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ANSWER KEY AND MARKING SCHEME

CLASS XII – MATHEMATICS (Code 041) | SESSION 2026–27 Maximum Marks: 80

SECTION A (1 mark each)

Instructions : The marks in [ ] brackets are the step marks in each questions.

Q.No.	Answer / Working	Marks
1.	(D) R is reflexive, symmetric and transitive; hence it is an equivalence relation.	1
2.	(B) $\tan(5\pi/6)=-1/\sqrt{3}$, so $\tan^{-1}(-1/\sqrt{3})=-\pi/6$.	1
3.	(B) $\lvert\text{adj } A\rvert=\lvert A\rvert^{(3-1)}=(-2)^2=4$.	1
4.	(A) $a\cdot b=2(1)+(-1)(2)+2(-1)=-2$.	1
5.	(B) det= $x^2-6=0 \Rightarrow x=\pm\sqrt{6}$.	1
6.	(C) Continuity: $3k+2=6+k \Rightarrow k=2$.	1
7.	(A) $dy/dx=(\cos x-\sin x)/(\sin x+\cos x)$.	1
8.	(C) $V=4\pi r^3/3 \Rightarrow dV/dr=4\pi r^2$; at r=2, $dV/dr=16\pi$.	1
9.	(A) $\int e^x(\sin x+\cos x)dx=e^x\sin x+C$.	1
10.	(C) $\int_0^{\pi} \sin x\,dx=[-\cos x]_0^{\pi}=2$.	1
11.	(A) Highest derivative is second order and its power is 3; order=2, degree=3.	1
12.	(C) I.F.=$e^{\int 3dx}=e^{3x}$.	1
13.	(B) $\cos\theta=(a\cdot b)/(\lvert a\rvert\lvert b\rvert)=10/20=1/2 \Rightarrow \theta=\pi/3$.	1
14.	(B) $\lvert a\times b\rvert=\lvert a\rvert\lvert b\rvert\sin 90°=3\times4=12$.	1
15.	(C) l=m=n and $l^2+m^2+n^2=1 \Rightarrow 3l^2=1 \Rightarrow l=m=n=1/\sqrt{3}$.	1
16.	(B) Z values are 0,20,23,20 respectively; maximum=23.	1
17.	(B) $P(A\cap B)=P(A)P(B)=0.6\times0.5=0.30$.	1
18.	(A) $f'=3x(x-2)$; f' changes + to − at x=0, so local maximum occurs at x=0.	1
19.	(A) For odd order, $\lvert A\rvert=\lvert A^T\rvert=\lvert -A\rvert=-\lvert A\rvert \Rightarrow \lvert A\rvert=0$; R explains A.	1
20.	(C) $f(x)=x^3$ is strictly increasing, but $f'(0)=0$, so the Reason is false.	1

SECTION B (2 marks each)

Q.No.	Answer / Solution (marks shown in brackets)	Marks
21.	$\sin^{-1}(1/2)=\pi/6$ [½]; $\cos^{-1}(-1/2)=2\pi/3$ [½]; sum=$5\pi/6$ [1]. OR One-one: $f(x_1)=f(x_2) \Rightarrow 3x_1-5=3x_2-5 \Rightarrow x_1=x_2$ [1]. For any $y\in R$, $x=(y+5)/3\in R$ and f(x)=y; hence onto and bijective [1].	2
22.	$\lvert A\rvert=3(2)-5(1)=1$ [½]. adj A=[[2,−1],[−5,3]] [1]. Hence $A^{-1}=(1/\lvert A\rvert)$adj A=[[2,−1],[−5,3]] [½].	2
23.	Differentiating: $2x+y+x(dy/dx)+2y(dy/dx)=0$ [1]. Therefore $dy/dx=-(2x+y)/(x+2y)$ [1].	2
24.	Put 3x=t, dx=dt/3 [½]. $\int dx/\sqrt{(16-9x^2)}=(1/3)\int dt/\sqrt{(16-t^2)}=(1/3)\sin^{-1}(t/4)+C$ [1]. Hence $(1/3)\sin^{-1}(3x/4)+C$ [½].	2
25.	$a\times b=(5,-5,-5)$ [1]; area=$\lvert a\times b\rvert=\sqrt{75}=5\sqrt{3}$ sq. units [1]. OR $a\cdot b=2-2\lambda+3=0$ [1] $\Rightarrow \lambda=5/2$ [1].	2

SECTION C (3 marks each)

Q.No.	Answer / Solution (marks shown in brackets)	Marks
26.	For $y=x^x$, $\log y=x\log x$ [1].	3

	Thus $(1/y)dy/dx=\log x+1$ [1]. Hence $dy/dx=x^x(\log x+1)$ [1]. OR $Dx=a\theta\cos\theta$ [1]; $Dy=a\theta\sin\theta$ [1]; therefore $dy/dx=\tan\theta$ [1].	
27.	$(2x+3)/[(x+1)(x+2)]=1/(x+1)+1/(x+2)$ [1]. Therefore $\int=\log\|x+1\|+\log\|x+2\|+C$ [2].	3
28.	Let $I=\int_0^{(\pi/2)} \sin x/(\sin x+\cos x)dx$ [½]. By $x\to\pi/2-x$, $I=\int_0^{(\pi/2)} \cos x/(\sin x+\cos x)dx$ [1]. Adding, $2I=\int_0^{(\pi/2)}1dx=\pi/2$ [1], so $I=\pi/4$ [½].	3
29.	For $dy/dx-y\tan x=\sin x$: $I.F.=e^{\int(-\tan x)dx}=\cos x$ [1]. Hence $d(y\cos x)/dx=\sin x\cos x$; $y\cos x=(1/2)\sin^2x+C$ [1]. Therefore $y=(1/2)\sin x\tan x+C\sec x$ [1]. OR For $dy/dx+y\cot x=\sin x$: $I.F.=\sin x$ [1]. Hence $d(y\sin x)/dx=\sin^2x$; $y\sin x=x/2-\sin2x/4+C$ [1]. Therefore $y=(x/2-\sin2x/4+C)\operatorname{cosec} x$ [1].	3
30.	Direction vectors are $b_1=(2,-1,2)$, $b_2=(1,2,2)$ [½]. $b_1\cdot b_2=4$ and $\|b_1\|=\|b_2\|=3$ [1]. Hence $\cos\theta=4/9$ [1], so $\theta=\cos^{-1}(4/9)$ [½].	3
31.	Let E_1=Bag I, E_2=Bag II and R=red. $P(E_1)=P(E_2)=1/2$ [½]. $P(R\|E_1)=4/7$, $P(R\|E_2)=2/7$ [½]. By Bayes, $P(E_1\|R)=[(1/2)(4/7)]/[(1/2)(4/7)+(1/2)(2/7)]$ [1] $=2/3$ [1].	3

SECTION D (5 marks each)

Q.No.	Answer / Solution (marks shown in brackets)	Marks
32.	$A=[[2,1,1],[1,2,1],[1,1,2]]$, $X=[x,y,z]^T$, $B=[6,6,6]^T$ [½]. $\|A\|=4\neq0$, so A^{-1} exists [1]. $A^{-1}=(1/4)[[3,-1,-1],[-1,3,-1],[-1,-1,3]]$ [1]. $X=A^{-1}B=[3/2,3/2,3/2]^T$ [2]. Hence $x=y=z=3/2$ [½].	5
33.	For $y^2=4x$ and $x=3$, $y=\pm2\sqrt{x}$. $Area=\int_0^3 4\sqrt{x}\,dx$ [2] $=[8/3\ x^{(3/2)}]_0^3$ [1] $=8\sqrt{3}$ sq. units [2]. OR For $y^2=8x$, $x=y^2/8$ and $y=2x\Rightarrow x=y/2$; intersections $y=0,4$ [1]. $Area=\int_0^4(y/2-y^2/8)dy$ [2] $=4/3$ sq. units [2].	5
34.	$f'(x)=3x^2-12x+9=3(x-1)(x-3)$ [1]. Critical points $x=1,3$; $f'>0$ on $(-\infty,1)$ and $(3,\infty)$, $f'<0$ on $(1,3)$ [1½]. Thus increasing on $(-\infty,1)\cup(3,\infty)$, decreasing on $(1,3)$ [1]. $f(1)=16$ gives local maximum; $f(3)=12$ gives local minimum [1½]. OR $f'=3(x-1)(x-3)$; critical points 1,3 [1½]. $f(0)=5$, $f(1)=9$, $f(3)=5$, $f(4)=9$ [2]. Absolute maximum=9 and absolute minimum=5 [1½].	5
35.	For the first pair, $a_1=(2,-1,1)$, $b_1=(1,2,-1)$, $a_2=(1,3,-2)$, $b_2=(2,-1,2)$ [1]. $a_2-a_1=(-1,4,-3)$ [1]. $b_1\times b_2=(3,-4,-5)$, $\|b_1\times b_2\|=5\sqrt{2}$ [1]. $(a_2-a_1)\cdot(b_1\times b_2)=-4$ [1]. Therefore $SD=4/(5\sqrt{2})=2\sqrt{2}/5$ units [1]. OR For the symmetric lines, $a_1=(1,2,3)$, $b_1=(2,3,4)$, $a_2=(2,4,6)$, $b_2=(3,4,5)$ [1]. $a_2-a_1=(1,2,3)$ [1]. $b_1\times b_2=(-1,2,-1)$, magnitude $\sqrt{6}$ [1]. Dot product $=(1,2,3)\cdot(-1,2,-1)=0$ [1]. Hence shortest distance=0; the lines intersect [1].	5

SECTION E (4 marks each)

Q.No.	Answer / Solution (marks shown in brackets)	Marks
36.	(i) For any $a\in A$, $a-a=0$, divisible by 2; hence $(a,a)\in R$, so R is reflexive [1]. (ii) If $a-b$ is divisible by 2, then $b-a=-(a-b)$ is divisible by 2; hence R is symmetric [1]. (iii) If $a-b$ and $b-c$ are divisible by 2, then $a-c=(a-b)+(b-c)$ is divisible by 2; hence R is transitive [1]. Equivalence classes: [1]={1,3,5}, [2]={2,4,6} [1].	4
37.	(i) Maximise $Z=40x+30y$ subject to $2x+y\leq40$, $x+2y\leq50$, $x\geq0,y\geq0$ [1]. (ii) Corner points are (0,0), (20,0), (10,20), (0,25) [2].	4

	(iii) Z values: 0,800,1000,750; maximum profit=₹1000 at x=10,y=20 [1].	
38.	(i) P(A)=0.40, P(B)=0.35, P(C)=0.25 [1]. (ii) P(D)=0.40(0.02)+0.35(0.03)+0.25(0.04)=0.0285 [1]. (iii) P(B|D)=P(B)P(D|B)/P(D)=0.0105/0.0285=7/19 [2].	4