Summary Method M1 (Jan '09)

1.
Use conservation of momentum principle $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$.

2.
a)
Read off points where the graph crosses the x axis.
b)
Area under a velocity-time graph gives displacement. Note that below the axis represents negative displacement.
c)
Calculate positive displacement for the first 30 seconds, then negative displacement during the last 20 seconds. The magnitude of displacement gives distance travelled.
d)
To find the distance away, you need the total displacement rather than the total distance. This time, take the negative signs into consideration.

3.
a)
Draw a force diagram and resolve forces parallel to the plane. Use $F = ma$.
b)
Use kinematic equations of motion to determine acceleration. $s = ut + \frac{1}{2}at^2$.
c)
Additional resistive forces are likely to be affecting motion – friction between the box and the surface.

4.
a)
The peg must be smooth, otherwise friction between it and the string would affect motion.
b)
The string must be light (so its mass does not affect motion) and inextensible (so it cannot store energy through elastic potential).
c)
Resolve forces vertically for each particle separately, solving the resulting equations simultaneously for a.
d)
i.
Use kinematic equations of motion to determine the velocity after this time.
ii.
Use kinematic equations to determine the displacement of either particle after this time. Note that for them to be at the same level each need only move $\frac{d}{2}$ because they are travelling towards each other.

5.

a)

The forces acting on the sledge will be the force exerted by the child, the weight of the sledge, the normal reaction of the sledge with the ground and friction between the sledge and the ground.

b)

Resolve forces vertically and note that the sledge is in equilibrium.

c)

Resolve forces horizontally and note that the sledge is in equilibrium.

d)

Use the inequality $F_r \leq \mu R$ for a body in equilibrium to find an inequality for μ.

6.

a)

To find the resultant of two vectors, add them together (i components with i components, j components with j components).

b)

Use Pythagoras to calculate the magnitude of your answer to a).

c)

Use $F = ma$. Note that acceleration and force are both vectors while mass is a scalar.

d)

i.

Use kinematic equations with the given acceleration. $x = x_0 + ut + \frac{1}{2}at^2$.

ii.

Substitute $t = 2$ into your expression for d)i, then calculate the magnitude using Pythagoras.

7.

a)

Draw a vector triangle and use the cosine rule (or resolve horizontally and vertically and use Pythagoras).

b)

Use the vector triangle to determine the angle. Make sure you leave it as a 3-figure bearing from north.

8.

a)

Use kinematics equations with final vertical velocity 0 to calculate the maximum vertical displacement.

b)

Use kinematics vertically with a displacement of 2 metres to calculate the time taken for the ball to be caught. Note that your equation will be a quadratic with two possible solutions, the larger of which is appropriate to the situation in the diagram.

c)

Use the vertical equations to calculate the vertical component of velocity, and horizontal ($speed = \frac{dist}{time}$) to calculate the horizontal component. Use Pythagoras to combine.