# EXERCISE 29.8

**Q1.**
**Solution:**
Given:
Equation of plane is $2x - 3y + z = 0$ …… (1)
We know that equation of a plane is parallel to given plane (1) is given as
$2x - 3y + z + k = 0$ …… (2)

Given that, plane (2) is passing through the point (1, – 1, 2). So it must satisfy plane (2),
$2(1) - 3(-1) + (2) + k = 0$
$2 + 3 + 2 + k = 0$
$7 + k = 0$
$k = -7$
Now, substitute the value of k in equation (2), we get
$2x - 3y + z - 7 = 0$
Hence, the equation of the required plane is, $2x - 3y + z = 7$.

**Q2.**
**Solution:**
Given:
The equation of the plane is:
$\vec{r}.\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) + 2 = 0$ …… (1)
We know that the equation of a plane is parallel to given plane (1) is given as
$\vec{r}.\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) + k = 0$ …… (2)
Given that, plane (2) is passing through the point $3\hat{i} + 4\hat{j} - \hat{k}$. So it must satisfy the equation (2),
$3\hat{i} + 4\hat{j} - \hat{k}\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) + k = 0$
$(3)(2) + (4)(-3) + (-1)(5) + k = 0$
$6 - 12 - 5 + k = 0$
$k = 11$
Now, substitute the value of k in equation (2), we get
$\vec{r}.\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) + 11 = 0$
Hence, the required equation of plane is,
$\vec{r}.\left(2\hat{i} - 3\hat{j} + 5\hat{k}\right) + 11 = 0$

**Q3.**
**Solution:**
We know that, equation of a plane passing through the line of intersection of two planes $a_1x + b_1y + c_1z + d_1 = 0$ and $a_2x + b_2y + c_2z + d_2 = 0$ is given by
$(a_1x + b_1y + c_1z + d_1) + k(a_2x + b_2y + c_2z + d_2) = 0$

Given, equation of plane is,
$2x – 7y + 4z – 3 = 0$ and
$3x – 5y + 4z + 11 = 0$

So equation of plane passing through the line of intersection of given two planes is
$(2x – 7y + 4z – 3) + k(3x – 5y + 4z + 11) = 0$
$2x – 7y + 4z – 3 + 3kx – 5ky + 4kz + 11k = 0$
$x(2 + 3k) + y( – 7 – 5k) + z(4 + 4k) – 3 + 11k = 0$ ……(1)

It is given that, plane (1) is passing through the point (–2, 1, 3). So it must satisfy the equation (1),
$(– 2) (2 + 3k) + (1) (– 7 – 5k) + (3) (4 + 4k) – 3 + 11k = 0$
$– 2 + 12k = 0$
$12k = 2$
$k = 2/12$
$= 1/6$
Now substitute the value of k in equation (1), we get
$x(2 + 3k) + y(– 7 – 5k) + z(4 + 4k) – 3 + 11k = 0$

$$x\left(2+\frac{3}{6}\right)+y\left(-7-\frac{5}{6}\right)+z\left(4+\frac{4}{6}\right)-3+\frac{11}{6}=0$$

$$x\left(\frac{12+3}{6}\right)+y\left(\frac{-42-5}{6}\right)+z\left(\frac{24+4}{6}\right)-\frac{18+11}{6}=0$$

$$\frac{15}{6}x-\frac{47}{6}y+\frac{28}{6}z-\frac{7}{6}=0$$

Multiply by 6, we get
$15x – 47y + 28z – 7 = 0$
Hence, the required equation of plane is $15x – 47y + 28z – 7 = 0$.

**Q4.**
**Solution:**
We know that, the equation of a plane passing through the line of intersection of two planes
$\vec{r}.\overrightarrow{n_1} = d_1$ and $\vec{r}.\overrightarrow{n_2} = d_2$ is given by

$\vec{r}.(\vec{n_1} + k\vec{n_2}) = d_1 + kd_2$

So the equation of the plane passing through the line of intersection of given two planes
$\vec{r}.(\hat{i} + 3\hat{j} - \hat{k}) = 0$ and $\vec{r}.(\hat{j} + 2\hat{k}) = 0$ is given by
$\vec{r}.\left(\hat{i} + 3\hat{j} - \hat{k} + k(\hat{j} + 2\hat{k})\right) = 0$ …… (1)

It is given that, plane (1) is passing through the point $2\hat{i} + \hat{j} - \hat{k}$. So it must satisfy equation (1).

$(2\hat{i} + \hat{j} - \hat{k})(\hat{i} + 3\hat{j} - \hat{k}) + k(2\hat{i} + \hat{j} - \hat{k})((\hat{j} + 2\hat{k}) = 0$
(2) (1) + (1) (3) + (–1) (–1) + k[(2) (0) + (1) (1) + (–1) (2)] = 0
(2 + 3 + 1) + k(1 – 2) = 0
6 – k = 0
k = 6
Now substitute the value of k in equation (1), we get
$\vec{r}.\left(\hat{i} + 3\hat{j} - \hat{k} + k(\hat{j} + 2\hat{k})\right) = 0$
$\vec{r}.\left(\hat{i} + 3\hat{j} - \hat{k} + 6(\hat{j} + 2\hat{k})\right) = 0$
$\vec{r}.\left(\hat{i} + 3\hat{j} - \hat{k} + 6\hat{j} + 12\hat{k}\right) = 0$
$\vec{r}.\left(\hat{i} + 9\hat{j} + 11\hat{k}\right) = 0$
Hence, the equation of the required plane is
$\vec{r}.\left(\hat{i} + 9\hat{j} + 11\hat{k}\right) = 0$

**Q5.**
**Solution:**
We know that, equation of a plane passing through the line of intersection of two planes
$a_1x + b_1y + c_1z + d_1 = 0$ and $a_2x + b_2y + c_2z + d_2 = 0$ is given by
$(a_1x + b_1y + c_1z + d_1) + k(a_2x + b_2y + c_2z + d_2) = 0$

So equation of plane passing through the line of intersection of given two planes
2x – y = 0 and 3z – y = 0 is
(2x – y) + k(3z – y) = 0
2x – y + 3kz – ky = 0
x(2) + y( – 1 – k) + z(3k) = 0 …… (1)

We know that, two planes are perpendicular if
$a_1a_2 + b_1b_2 + c_1c_2 = 0$ …… (2)

It is given, plane (1) is perpendicular to plane
$4x + 5y – 3z = 8$ …… (3)

By using equation (1) and (3) in equation (2), we get
$(2)(4) + (–1 – k)(5) + (3k)(–3) = 0$
$8 – 5 – 5k – 9k = 0$
$3 – 14k = 0$
$–14k = –3$
$k = 3/14$

Now, substitute the value of k in equation (1), we get
$x(2) + y(– 1 – k) + z(3k) = 0$
$$2x + y\left(-1-\frac{3}{14}\right) + z.3\left(\frac{3}{14}\right) = 0$$
$$2x + y\left(\frac{-14-3}{14}\right) + \frac{9z}{14} = 0$$
$$2x + y\left(-\frac{17}{14}\right) + \frac{9z}{14} = 0$$
Multiply by 14, we get
$28x – 17y + 9z = 0$
Hence, the required equation of plane is, $28x – 17y + 9z = 0$.