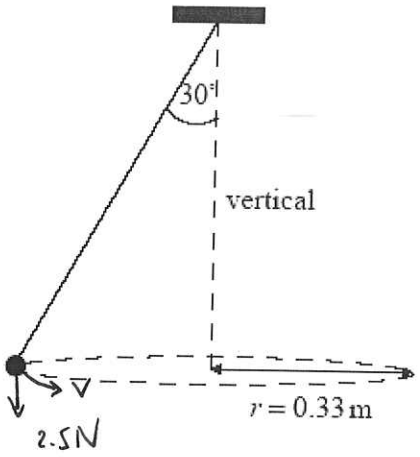
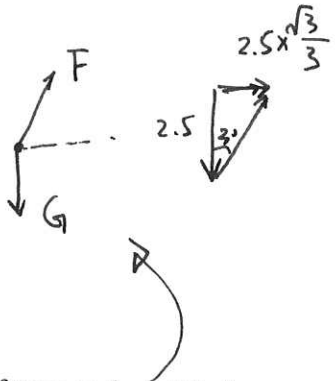
1. This question is about circular motion.

A ball of mass 0.25 kg is attached to a string and is made to rotate with constant speed v along a horizontal circle of radius $r = 0.33$ m. The string is attached to the ceiling and makes an angle of 30° with the vertical.





(a) (i) On the diagram above, draw and label arrows to represent the forces on the ball in the position shown.

(2)

(ii) State and explain whether the ball is in equilibrium.

No. $F_{net} \neq 0$ $a \neq 0$

(2)

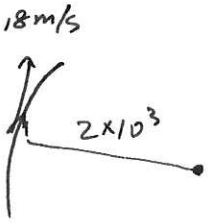
(b) Determine the speed of rotation of the ball.

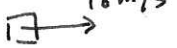
$F = mv^2/r$

$0.33 \times 1.44 = 0.25\, v^2$ $v = 1.38$

2. This question is about circular motion

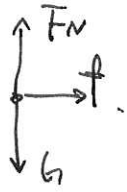
(a) A car is travelling at constant speed of 18 m s^{-1} around a horizontal bend in the road. The mass of the car is 1.5×10^3 kg and the bend forms part of a circle of radius 2.0×10^3 m.





(i) State why the car is accelerating.

direction changes.



(1)

(ii) Determine the frictional force between the tyres of the car and the surface of the road that produces the acceleration.

$F = m\frac{v^2}{r} = 1.5 \times 10^3 \frac{18^2}{2 \times 10^3}$

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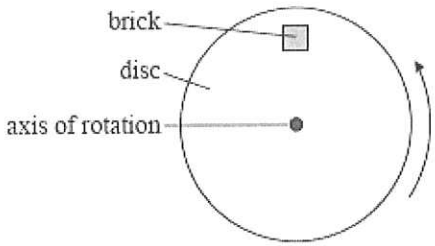
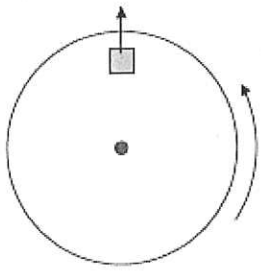
3. A brick is placed on the surface of a flat horizontal disc as shown in the diagram below. The disc is rotating at constant speed about a vertical axis through its centre. The brick does not move relative to the disc.

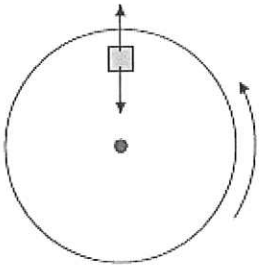


Which of the diagrams below correctly represents the **horizontal** force or forces acting on the brick?

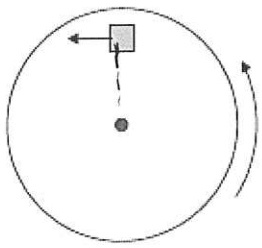
A.



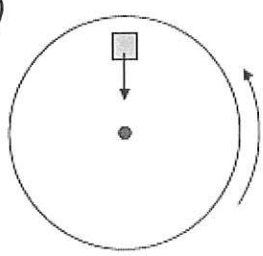
B.



C.

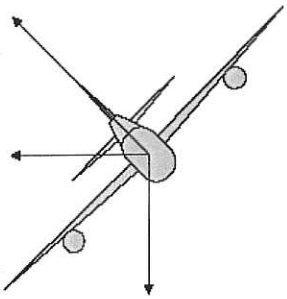


D.

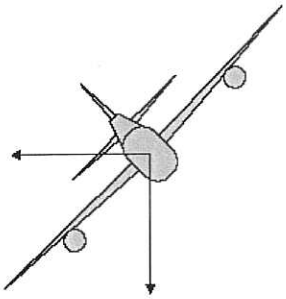


4. An aircraft is flying at constant speed in a horizontal circle. Which of the following diagrams best illustrates the forces acting on the aircraft in the vertical plane?

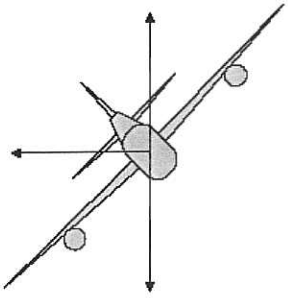
A.



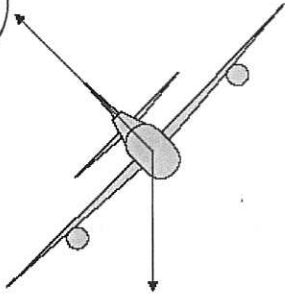
B.



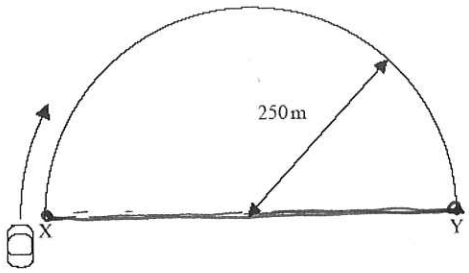
C.



D.



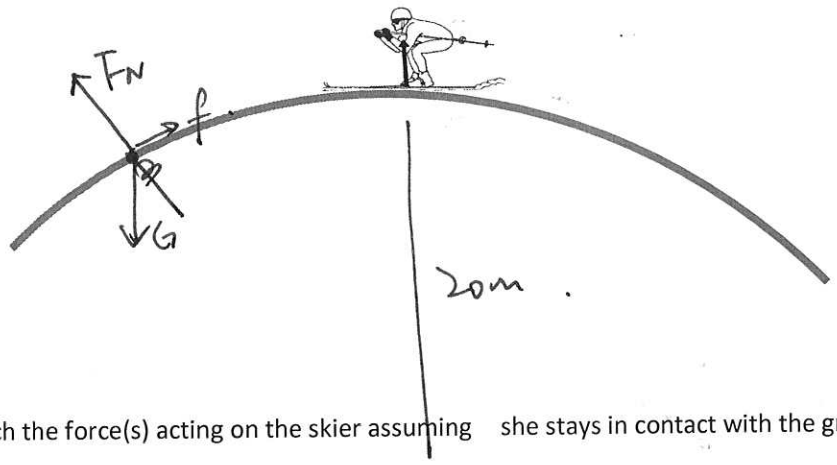
5. A car moves from X to Y along a semicircular path. The radius of the path is 250 m and the time taken to complete the trip is 50 s.



Which of the following correctly shows the magnitude of the average velocity and the magnitude of the average speed?

	Average velocity	Average speed
A.	10 m s^{-1}	10 m s^{-1} ✓
B.	10 m s^{-1}	16 m s^{-1}
C.	16 m s^{-1} ✓	10 m s^{-1} ✓
D.	16 m s^{-1} ✓	16 m s^{-1}

1. A **50kg** skier is riding over a hill as shown below. The hill has a **radius of 20m**



(a) Sketch the force(s) acting on the skier assuming she stays in contact with the ground (2)

It is possible that the skier could be travelling with a speed at the top of the hill such that they briefly leave the surface.

(b) What is the acceleration of the skier at the instant they leave the surface? (1)

$a = \frac{F}{m} = \frac{500}{50} = 10 \text{ m s}^{-2}$

(c) Show that the speed at which the speed must be travelling in order to **briefly** leave the surface is 14 ms^{-1}.

$F = m\frac{v^2}{r}$ $\quad 500 = 50\frac{v^2}{20}$

$v^2 = 200 = 14$ ✓

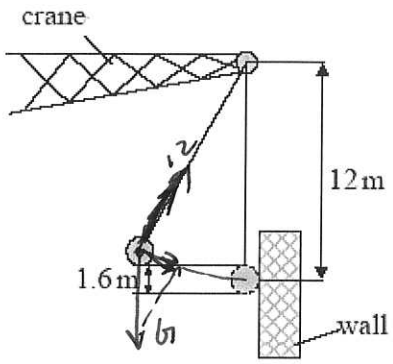
Assume now the skier were to reach the top of the hill with half the speed determined in question (c)

(d) What **normal force** does the skier experience while travelling with a speed of half of the value required to leave the surface? (2)

$G - F_N = 500 \times \frac{1}{4}$ $\quad F_N = 500 - 125$

$= 125\ N$ $\quad = 375\ N$

The ball is pulled back from the vertical and then released. It falls through a vertical height of 1.6 m and strikes a wall.



v

5.66.

(i) Calculate the speed of the ball just before impact.

$\Delta E_p = \Delta E_K$

$mg(1.6) = \frac{1}{2} m v^2$ $\quad \sqrt{20 \times 1.6} = v^2$ $\quad v^2 = 5.66.$

(2)

(ii) Calculate the tension in the rope just before impact.

$a = 0$ $\quad F = 0$

$F = G$