TASHKENT UNIVERSITY OF TECHNOLOGY

Mathematics

Variant 5

CONSTRUCTOR KNOWLEDGE

Part 1

Mathematics. Questions 1–10

Write your answer on Answer Sheet No. 1 to the right of the corresponding question number.

1. In triangle ABC, $\angle ACB = 90°$ and $\angle ABC = 58°$. The segment CD is a median.
Find $\angle ACD$. Give your answer in degrees.

2. A regular square pyramid has a base side length of 20 and a lateral edge of 26. Find its surface area.

3. Given the vectors $\vec{a} = (6, -4)$ and $\vec{b} = (\lambda, 6)$, find the value of λ for which the vectors are collinear.

4. Two liters of a 6% salt solution were mixed with one liter of a 12% salt solution. What is the concentration of the resulting solution?

5. Simplify the expression so that the result does not contain any sums or differences.

$$\frac{\sin x + \sin 2x}{1 + \cos x + \cos 2x}.$$

6. Find the value of the expression:

$$\frac{0.6^0 - (0.1)^{-1}}{\left(\frac{3}{2^3}\right)^{-1} \cdot \left(\frac{3}{2}\right)^3 \cdot \left(-\frac{1}{3}\right)^{-1}}.$$

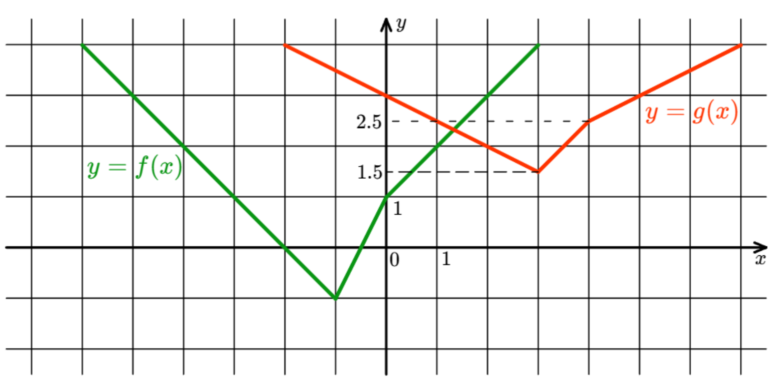
7. Solve the equation

$$\log_5(x+1) + \log_5(x-2) = \log_5(2x+8).$$

8. Alice found out that the number of mugs in her cupboard is exactly three times the number of bowls she has. But if she had twice as many bowls, she could have invited 30 guests, and each guest would have received either a mug or a bowl. How many mugs does Alice have?

9. The graph $y = g(x)$ is obtained from the graph $y = f(x)$ by a transformation of the form

$$g(x) = a \cdot f(x+b) + c.$$



Find the value of $a + b + c$.

10. Find the absolute maximum value of $f(x)$ on the given interval.

$$f(x) = e^{\sin 2x}, \quad \left[-\frac{\pi}{2}, 0\right]$$

Part 2

Mathematics. Questions 11–14

Use Answer Sheets No. 2 to write your solutions and answers to questions 11–14. Write your solution as completely and in as much detail as possible. Remember that even if you are unable to solve the problem completely, you may still receive some points for significant progress according to the marking criteria.

11. (2 points) Oil is spilled on a calm sea and forms a circular slick of uniform thickness. The radius r of the slick increases at a constant rate of 0.2 m/min.

(a) At the moment when the radius is 50 m, find the rate at which the area of the slick is increasing.

(b) The thickness of the slick is inversely proportional to the square of the radius:

$$h = \frac{0.01}{r^2} \text{ (metres).}$$

Find the rate of change of the thickness when $r = 50$ m.

(c) Determine the volume of the slick when $r = 50$ m, and the rate of change of the volume at that instant. Is the volume constant?

12. (3 points) A vehicle moves along a straight test track. Its velocity v (in m/s) is given by

$$v(t) = \begin{cases} 4t, & 0 \le t \le 3, \\ 12 - (t-3)^2, & 3 < t \le 7. \end{cases}$$

(a) Calculate the displacement of the vehicle during the first 7 seconds.

(b) Determine the total distance traveled by the vehicle in the same time interval.

13. (2 points) Solve the inequality:

$$\frac{(1 - 6x + 12x^2 - 8x^3)\sqrt{x+3}}{\sqrt{|x|(x^2 - 4x + 4)}} \le 0.$$

14. (3 points) A factory produces x tons of a product per year. The yearly production cost, in thousands of dollars, is

$$2x^2 + 6x + 20.$$

The product is sold for p thousand dollars per ton. The factory wants its maximum possible yearly profit to be at least 20 thousand dollars.
Find the smallest integer value of p.

Mathematics

Variant 5

Part 1

Mathematics. Questions 1–10

Write your answer on Answer Sheet No. 1 to the right of the corresponding question number.

1. In triangle ABC, $\angle ACB = 90°$ and $\angle ABC = 58°$. The segment CD is a median. Find $\angle ACD$. Give your answer in degrees.

Answer: $32°$

SOLUTION / PROOF :

Since the sum of the angles of a triangle is 180°,

$$\angle BAC = 180° - 90° - 58° = 32°.$$

Since CD is a median, the point D is the midpoint of the hypotenuse AB.
The midpoint of the hypotenuse of a right triangle is equidistant from all three vertices. Therefore,

$$AD = CD.$$

Hence, triangle ACD is isosceles, so its base angles are equal:

$$\angle ACD = \angle CAD.$$

Since D lies on AB,

$$\angle CAD = \angle CAB = 32°.$$

Therefore,

$$\boxed{\angle ACD = 32°}.$$

2. A regular square pyramid has a base side length of 20 and a lateral edge of 26. Find its surface area.

Answer: 1360

SOLUTION / PROOF :

Each lateral face is an isosceles triangle with side lengths 26, 26, and 20.
The altitude drawn to the base is also a median, so it divides the triangle into two congruent right triangles with hypotenuse 26 and one leg $20/2 = 10$.
Using the Pythagorean theorem, we find the height of the lateral face:

$$h = \sqrt{26^2 - 10^2} = \sqrt{676 - 100} = \sqrt{576} = 24.$$

Therefore, the area of each lateral face is

$$S_1 = \frac{1}{2} \cdot 20 \cdot 24 = 240.$$

Since the pyramid has four congruent lateral faces, their total area is

$$4S_1 = 4 \cdot 240 = 960.$$

The area of the square base is

$$20 \cdot 20 = 400.$$

Hence, the total surface area of the pyramid is

$$S = 960 + 400 = 1360.$$

3. Given the vectors $\vec{a} = (6, -4)$ and $\vec{b} = (\lambda, 6)$, find the value of λ for which the vectors are collinear.

Answer: -9

SOLUTION / PROOF :

Two vectors are collinear if and only if their corresponding coordinates are proportional:

$$\frac{6}{\lambda} = \frac{-4}{6};$$

$$\lambda = \frac{6 \cdot 6}{-4} = -9.$$

4. Two liters of a 6% salt solution were mixed with one liter of a 12% salt solution. What is the concentration of the resulting solution?

Answer: 8

SOLUTION / PROOF :

The amount of pure salt in the resulting solution is

$$2 \cdot 0.06 + 1 \cdot 0.12 = 0.24.$$

liters.
Since the total volume of the mixture is 3 liters, the concentration of the resulting solution is

$$\frac{0.24}{3} = 0.08 = 8\%.$$

5. Simplify the expression so that the result does not contain any sums or differences.

$$\frac{\sin x + \sin 2x}{1 + \cos x + \cos 2x}.$$

Answer: $\operatorname{tg} x$

SOLUTION / PROOF :

Use the identity

$$\sin 2x = 2 \sin x \cos x.$$

Then the numerator becomes

$$\sin x + \sin 2x = \sin x + 2 \sin x \cos x = \sin x(1 + 2\cos x).$$

For the denominator, use

$$\cos 2x = 2\cos^2 x - 1.$$

Hence,

$$1 + \cos x + \cos 2x = 1 + \cos x + 2\cos^2 x - 1 = \cos x(1 + 2\cos x).$$

Therefore,

$$\frac{\sin x + \sin 2x}{1 + \cos x + \cos 2x} = \frac{\sin x(1 + 2\cos x)}{\cos x(1 + 2\cos x)} = \frac{\sin x}{\cos x} = \operatorname{tg} x.$$

Thus, the simplified expression is

$$\boxed{\operatorname{tg} x}.$$

6. Find the value of the expression:

$$\frac{0.6^0 - (0.1)^{-1}}{\left(\frac{3}{2^3}\right)^{-1} \cdot \left(\frac{3}{2}\right)^3 \cdot \left(-\frac{1}{3}\right)^{-1}}.$$

Answer: $\frac{1}{3}$

SOLUTION / PROOF :

First simplify the numerator:

$$0.6^0 = 1$$

and

$$(0.1)^{-1} = \left(\frac{1}{10}\right)^{-1} = 10.$$

Therefore,

$$0.6^0 - (0.1)^{-1} = 1 - 10 = -9.$$

Now simplify the denominator:

$$\left(\frac{3}{2^3}\right)^{-1} = \left(\frac{3}{8}\right)^{-1} = \frac{8}{3},$$

$$\left(\frac{3}{2}\right)^3 = \frac{27}{8},$$

and

$$\left(-\frac{1}{3}\right)^{-1} = -3.$$

Hence,

$$\left(\frac{3}{2^3}\right)^{-1} \cdot \left(\frac{3}{2}\right)^3 \cdot \left(-\frac{1}{3}\right)^{-1} = \frac{8}{3} \cdot \frac{27}{8} \cdot (-3).$$

Simplifying,

$$\frac{8}{3} \cdot \frac{27}{8} = 9,$$

so

$$9 \cdot (-3) = -27.$$

Therefore, the whole expression is

$$\frac{-9}{-27} = \frac{1}{3}.$$

7. Solve the equation

$$\log_5(x+1) + \log_5(x-2) = \log_5(2x+8).$$

Answer: 5

SOLUTION / PROOF :

Under conditions

$$x + 1 > 0, \quad x - 2 > 0, \quad 2x + 8 > 0$$

, we obtain

$$\log_5(x+1) + \log_5(x-2) = \log_5(2x+8);$$

$$\log_5(x+1)(x-2) = \log_5(2x+8);$$

$$(x+1)(x-2) = (2x+8);$$

$$x^2 + x - 2x - 2 - 2x - 8 = 0;$$

$$x^2 - 3x - 10 = 0;$$

$$x_1 = -2, x_2 = 5.$$

The first root does not satisfy the given conditions and must be discarded as extraneous. Therefore, the equation has only one solution: $x = 5$.

8. Alice found out that the number of mugs in her cupboard is exactly three times the number of bowls she has. But if she had twice as many bowls, she could have invited 30 guests, and each guest would have received either a mug or a bowl. How many mugs does Alice have?

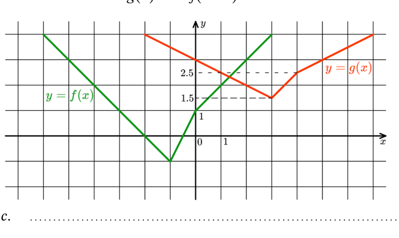
Answer: 18

SOLUTION / PROOF :

Let x be the number of mugs, y the number of bowls. We know that $x = 3y$ and $x + 2y = 30$. Solving the system, we find $y = 6$, $x = 18$.

9. The graph $y = g(x)$ is obtained from the graph $y = f(x)$ by a transformation of the form

$$g(x) = a \cdot f(x + b) + c.$$



Find the value of $a + b + c$.

Answer: $-\frac{3}{2}$

SOLUTION / PROOF :

Consider the two vertices of the graph of f:

$$(-1, -1) \qquad \text{and} \qquad (0, 1).$$

The corresponding vertices of the graph of g are

$$\left(3, \frac{3}{2}\right) \qquad \text{and} \qquad \left(4, \frac{5}{2}\right).$$

First, compare their x-coordinates. Each vertex is shifted 4 units to the right:

$$-1 \longmapsto 3, \qquad 0 \longmapsto 4.$$

Since the transformation is written as $f(x + b)$, a shift by 4 units to the right corresponds to

$$b = -4.$$

Next, compare the vertical distance between the vertices of the two graphs. For f, this distance is

$$1 - (-1) = 2,$$

while for g, it is

$$\frac{5}{2} - \frac{3}{2} = 1.$$

Therefore, the graph is compressed vertically by a factor of $\frac{1}{2}$, so

$$a = \frac{1}{2}.$$

To find c, use the correspondence

$$(-1, -1) \longmapsto \left(3, \frac{3}{2}\right).$$

Thus,

$$\frac{3}{2} = \frac{1}{2} \cdot (-1) + c.$$

Hence,

$$c = 2.$$

Therefore,

$$g(x) = \frac{1}{2} f(x - 4) + 2.$$

Finally,

$$a + b + c = \frac{1}{2} - 4 + 2 = -\frac{3}{2}.$$

10. Find the absolute maximum value of $f(x)$ on the given interval.

$$f(x) = e^{\sin 2x}, \quad \left[-\frac{\pi}{2}, 0\right]$$

Answer: 1

SOLUTION / PROOF :

The derivative is $2e^{\sin 2x} \cos 2x$. Its zeroes are zeroes of $\cos 2x$, which are $x = \pm\pi/4 + \pi n$. There is only $x = -\pi/4$ on the given interval. Since the derivative change the sign from − to + in this point, then we need to find the absolute maximum value of $f(x)$ among the ends of the interval. Let's check: in $x = -\pi$ and $x = \pi$ function equals 1.
OR
One may notice, that on the given interval $\sin 2x$ takes all its possible values, while e^t is monotonous. Therefore, maximum and minimum of $f(x)$ are taken exactly when $\sin 2x$ has maximum and minimum, which are ± 1.

Mathematics. Questions 11–14

Use Answer Sheets No. 2 to write your solutions and answers to questions 11–14. Write your solution as completely and in as much detail as possible. Remember that even if you are unable to solve the problem completely, you may still receive some points for significant progress according to the marking criteria.

11. (2 points) Oil is spilled on a calm sea and forms a circular slick of uniform thickness. The radius r of the slick increases at a constant rate of 0.2 m/min.

(a) At the moment when the radius is 50 m, find the rate at which the area of the slick is increasing.

(b) The thickness of the slick is inversely proportional to the square of the radius:

$$h = \frac{0.01}{r^2} \text{ (metres)}.$$

Find the rate of change of the thickness when $r = 50$ m.

(c) Determine the volume of the slick when $r = 50$ m, and the rate of change of the volume at that instant. Is the volume constant?

Answer: см. решение

SOLUTION / PROOF :

(a) The area of the slick is $A = \pi r^2$. Differentiating with respect to time t,

$$\frac{dA}{dt} = 2\pi r \frac{dr}{dt}.$$

At $r = 50$ m and $\frac{dr}{dt} = 0.2$ m/min,

$$\frac{dA}{dt} = 2\pi \times 50 \times 0.2 = 20\pi \approx 62.8 \text{ m}^2/\text{min}.$$

(b) Thickness $h = 0.01 r^{-2}$. Its rate of change is

$$\frac{dh}{dt} = 0.01 \times (-2) r^{-3} \frac{dr}{dt} = -0.02 r^{-3} \frac{dr}{dt}.$$

Substitute $r = 50$ m and $\frac{dr}{dt} = 0.2$ m/min:

$$\frac{dh}{dt} = -0.02 \times \frac{1}{50^3} \times 0.2 = -\frac{0.02 \times 0.2}{125\,000} = -\frac{0.004}{125\,000} = -3.2 \times 10^{-8} \text{ m/min}.$$

(c) The volume of the cylindrical slick is $V = \pi r^2 h$. Using $h = 0.01/r^2$,

$$V = \pi r^2 \cdot \frac{0.01}{r^2} = 0.01\pi \approx 0.0314 \text{ m}^3.$$

Since V is independent of r (it is a constant), its rate of change is

$$\frac{dV}{dt} = 0.$$

Thus the volume of the slick remains constant as it spreads — the decrease in thickness exactly compensates the increase in area.

Criterion content	Points
A correct answer is obtained with proper justification in part a)	0.7
A correct answer is obtained with proper justification in part b)	0.7
A correct answer is obtained with proper justification in part c)	0.6
The solution is generally correct, but contains a computational error: 0.2 points are deducted. This criterion applies separately to each of the parts a), b), c).	–
In part a), the candidate correctly wrote down the area of the slick and showed that a derivative needs to be taken, but was unable to take it correctly	0.3
In part a), the candidate only correctly wrote down the area of the slick, with no further progress	0.1
In part b), the candidate showed that a derivative needs to be taken, but was unable to take it correctly	0.3
In part c), the candidate only correctly wrote down the volume of the cylinder, with no further progress	0.2
In part c), the candidate correctly wrote down the volume of the cylinder and calculated it, with no further progress	0.3
Only the answer is given, without justification	0
The solution does not correspond to any of the criteria listed above	0

12. (3 points) A vehicle moves along a straight test track. Its velocity v (in m/s) is given by

$$v(t) = \begin{cases} 4t, & 0 \le t \le 3, \\ 12 - (t-3)^2, & 3 < t \le 7. \end{cases}$$

(a) Calculate the displacement of the vehicle during the first 7 seconds.

(b) Determine the total distance traveled by the vehicle in the same time interval.

! answer needed !

SOLUTION / PROOF :

(a) Displacement $s = \int_0^7 v(t)\,dt = \int_0^3 4t\,dt + \int_3^7 \left[12 - (t-3)^2\right] dt.$

$$\int_0^3 4t\,dt = \left[2t^2\right]_0^3 = 18 \text{ m}.$$

For the second integral substitute $u = t - 3$, $du = dt$, limits $u = 0$ to $u = 4$:

$$\int_3^7 \left[12 - (t-3)^2\right] dt = \int_0^4 (12 - u^2)\,du = \left[12u - \frac{u^3}{3}\right]_0^4 = 48 - \frac{64}{3} = \frac{80}{3} \text{ m}.$$

Hence total displacement:

$$s = 18 + \frac{80}{3} = \frac{54}{3} + \frac{80}{3} = \frac{134}{3} \text{ m} \approx 44.67 \text{ m}.$$

(b) Total distance $= \int_0^7 |v(t)|\,dt$. We split the integration where $v(t)$ changes sign. $v(t) = 0$ for $t > 3$ when $12 - (t-3)^2 = 0 \implies t - 3 = \sqrt{12} = 2\sqrt{3} \approx 3.464$, so the sign change is at $t = 3 + 2\sqrt{3}$.

- $0 \le t \le 3$: $v \ge 0$, $|v| = 4t$.
- $3 < t \le 3 + 2\sqrt{3}$: $v > 0$, $|v| = 12 - (t-3)^2$.
- $3 + 2\sqrt{3} \le t \le 7$: $v \le 0$, $|v| = -[12 - (t-3)^2] = (t-3)^2 - 12$.

Thus

$$\text{Distance} = \int_0^3 4t\,dt + \int_3^{3+2\sqrt{3}} \left[12 - (t-3)^2\right] dt + \int_{3+2\sqrt{3}}^7 \left[(t-3)^2 - 12\right] dt.$$

First part: 18 m (as before).
Second part: substitute $u = t - 3$, u from 0 to $2\sqrt{3}$.

$$\int_0^{2\sqrt{3}} (12 - u^2)\,du = \left[12u - \frac{u^3}{3}\right]_0^{2\sqrt{3}} = 12(2\sqrt{3}) - \frac{(2\sqrt{3})^3}{3} = 24\sqrt{3} - \frac{24\sqrt{3}}{3} = 24\sqrt{3} - 8\sqrt{3} = 16\sqrt{3}.$$

Third part: u from $2\sqrt{3}$ to 4, integrand $u^2 - 12$.

$$\begin{aligned} \int_{2\sqrt{3}}^4 (u^2 - 12)\,du &= \left[\frac{u^3}{3} - 12u\right]_{2\sqrt{3}}^4 \\ &= \left(\frac{64}{3} - 48\right) - \left(\frac{(2\sqrt{3})^3}{3} - 12(2\sqrt{3})\right) \\ &= \left(\frac{64}{3} - \frac{144}{3}\right) - \left(\frac{24\sqrt{3}}{3} - 24\sqrt{3}\right) \\ &= -\frac{80}{3} - (8\sqrt{3} - 24\sqrt{3}) \\ &= -\frac{80}{3} - (-16\sqrt{3}) = 16\sqrt{3} - \frac{80}{3}. \end{aligned}$$

Now total distance:

$$\text{Distance} = 18 + 16\sqrt{3} + \left(16\sqrt{3} - \frac{80}{3}\right) = 18 + 32\sqrt{3} - \frac{80}{3} = \frac{54}{3} - \frac{80}{3} + 32\sqrt{3} = -\frac{26}{3} + 32\sqrt{3} \text{ m}.$$

Criterion content	Points
A correct answer is obtained with proper justification in part a)	1.2
A correct answer is obtained with proper justification in part b)	1.8
The solution is generally correct, but contains a minor arithmetic error: 0.2 points are deducted. This criterion applies separately to each of the parts a), b).	–
In part a), the candidate correctly wrote down the integral/motion formula, but was unable to evaluate it	0.6
In part a), the candidate correctly wrote down and evaluated the integral/motion formula only on the first section of the path	0.5
In part a), the candidate correctly wrote down and evaluated the integral/motion formula only on the second section of the path	0.7
In part a), the candidate explicitly indicated what needs to be found (for example, an integral), but was unable to correctly construct the mathematical model for the whole section	0.3
In part b), the candidate explicitly explained why displacement differs from the total distance traveled, but made no further progress	0.2
In part b), the candidate correctly identified, in one way or another, the section of motion that needs to be taken with a negative sign	1
Only the answer is given, without justification	0
The solution does not correspond to any of the criteria listed above	0

13. (2 points) Solve the inequality:

$$\frac{(1 - 6x + 12x^2 - 8x^3)\sqrt{x+3}}{\sqrt{|x|(x^2 - 4x + 4)}} \le 0.$$

Answer: $-3 \cup \left[\frac{1}{2}; 2\right) \cup (2; +\infty)$

SOLUTION / PROOF :

First, factor the expressions:

$$1 - 6x + 12x^2 - 8x^3 = (1 - 2x)^3.$$

$$x^2 - 4x + 4 = (x - 2)^2.$$

So the inequality becomes

$$\frac{(1 - 2x)^3 \sqrt{x+3}}{\sqrt{|x|(x-2)^2}} \le 0.$$

Now find the domain. We need

$$x + 3 \ge 0.$$

Hence,

$$x \ge -3.$$

Also, the denominator must be defined and not equal to zero:

$$|x|(x - 2)^2 > 0.$$

Therefore,

$$x \ne 0, \quad x \ne 2.$$

So the domain is

$$x \ge -3, \quad x \ne 0, \quad x \ne 2.$$

On the domain, the denominator is always positive:

$$\sqrt{|x|(x-2)^2} > 0.$$

Therefore, the sign of the whole fraction depends only on the numerator:

$$(1 - 2x)^3 \sqrt{x+3} \le 0.$$

Since

$$\sqrt{x+3} \ge 0,$$

the product is equal to zero when

$$x = -3$$

or

$$1 - 2x2 = 0.$$

From

$$1 - 2x = 0$$

we get

$$x = \frac{1}{2}.$$

For $x > -3$, the factor $\sqrt{x+3}$ is positive, so the sign depends on

$$(1 - 2x)^3.$$

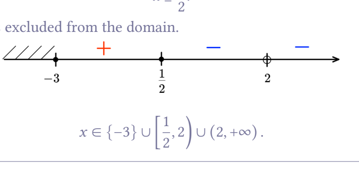
Since the cube has the same sign as its base, we need

$$1 - 2x \le 0.$$

Thus,

$$x \ge \frac{1}{2}.$$

Now remember that $x = 2$ is excluded from the domain.



Therefore, the solution is

$$x \in \{-3\} \cup \left[\frac{1}{2}, 2\right) \cup (2, +\infty).$$

Criteria	Points
Correct answer obtained with valid justification	2
Solution carried through to completion, i.e., all solution-advancing steps were performed (domain correctly found, correct factorization, etc.), but a computational error was made	1.8
Solution carried through to completion, but a computational and/or mathematical error was made (incorrect domain, incorrect factorization, incorrect use of the interval method, incorrect zeros of the inequality, etc.)	1
Several solution-advancing steps correctly performed, but no further substantial progress	0.7
One solution-advancing step correctly performed, with no further progress or further steps containing errors	0.5
Several solution-advancing steps present, but they contain errors	0.2
Answer only, without justification	0
Solution does not meet any of the criteria listed above	0

14. (3 points) A factory produces x tons of a product per year. The yearly production cost, in thousands of dollars, is

$$2x^2 + 6x + 20.$$

The product is sold for p thousand dollars per ton. The factory wants its maximum possible yearly profit to be at least 20 thousand dollars.
Find the smallest integer value of p.

Answer: 24

SOLUTION / PROOF :

The yearly revenue is

$$px.$$

The yearly profit is

$$P(x) = px - (2x^2 + 6x + 20).$$

Simplify:

$$P(x) = -2x^2 + (p - 6)x - 20.$$

This is a downward-opening quadratic function. Its maximum value is

$$P_{\max} = \frac{(p-6)^2}{8} - 20.$$

We need

$$\frac{(p-6)^2}{8} - 20 \ge 20.$$

Therefore,

$$\frac{(p-6)^2}{8} \ge 40.$$

Hence,

$$(p - 6)^2 \ge 320.$$

Since p is positive and should be as small as possible,

$$p - 6 \ge \sqrt{320} = 8\sqrt{5}.$$

Thus,

$$p \ge 6 + 8\sqrt{5} \approx 23.89.$$

The smallest integer value is

$$p = 24.$$

Criteria	Points
Extremum problem is correctly modeled, the correct method is used, all calculations are correct, and the final answer is complete	3
Solution is essentially correct, but the answer is not exactly what the problem asks for or the final answer is incomplete	2.8
Logical structure of the solution is correct, but an arithmetic or minor algebraic error changes the final answer	2.5
Correct method is chosen and substantially applied: the vertex, discriminant condition, derivative, or relevant inequality method is found or used correctly	2
Extremum problem is correctly set up and the needed function or condition is constructed	1
Some relevant elements of the model are identified, but the full extremum model is not constructed	0.5
No correct extremum model is formed, or the work is unrelated to the problem	0
Answer only, without valid justification	0
Solution does not meet any of the criteria listed above	0