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Question: 1

Use integration by parts to evaluate

$$\int x^2 \ln x\, dx$$

A. 1/9x3(3lnx - 1) + c
B. 1/3x3lnx + c
C. 1/2x2(lnx)2 + c
D. 1/6x3(lnx)2 + c

Answer: A

Explanation:
Let u = lnx and dv = x2dx
∴ du = (1/x)dx   and   v = 1/3x3
Use the integration by parts formula:

$$\int u\,dv = uv - \int v\,du$$

$$\therefore \int x^2 \ln x\, dx = \tfrac{1}{3} x^3 \ln x - \int \tfrac{1}{3}x^3 \times \frac{1}{x}\, dx$$

$$= \tfrac{1}{3} x^3 \ln x - \tfrac{1}{3}\int x^2 dx$$

$$= \tfrac{1}{3} x^3 \ln x - \tfrac{1}{9} x^3 + c$$

$$= \tfrac{1}{9} x^3 \left(3\ln x - 1\right) + c$$

Question: 2

Solve sinx + cosx = (√3 + 1)/2 for values of x in [0, π]

A. x = 2π/3
B. x = π/12 or 11π/12
C. x = π/6 or 5π/6
D. x = π/6 or π/3

Answer: D

Explanation:
sinx + cosx = (√3 + 1)/2
You will need to use the following identities:

sin2x + cos2x = 1
sin2x = 2sinxcosx
Square both sides of the equation:
(sinx + cosx)2 = ((√3 + 1)/2)2
sin2x + 2sinxcosx + cos2x = (3 + 2√3 + 1)/4
sin2x + cos2x + 2sinxcosx = (4 + 2√3)/4
 1 + 2sinxcosx = 1 + √3/2
2sinxcosx = √3/2
sin2x = √3/2
If 0 ≤ x ≤ π, then 0 ≤ 2x ≤ 2π
2x = π/3 or 2π/3
x = π/6 or π/3

Question: 3

If z = -1/2 + i√(3) / 2, what is (z + 1/z) expressed as a single number (complex, real or imaginary)?

A. -5/2 + 7i√3/6
B. i√3
C. -1
D. (√3 -1)/2 + i(√3 + 1)/2

Answer: C

Explanation:
z = -1/2 + i√(3) / 2
∴ 1/z = 1/(-1/2 + i√(3) / 2)
Rationalize the denominator:
Multiply by 1 = (-1/2 - i√(3) / 4) / (-1/2 - i√(3) / 4):
∴ 1/z = (-1/2 – i√(3) / 2) / (-1/2 + i√(3) / 2)(-1/2 – i√(3) / 2)
= (-1/2 – i√(3) / 2) / (1/4 + i√(3) / 4 – i√(3) / 4 – (3/4)i2)
= (-1/2 – i√(3) / 2)/(1/4 + 3/4)
= -1/2 – i√(3) / 2
∴ z + 1/z = -1/2 + i√(3) / 2 + -1/2 – i√(3) / 2 = -1
Alternatively, use De Moivre's theorem:
z = -1/2 + i√3/2 = cos2π/3 + isin2π/3
∴1/z = z-1 = (cos2π/3 + isin2π/3)-1
= cos(-2π/3) + isin(-2π/3)
= -1/2 – i√3/2
∴ z + 1/z = -1/2 + i√3/2 + -1/2 – i√3/2 = -1

Question: 4

At the end of the semester, Alice had to complete eight examinations. Six of them were in different subjects, but the other two were both mathematics exams.

In how many ways could the examination timetable have been written given that the two mathematics exams were not consecutive?

A. 30,240
B. 35,280
C. 38,880
D. 9,360

Answer: A

Explanation:
To find the number of ways of writing the exam timetable so that the two math exams are not consecutive, find the total number of ways of writing table, and subtract the number of ways of writing the timetable so that the math exams are consecutive. In the remaining possibilities, the math exams will not be consecutive.
The total number of ways of writing the exam timetable (including those where the math exams are consecutive) = 8! = 40,320
Now consider the case where the two math exams are consecutive:
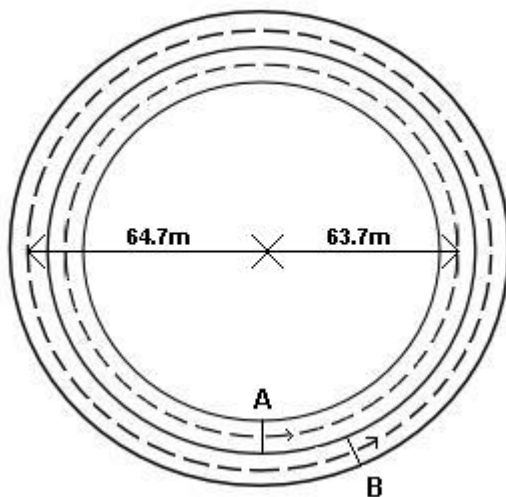Let the subjects be labeled a, b, c, d, e, f, m and m
There are seven things to be arranged – a,b,c,d,e,f and (mm) – this can be done in 7! ways. Also the two math exams could be in either order, so we multiply by 2.
∴ The number of ways of writing the timetable with the two math exams consecutive = 2 * 7! = 10,080
∴The number of ways of writing the timetable with the two math exams not consecutive = 40,320 – 10,080
= 30,240

Question: 5

A running track is circular and has only two lanes. Each lane consists of a pair of concentric circles which are 1 meter apart. The runners run around concentric circles (dotted) that are exactly halfway between the two circles that mark the lanes.

Ambrose starts running from point A and runs around a circle (dotted) of radius 63.7m.
Byron starts running from point B and runs around a circle (dotted) of radius 64.7m.
How far (to the nearest 0.1m) does Byron start in front of Ambrose so that they complete one lap of the running track at the same finishing point, A?

A. 6.3 meters
B. 6.4 meters
C. 10.0 meters
D. 12.6 meters

Answer: A

Explanation:
The distance Byron starts in front of Ambrose is equal to the difference between the circumferences of the two dotted circles
= 2 * π * 64.7 – 2 * π * 63.7 meters
= 2 * π * (64.7 – 63.7) meters
= 2π meters
= 6.3 meters to the nearest 0.1m

Question: 6

(1)The 1620s were a time of political and religious turmoil in England. (2) The protracted struggle for supremacy between monarch and Parliament reached new heights in 1629, when Charles I disbanded the rival body and ruled alone for 11 years. (3) Official pressure was also applied on religious dissenters, notably the Pilgrims and the Puritans. (4) Some were imprisoned for their nonconformist views and others lost lucrative official positions. (5)
In 1628, a group of distinguished Puritan businessmen formed a venture named the Governor and Company of Massachusetts Bay, which was initially conceived as a profit-making endeavor in the New World. (6) A land grant was received from the Council of New England, the successor to the ineffective Virginia Company of Plymouth, providing rights to the area between the Charles and Merrimack rivers and westward to the Pacific Ocean. (7) Preliminary voyages were made in 1628 and 1629, and resulted in the establishment of a small colony on Cape Ann and later at Salem. (8)
The careful Puritan businessmen sought additional protection for their scheme by requesting and receiving a charter from the king, who had apparently been misinformed about their religious views. (9) While still in England, the company members signed the Cambridge Agreement (1629), in which they agreed to undertake the rigors of the Atlantic voyage if full authority over the charter and colony would be vested in the members themselves. (10) Those stockholders who did not wish to migrate sold their shares to emigrants.
While still in England, the company members signed what agreement?

A. The Massachusetts' Bay Agreement
B. The Cambridge Agreement
C. The Council of New England Agreement
D. The Charles and Merrimack Agreement

Explanation:
While the other answer choices are mentioned within the article, they are not the correct names of the agreement referred to and are incorrect answers. The Cambridge Agreement is the correct answer.

Question: 7

(1)The 1620s were a time of political and religious turmoil in England. (2) The protracted struggle for supremacy between monarch and Parliament reached new heights in 1629, when Charles I disbanded the rival body and ruled alone for 11 years. (3) Official pressure was also applied on religious dissenters, notably the Pilgrims and the Puritans. (4) Some were imprisoned for their nonconformist views and others lost lucrative official positions. (5)
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Choose a word from the following that means the same as "protracted" from the second sentence of this passage.

A. Extended
B. Bloody
C. Unfair
D. Cruel

Explanation:
Choices B, C and D are incorrect because their meanings do not define the word protracted. Choice A, extended, means drawn out, which is the meaning of protracted.

Question: 8

(1) Compared with the way things used to be, we have it so very soft today. (2) It's easy to take our modern conveniences for granted. (3) We can fill our days with leisure, bustle around in comfy autos, work only 40 of the 168 hours in a week, chat with therapists, read philosophy,

shop for unnecessary stuff to clog our closets and garages, climate control our dwellings and complain about the softness of our mattresses. (4) In the year 1000, even when agriculture had been around for some 10,000 years, life was

entirely different. (5) In Anglo-Saxon

society, a precursor to the modern West, the possibility of famine was ever-present and memories of the last one made dread and fear a part of everyday life. (6) Looming natural disasters were constant specters. (7) Domiciles were not the neat and clean hygienic environs we

experience today. (8) They did not smell of disinfectant or exhaust from engines wafting in the windows, but the exhaust from every manner of farm creature and humans always hung in the air. (9) Manure was everywhere with each one having its characteristic bouquet of fragrance. (10) The human nose in the year 1000 could certainly not be so prissy as ours today. (11)

The primary purpose of the passage is to

A. emphasize the impact modern medicine has had on extending life expectancies
B. explain the fragility of life relying upon agriculture
C. describe life in the early Middle Ages
D. contrast the living conditions of the year 1000 in Anglo-Saxon society with those of today

Answer: D

Explanation:
The author discusses many aspects of life in the year 1000 and goes on to contrast them with how we live today. "Emphasize the impact modern medicine has had on extending life expectancies" is not correct because medicine is not discussed. The remaining choices represent supporting ideas of the passage.

Question: 9

(1) When oil spills occur in the ocean there is always a chance that the marine life as well as birds and other animals will be negatively affected. (2) Some oil spills have a greater impact on the wildlife than others, but no spill is good. (3) In the case of birds and other animals that are covered in fur, the oil itself actually destroys or breaks down the insulating ability of the fur. (4) For birds, if the fur is covered in oil, the water-repelling abilities of the fur are affected. (5) This exposes the animals to the harsh elements of the environments in which they live. (6) There have been many animals killed as a result of oil spills in the oceans around the world. (7)

This passage is mainly concerned with

A. comparing different types of oil spills
B. oil spills in the ocean
C. the effect of an oil spill on marine life as opposed to birds and animals
D. the effects of oil spills on wildlife

Answer: D

Explanation:

The passage discusses the impact of oil spills on various types of wildlife. Every sentence deals with this issue. Choice (C) is not correct because all three life forms are mentioned with greater description given to birds and animals. Choice (B) would seem like a possible answer. However, the passage focuses on the effects of these spills on wildlife. Choice (A) is not viable.

Question: 10

(1) When oil spills occur in the ocean there is always a chance that the marine life as well as birds and other animals will be negatively affected. (2) Some oil spills have a greater impact on the wildlife than others, but no spill is good. (3) In the case of birds and other animals that are covered in fur, the oil itself actually destroys or breaks down the insulating ability of the fur. (4) For birds, if the fur is covered in oil, the water-repelling abilities of the fur are affected. (5) This exposes the animals to the harsh elements of the environments in which they live. (6) There have been many animals killed as a result of oil spills in the oceans around the world. (7)

According to the passage, oil affects wildlife in all of the following ways EXCEPT

A. by killing off some wildlife, the food chain is disrupted
B. by removing natural defenses, the oil may expose wildlife to its environment
C. the oil may break down the insulating ability of fur in fur-bearing animals
D. the oil may reduce or eliminate the water-repelling ability of fur or feathers

Answer: A

Explanation:
The potential impact on the food chain is not mentioned in this passage. All other choices are included in the reading.

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