1)

The wheel of the London Eye has a diameter of 130 m and rotates at a steady speed, completing one rotation every 30 minutes. What is the centripetal acceleration of a person in a capsule at the rim of the wheel?

A $1.2 \times 10^{-4}\,\mathrm{m\,s^{-2}}$

B $2.5 \times 10^{-4}\,\mathrm{m\,s^{-2}}$

C $3.9 \times 10^{-4}\,\mathrm{m\,s^{-2}}$

D $7.9 \times 10^{-4}\,\mathrm{m\,s^{-2}}$

2)

A body of mass 0.50 kg, fixed to one end of a string, is rotated in a vertical circle of radius 1.5 m at an angular speed of $5.0\,\mathrm{rad\,s^{-1}}$. What is the maximum tension in the string?

A 5.0N

B 14N

C 19N

D 24N

3)

A mass on the end of a string is whirled round in a horizontal circle at increasing speed until the string breaks. The subsequent path taken by the mass is

A a straight line along a radius of the circle.
B a horizontal circle.
C a parabola in a horizontal plane.
D a parabola in a vertical plane.

4)

A young child of mass 20 kg stands at the centre of a uniform horizontal platform which rotates at a constant angular speed of $3.0\,\mathrm{rad\,s^{-1}}$. The child begins to walk radially outwards towards the edge of the platform. The maximum frictional force between the child and the platform is 200 N. What is the maximum distance from the centre of the platform to which the child could walk without the risk of slipping?

A 1.1 m
B 1.3 m
C 1.5 m
D 1.7 m

5) You should have done Gravitational fields before attempting this question

A satellite of mass m is in a circular orbit at height R above the surface of a uniform spherical planet of radius R and density ρ.

What is the force of gravitational attraction between the satellite and the planet?

A $\frac{\pi\rho GmR}{3}$

B $\frac{2\pi\rho GmR}{3}$

C $\frac{\pi\rho GmR^2}{3}$

D $\frac{2\pi\rho GmR^2}{3}$

6) You should have done Gravitational fields before attempting this question

A satellite orbiting the Earth moves to an orbit which is closer to the Earth.

Which line, **A** to **D**, in the table shows correctly what happens to the speed of the satellite and to the time it takes for one orbit of the Earth?

	Speed of satellite	Time for one orbit of Earth
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

7) You should have done Gravitational fields before attempting this question

A small body of mass m rests on a horizontal turntable at a distance r from the centre. If the maximum frictional force between the body and the turntable is $\frac{mg}{2}$, what is the angular speed at which the body starts to slip?

A $\sqrt{\frac{gr}{2}}$

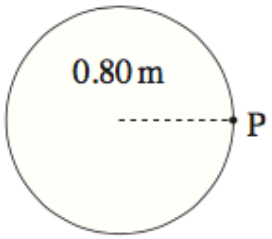
B $\frac{g}{r}$

C $\sqrt{\frac{g}{2r}}$

D $\frac{1}{2}\sqrt{\frac{g}{r}}$

8)

A model car moves in a circular path of radius 0.80 m at an angular speed of $\frac{\pi}{2}$ rad s^{-1}.



What is its displacement from point P 6.0 s after passing P?

A zero

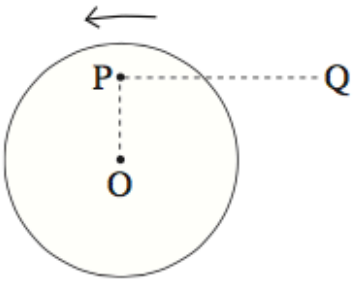
B 0.4π m

C 1.6 m

D 1.6π m

9)

A small mass is placed at P on a horizontal disc which has its centre at O. The disc rotates anti-clockwise about a vertical axis through O with constant angular speed.



Which one of the following describes the force which keeps the mass at rest relative to the disc when in the position shown?

A the weight of the mass

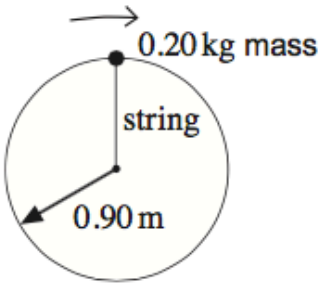
B a frictional force from P to Q

C a frictional force directed away from O

D a frictional force directed towards O

10)

A 0.20 kg mass is whirled round in a vertical circle on the end of a light string of length 0.90 m.



At the top point of the circle the speed of the mass is $8.2\,\text{m s}^{-1}$. What is the tension in the string at this point?

A 10 N

B 13 N

C 17 N

D 20 N

11)

The Earth moves around the Sun in a circular orbit with a radius of 1.5×10^8 km. What is the Earth's approximate speed?

A $1.5 \times 10^3\,\text{m s}^{-1}$

B $5.0 \times 10^3\,\text{m s}^{-1}$

C $1.0 \times 10^4\,\text{m s}^{-1}$

D $3.0 \times 10^4\,\text{m s}^{-1}$

12)

A particle moves in a circular path at constant speed. Which one of the following statements is correct?

A The velocity of the particle is directed towards the centre of the circle.

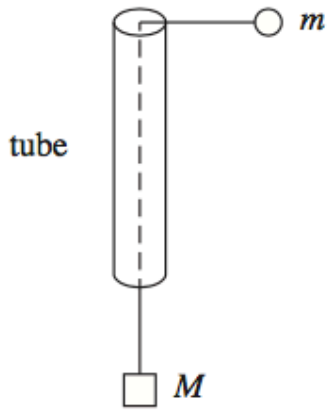
B There is no force acting on the particle.

C There is no change in the kinetic energy of the particle.

D The particle has an acceleration directed along a tangent to the circle.

13)

The diagram shows a smooth thin tube through which passes a string with masses m and M attached to its ends. The tube is moved so that the mass m travels in a horizontal circle of constant radius r at constant speed v.



Which one of the following expressions is equal to M?

A $\frac{mv^2}{2r}$

B mv^2rg

C $\frac{mv^2}{rg}$

D $\frac{mv^2g}{r}$

14)

For a particle moving in a circle with uniform speed, which one of the following statements is correct?

A The kinetic energy of the particle is constant.
B The force on the particle is in the same direction as the direction of motion of the particle.
C The momentum of the particle is constant.
D The displacement of the particle is in the direction of the force.

15)

A particle travels at a constant speed around a circle of radius r with centripetal acceleration a. What is the time taken for ten complete rotations?

A $\frac{\pi}{5}\sqrt{\frac{a}{r}}$

B $\frac{\pi}{5}\sqrt{\frac{r}{a}}$

C $20\pi\sqrt{\frac{a}{r}}$

D $20\pi\sqrt{\frac{r}{a}}$

16)

A particle of mass m moves in a circle of radius r at uniform speed, taking time T for each revolution. What is the kinetic energy of the particle?

A $\frac{\pi^2 mr}{T^2}$

B $\frac{\pi^2 mr^2}{T^2}$

C $\frac{2\pi^2 mr^2}{T}$

D $\frac{2\pi^2 mr^2}{T^2}$

17)

A lead ball of mass 0.25 kg is swung round on the end of a string so that the ball moves in a horizontal circle of radius 1.5 m. The ball travels at a constant speed of 8.6 m s^{-1}.

(a) (i) Calculate the angle, in degrees, through which the string turns in 0.40 s.

[3 marks]

angle ..... degree

(a) (ii) Calculate the tension in the string.
You may assume that the string is horizontal.

[2 marks]

tension ..... N

(b) The string will break when the tension exceeds 60 N.
Calculate the number of revolutions that the ball makes in one second when the tension is 60 N.

[2 marks]

number of revolutions .....

(c) Discuss the motion of the ball in terms of the forces that act on it. In your answer you should:

- explain how Newton's three laws of motion apply to its motion in a circle
- explain why, in practice, the string will not be horizontal.

You may wish to draw a diagram to clarify your answer.

The quality of your written communication will be assessed in your answer.

[6 marks]

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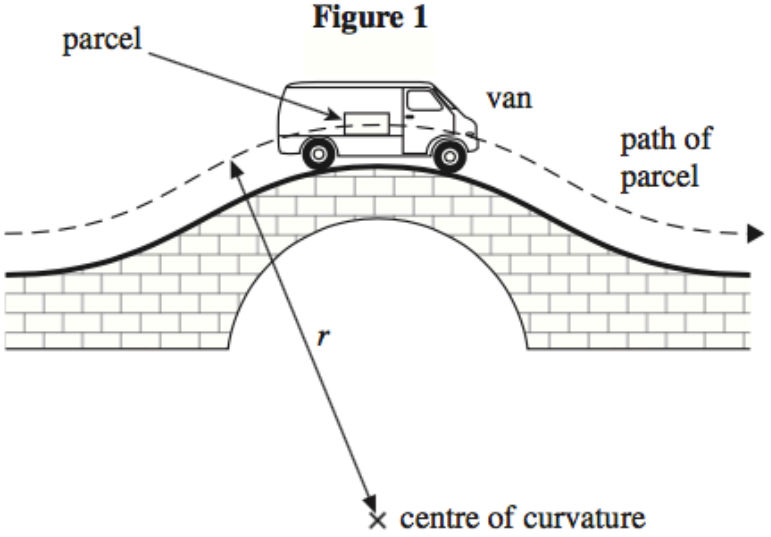
18)

Figure 1 shows a parcel on the floor of a delivery van that is passing over a hump-backed bridge on a straight section of road. The radius of curvature of the path of the parcel is r and the van is travelling at a constant speed v. The mass of the parcel is m.

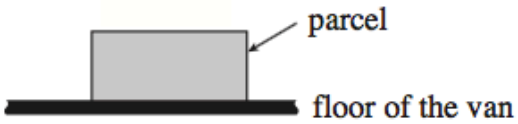
Figure 1



(a) (i) Draw arrows on **Figure 2** below to show the forces that act on the parcel as it passes over the highest point of the bridge. Label these forces.

(1 mark)

Figure 2



(a) (ii) Write down an equation that relates the contact force, R, between the parcel and the floor of the van to m, v, r and the gravitational field strength, g.

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(1 mark)

(a) (iii) Calculate R if $m = 12\,\text{kg}$, $r = 23\,\text{m}$, and $v = 11\,\text{m s}^{-1}$.

answer = ...N

(2 marks)

(b) Explain what would happen to the magnitude of R if the van passed over the bridge at a higher speed. What would be the significance of any van speed greater than $15\,\text{m s}^{-1}$? Support your answer with a calculation.

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(3 marks)

19)

The Hubble space telescope was launched in 1990 into a circular orbit near to the Earth. It travels around the Earth once every 97 minutes.

(a) Calculate the angular speed of the Hubble telescope, stating an appropriate unit.

answer = ...

(3 marks)

(b) (i) Calculate the radius of the orbit of the Hubble telescope.

You should have done Gravitational fields before attempting this question

answer = ... m

(3 marks)

(b) (ii) The mass of the Hubble telescope is 1.1×10^4 kg. Calculate the magnitude of the centripetal force that acts on it.

answer = ... N

(2 marks)