FIITJEE INTERNAL MONTHLY TEST-2

PHYSICS, CHEMISTRY & MATHEMATICS

Batch: SANKALP-79

IIT – JEE, 2019

QP CODE:111276

ANSWERS

PHYSICS (SECTION-I

PART – A

1. **A** P120307
2. **C** P120302
3. **B** P120305
4. **C** P120208
5. **B** P120216
6. **A** P120306
7. **B** P120305
8. **C** P120215

PART – A

9. **ABD** P120216
10. **AC** P120305
11. **BC** P120213, P120214
12. **CD** P120304

PART – B

1. **A → P, B → Q,**
   C → S D → R P120206
2. **A → PQS, B → PQRS**
   C → PQS, D → Q P120305

PART – C

1. **2** P120309
2. **3** P120213
3. **5** P120305
4. **3** P120207
5. **6** P120216
6. **5** P120306

CHEMISTRY (SECTION-II)

PART – A

1. D (Concept Code: C121206)
2. A (Concept Code: C121204)
3. A (Concept Code: C121207)
4. D (Concept Code: C121207)
5. D (Concept Code: C121208)
6. A (Concept Code: C121206)
7. A (Concept Code: C121206)
8. A (Concept Code: C121207)

PART – A

9. ABC (Concept Code: C121206)
10. ABD (Concept Code: C121207)
11. ABCD (Concept Code: C121206)
12. BCD (Concept Code: C121206)

PART – B

1. $A \rightarrow PR, B \rightarrow QS$
   $C \rightarrow PQ, D \rightarrow R$
   (Concept Code: C121206, C121207)

2. $A \rightarrow PQRST, B \rightarrow PQ$
   $C \rightarrow RT, \quad D \rightarrow RST$
   (Concept Code: C121206)

PART – C

1. 6 (Concept Code: C121207)
2. 9 (Concept Code: C121208)
3. 5 (Concept Code: C121206)
4. 4 (Concept Code: C121206)
5. 2 (Concept Code: C121206)
6. 8 (Concept Code: C121209)

MATHEMATICS (SECTION-III)

PART – A

1. **C, M120608**
2. **D, M120701**
3. **B,**
4. **D, M120805**
5. **A, M120605**
6. **B, M120606**
7. **B, M120601**
8. **C, M120602**

PART – A

9. **AC, M120604, M120608**
10. **ABCD M120601**
11. **BD**
12. **ABCD M120802, M120803 M120805, M120806**

PART – B

1. **A → Q M120804**
   B → P M120807
   C → P M120803
   D → R M120807

2. **A → QS M120507**
   B →PT M120508
   C →ST M120508
   D → QR

PART – C

1. **2 M120701**
2. **0 M120701**
3. **5 M120812**
4. **4 M120606**
5. 9 **M120612**
6. **2 M120606**

Hints & Solutions

PHYSICS
PART – A

1. **A** P120307

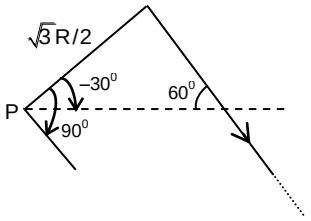
Sol. $\tau_{net} = 0$

$mgR = MB_0$ (M = magnetic dipole moment)

$mgR = I(\pi R^2)B_0$

$I = \dfrac{mg}{\pi R B_0}$

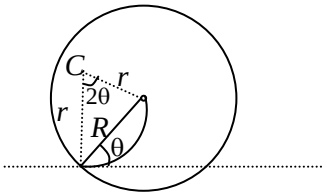
2. **C** P120302



Sol. $B = \dfrac{\mu_0 I}{4\pi\sqrt{3}\,R/2}\left[\sin 90^\circ + \sin(-30^\circ)\right]$

$= \dfrac{\mu_0 I}{4\sqrt{3}\,R}$

3. **B** P120305



Sol. $r = \dfrac{R}{2\sin\theta}$

$\dfrac{mv_0}{qB} = \dfrac{R}{2\sin\theta}$

$v_0 = \dfrac{qBR}{2m\sin\theta}$

4. **C** P120208

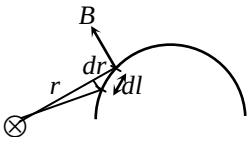
Sol. $4 \times \ell\,\dfrac{12}{24} = \dfrac{\varepsilon_1 r_2 - r_1\varepsilon_2}{r_1 + r_2}$

5. **B** P120216

Sol. Required value = $\left(V_C \cdot i_C\right)_{max} = \dfrac{\xi}{2} \cdot \dfrac{\xi}{2R} = \dfrac{\xi^2}{4R}$

6. **A** P120306

Sol. Magnetic field at a distance r from the wire will be



$B = \dfrac{\mu_0}{2\pi}\dfrac{i_1}{r}$

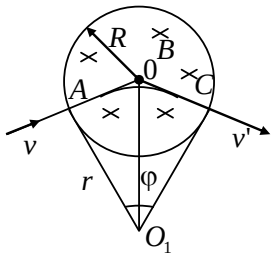
force on the small element of length dl on semicircular wire is

$dF = i_2\, d\vec{l} \times \vec{B} = i_2\left(dl_\perp\right)B \qquad = i_2 B\, dr \qquad (\because dl_\perp = dr)$

$F = \int_R^{3R} i_2\, B\, dr = \dfrac{\mu_0}{2\pi} i_1 i_2 \ln 3.$

7. **B** P120305

Sol. The magnetic induction of the solenoid is directed along its axis. Therefore, the Lorentz force acting on the electron at any instant of time will lie in the plane perpendicular to the solenoid axis. Since the electron velocity at the initial moment is directed at right angles to the solenoid axis, the electron trajectory will lie in the plane perpendicular to the solenoid axis. The Lorentz force can be found from the formula $F = evB$.



The trajectory of the electron in the solenoid is an arc of the circle whose radius can be deter mined from the relation $evB = mv^2 / r$.

The trajectory of the electron in shown in figure, where O_1 is the centre of the arc AC described by the electron, v' is the velocity at which the electron leaves the solenoid. The segments OA and OC are tangents to the electron trajectory at points A and C. The angle between v and v' is obviously $\phi = \angle AO_1C$ since $\angle OAO_1 = \angle OCO_1$.

In order to find ϕ, let us consider the right triangle OAO_1; side $OA = R$ and side $AO_1 = r$.

Therefore, $\tan(\phi/2) = R/r = eBR/(mv)$.

Therefore, $$\phi = 2\tan^{-1}\left(\frac{eBR}{mv}\right)$$

Obviously, the magnitude of the velocity remains unchanged over the entire trajectory since the Lorentz force is perpendicular to the velocity at any instant. Therefore, the transit time of electron in the solenoid can be determined from the relation

$$t = \frac{r\phi}{v} = \frac{m\phi}{eB} = \frac{2m}{eB}\tan^{-1}\left(\frac{eBR}{mv}\right).$$

8. **C** P120215

Sol. $V_{AB} = IR_{eff} = \frac{I}{3}r + \frac{I}{3}r = \frac{2rI}{3}$, hence R_{eff} is $\frac{2r}{3}$.

9. **ABD** P120216

Sol. $q = \frac{CV}{3}\left(1 - e^{-t/RC}\right)$

Current through V_2 $\quad i_2 = \frac{V}{3R}\left(e^{-t/RC}\right)$

Current through V_1 $\quad i_1 = \frac{V}{2R} - \frac{V}{6R}e^{-1/RC}$

at t = RC, power delivered by $V_2 = Vi_2 = \frac{V^2}{3Re}$

10. **AC** P120305

Sol. $r \propto \frac{\sqrt{m}}{q} \Rightarrow r_H : r_{He} : r_0 = \frac{\sqrt{1}}{1} : \frac{\sqrt{4}}{1} : \frac{\sqrt{16}}{2} = 1:2:2$

Radius is smallest for H^+, so it is deflected most

11. **BC** P120213, P120214

Sol. $50 \times 10^{-6} = \frac{r \times i}{100 + r} \Rightarrow$ for I = 5 mA

$r = 1\Omega$.

$V = 50 \times 10^{-6}(100 + r_o) = 50 \times 10^{-6} r_o$

12. **CD** P120304

Sol. $B_{net} = B_1 - B_2 \Rightarrow B_1 - B_2 = 0 \Rightarrow B_1 = B_2 \quad \Rightarrow B \propto ni.$

So, $n_1 i_1 = n_2 i_2$ or $n_1 = n_2$ and $i_1 = i_2$

PART – B

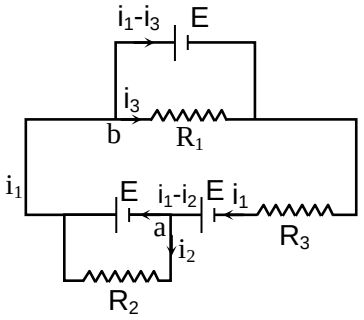
1. **(A) → P** **(B) → Q** **(C) → S** **(D) → R**
P120206

Sol. On solving by KVL we get, $i_1 = \frac{E}{R}$, $i_2 = -\frac{E}{R}$, $i_3 = \frac{E}{R}$

$\Rightarrow \quad i_1 - i_2 = \frac{2E}{R}$ and $i_1 - i_3 = 0$

So reading of ammeter A_1 is E/R = 4/3

A_2 is 2E/R = 8/3, A_3 is zero and ΔV_{ab} = 4V



2. **(A) → PQS** **(B) → PQRS** **(C) → PQS** **(D) → Q**
P120305

Sol. In uniform magnetic field the force is always perpendicular to velocity and magnetic field. Whereas the force in electric and gravitational field is along or opposite to the field.

PART – C

1. **2** P120309

Sol. Force exerted by air on the rod $= \left(\rho \frac{L}{2} 2R\right) v^2 = \rho L R v^2$

Balancing torque about point O $NI\left(\pi R^2\right)B = \rho L R v^2 \times \frac{3L}{4}$

$\Rightarrow \qquad 300\pi IBR = \frac{3\rho v^2 L^2}{4}$

$\Rightarrow \qquad I = \frac{\rho L^2 v^2}{400\pi BR} = 0.01A$

Thus, I_o is 2.

2. **3** P120213

Sol. $R_{Voltmeter} = 6\Omega$, $R_{ammeter} = 0.5\Omega$

$R_{eq} = 10\Omega$

$I = \frac{30}{10} = 3A$

Reading of voltmeter = 1 × 3 = 3 volt.

3. **5** P120305

Sol. $q[v_x\hat{i} + v_y\hat{j}] \times B_0\hat{k} - \alpha[v_x\hat{i} + v_y\hat{j}] = m\frac{d\vec{v}}{dt}$ … (i)

$\therefore \quad a_y = \frac{1}{m}\left[qv_xB_0 + \alpha v_y\right]$ and $a_x = \frac{1}{m}[qB_0v_y - \alpha v_x]$ … (iii)

$\therefore$ At t = 0, $v_y = v_0$ and $v_x = 0$ and t = t, $v_x = 0$, $v_y = 0$

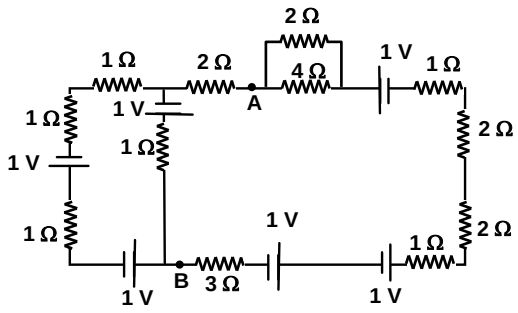
$\therefore \quad v_0 = \frac{1}{m}\left[qB_0x + \frac{\alpha^2 x}{qB_0}\right]$

$\Rightarrow \quad x = \frac{qB_0mv_0}{\alpha^2 + q^2B^2}$ = 10.

Hence, 'n' is 5.

4. **3** P120207

Sol. According to Kirchoff's current rule. Current passing through A towards left = current passing through B toward right.



5. **6** P120216

Sol. Current through 30Ω is $\frac{12}{40}$ A and apply loop rule then charge on the capacitor C_2 is 60μC.

6. **5** P120306

Sol. $\text{Impulse} = \int F dt = \int BIl\, dt \Rightarrow mv = Blq \Rightarrow v = \frac{Blq}{m} \Rightarrow h = \frac{v^2}{2g} = \frac{B^2l^2q^2}{2m^2g}$.

Chemistry

PART – A

1. D (Concept Code: C121206)

Sol. Acetal formation, then attack of G.R on ester to give complex and finally acidification leads to (D).

2. A (Concept Code: C121204)

Sol. Epoxydation, then reduction and finally S_N2.

3. A (Concept Code: C121207)

Sol. Reduction of ketone and then convert –OH to –OTS and finally S_N2

4. D (Concept Code: C121207)

Sol. Grignard reagent formation then decomposition of acetal and acid-base reaction with Ar-MgX

5. D (Concept Code: C121208)

Sol. Conversion to acid chloride, then nucleophilic acyl substitution followed by reduction.

6. A (Concept Code: C121206)

Sol. Ketol formation, then grignard reagent intramolecular attack and finally hydrolysis.

7. A (Concept Code: C121206)

Sol. Acetal formation.

8. A (Concept Code: C121207)

Sol. Reduction followed by selective oxidation.

9. ABC (Concept Code: C121206)

Sol. Fact based

10. ABD (Concept Code: C121207)

Sol. Fact based

11. ABCD (Concept Code: C121206)

Sol. Fact based

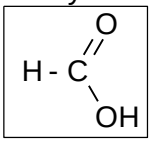
12. BCD (Concept Code: C121206)

Sol. The hydrogen of α-bromoketone is more acidic.

PART – B

1. A $\rightarrow$ PR, B $\rightarrow$ QS, C $\rightarrow$ PQ, D $\rightarrow$ R (Concept Code: C121206, C121207)

Sol. (A) Methyl ketone so PR

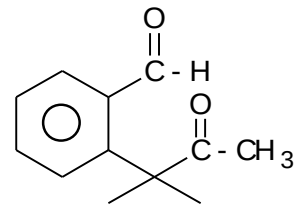
(B)  contains formyl groups so QS.

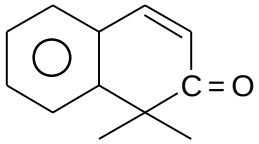
(C) Benzaldehyde does not give fehling test

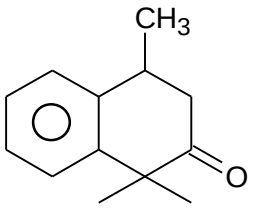
(D) 2-ol will give +ve iodoform test

2. A $\rightarrow$ PQRST B $\rightarrow$ PQ, C $\rightarrow$ RT, D $\rightarrow$ RST (Concept Code: C121206)

Sol.

L is  formed by reductive ozonolysis

M is  formed by intramolecular adol

N is  formed by conjugate addition

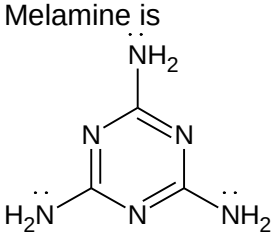
PART – C

1. 6 (Concept Code: C121207)

Sol. β-keto acid, β, r-unsaturated acid and gem-diacid readily undergoes decarboxylation.

2. 9 (Concept Code: C121208)

Sol. Melamine is



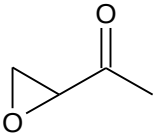
3. 5 (Concept Code: C121206)

Sol. Based catalysted aldol and then crossed Cannizzaro.

4. 4 (Concept Code: C121206)

Sol. X is glyoxal, which undergoes internal Cannizzaro to give α - hydroxyacid after acidification, which gives cyclic diester lactide

5. 2 (Concept Code: C121206)

Sol. X is  formed by conjugate addition of $H - OO^-$ and then elimination.

6. 8 (Concept Code: C121209)

Sol. All the monosaccharides and disaccharides except sucrose are reducing sugar.

Mathematics
MCQ Single Correct (01 – 08) (+3, –2)

1. C M120608

1. $f'(x) = 6x^2 - 18ax + 12a^2 = 0$ (for max or min)

$\Rightarrow \quad x = a, 2a$

$x_2 = x_1^2$

$\Rightarrow a$ cannot be negative.

If $a > 0$, then local minimum occurs at x = 2a and local maximum at x = a. Thus, $x_1 = a$ and $x_2 = 2a$.

2. D M120701

2. $f(x) = \lim\limits_{n\to\infty} \dfrac{x^n - x^{-n}}{x^n + x^{-n}},\ x > 1$

$= \lim\limits_{n\to\infty} \dfrac{1 - x^{-2n}}{1 + x^{-2n}}$

$= \dfrac{1-0}{1+0} = 1$

$$I = \int \frac{x f(x) \ln\left(x + \sqrt{1+x^2}\right)}{\sqrt{1+x^2}} dx = \int \frac{x \ln\left(x + \sqrt{1+x^2}\right)}{\sqrt{1+x^2}} dx$$

Put $\ln\left(x + \sqrt{1+x^2}\right) = t \quad \Rightarrow x + \sqrt{1+x^2} = e^t$

$\Rightarrow \quad \dfrac{dx}{\sqrt{1+x^2}} = dt \quad$ and $\quad \left(e^t - x\right)^2 = 1 + x^2$

or $\quad x = \dfrac{1}{2}\left(e^t - e^{-t}\right)$

$\therefore \quad I = \int \dfrac{1}{2}\left(e^t - e^{-t}\right).t\,dt = \dfrac{1}{2}\left(t\left(e^t + e^{-t}\right) - \left(e^t - e^{-t}\right)\right) + c$

$= \sqrt{1+x^2}\ \ln\left(x + \sqrt{1+x^2}\right) - x + c$

3. B

3. $f'(x) = f(x) + \int_0^1 f(x)$

or $\quad f'(x) = f(x) + k$

Now, solve for f(x).

4. D M120805

4. $I_1 = \int_0^x e^{zx}\ e^{-z^2} dz = \int_0^x e^{-\left(z^2 - zx\right)} dz$

$= \int_0^x e^{-\left(\left(z - \frac{x}{2}\right)^2 - \frac{x^2}{4}\right)} dz = e^{x^2/4} \int_0^x e^{-\left(z - \frac{x}{2}\right)^2} dz$

$= e^{x^2/4} \int_{-x/2}^{x/2} e^{-z^2}\, dz = \dfrac{1}{2} e^{x^2/4} \int_{-x}^{x} e^{-z^2/4}\, dz$

$= e^{x^2/4} \int_0^x e^{-z^2/4}\, dz$

$= e^{x^2/4} I_2$

5. A M120605

5. $f'(x) = |x| - \{x\}$

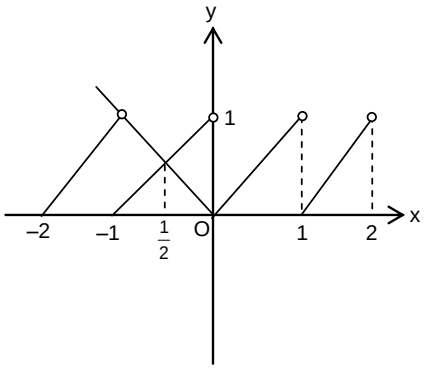
$f'(x) < 0$

$\Rightarrow \quad |x| - \{x\} < 0$

$\Rightarrow \quad |x| < \{x\}$

It is clear from the figure that

$x \in \left(-\frac{1}{2}, 0\right)$.



6. B M120606

6. $f'(x) = 5\left(\frac{\sqrt{a+4}}{1-a} - 1\right)x^4 - 3 < 0$

$\Rightarrow \quad \frac{\sqrt{a+4}}{1-a} - 1 \le 0$

7. B M120601

7. $x^m y = b^m$

Taking logarithm, $\frac{dy}{dx} = -\frac{my}{x}$.

Equation of tangent at (x, y) is $Y - y = -\frac{my}{x}(X - x)$

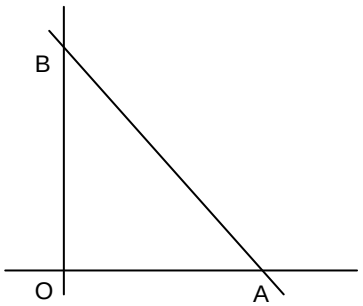
$\Rightarrow \quad \frac{X}{\frac{x(1+m)}{m}} + \frac{Y}{y(1+m)} = 1$

$\therefore$ Area of triangle OAB $= \frac{1}{2}.OA.OB$

$= \frac{1}{2}\left|\frac{x(1+m)}{m}\right||y(1+m)|$

$= \frac{|xy|(1+m)^2}{2|m|}$

For m = 1, area is a constant.



8. C M120602

8. $f'(0) = -\frac{1}{3}$

Replace x^2 by x and then apply LH-rule.

MCQ Multi Correct (09 – 12) (+4, 0)

9. AC M120604, M120608

9. $f(x) = \frac{(x-1)^2 e^x}{(1+x^2)^2}$

$f'(x) = \frac{(x-1)(x^3 - 3x^2 + 5x + 1)}{(x^2+1)^3}.e^x$

Let $g(x) = x^3 - 3x^2 + 5x + 1$

$g'(x) = 3x^2 - 6x + 5$

Discriminant < 0 so g(x) has only one real root.

Also, $g(-1)g(0)<0$ so one root of $g(x)=0$ belongs to the interval $(-1, 0)$.

10. ABCD M120601

10. Given curve is $y=ax^3+b$.

Let point P_1 be $\left(t_1, at_1^3+b\right)$.

Slope of tangent $=3at_1^2$.

$\therefore$ Equation of tangent is $y-\left(at_1^3+b\right)=3\,at_1^2\left(x-t_1\right)$.

Tangent meets the curve at $P_2\left(t_2, at_2^3+b\right)$.

$\therefore \left(at_2^3+b\right)-\left(at_1^3+b\right)=3at_1^2\left(t_2-t_1\right)$

$\Rightarrow \quad a\left(t_2^3-t_1^3\right)=3at_1^2\left(t_2-t_1\right)$

$\Rightarrow \quad t_2^2+t_2t_1-2t_1^2=0$

$\Rightarrow \quad \left(t_2+2t_1\right)\left(t_2-t_1\right)=0$

$\Rightarrow \quad t_2=-2t_1$

Similarly, $t_3=-2t_2$

$\therefore$ Abscissae are in G.P. for all values of a and b.

11. BD

11. We have $f(x)=x^2+ax^2+bx^3$, where $a=\int_{-1}^{1} t.f(t)\,dt$ and $b=\int_{-1}^{1} f(t)\,dt$.

Now, $a=\int_{-1}^{1} t\left((a+1)t^2+bt^3\right)dt$

$$a=\frac{2b}{5} \qquad \text{...(i)}$$

Again, $b=\int_{-1}^{1} f(t)\,dt=\int_{-1}^{1}\left((a+1)t^2+bt^3\right)dt$

$$b=\frac{2(a+1)}{3} \qquad \text{…(ii)}$$

From (i) and (ii), $a=\frac{4}{11}$ and $b=\frac{10}{11}$.

12. ABCD M120802, M120803, M120805, M120806

12. $I=\int_{-\pi}^{\pi}\underbrace{\left(\cos 2x.\cos 2^2x.\cos 2^3x.\cos 2^4x.\cos 2^5x\right)}dx$

$I=2\int_0^{\pi} f(x)\,dx \qquad \left(f(x) \text{ is even}\right)$

$I=2.2\int_0^{\pi/2} f(x)\,dx$

$I=4\int_0^{\pi/2} f(x)\,dx=4I_1$

Now, $I_1=\int_0^{\pi/2} f(x)\,dx$

$I_1=-I_1$

$\therefore \; I_1=0$

$\Rightarrow I=0$

Part – B
2 Comprehension Type (+8, –1)

1. A $\rightarrow$ **Q** **M120804**
   B $\rightarrow$ **P** **M120807**
   C $\rightarrow$ **P** **M120803**
   D $\rightarrow$ **R** **M120807**

1.

(A) $I_1 = \int_2^3 \left((x-1)^3 + (4-x)^3 + x\right)\cos \pi x \, dx$

$= \int_2^3 \left((4-x)^3 + (x-1)^3 + 5 - x\right)\cos\left(\pi(5-x)\right) dx$

$= -\int_2^3 \left((4-x)^3 + (x-1)^3 + 5 - x\right)\cos \pi x \; dx$

$\therefore \; 2I_1 = \int_2^3 (2x-5)\cos \pi x \; dx$

$\Rightarrow 2I_1 = \int_2^3 2x \cos \pi x \, dx - \int_2^3 5\cos \pi x \, dx$

Now, integrate by parts.

$I_1 = -\frac{2}{\pi^2}$

(B) $J = \int_0^{10} \text{sgn}(\sin \pi x) \, dx$

$= 5\int_0^2 \text{sgn}(\sin \pi x) \, dx$ ($\text{sgn}(\sin \pi x)$ is periodic with fundamental period 2)

$= 5\int_0^1 1 dx + 5\int_1^2 (-1) dx = 5 - 5 = 0$

(C) $K = \int_0^{102} \left[\cot^{-1} x\right] dx = \int_0^{\cot 1} 1 dx + \int_{\cot 1}^{102} 0 \; dx = \cot 1 < 1$

So, $[K] = 0$

(D) $L = \frac{\int_0^{51} [x + 25] \, dx}{\int_0^{51} \{x + 25\} \, dx}$

$Nr = \int_0^{51} [x + 25] \, dx = \int_0^{51} (x - \{x\} + 25) \, dx$

$= \frac{51 \times 51}{2} - 51\int_0^1 \{x\} \, dx + 25 \times 51 = 50 \times 51$

Also, $Dr = \int_0^{51} \{x + 25\} \, dx$

$= \int_0^{51} \{x\} \, dx = \frac{51}{2}$

2. A $\rightarrow$ **QS** **M120507**
B $\rightarrow$ **PT** **M120508**
C $\rightarrow$ **ST** **M120508**
D $\rightarrow$ **QR**

2.

(A) $\ln(f(x)) = \ln(x-1) + \ln(x-2) + ... + \ln(x-n)$

$f'(x) = f(x)\left(\frac{1}{x-1} + \frac{1}{x-2} + ... + \frac{1}{x-n}\right)$

$f'(x) = (x-2)(x-3)...(x-n) + (x-1)(x-3)... (x-n) + ... + (x-1)(x-2)...(x-(n-1))$

$f'(n) = (n-1)(n-2)...3.2.1 = (n-1)!$

$5040 = (n-1)! \qquad \Rightarrow n = 8$

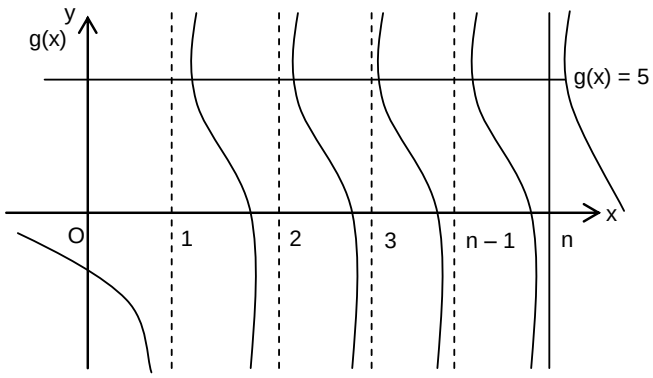
(B) $g(x) = \frac{f'(x)}{f(x)} = \frac{1}{x-1} + \frac{1}{x-2} + ... + \frac{1}{x-n} + k$

$g(x)$ is discontinuous at n points. $\Rightarrow \; n = 9$

(C) $g(x)=5$ has either n – 1 or n roots.

(D) Number of roots of $f'(x)=0$ is n – 1. (Use Rolle's theorem.)

$\Rightarrow (n-1)(n-5)^2=n-1\Rightarrow (n-1)(n-6)(n-4)=0$



Part – C
Integer Type (01 – 06) (+4, –1)

1. 2 M120701

1. $\int \frac{1+x^4}{\left(1-x^4\right)^{3/2}}\,dx=\int \frac{x+\frac{1}{x^3}}{\left(\frac{1}{x^2}-x^2\right)^{3/2}}dx=-\int \frac{t}{t^3}dt=\frac{1}{t}+C_1=\frac{x}{\sqrt{1-x^4}}+C_1$ (Put $\frac{1}{x^2}-x^2=t^2$)

Now, $\int \frac{x}{\sqrt{1-x^4}}dx=\frac{1}{2}\sin^{-1}x^2+C_2$

Hence, $g\left(\frac{1}{\sqrt{2}}\right)=\frac{\pi}{12}=\frac{\pi}{k}$

$\Rightarrow \quad k=12$

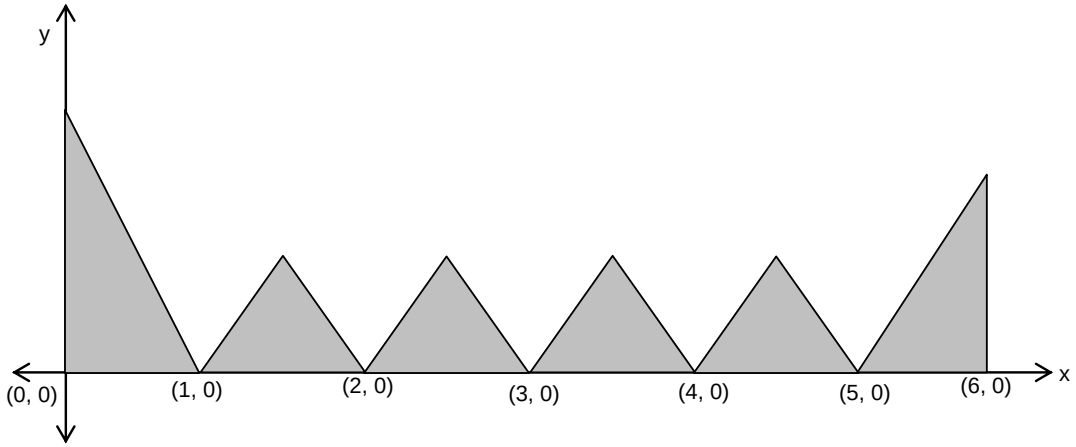
2. 0 M120701

2. Put $\frac{2}{x}=y$.

We get $I=-I\Rightarrow I=0$

3. 5 M120812

3. Here, the area of each big triangle is $\frac{1}{2}$ and there are 2 of them.



Also, the area of each small triangle is $\frac{1}{4}$ and there are (n – 1) of them.

So $\int_0^{n+1} f(x)\,dx = \frac{1}{2}(2) + \frac{1}{4}(n-1)$

4. 4 M120606

4. $f'(x) = x^2 + x + 1 > 0 \ \forall x \in R$

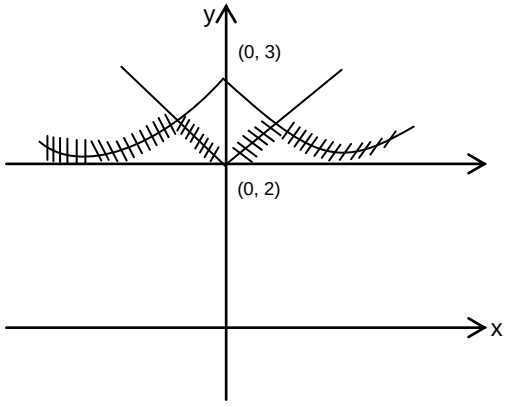
$h(x) = f(g(x))$

$h'(x) = f'\underbrace{(g(x))}_{+ve}\, g'(x)$

$n_1 = 2, n_2 = 2$

5. 9 **M120612**

5. $f'(x) = 2 \Rightarrow$ Graph of $f(x)$ is concave upward on $(0, \infty)$.



As $x \to \infty, f(x) \to \infty$ and $f'(x) \to \infty$.

$$L = \lim_{x\to\infty}\left(\frac{3x^2}{f(x)} - \frac{3}{(x^2+1)f(x)} - \frac{4f'(x)}{f(x)}\right)$$

$$= \lim_{x\to\infty}\left(\frac{6x}{f'(x)} - \frac{4f''(x)}{f'(x)}\right)$$

$$= \lim_{x\to\infty}\left(\frac{6}{f''(x)}\right) = 3$$

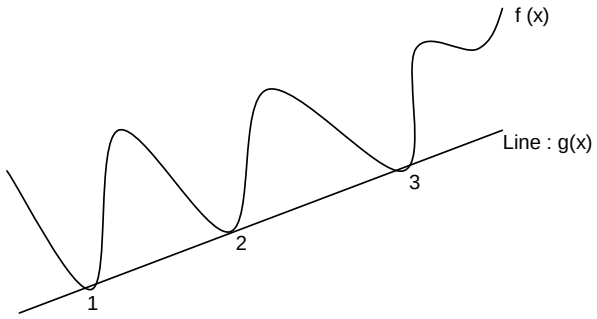
$\therefore \left[L^2\right] = 9$

6. 2 M120606

6. Since the line touches the graph of $f(x)$ at 1, 2, 3,

$h(x) = f(x) - g(x)$ has a double root at 1, 2, 3.

$\therefore \quad h(x) = a(x-1)^2(x-2)^2(x-3)^2$

$I = a\int_1^3 (x-1)^2(x-2)^2(x-3)^2\,dx = \frac{32}{105}$

$\therefore \quad a = 2$