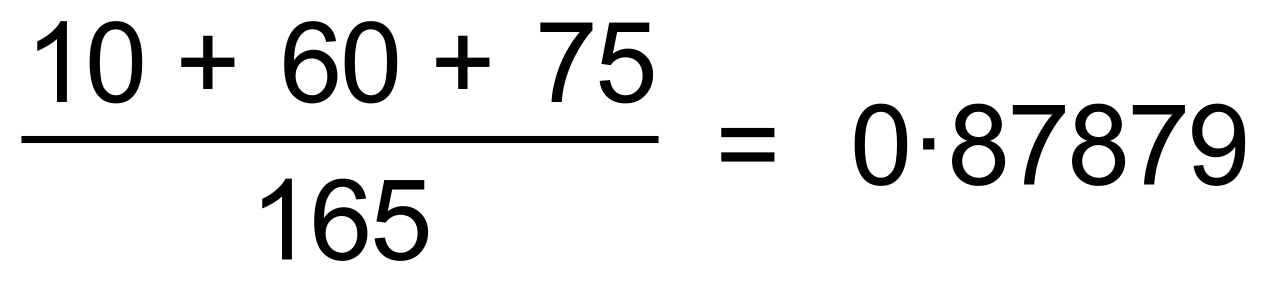
= 0.00967 ✓

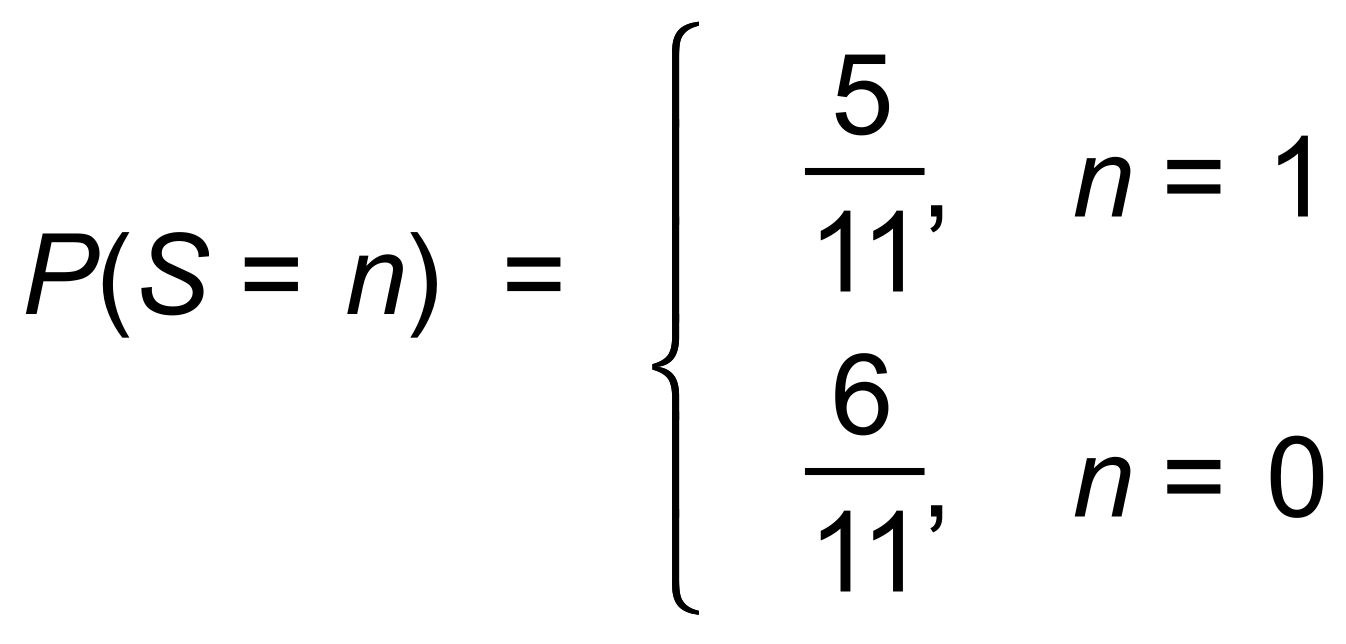
(b)  where *Y* is the number who graduated out of *n*

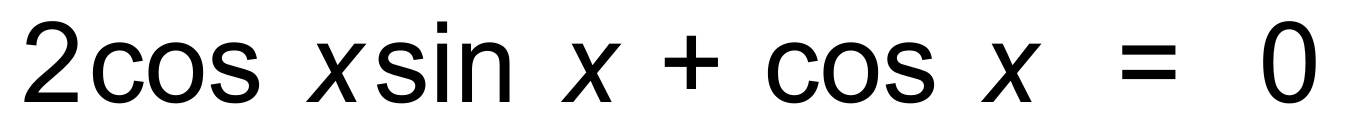
∴  using trial and error ✓✓✓

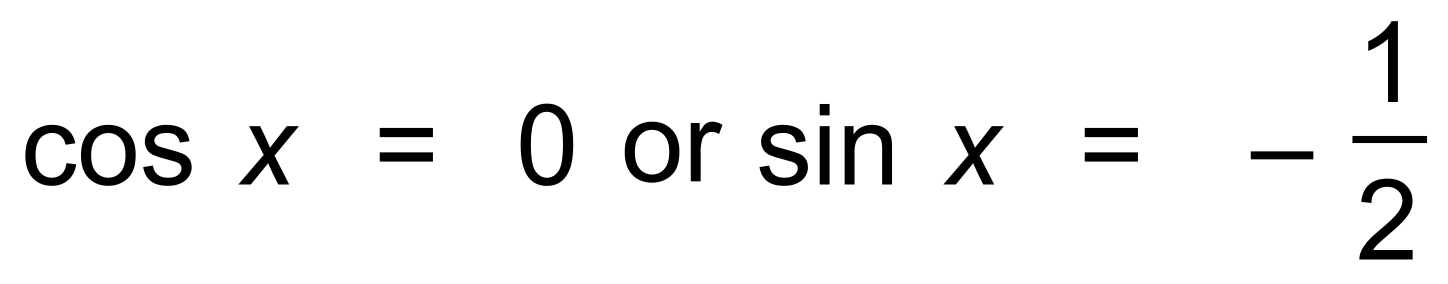
|  |  |
| --- | --- |
| n | Y |
| 18 | 0.981 |
| 19 | 0.991 |
| 20 | 0.996 |

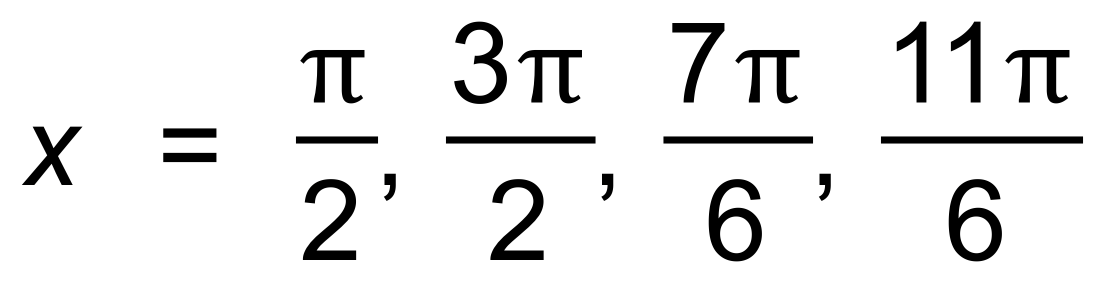
(c) (i)  ✓✓

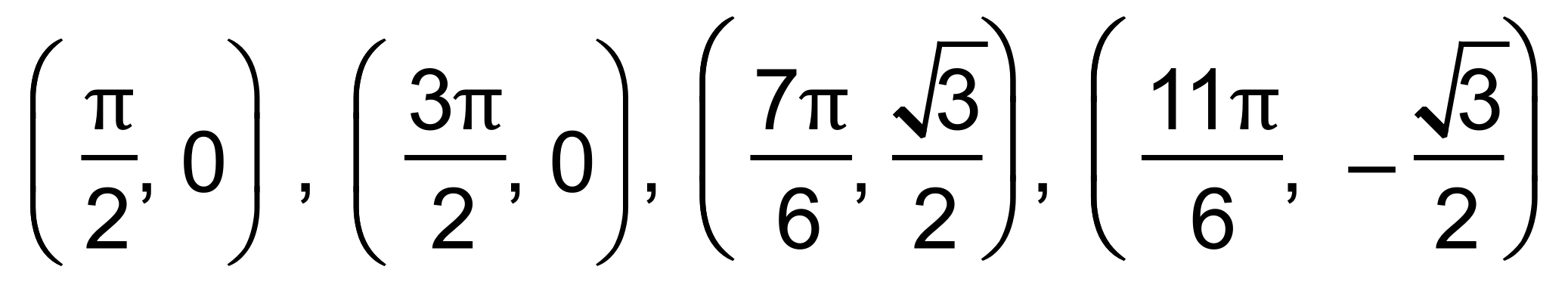
=  ✓

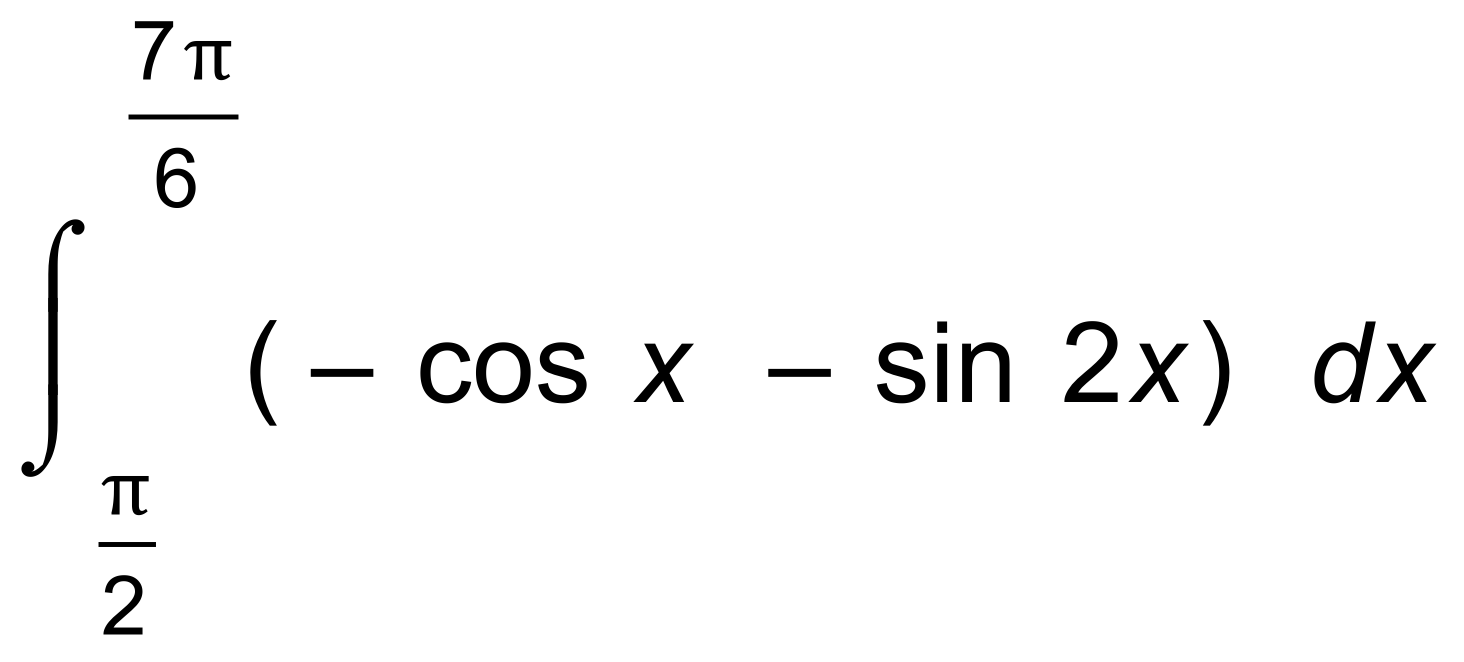
(ii)  ✓✓✓ [15]

16. (a) 

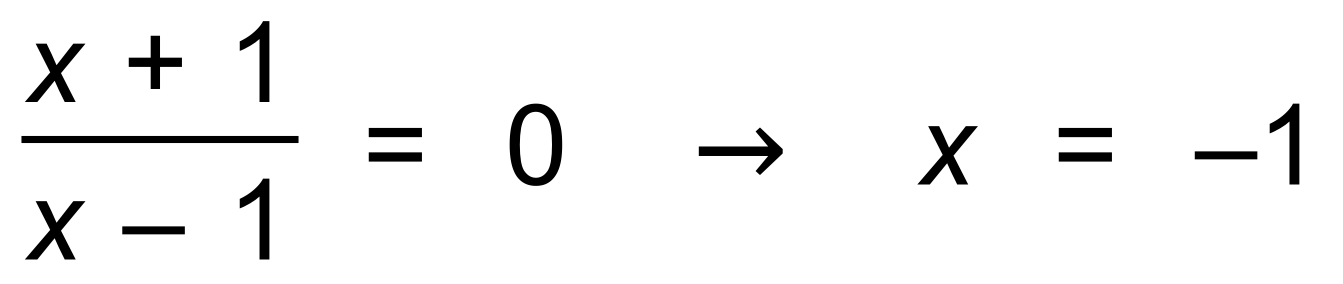
∴ 

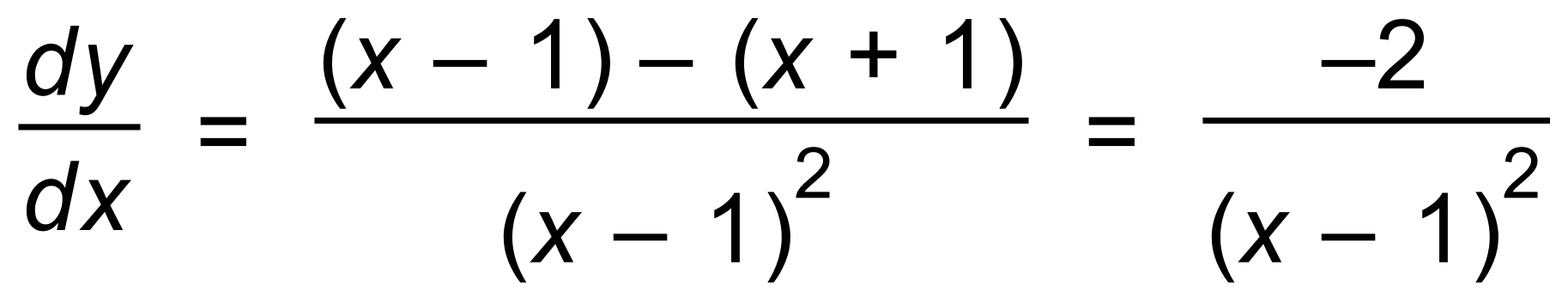
∴  ✓✓

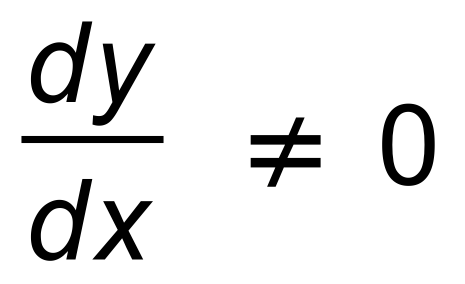
(b)  ✓✓

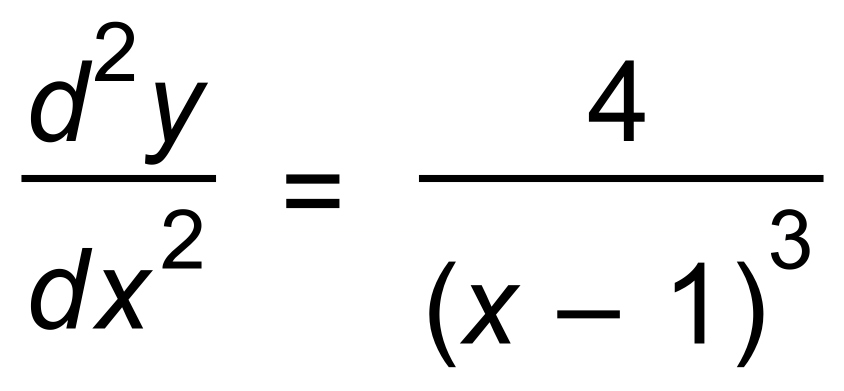
(c) A =  ✓

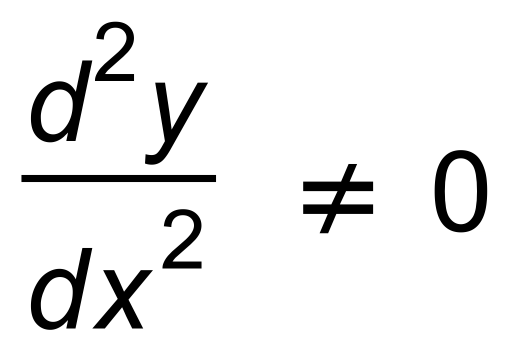
= 2.25 units2 ✓ [6]

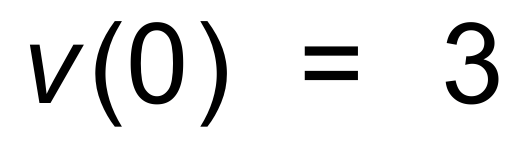
17. (a)  ✓

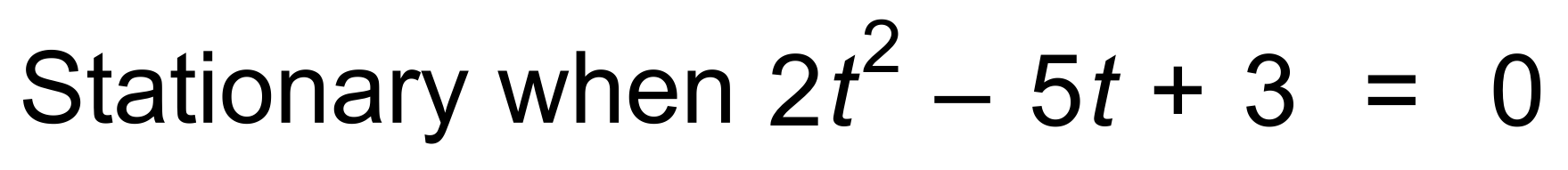
(b) (i)  ✓

(ii) True since  for any value of *x*. ✓

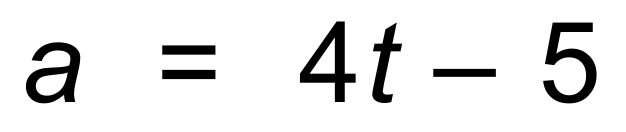
(c) (i)  ** ✓

(ii) True since ** for any value of *x*. ✓ [5]

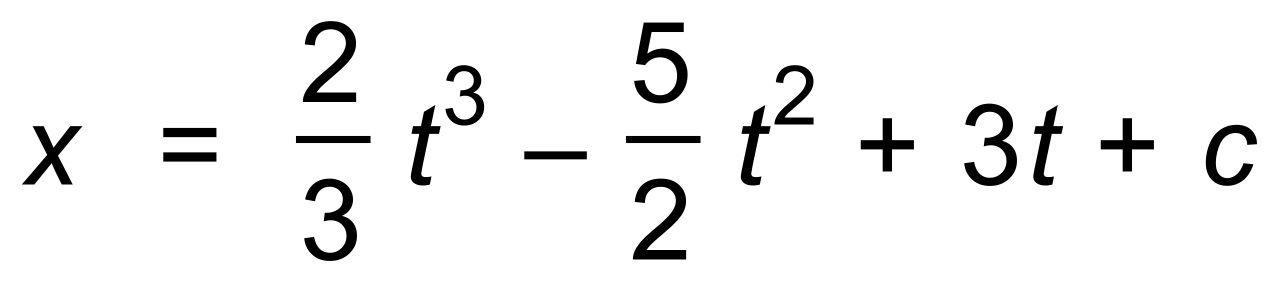
18. (a)  ✓

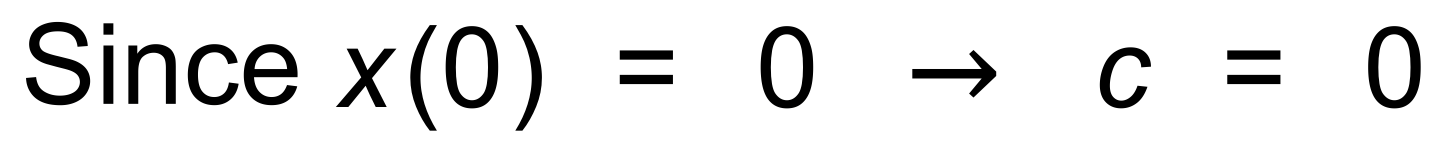
(b)  ✓

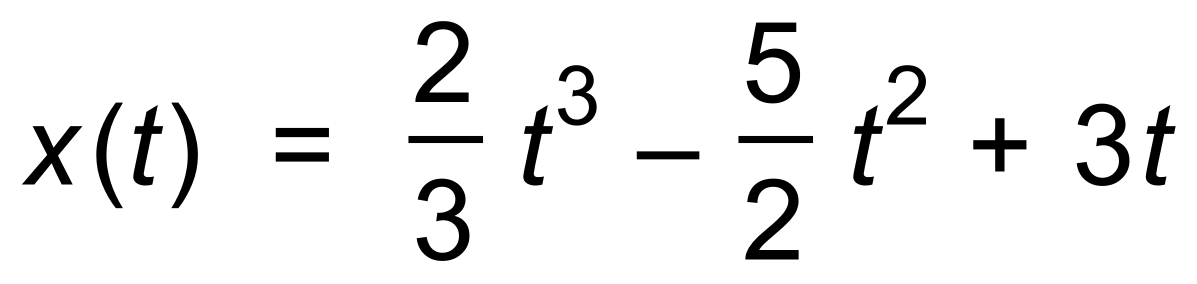
∴ *t* = 1 and 1.5 ✓✓

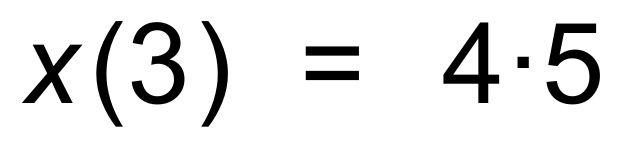
(c) (i)  ✓

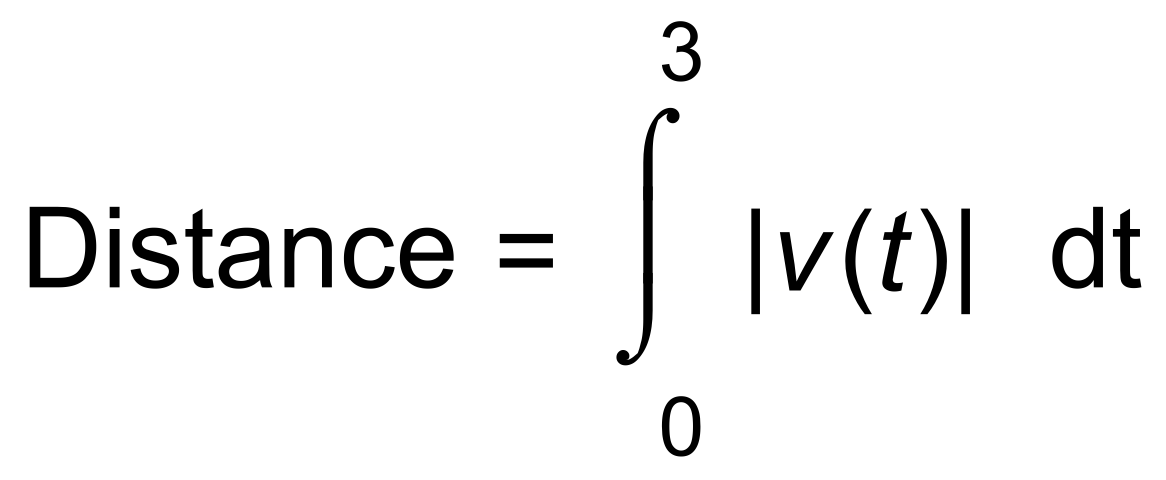
(ii)  ✓✓

(d)  ✓



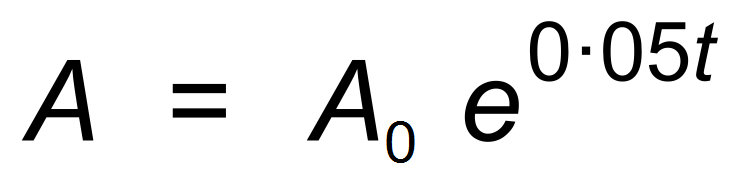
∴  ✓

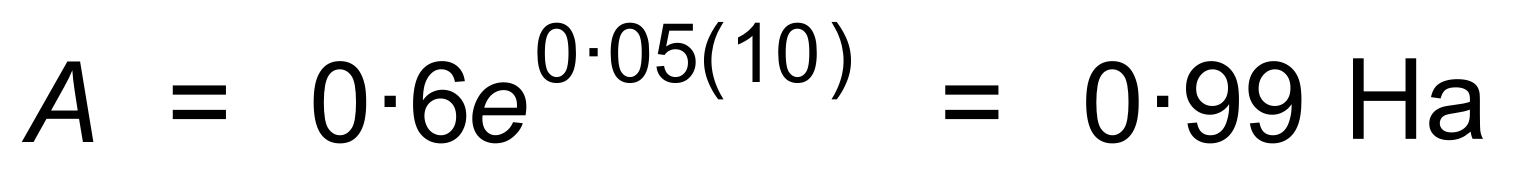
∴  ✓

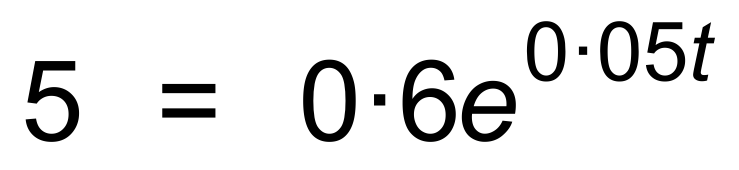
(e)  ✓

= 4.58 ✓

(f) Distance travelled ≠ Displacement ✓ [13]

19. (a)  ✓

∴  ✓✓

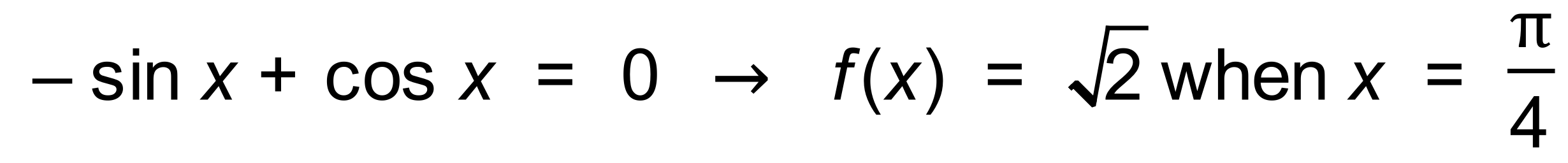
(b)  ✓

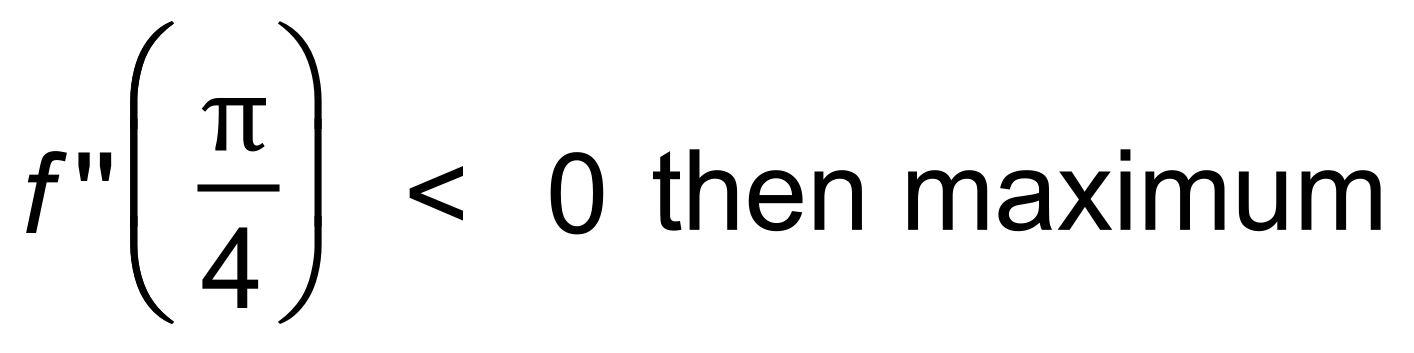
∴ *t* = 42.4 hours ✓✓ [6]

20. (a) (i)  ✓

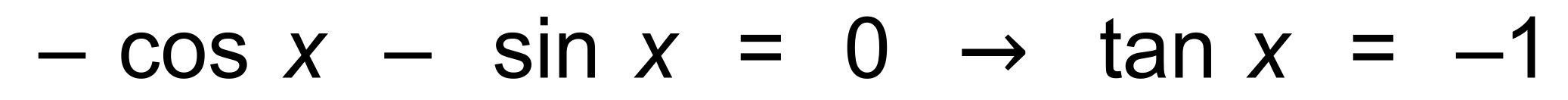
(ii)  ✓

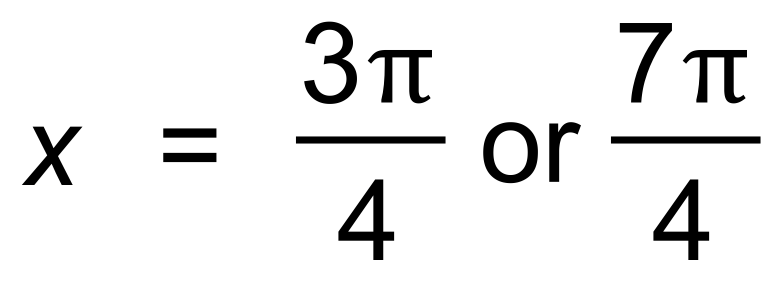
(b) Maximum value occurs when *f* ′(*x*) = 0

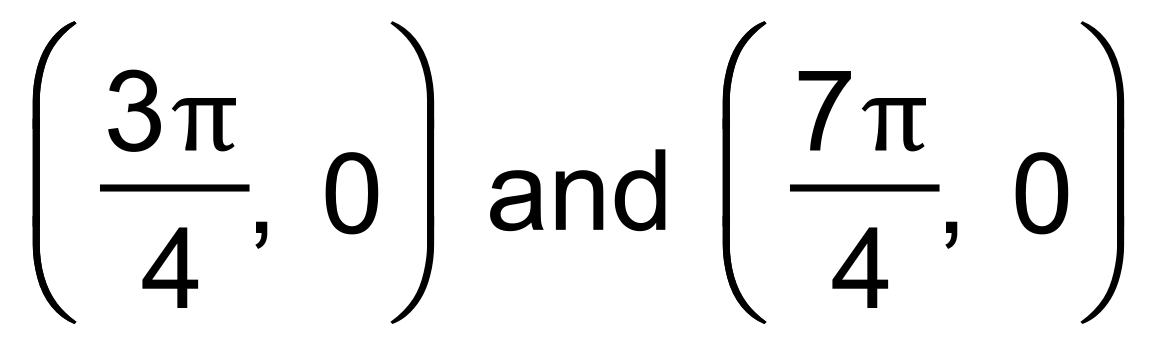
∴  ✓✓

Since  ✓✓

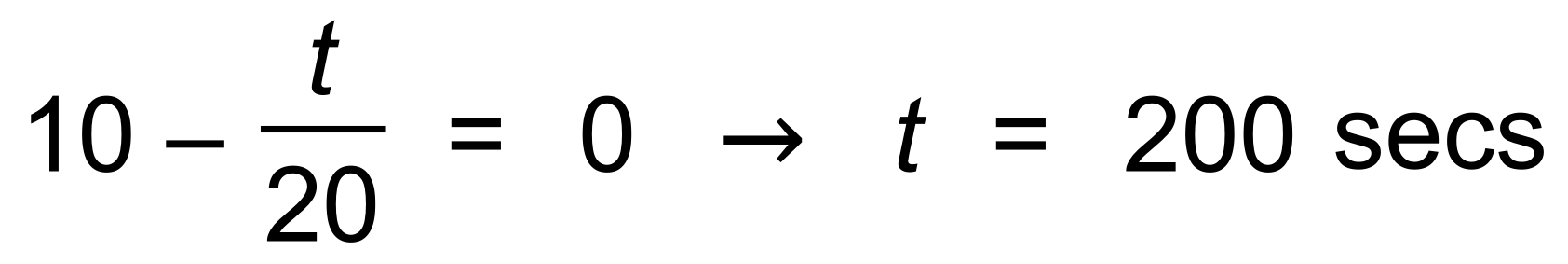
(c) POI occurs when *f* ′′(*x*) = 0

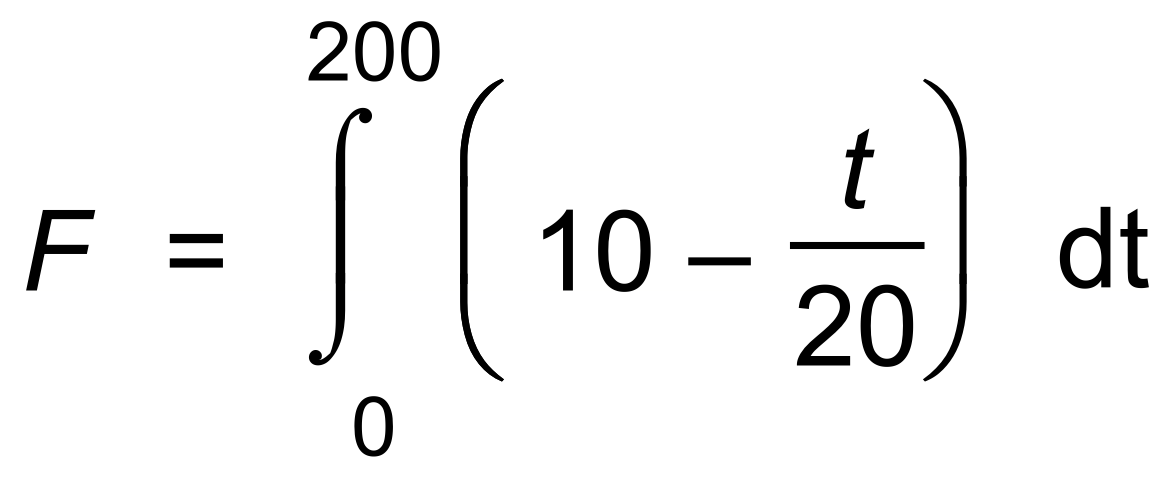
∴  ✓

∴  ✓✓

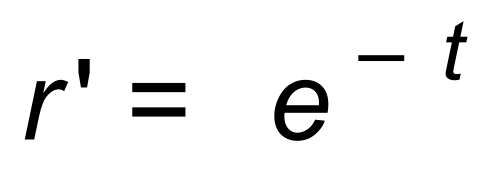
∴  ✓ [10]

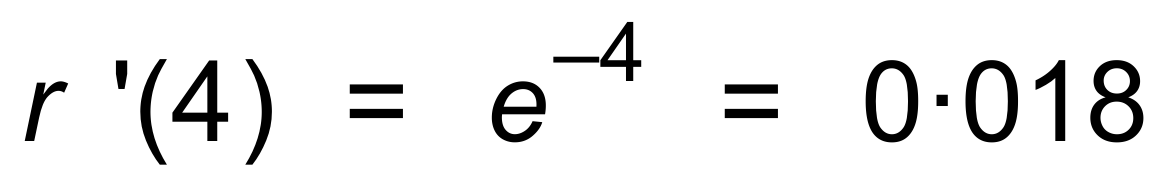
21. (a) 10 L/sec ✓

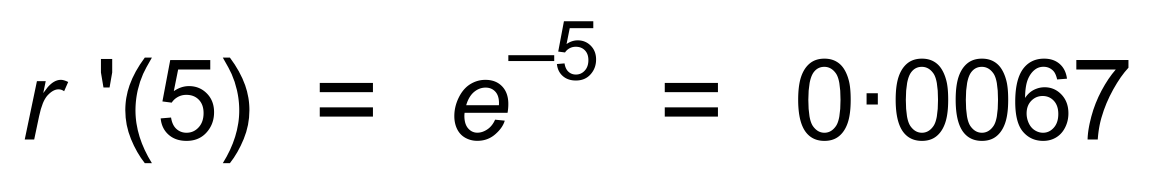
(b)  ✓

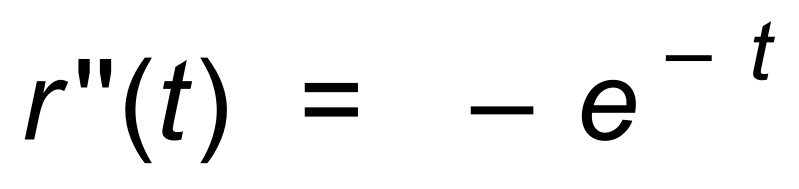
(c)  ✓

= 1000 L ✓ [4]

22. (a)  ✓

∴  ✓

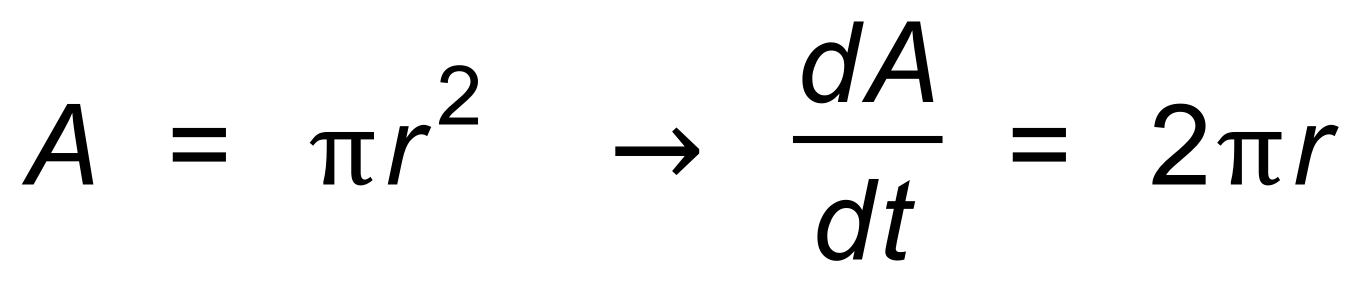
and  ✓

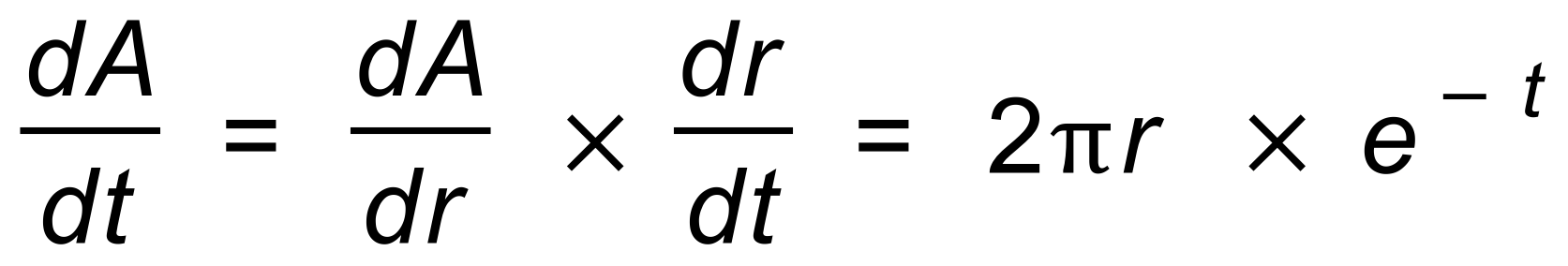
(b)  ✓

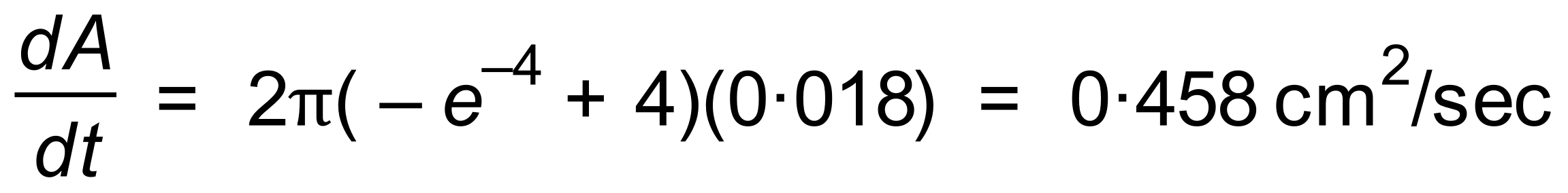
Since  at its

greatest rate at the start of the fire,

Or the graph has greatest slope at t = 0. ✓

(c)  ✓

∴  ✓

When *t* = 4  ✓✓ [9]