

# HIGHER MATHEMATICS

## OBJECTIVE QUESTIONS

AUGUST 2007

**Items 1-72**

These cover the full range of Examinable Content where appropriate.

**Items 73-144**

These are a repeat of 1-72.

Cat. no	ans	Syll.	Code	item no
1	D	A	1	204
2	C	A	2	244
3	B	A	3	924
4	D	A	4	11
5	C	A	5	926
6	D	A	6	1105
7	C	A	7	273
8	C	A	10	1073
9	A	A	11	1237
10	D	A	12	1364
11	A	A	13	1160
12	B	A	15	1240
13	C	A	16	289
14	B	A	17	1242
15	D	A	18	932
16	A	A	19	1115
17	D	A	21	33
18	C	A	28	66
19	A	A	31	198
20	C	A	32	325
21	B	A	33	249
22	D	C	1	71
23	A	C	2	937
24	D	C	3	378
25	B	C	4	21
26	D	C	6	324
27	B	C	7	48
28	C	C	8	141
29	C	C	11	47
30	C	C	12	53
31	C	C	13	154
32	A	C	14	354
33	C	C	15	1479
34	B	C	16	185
35	C	C	17	166
36	B	C	18	46
37	D	C	20	61
38	B	C	21	45
39	C	C	22	26
40	B	C	23	81
41	D	G	1	946
42	B	G	2	175
43	A	G	3	2
44	B	G	4	372
45	B	G	5	104
46	D	G	6	973
47	C	G	7	949
48	B	G	9	83

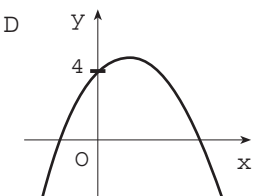
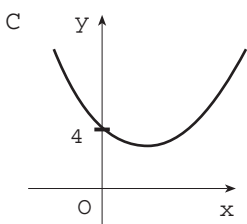
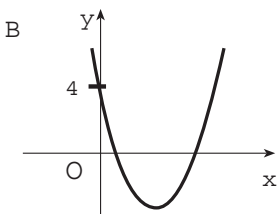
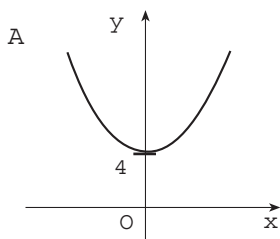
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49	D	G	10	93
50	B	G	11	357
51	A	G	12	37
52	D	G	16	305
53	C	G	17	90
54	D	G	18	955
55	A	G	19	19
56	D	G	20	351
57	B	G	21	958
58	A	G	22	959
59	D	G	24	315
60	B	G	25	961
61	C	G	26	962
62	C	G	27	162
63	D	G	28	116
64	B	G	29	102
65	C	T	1	67
66	C	T	3	64
67	B	T	4	224
68	D	T	5	131
69	B	T	7	148
70	C	T	8	20
71	D	T	9	393
72	B	T	12	967
73	A	A	1	1325
74	A	A	2	1070
75	A	A	3	1433
76	D	A	4	108
77	B	A	5	1359
78	B	A	6	1462
79	C	A	7	1361
80	B	A	10	1337
81	A	A	11	1322
82	C	A	12	1440
83	C	A	13	1365
84	A	A	15	1366
85	B	A	16	1318
86	A	A	17	1343
87	A	A	18	1344
88	A	A	19	1244
89	D	A	21	257
90	D	A	28	80
91	A	A	31	1117
92	A	A	32	349
93	B	A	33	388
94	A	C	1	1246
95	A	C	2	938
96	A	C	3	1080

Cat. no	ans	Syll.	Code	item no
97	C	C	4	76
98	C	C	6	940
99	A	C	7	124
100	B	C	8	261
101	A	C	11	201
102	D	C	12	1078
103	B	C	13	943
104	A	C	14	1312
105	D	C	15	1480
106	A	C	16	255
107	A	C	17	1149
108	B	C	18	1015
109	B	C	20	1167
110	B	C	21	126
111	B	C	22	214
112	D	C	23	194
113	D	G	1	977
114	C	T	3	74
115	C	G	3	1263
116	A	G	4	1203
117	D	G	5	132
118	D	G	6	1047
119	A	G	7	1283
120	B	G	9	232
121	D	G	10	1025
122	C	G	11	953
123	C	G	12	1028
124	D	G	16	954
125	B	G	17	231
126	D	G	18	978
127	B	G	19	1051
128	C	G	20	957
129	B	G	21	994
130	A	G	22	991
131	A	G	24	960
132	C	G	25	988
133	A	G	26	1058
134	A	G	27	963
135	B	G	28	1193
136	B	G	29	982
137	C	T	1	112
138	A	T	3	1041
139	C	T	4	964
140	D	T	5	363
141	B	T	7	145
142	A	T	8	984
143	C	T	9	1260
144	B	T	12	981

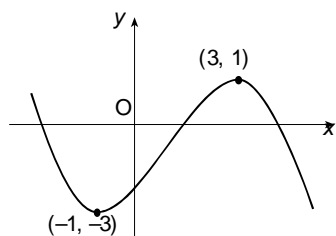
1. For which real value of  $x$  is the function  $f$  given by  $f(x) = \frac{1}{\sqrt{1-x^2}}$  defined on the set of real numbers ?

- A all  $x$  except 1 and  $-1$
- B  $x < 1$  only
- C  $x > 1, x < -1$  only
- D  $-1 < x < 1$  only

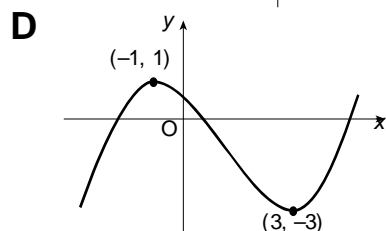
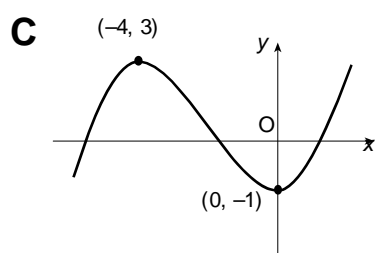
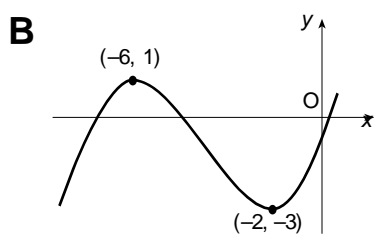
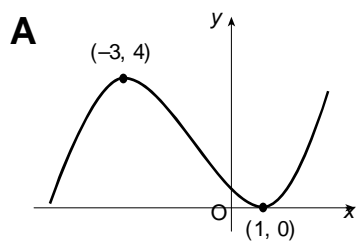
2. Which of the graphs shown below is most likely to be the graph with equation  $y = 3x^2 - 2x + 4$  ?



3. The diagram shows part of the graph of a function with equation  $y = f(x)$ .



Which of the following diagrams shows the graph with equation  $y = f(3 - x)$ ?



4.  $f(x) = 2x^2 - 4$  and  $g(x) = 1 - x$  define functions on the set of real numbers.

What is the value of  $f(g(2))$ ?

- A 4
- B 3
- C 0
- D -2

5. When  $2x^2 - 12x + 13$  is written in the form  $2(x+q)^2 + r$ , what is the value of  $r$ ?

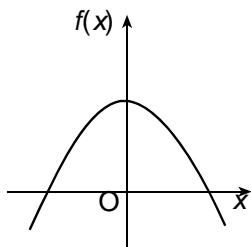
- A 13
- B 1
- C -5
- D -13

6. A function  $f$  is given by  $f(x) = (x-2)^2 - 3$ .  
The function  $g$  is given by  $g(x) = \frac{1}{f(x)+10}$ .

Which of the following statements about the stationary value of  $g$  is true?

- A minimum value of  $g$  is 7
- B maximum value of  $g$  is 7
- C minimum value of  $g$  is  $\frac{1}{7}$
- D maximum value of  $g$  is  $\frac{1}{7}$

7. The diagram shows the graph of the function  $f$  where  $f(x) = p(x - q)^2 + r$ .  
The line  $x = 0$  is an axis of symmetry of the curve. Which of the following is true about  $p$ ,  $q$  and  $r$ ?



- A  $p > 0, q > 0, r > 0$   
 B  $p > 0, q = 0, r < 0$   
 C  $p < 0, q = 0, r > 0$   
 D  $p < 0, q < 0, r = 0$
8. The population of hamsters in a breeding centre increases by 5% during each month.  
At the end of each month the breeder sells 30 hamsters.  
If  $u_n$  represents the hamster population at the beginning of a month, find an expression for  $u_{n+1}$ .
- A  $u_{n+1} = 1.5u_n + 30$   
 B  $u_{n+1} = 5u_n - 30$   
 C  $u_{n+1} = 1.05u_n - 30$   
 D  $u_{n+1} = 0.95u_n + 30$
9. A sequence is defined by the recurrence relation  $u_{n+1} = au_n + b$  and  $u_0 = 4$ .  
Express  $u_2$  in terms of  $a$  and  $b$ .
- A  $u_2 = 4a^2 + ab + b$   
 B  $u_2 = 4 + 2b$   
 C  $u_2 = 4a^2 + a^2b$   
 D  $u_2 = 2a + b$

10. A sequence is defined by the recurrence relation  $u_{n+1} = 0.5u_n + 2$  and  $u_0 = 8$ . Here are two statements about this sequence:

- (1) A limit exists for this sequence.
- (2) No term in the sequence is greater than 8.

Which of the following is true ?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

11. A sequence is defined by the recurrence relation  $u_{n+1} = \frac{1}{3}u_n - 7$  and  $u_0 = -2$ . What is the limit of this sequence as  $n \rightarrow \infty$ ?

- A  $-\frac{21}{2}$
- B  $-\frac{7}{3}$
- C  $-\frac{1}{18}$
- D  $-\frac{1}{24}$

12. A parabola has equation  $y = x^2 + 6x - 8$ . At what value of  $x$  does the minimum point of the parabola occur ?

- A -8
- B -3
- C 0
- D 3

13. Find the solution of  $x^2 + x - 12 < 0$ .

- A  $x < -4$  or  $x > 3$
- B  $x < -3$  or  $x > 4$
- C  $-4 < x < 3$
- D  $-3 < x < 4$

14. Here are two statements about the equation  $(x-3)^2 = 17$  :
- (1) the roots of the equation are real
  - (2) the roots of the equation are equal

Which of the following is true ?

- A neither statement is correct
  - B only statement (1) is correct
  - C only statement (2) is correct
  - D both statements are correct
15. The equation  $x^2 + 2x + p = 0$  has no real roots.  
What is the range of values of  $p$  ?
- A  $p < -1$
  - B  $p < 0$
  - C  $p > 0$
  - D  $p > 1$
16. The roots of a quadratic equation are  $-1$  and  $p$ .  
Which of the following could be the quadratic equation ?
- A  $x^2 + (1-p)x - p = 0$
  - B  $x^2 - (1+p)x + p = 0$
  - C  $x^2 + (1+p)x + p = 0$
  - D  $x^2 + (p-1)x - p = 0$
17. If  $x-1$  is a factor of  $x^3 - 6x^2 + px - 6$ , what is the value of  $p$  ?
- A  $-6$
  - B  $-1$
  - C  $1$
  - D  $11$



18. If  $\log(x) = 2\log(y) - 3\log(z)$ , find an expression for  $x$  in terms of  $y$  and  $z$ .

A  $x = 2y - 3z$

B  $x = \frac{2y}{3z}$

C  $x = \frac{y^2}{z^3}$

D  $x = 2y + \frac{z}{3}$

19. Given that  $\log_a(64) = \frac{3}{2}$ , what is the value of  $a$ ?

A 16

B  $42\frac{2}{3}$

C 96

D 512

20. Given that  $\log_{10}(y) = 2\log_{10}(x) + \log_{10}(3)$ , express  $y$  in terms of  $x$ .

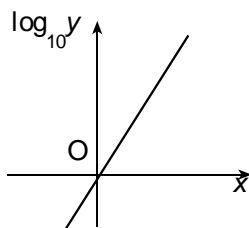
A  $y = 2x + 3$

B  $y = 6x$

C  $y = 3x^2$

D  $y = 3 \times 2^x$

21. The diagram shows the graph of  $\log_{10}(y)$  plotted against  $x$ . The graph is a straight line through the origin with gradient 2.



What is the equation of this line?

A  $y = 2x$

B  $y = 10^{2x}$

C  $y = 10^{x^2}$

D  $y = x^2$

22. If  $f(x) = 4x^3 + 5$ , what is the value of  $f(2)$ ?

- A 22
- B 26
- C 37
- D 48

23. If  $f(x) = 6x^3 - 2x^{-\frac{1}{2}}$  find  $f(x)$ .

- A  $18x^2 + x^{-\frac{3}{2}}$
- B  $2x^2 + 4x^{\frac{1}{2}}$
- C  $6x^2 - x^{-\frac{3}{2}}$
- D  $18x^2 + x^{\frac{1}{2}}$

24. Given that  $f(x) = \frac{x^2 + 1}{x}$ ,  $x \neq 0$ , find  $f(x)$ .

- A  $2x$
- B  $2x + 1$
- C 1
- D  $1 - \frac{1}{x^2}$

25. The tangent to the curve with equation  $y = 2x^2 - 1$  is drawn at the point where  $x = 0$ .

What is the gradient of this tangent?

- A -1
- B 0
- C 1
- D 2

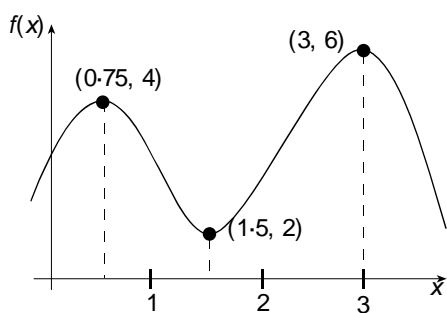
26. The function  $f$  is defined by  $f(x) = 4x^3 - x^4$ , where  $x$  is a real number.  
What is the rate of change of  $f$  with respect to  $x$  at  $x = -1$  ?

- A -6
- B -5
- C 5
- D 16

27. The graph of  $y = f(x)$  is shown with stationary points at  $x = 0.75$ ,  $x = 1.5$  and  $x = 3$ .

Here are two statements about  $f(x)$ :

- (1)  $f(1) < 0$
- (2)  $f(2) < 0$



Which of the following is true?

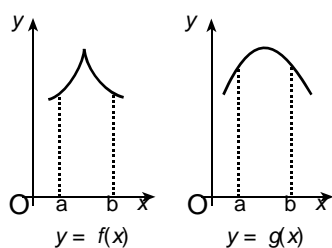
- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

28.  $f(x) = ax^2 - 2x - 5$  has a stationary value where  $x = 3$ .  
What is the value of  $a$  ?

- A -1
- B 0
- C  $\frac{1}{3}$
- D  $\frac{11}{9}$

29. The diagram shows the graphs of two functions,  $f$  and  $g$ .  
Here are two statements about the functions in the interval  $a \leq x \leq b$ :

- (1) Function  $f$  is differentiable for all values of  $x$
- (2) Function  $g$  is differentiable for all values of  $x$ .



Which of the following is true?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

30. Find  $\int_{-1}^1 x^4 dx$ .

- A 0
- B  $\frac{1}{4}$
- C  $\frac{2}{5}$
- D 8

31. Find  $\int \left(1 - x^{-\frac{3}{2}}\right)$

A  $2x^{\frac{1}{2}} + c$

B  $x + 2x^{\frac{1}{2}} + c$

C  $x - 2x^{\frac{1}{2}} + c$

D  $x - 2x^{\frac{3}{2}} + c$

32. Find  $\int \left(x^4 + \frac{1}{x^4}\right) dx$

A  $\frac{x^5}{5} - \frac{1}{3x^3} + c$

B  $4x^3 - \frac{4}{x^5} + c$

C  $\frac{x^5}{5} + \frac{1}{5x^5} + c$

D  $\frac{x^5}{5} + \frac{1}{4x^3} + c$

33. What is the value of  $\int_{-1}^3 3x^2 dx$ ?

A 20

B 24

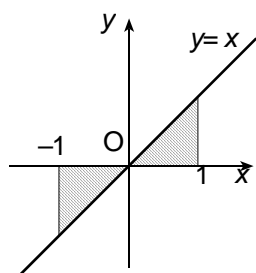
C 28

D 32

34. Here are two statements about the numerical value of the shaded area shown in the diagram:

(1) Shaded area =  $2 \int_0^1 x \, dx$

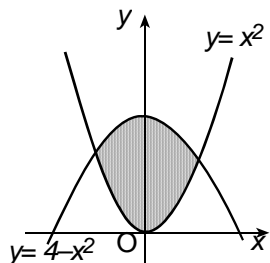
(2) Shaded area =  $\int_{-1}^1 x \, dx$ .



Which of the following is true ?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

35. The diagram shows the curves with equations  $y = x^2$  and  $y = 4 - x^2$ .



Which of the following integrals gives the shaded area ?

A  $\int_0^4 (4 - 2x^2) dx.$

B  $\int_{-2}^2 (4 - 2x^2) dx.$

C  $\int_{-\sqrt{2}}^{\sqrt{2}} (4 - 2x^2) dx.$

D  $\int_0^{\sqrt{2}} (2x^2 - 4) dx.$

36. If  $\frac{dy}{dx} = 2x + 1$  and  $y = 3$  when  $x = 1$ , express  $y$  in terms of  $x$ .

A  $y = x^2$

B  $y = x^2 + x + 1$

C  $y = 2$

D  $y = x^2 + 2$

37. Given that  $f(x) = \cos(3x^2 + 5)$ , find  $f'(x)$ .

- A  $3\sin(3x^2 + 5)$
- B  $3\cos(3x^2 + 5)$
- C  $-\sin(6x)$
- D  $-6x\sin(3x^2 + 5)$

38. If  $f(x) = (2x^2 - 1)^3$ , find  $f'(x)$ .

- A  $\frac{1}{16x}(2x^2 - 1)^4$
- B  $12x(2x^2 - 1)^2$
- C  $48x^5$
- D  $48x^2$

39. Find  $\int (4x - 1)^2 dx$ .

- A  $\frac{1}{3}(2x^2 - x)^3 + c$
- B  $12(4x - 1)^3 + c$
- C  $\frac{1}{12}(4x - 1)^3 + c$
- D  $(2x^2 - x)^2 + c$



40. Find  $\int_0^{\frac{\pi}{4}} \cos 2x \, dx$ .

A  $-2\sqrt{2}$

B  $\frac{1}{2}$

C 0

D  $\sqrt{2}$

41. What is the distance between the points  $(-2, 5, 3)$  and  $(4, -1, 1)$  ?

A 6

B 10

C  $2\sqrt{14}$

D  $2\sqrt{19}$

42. The line joining the points  $(-2, -3)$  and  $(6, k)$  has gradient  $\frac{2}{3}$ .

What is the value of  $k$  ?

A  $\frac{14}{3}$

B  $\frac{7}{3}$

C  $-\frac{1}{3}$

D -9

43. A straight line passes through the points  $P(-5, -2)$  and  $Q(-2, -1)$ .  
What is the equation of the straight line which passes through P and is perpendicular to PQ ?

A  $y + 2 = -3(x + 5)$

B  $y - 2 = -\frac{3}{7}(x - 5)$

C  $y - 1 = -\frac{3}{7}(x - 2)$

D  $y - 1 = -\frac{1}{3}(x - 2)$

44. The equation  $ax + y + 4a = 0$  defines a set of straight lines for different values of  $a$ , where  $a \neq 0$ .

Here are two statements about this set of lines:

- (1) All cut the  $x$ -axis at the same point
- (2) They are parallel

Which of the following is true ?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

45. P and Q are the points (2, 3) and (-1, 4).  
What is the gradient of a line perpendicular to PQ ?

- A  $-\frac{8}{7}$
- B 3
- C 5
- D 7

46. P is the point  $(a, -2)$  and Q is  $(0, b)$ .  
M(1, 2) is the midpoint of PQ.  
What are the values of  $a$  and  $b$  ?

	$a$	$b$
A	1	-6
B	1	6
C	2	-6
D	2	6

47. Triangle OPQ has vertices at  $O(0, 0)$ ,  $P(5, 3)$  and  $Q(1, -7)$ .  
OS is a median. What are the coordinates of S ?

- A (-5, -2)
- B (3, -5)
- C (3, -2)
- D (2, 5)

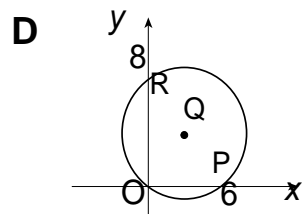
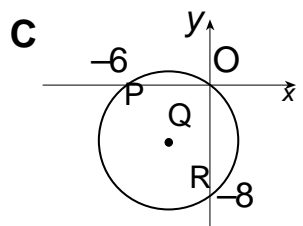
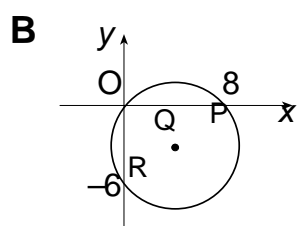
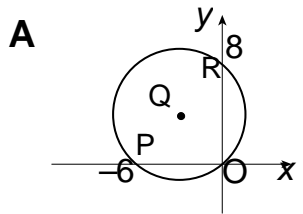
48. A circle has equation  $x^2 + y^2 = 4 - 4x + 2y$ .  
What is the radius of this circle ?

- A 2
- B 3
- C 4
- D 5

49. PQ is a diameter of a circle.  
P and Q have coordinates (3, 2) and (7, 2) respectively.  
What is the equation of this circle ?

- A  $(x-3)^2 + (y-2)^2 = 16$
- B  $(x-4)^2 + y^2 = 2$
- C  $(x+5)^2 + (y+2)^2 = 2$
- D  $(x-5)^2 + (y-2)^2 = 4$

50. The following diagrams each show a circle with centre  $Q(a, b)$  and radius 5 units, cutting the  $x$  and  $y$  axes in  $P$  and  $R$  respectively. In which diagram would the gradient of the tangent at  $P$  equal  $-\frac{4}{3}$ ?



51. The line with equation  $y = k$  intersects the circle with equation  $x^2 + y^2 = 4$  in at least one point.

What is the range of values of  $k$  ?

- A  $-2 \leq k \leq 2$
- B  $-4 \leq k \leq 4$
- C  $k \geq 2, k \leq -2$
- D  $k \geq 4, k \leq -4$

52. Given that  $\mathbf{u} = \begin{pmatrix} 3 \\ -4 \\ 1 \end{pmatrix}$  and  $\mathbf{v} = \begin{pmatrix} -2 \\ -1 \\ 1 \end{pmatrix}$ , what is the magnitude of  $(\mathbf{u} - \mathbf{v})$ ?

- A 1
- B  $\sqrt{20}$
- C  $\sqrt{32}$
- D  $\sqrt{34}$

53. P, Q and R are points such that  $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}$ ,  $\overrightarrow{PR} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$  and R is (0, 2, 1).

What are the coordinates of Q ?

- A (-1, 3, 2)
- B (-1, -1, 0)
- C (1, 1, 0)
- D (2, 0, 1)

54. The vector  $\mathbf{u}$  is given by  $\mathbf{u} = \frac{1}{4}\mathbf{i} + p\mathbf{k}$  where  $p > 0$ .

If  $\mathbf{u}$  is a unit vector, what is the value of  $p$  ?

A  $\frac{3}{4}$

B 1

C  $\frac{\sqrt{17}}{16}$

D  $\frac{\sqrt{15}}{4}$

55. For what value of  $z$  are the vectors  $\begin{pmatrix} -2 \\ 3 \\ 6 \end{pmatrix}$  and  $\begin{pmatrix} 6 \\ -9 \\ z \end{pmatrix}$  parallel ?

A -18

B -6

C 14

D 54

56. Given that  $\mathbf{p} = \begin{pmatrix} 1 \\ 0 \\ -2 \end{pmatrix}$ ,  $\mathbf{q} = \begin{pmatrix} 4 \\ -1 \\ -3 \end{pmatrix}$ , and  $\mathbf{r} = \begin{pmatrix} 0 \\ -1 \\ 3 \end{pmatrix}$ , what are

the components of  $\mathbf{p} - \mathbf{q} + 3\mathbf{r}$  ?

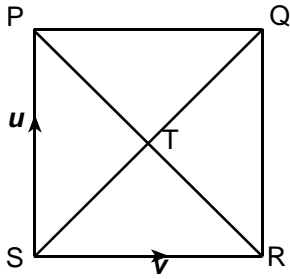
A  $\begin{pmatrix} -3 \\ 0 \\ -2 \end{pmatrix}$

B  $\begin{pmatrix} 5 \\ 0 \\ -8 \end{pmatrix}$

C  $\begin{pmatrix} 0 \\ 0 \\ 54 \end{pmatrix}$

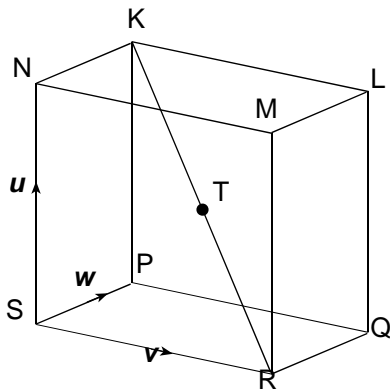
D  $\begin{pmatrix} -3 \\ -2 \\ 10 \end{pmatrix}$

57. The diagram shows a square PQRS where  $\overrightarrow{SP} = \mathbf{u}$  and  $\overrightarrow{SR} = \mathbf{v}$ .



Express  $\overrightarrow{ST}$  in terms of  $\mathbf{u}$  and  $\mathbf{v}$ .

- A  $\overrightarrow{ST} = \mathbf{u} + \frac{1}{2}\mathbf{v}$   
 B  $\overrightarrow{ST} = \frac{1}{2}\mathbf{u} + \frac{1}{2}\mathbf{v}$   
 C  $\overrightarrow{ST} = \mathbf{u} - \frac{1}{2}\mathbf{v}$   
 D  $\overrightarrow{ST} = \frac{1}{2}\mathbf{u} - \frac{1}{2}\mathbf{v}$
58. PQRS,KLMN is a cuboid as shown in the diagram.  
 $\overrightarrow{SN} = \mathbf{u}$ ,  $\overrightarrow{SR} = \mathbf{v}$  and  $\overrightarrow{SP} = \mathbf{w}$ .  
 T is the midpoint of KR.



Express  $\overrightarrow{KT}$  in terms of  $\mathbf{u}$ ,  $\mathbf{v}$  and  $\mathbf{w}$ .

- A  $\overrightarrow{KT} = -\frac{1}{2}\mathbf{u} + \frac{1}{2}\mathbf{v} - \frac{1}{2}\mathbf{w}$   
 B  $\overrightarrow{KT} = -\mathbf{u} + \mathbf{v} - \mathbf{w}$   
 C  $\overrightarrow{KT} = \frac{1}{2}\mathbf{u} + \frac{1}{2}\mathbf{v} + \frac{1}{2}\mathbf{w}$   
 D  $\overrightarrow{KT} = \mathbf{u} - \mathbf{v} + \mathbf{w}$

59. The points A(1, 4, 2), B(3, 2, z) and C(7, y, -1) are collinear.  
What are the values of y and z?

	y	z
A	2	-3
B	2	1
C	-2	-3
D	-2	1

60. The point N divides the line LM in the ratio 3 : 1.

L has coordinates (-1, 1, 0) and  $\overrightarrow{LM} = \begin{pmatrix} 4 \\ 4 \\ 4 \end{pmatrix}$ .

What are the coordinates of N?

- A  $\left(\frac{3}{2}, 2, 1\right)$   
 B (2, 4, 3)  
 C  $\left(\frac{5}{2}, 4, 3\right)$   
 D (5, 3, 4)

61. The components of vectors  $\mathbf{u}$  and  $\mathbf{v}$  are given by  $\mathbf{u} = \begin{pmatrix} 0 \\ 2 \\ -1 \end{pmatrix}$  and  $\mathbf{v} = \begin{pmatrix} 3 \\ -1 \\ -5 \end{pmatrix}$ .

What is the value of  $\mathbf{u} \cdot \mathbf{v}$ ?

- A -10  
 B -3  
 C 3  
 D 5



62. The vectors  $\begin{pmatrix} 1 \\ 2 \\ 4 \end{pmatrix}$  and  $\begin{pmatrix} -5 \\ 2 \\ z \end{pmatrix}$  are perpendicular.

What is the value of  $z$ ?

- A  $-1$
- B  $0$
- C  $\frac{1}{4}$
- D  $4$

63. What is the angle between the vectors  $\begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}$  and  $\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$ ?

- A  $\frac{\pi}{6}$
- B  $\frac{\pi}{4}$
- C  $\frac{\pi}{3}$
- D  $\frac{\pi}{2}$

64. What is the value of  $(i + 2j)(j + 2k)$ ?

- A  $0$
- B  $2$
- C  $5$
- D  $9$

65. Here are two statements about a stationary value for the function  $f(x) = 4 \sin x - 2$ :

(1)  $f$  has a stationary value when  $x = \frac{\pi}{3}$

(2)  $f$  has a stationary value when  $x = \frac{\pi}{2}$

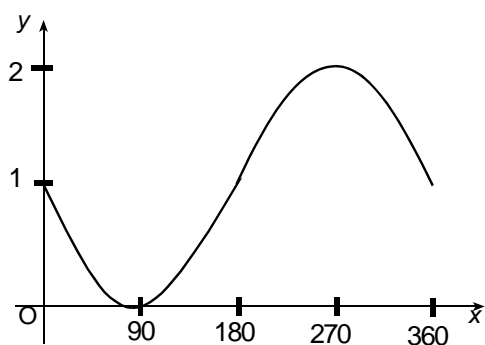
Which of the following is true?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

66. What is the exact value of  $\sin \frac{2\pi}{3} + \sin \frac{7\pi}{3}$ ?

- A 0
- B 1
- C  $\sqrt{3}$
- D 3

67. The diagram shows the graph of a trigonometric function.



Which of the following could be the equation of the graph?

- A  $y = 1 + \sin x^\circ$
- B  $y = 1 - \sin x^\circ$
- C  $y = 2 - \cos x^\circ$
- D  $y = 2 \cos x^\circ - 1$

68. What is the minimum value of  $4\cos\left(x - \frac{\pi}{3}\right) + 6$  ?

- A 10
- B 9
- C 5
- D 2

69. Given that  $3\cos x^\circ + 4\sin x^\circ = 5\cos(x - 53.1)^\circ$ , which of the following equations has a solution when  $x$  is a real number ?

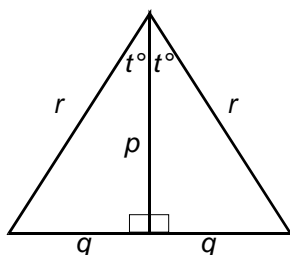
- (1)  $3\cos x^\circ + 4\sin x^\circ = 2$
- (2)  $3\cos x^\circ + 4\sin x^\circ = 8$ .

- A neither equation has a solution
- B only equation (1) has a solution
- C only equation (2) has a solution
- D both equations have a solution

70. If  $\sin x^\circ = \frac{4}{5}$  and  $0 < x < 90$ , what is the exact value of  $\sin 2x^\circ$  ?

- A  $\frac{17}{25}$
- B  $\frac{8}{10}$
- C  $\frac{24}{25}$
- D  $\frac{6}{5}$

71. The diagram shows an isosceles triangle with lengths as shown.



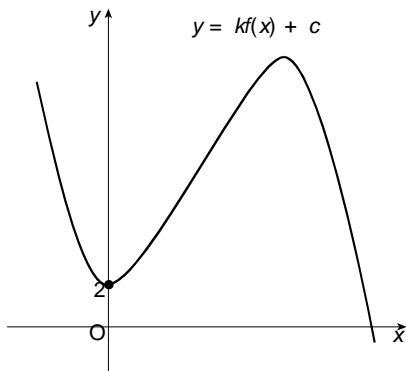
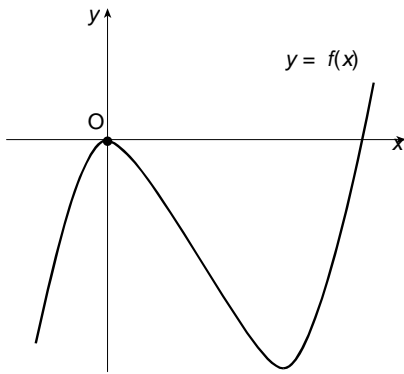
Express  $\sin 2t^\circ$  in terms of  $p$ ,  $q$  and  $r$ .

- A  $\sin 2t^\circ = \frac{2q^2}{r^2}$
- B  $\sin 2t^\circ = \frac{2q}{r}$
- C  $\sin 2t^\circ = \frac{2p}{r}$
- D  $\sin 2t^\circ = \frac{2pq}{r^2}$
72. If  $\sqrt{3} \cos x + \sin x = k \cos x \cos p + k \sin x \sin p$ , where  $k > 0$ , what is the value of  $k$  ?
- A 1
- B 2
- C 3
- D 4
73. A function  $f$  is defined by  $f(x) = 5 + 2 \cos 3x$ , where  $x$  is a real number. What is the range of  $f$  ?
- A  $3 \leq f(x) \leq 7$
- B  $5 \leq f(x) \leq 7$
- C  $5 \leq f(x) \leq 11$
- D  $-1 \leq f(x) \leq 11$

74. The graph with equation  $y = (x-4)^2 + k$  passes through the point (3, 9).  
What are the coordinates of the stationary point of the graph ?

- A (4, 8)
- B (4, 9)
- C (4, 10)
- D (4, 11)

75. The diagram shows sketches of  $y = f(x)$  and  $y = kf(x) + c$ .



What are the values of  $k$  and  $c$  ?

	$k$	$c$
A	-1	2
B	-1	-2
C	1	2
D	1	-2

76.  $f(x) = 2x - 1$  and  $g(x) = 2x + 1$  are functions defined on the set of real numbers. Find an expression for  $f(g(x))$ .

A  $f(g(x)) = 4x^2 - 1$

B  $f(g(x)) = 4x^2$

C  $f(g(x)) = 4x$

D  $f(g(x)) = 4x + 1$

77. When  $x^2 + 8x + 5$  is expressed in the form  $(x + a)^2 + b$ , what is the value of  $b$ ?

A  $-59$

B  $-11$

C  $0$

D  $5$

78. A function  $f$  is given by  $f(x) = 4 - 2\cos 3x$  on a suitable domain. What is the minimum value of  $f$ ?

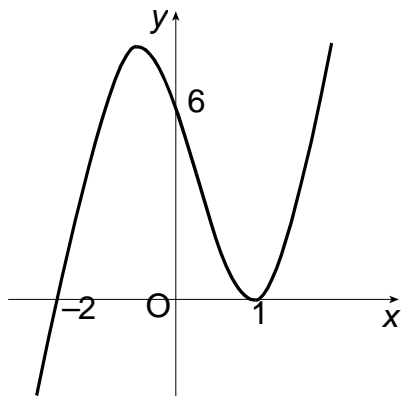
A  $1$

B  $2$

C  $6$

D  $7$

79. The diagram shows part of the graph of a cubic function.



What is the equation of this graph?

A  $y = 3(x + 2)^2(x - 1)$

B  $y = (x + 2)(x - 1)^2$

C  $y = 3(x + 2)(x - 1)^2$

D  $y = (x + 2)(x - 1)(x + 1)$

80. A fish farm starts with a stock of 5000 fish. Each Friday 30% of the fish are removed for sale and it is then restocked with 400 new fish.  
Let  $u_n$  represent the number of fish after restocking  $n$  times.

What is the recurrence relation that describes the situation after restocking ?

- A  $u_{n+1} = 0.3u_n + 400$  and  $u_0 = 5000$   
B  $u_{n+1} = 0.7u_n + 400$  and  $u_0 = 5000$   
C  $u_{n+1} = 0.3(u_n + 400)$  and  $u_0 = 5000$   
D  $u_{n+1} = 0.7(u_n + 400)$  and  $u_0 = 5000$

81. A sequence is defined by the recurrence relation  
 $u_{n+1} = 3u_n - 7$  and  $u_0 = 1$ .

What is the value of  $u_2$  ?

- A -19  
B -11  
C -4  
D -1

82. A sequence is generated by the recurrence relation  
 $2u_{n+1} = ku_n + 7$ .

What is the largest range of  $k$  for which the sequence has a limit ?

- A  $-0.5 < k < 0.5$   
B  $-1 < k < 1$   
C  $-2 < k < 2$   
D  $0 < k < 3$

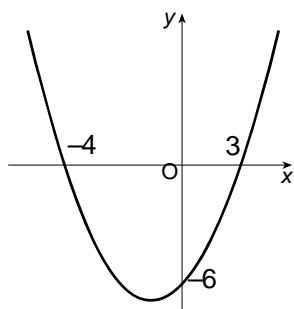
83. A sequence is defined by the recurrence relation  
 $u_{n+1} = 0.6u_n + k$  and  $u_0 = 3$ .

As  $n \rightarrow \infty$ , the limit of this sequence is 5.

What is the value of  $k$  ?

- A 0  
B 0.88  
C 2  
D 8

84. The diagram shows the graph of a parabola.

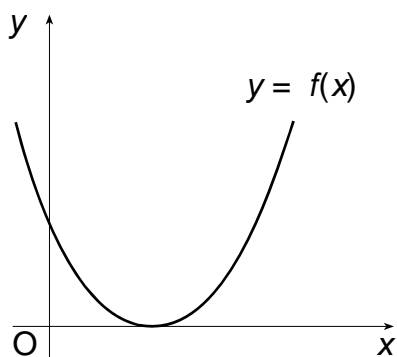


What is the equation of this graph?

- A  $y = \frac{1}{2}x^2 + \frac{1}{2}x - 6$
- B  $y = x^2 + x - 12$
- C  $y = \frac{1}{2}x^2 - \frac{1}{2}x - 6$
- D  $y = 6x^2 + 6x - 72$
85. What is the solution of  $2(x-3)(x+5) > 0$  ?
- A  $2 < x < 5$
- B  $x < -5, x > 3$
- C  $-5 < x < 3$
- D  $x < -3, x > 5$
86. The function  $g$  is given by  $g(x) = 4x^2 - 12x + 9$ .  
Which condition describes the nature of the roots of  $g(x) = 0$  ?
- A Equal roots
- B Exactly three distinct roots
- C Exactly two distinct roots
- D No real roots

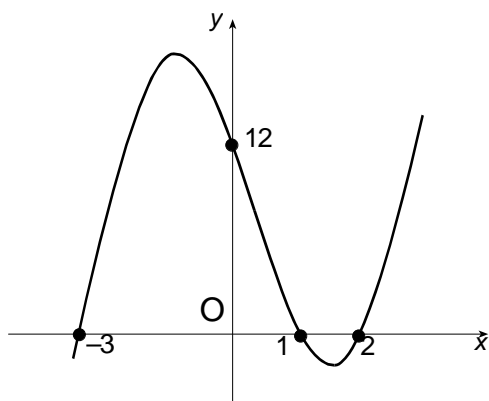


87. The diagram shows part of the graph of a parabola with equation  $y = px^2 + qx + r$ . The  $x$ -axis is a tangent to the parabola.



What is the relationship between  $p$ ,  $q$  and  $r$  ?

- A  $q^2 = 4pr$
  - B  $q^2 > 4pr$
  - C  $q^2 < 4pr$
  - D  $q^2 = -4pr$
88. The diagram shows part of the graph of a cubic function.



What is the equation of this graph ?

- A  $y = 2(x-2)(x-1)(x+3)$
- B  $y = 12(x-2)(x-1)(x+3)$
- C  $y = -2(x-3)(x+1)(x+2)$
- D  $y = 12(x-3)(x+1)(x+2)$

89. What is the remainder on dividing the polynomial  $5x^3 - 4x + 8$  by  $x - 2$ ?

- A -24
- B 0
- C 8
- D 40

90. What is the value of  $\frac{\log_3(8)}{\log_3(2)}$ ?

- A  $\log_3(4)$
- B  $\log_3(6)$
- C 4
- D 3

91. If  $\log_9(x) = \frac{1}{4}$ , what is the value of  $x$ ?

- A  $\sqrt{3}$
- B  $\frac{9}{4}$
- C  $\left(\frac{1}{4}\right)^9$
- D  $\frac{3}{2}$

92. Given that  $\log_{10}(x) = y \log_{10}(3) + 1$ , express  $x$  in terms of  $y$ .

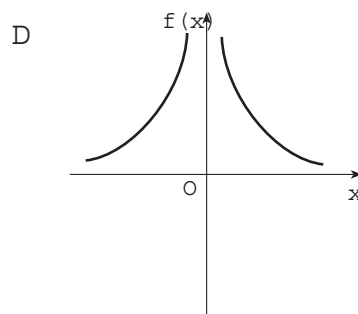
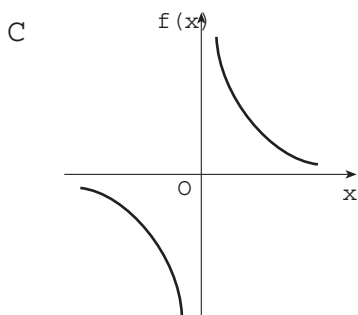
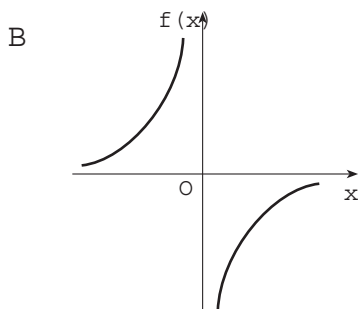
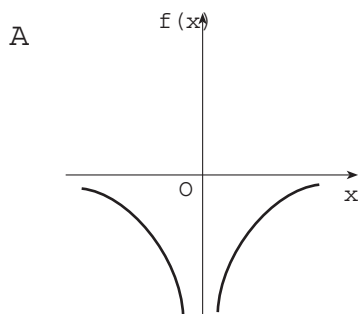
- A  $x = 10 \times 3^y$
- B  $x = 30^{10y}$
- C  $x = 3y + 10$
- D  $x = y^3 + 10$

93. Given that  $y = kn^x$  where  $k$  and  $n$  are constants, what would you plot in order to get a straight line graph ?
- A  $x$  against  $y$
  - B  $x$  against  $\log(y)$
  - C  $\log(x)$  against  $y$
  - D  $\log(x)$  against  $\log(y)$
94. Given that  $f(x) = 2x^3 - 8x$ , what is the value of  $f(-1)$ ?
- A  $-2$
  - B  $0$
  - C  $4\frac{1}{2}$
  - D  $6$
95. If  $f(x) = 4x^{-\frac{1}{2}}$ , what is the value of  $f(4)$ ?
- A  $-\frac{1}{4}$
  - B  $\frac{1}{4}$
  - C  $2$
  - D  $4$
96. If  $f(x) = 3x^2(2x^3 + 4x - 1)$ , find  $f(x)$ .
- A  $30x^4 + 36x^2 - 6x$
  - B  $36x^3 + 24x$
  - C  $30x^4 + 12x^3 - 3x^2$
  - D  $x^6 - 3x^4 - x^3$
97. At a point P on the curve  $y = 6 - 3x^2$ , the gradient is 6. What is the  $x$ -coordinate of P ?
- A  $-102$
  - B  $-3$
  - C  $-1$
  - D  $6$

98. A function  $f$  is defined by  $f(x) = (x-2)^3$ .  
 What is the rate of change of  $f$  with respect to  $x$  at  $x = 3$  ?

- A 0
- B 1
- C 3
- D 19

99. Which of the functions shown satisfies the conditions  $f(x) < 0$  for  $x < 0$  and  $f(x) > 0$  for  $x > 0$ , where  $x$  is a real number and  $x \neq 0$  ?

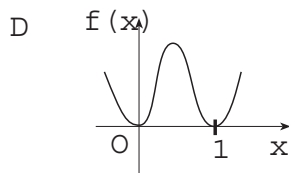
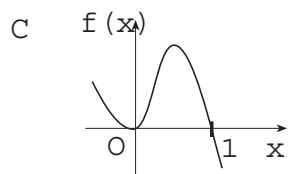
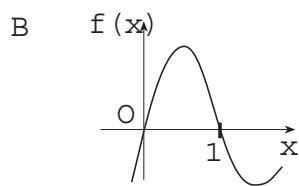
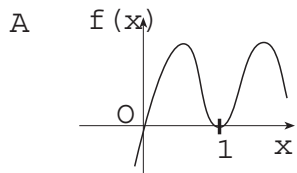


100. A function  $f$  is given by  $f(x) = (x-1)(x+5)$ .  
 $f$  has a stationary value when  $x = a$ .

What is the value of  $a$  ?

- A -5
- B -2
- C 0
- D 1

101. Which of the following could represent a function  $f$  such that  $f(0) = 0$ ,  $f(1) = 0$ ,  $f'(0) = 1$  and  $f'(1) = 0$  ?



102. The graph of a function  $f$  passes through the point  $(1, 5)$ .

If  $f(x) = \int 3x^2 dx$ , find an explanation for  $f(x)$ .

A  $f(x) = x^3 - 1$

B  $f(x) = 6x + 5$

C  $f(x) = x^3 + 5$

D  $f(x) = x^3 + 4$

103. If  $f'(x) = \frac{1}{\sqrt[4]{x^3}}$ , what is  $f(x)$ ?

A  $f(x) = \frac{1}{4}x^{\frac{1}{4}} + c$

B  $f(x) = 4x^{\frac{1}{4}} + c$

C  $f(x) = -\frac{4}{7}x^{-\frac{7}{4}} + c$

D  $f(x) = \frac{3}{4}x^{-\frac{7}{4}} + c$

104. Find  $\int \frac{1}{5\sqrt{x}} dx$ .

A  $\frac{2}{5}x^{\frac{1}{2}} + c$

B  $\frac{5}{2}x^{\frac{1}{2}} + c$

C  $-\frac{1}{10}x^{-\frac{3}{2}} + c$

D  $\frac{1}{10}x^{-\frac{3}{2}} + c$

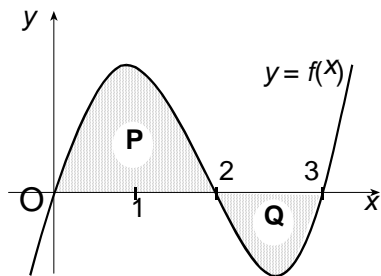
105. What is the value of  $\int_0^3 (3x^2 + 4x) dx$  ?

- A 22
- B 31
- C 39
- D 45

106. In the diagram area P = 5 sq. units and area Q = 3 sq. units. Here are two statements relating to this diagram:

(1)  $\int_0^3 f(x) dx = 8$

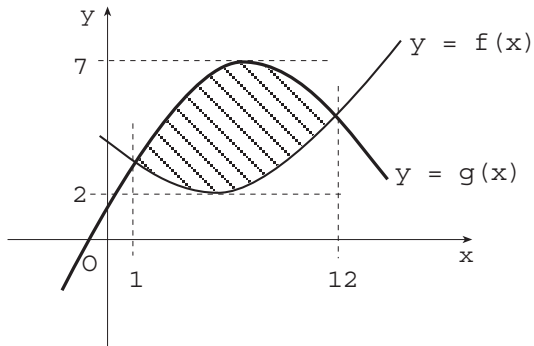
(2)  $\int_2^3 f(x) dx = 3$



Which of the following is true ?

- A neither statement is correct
- B only statement (1) is correct
- C only statement (2) is correct
- D both statements are correct

107. The graphs of functions  $f$  and  $g$  are shown in the diagram.



Which of the following gives the area of the shaded section ?

A  $\int_1^{12} (g(x) - f(x)) dx$

B  $\int_1^{12} (f(x) - g(x)) dx$

C  $\int_2^7 (g(x) - f(x)) dx$

D  $\int_2^7 (f(x) - g(x)) dx$



108. A curve passes through the point (2, 3). At every point on the curve  $\frac{dy}{dx} = 6x^2$ . What is the equation of the curve ?

A  $y = 18x^3 - 141$

B  $y = 2x^3 - 13$

C  $y = 2x^3$

D  $y = 12x - 21$

109. If  $y = \sin 3x - \cos x$ , what is  $\frac{dy}{dx}$  ?

A  $-3 \cos 3x - \sin x$

B  $3 \cos 3x + \sin x$

C  $\cos 3x - \sin x$

D  $3 \cos 2x + \sin x$

110. If  $f(x) = (x^3 + 7)^2$ , find  $f'(x)$ .

A  $\frac{1}{3}(x^3 + 7)^3$

B  $6x^2(x^3 + 7)$

C  $2(3x^2 + 7)$

D  $6x^2$

111. Find  $\int (4x+1)^{\frac{1}{2}} dx$

A  $2(2x^2 + 1)^{\frac{1}{2}} + c$

B  $\frac{1}{2}(4x+1)^{\frac{1}{2}} + c$

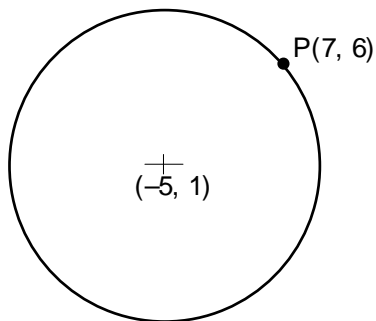
C  $\frac{1}{4}(4x+1)^{\frac{1}{2}} + c$

D  $-\frac{8}{3}(4x+1)^{\frac{-3}{2}} + c$

112. Find  $\int_0^{\pi} (1 + \cos x) dx$ .

- A 1
- B  $\pi - 2$
- C 2
- D  $\pi$

113. The point P(7, 6) lies on a circle with centre (-5, 1) as shown in the diagram.



What is the length of the diameter ?

- A  $2\sqrt{53}$  units
  - B  $2\sqrt{111}$  units
  - C  $2\sqrt{157}$  units
  - D 26 units
114. What is the exact value of  $\tan \frac{7\pi}{6}$  ?

- A  $-\sqrt{3}$
- B  $-\frac{\sqrt{3}}{2}$
- C  $\frac{1}{\sqrt{3}}$
- D  $\sqrt{3}$

115. A line L is parallel to the line with equation  $4x + 2y = 6$  and passes through the point  $(-3, 1)$ .

What is the equation of L ?

A  $y - 1 = -2(x - 3)$

B  $y - 1 = 4(x - 3)$

C  $y - 1 = -2(x + 3)$

D  $y + 3 = -2(x - 1)$

116. The lines with the equations  $ax - 2y + 5 = 0$  and  $3x + y - 4 = 0$  are parallel.

What is the value of  $a$  ?

A  $-6$

B  $-2$

C  $-\frac{1}{3}$

D  $3$

117. A line L has equation  $x + 3y + 7 = 0$ .

What is the gradient of a line perpendicular to L ?

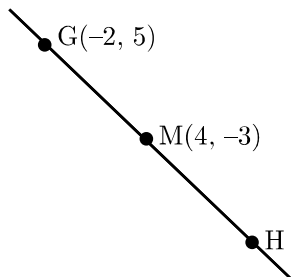
A  $-\frac{4}{3}$

B  $-1$

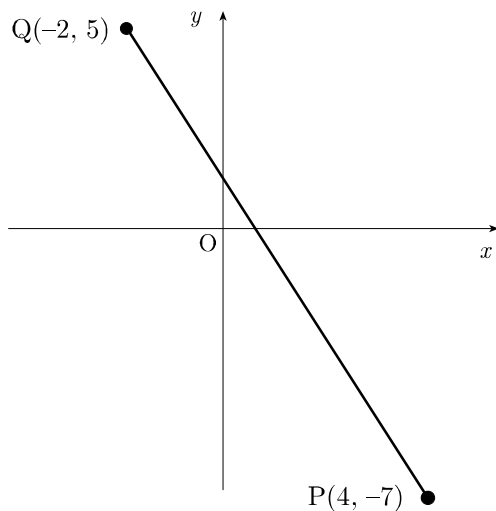
C  $1$

D  $3$

118. A straight line passes through the points G, M and H where  $G = (-2, 5)$  and  $M = (4, -3)$ . M is the midpoint of GH. What are the coordinates of H ?



- A (6, -8)  
 B (6, 1)  
 C (-6, 1)  
 D (10, -11)
119. P and Q have coordinates  $(4, -7)$  and  $(-2, 5)$  respectively. The perpendicular bisector of PQ has a gradient of  $\frac{1}{2}$ .



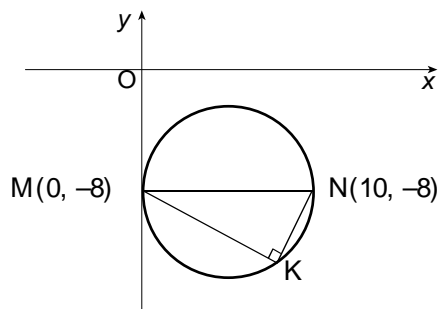
What is the equation of the perpendicular bisector of PQ ?

- A  $2y = x - 3$   
 B  $y = -2x + 1$   
 C  $y = 2x + 3$   
 D  $2y = -x - 1$

120. Q is the centre of the circle with equation  $x^2 + y^2 + 2x - 4y - 15 = 0$  and R(3, 4) lies on the circumference.  
What is the gradient of QR ?

- A  $\frac{1}{8}$   
 B  $\frac{1}{2}$   
 C 1  
 D  $\frac{8}{5}$

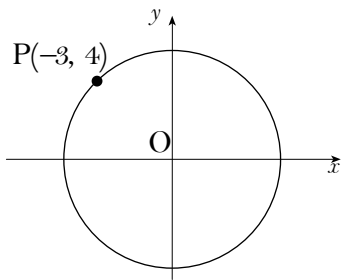
121. The diagram shows a circle with the y-axis as a tangent.  
M and N have coordinates (0, -8) and (10, -8) and angle MKN equals  $90^\circ$ .



What is the equation of the circle passing through M, K and N ?

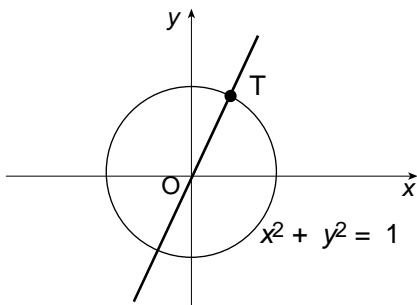
- A  $(x+5)^2 + (y-8)^2 = 100$   
 B  $(x-10)^2 + (y+8)^2 = 100$   
 C  $(x+5)^2 + (y-8)^2 = 5$   
 D  $(x-5)^2 + (y+8)^2 = 25$

122. The point  $P(-3, 4)$  lies on the circle  $x^2 + y^2 = 25$  as shown in the diagram.



What is the gradient of the tangent at P ?

- A  $-\frac{4}{3}$   
B  $-\frac{1}{5}$   
C  $\frac{3}{4}$   
D  $\frac{5}{3}$
123. The line with the equation  $y = 2x$  intersects the circle with equation  $x^2 + y^2 = 1$  at the point T.  
What is the  $x$ -coordinate of T ?



- A  $\frac{1}{3}$   
B  $\frac{1}{\sqrt{6}}$   
C  $\frac{1}{\sqrt{5}}$   
D  $\frac{1}{2}$

124. What is the magnitude of the vector  $\mathbf{v} = -2\mathbf{i} + 5\mathbf{j} + \mathbf{k}$ ?

- A 3
- B 4
- C  $\sqrt{21}$
- D  $\sqrt{30}$

125. P is the point (1,2,3),  $\overline{PR}$  represents the vector  $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$  and  $\overline{RQ}$  represents the vector  $\begin{pmatrix} 3 \\ 1 \\ 2 \end{pmatrix}$ .

What are the coordinates of Q?

- A (4, 3, 5)
- B (5, 4, 6)
- C (-2, 0, -1)
- D (3, 2, 4)

126. Vector  $\mathbf{p}$  has components  $\begin{pmatrix} \frac{2}{5} \\ \frac{\sqrt{5}}{5} \\ a \end{pmatrix}$ , where  $a > 0$ .

If  $\mathbf{p}$  is a unit vector, what is possible value of  $a$ ?

- A  $\frac{3-\sqrt{5}}{5}$
- B  $\frac{9}{25}$
- C  $\frac{3}{5}$
- D  $\frac{4}{5}$

127. A vector  $\mathbf{u}$  has components  $\begin{pmatrix} 2 \\ -3 \\ 6 \end{pmatrix}$ .

What are the components of a unit vector parallel to  $\mathbf{u}$  ?

A  $\begin{pmatrix} \frac{5}{2} \\ -\frac{5}{3} \\ \frac{5}{6} \end{pmatrix}$

B  $\begin{pmatrix} \frac{2}{7} \\ -\frac{3}{7} \\ \frac{6}{7} \end{pmatrix}$

C  $\begin{pmatrix} -\frac{2}{11} \\ -\frac{3}{11} \\ \frac{6}{11} \end{pmatrix}$

D  $\begin{pmatrix} 4 \\ -6 \\ 12 \end{pmatrix}$



128. Vector  $\mathbf{u}$  and  $\mathbf{v}$  are given by  $\mathbf{u} = 2\mathbf{i} + \mathbf{k}$  and  $\mathbf{v} = \mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ .

What are the components of vector  $2\mathbf{u} - \mathbf{v}$ ?

A  $\begin{pmatrix} 6 \\ 8 \\ -8 \end{pmatrix}$

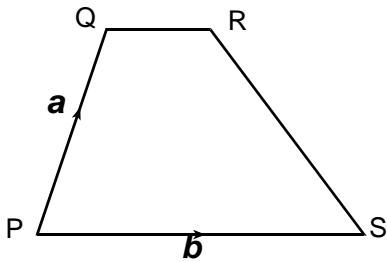
B  $\begin{pmatrix} -1 \\ 1 \\ -2 \end{pmatrix}$

C  $\begin{pmatrix} 3 \\ 3 \\ -2 \end{pmatrix}$

D  $\begin{pmatrix} 4 \\ 6 \\ -6 \end{pmatrix}$

129. The diagram shows a trapezium PQRS.  
PS is parallel to QR and  $|PS| = 3|QR|$ .

$\overrightarrow{PQ}$  and  $\overrightarrow{PS}$  represent vectors  $\mathbf{a}$  and  $\mathbf{b}$  respectively.



Express  $\overrightarrow{SR}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

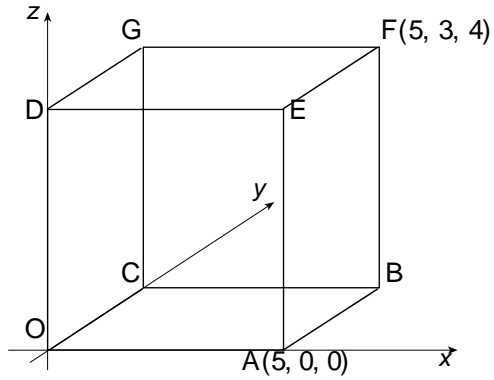
A  $\overrightarrow{SR} = \mathbf{a}$

B  $\overrightarrow{SR} = \mathbf{a} - \frac{2}{3}\mathbf{b}$

C  $\overrightarrow{SR} = -\mathbf{a} + \frac{4}{3}\mathbf{b}$

D  $\overrightarrow{SR} = \mathbf{a} - 4\mathbf{b}$

130. OABC,DEFG is a cuboid where A is the point (5, 0, 0) and F is (5, 3, 4), as shown in the diagram.



What are the components of  $\overrightarrow{AG}$  ?

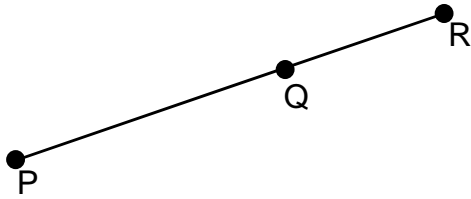
A  $\begin{pmatrix} -5 \\ 3 \\ 4 \end{pmatrix}$

B  $\begin{pmatrix} 3 \\ 4 \\ 0 \end{pmatrix}$

C  $\begin{pmatrix} 4 \\ -5 \\ -3 \end{pmatrix}$

D  $\begin{pmatrix} 5 \\ 4 \\ 3 \end{pmatrix}$

131. The diagram shows three collinear points P, Q and R where  $3\overline{PQ} = 2\overline{PR}$ .



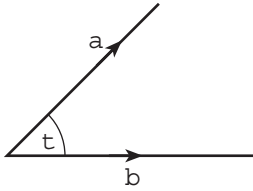
What is the ratio in which Q divides PR ?

- A 2 : 1  
B 3 : 1  
C 3 : 2  
D 5 : 3
132. A is the point (1,4,-2) and  $\overline{AB} = \begin{pmatrix} -1 \\ -5 \\ 7 \end{pmatrix}$ .

If  $\overline{AC} = 3\overline{AB}$ , what are the coordinates of C ?

- A (1, 1, 13)  
B (-3, -15, 21)  
C (-2, -11, 19)  
D (3, 15, -21)
133. Vectors  $\mathbf{u}$  and  $\mathbf{v}$  are defined by  $\mathbf{u} = \mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$  and  $\mathbf{v} = 3\mathbf{i} + 2\mathbf{k}$ .  
What is the value of  $\mathbf{u} \cdot \mathbf{v}$  ?
- A -5  
B -1  
C 0  
D 3
134. Vectors  $\mathbf{u}$  and  $\mathbf{v}$  are given  $\mathbf{u} = 2\mathbf{i} - \mathbf{j} + 5\mathbf{k}$  and  $\mathbf{v} = 3\mathbf{i} + p\mathbf{j} - \mathbf{k}$ .  
If  $\mathbf{u}$  and  $\mathbf{v}$  are perpendicular, what is the value of  $p$  ?
- A 1  
B 4  
C 7  
D 8

135. Vectors  $\mathbf{a}$  and  $\mathbf{b}$  are inclined at an angle of  $t$  radians to each other, as shown in the diagram.

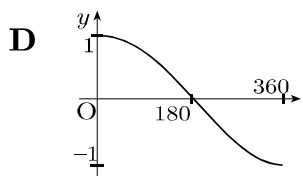
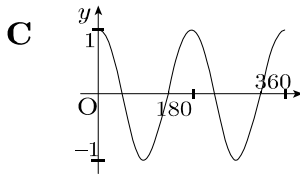
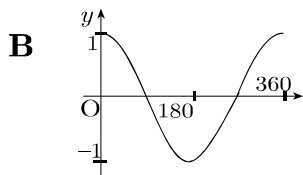
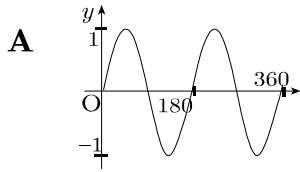


If  $\mathbf{a} \cdot \mathbf{b} = 2$  and  $|\mathbf{a}| = |\mathbf{b}| = \sqrt{3}$  units, what is the value of  $\cos t$ ?

- A  $-1$   
B  $\frac{2}{3}$   
C  $\frac{2}{\sqrt{3}}$   
D  $\frac{3}{2}$
136. Two vectors,  $\mathbf{a}$  and  $\mathbf{b}$ , are perpendicular and  $|\mathbf{a}| = 2$  units,  $|\mathbf{b}| = 3$  units. What is the value of  $\mathbf{a} \cdot (\mathbf{a} + \mathbf{b})$ ?

- A  $0$   
B  $4$   
C  $7$   
D  $10$

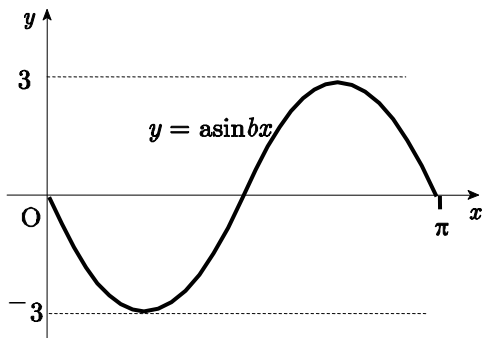
137. Which of the four graphs is most likely to show the graph of  $y = \cos 2x^\circ$  for  $0 \leq x \leq 360$ ?



138. If  $f(x) = 1 + \cos x$ , what is the value of  $f'\left(\frac{2\pi}{3}\right)$ ?

- A  $-\frac{\sqrt{3}}{2}$   
 B  $-\frac{1}{2}$   
 C  $\frac{1}{2}$   
 D  $\frac{1}{\sqrt{3}}$

139. The diagram shows part of the graph whose equation is of the form  $y = a \sin bx$ .



What is the equation of this graph?

- A  $y = -3 \sin \frac{1}{2}x$   
B  $y = 3 \sin \frac{1}{2}x$   
C  $y = -3 \sin 2x$   
D  $y = 3 \sin 2x$
140. The maximum value of  $1 - \cos\left(x - \frac{\pi}{6}\right)$ ,  $0 \leq x < 2\pi$  occurs when  $x = t$ .

What is the value of  $t$ ?

- A 0  
B  $\frac{\pi}{6}$   
C  $\frac{2\pi}{3}$   
D  $\frac{7\pi}{6}$

141. What is the solution of the equation  $\sqrt{3} \sin x = -\cos x$  where  $0 \leq x \leq \frac{3\pi}{2}$  ?

A  $\frac{2\pi}{3}$

B  $\frac{5\pi}{6}$

C  $\frac{7\pi}{6}$

D  $\frac{4\pi}{3}$

142. Expand  $\cos\left(x + \frac{\pi}{4}\right)$ .

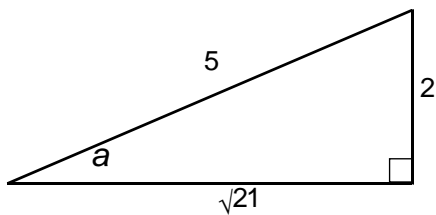
A  $\cos\left(x + \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}} \cos x - \frac{1}{\sqrt{2}} \sin x$

B  $\cos\left(x + \frac{\pi}{4}\right) = \cos x + \frac{1}{\sqrt{2}}$

C  $\cos\left(x + \frac{\pi}{4}\right) = \cos x - \frac{1}{\sqrt{2}}$

D  $\cos\left(x + \frac{\pi}{4}\right) = \frac{1}{2} \cos x + \frac{\sqrt{3}}{2} \sin x$

143. The diagram shows a right-angled triangle with side lengths of 2,  $\sqrt{21}$  and 5.



What is the exact value of  $\sin 2a$  ?

A  $\frac{4}{5}$

B  $\frac{17}{25}$

C  $\frac{4\sqrt{21}}{25}$

D  $\frac{2\sqrt{21}}{5}$

144.  $k$  and  $a$  are given by

$$k \sin a = 1$$

$$\text{and } k \cos a = 1$$

where  $k > 0$  and  $0 \leq a \leq \frac{\pi}{2}$ .

What are the values of  $k$  and  $a$  ?

	$k$	$a$
A	$\sqrt{2}$	0
B	$\sqrt{2}$	$\frac{\pi}{4}$
C	2	0
D	2	$\frac{\pi}{4}$