Vectors and Projectiles Practice
Answer Section

MULTIPLE CHOICE

1. C
2. D
3. D
4. A
5. D
6. D
7. C
8. B
9. C
10. D
11. C
12. C

PROBLEM

13. The pilot should steer the plane in a direction south 14° east to compensate for the effect of the crosswind.
14. **a** resultant velocity, V_R
    $= \sqrt{(0.80^2 + 0.45^2)} = 0.92$ m /s $\theta = \tan^{-1}(0.45/0.80) = 29°$
    $\therefore V_R = 0.92$ m /s at 61° to the riverbank.
    b $x = 20 \tan\theta = 20 \tan 29° = 11.3$ m.
15. **a** The horizontal velocity of the ball remains constant and $v_x = 10$ m s^{-1}
    b $V_2^2 = V_1^2 + 2ad$
    and $v_y^2 = 0^2 + 2(9.8 \text{ m s}^{-2})(1.0 \text{ m})$
    and $v_y = 4.4$ m /s down.
    c $v = [(10 \text{ m/s})^2 + (4.43 \text{ m /s})^2]^{1/2} = 10.9$ m /s at 24° to the horizontal, where the angle is determined from
    $\tan\theta = 4.43 \text{ m s}^{-1}/10 \text{ m s}^{-1} = 0.443$ and $\theta = 24°$
    d $d = V_1 t + 0.5at^2$
    and $1.0 \text{ m} = 0 + 0.5(9.8 \text{ m s}^{-2})t^2$
    so $t = 0.45$ s
    e Horizontal distance = (Vx)(time) = (10 m /s)(0.45 s) = 4.5 m.
16. a) start and finish - 28 m/s

    b) minimum velocity = Vx at the the peak = cos 30(28)

    c) time occurs when Vy = 0, $t = \dfrac{0 - Vy}{9.81} = \dfrac{0 - \sin 30(28)}{9.81}$

17. **a** The flight of the ball is symmetrical,
therefore the time for it to reach the ground after launching = 2(1.43 s) =2.86 s
b The flight of the ball is symmetrical, therefore the ball will strike the ground at the same velocity as which it was launched: 28 m /s at an angle of 30° to the horizontal.
c horizontal range = (horizontal speed)(time) = (24.2 m /s)(2.86 s) = 69.2 m.

18. **a** $V_2 = V_1 + at$
$\therefore V_1 = V_2 - at$
$= 0-(-9.8 \times 1.75)$
$= 17.2$ m /s.
b $d = V_1 t + 1/2at^2$
$= (17.2 \times 1.75) + (0.5 \times -9.8 \times 1.75^2)$
$= 15.1$ m.
c $V_R = 17.2/\sin 45°$
$= 24.3$ m /s.
d Distance = speed × t
$= 17.2 \times 3.5$
$= 60.2$ m.

19. Answer: The initial vertical velocity u_y can be determined from:
$0 = v_y^2 - 2(9.8 \text{ m /s}^2)(100 \text{ m})$
and $v_y = 44.27$ m /s.
The initial horizontal velocity u_x can be determined from:
$200 \text{ m} = v_x T$,
where T = time of flight of ball.
T is found using $0 = 44.27 \text{ m/ s} - (9.8 \text{ m /s}^2)t$,
where t is the time taken for the ball to reach its maximum height.
Then t = 4.517 s
and T = 2(4.517 s) = 9.035 s.
Consequently $v_x = 200 \text{ m}/9.035 \text{ s} = 22.14$ m /s.
The initial speed of the ball is given by:
$v = [(44.27 \text{ m /s})^2 + (22.14 \text{ m /s})^2]^{1/2} = 50$ m /s.

20. Cos (50) * 40 + Cos (30)* 70 - 90 N = Fy