Q1. 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.

(Total 1 mark)

Q2. What is the value of the angular velocity of a point on the surface of the Earth?

A 1.2×10^{-5} rad s^{-1}

B 7.3×10^{-5} rad s^{-1}

C 2.6×10^{-1} rad s^{-1}

D 4.6×10^{2} rad s^{-1}

(Total 1 mark)

Q3. 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 $\frac{\pi^2 mr}{T^2}$

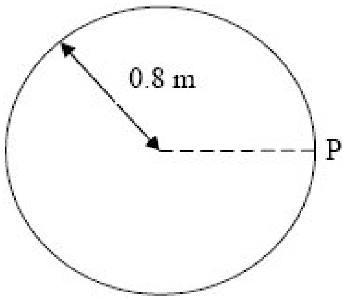
B $\frac{\pi^2 mr^2}{T^2}$

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

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

(Total 1 mark)

Q4.



A model car moves in a circular path of radius 0.8 m at an angular speed of $\frac{\pi}{2}$ rad s^{-1}. What is its displacement from point P, 6 s after passing P?

A zero

B 1.6 m

C 0.4 πm

D 1.6 πm

(Total 1 mark)

Q5. 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.

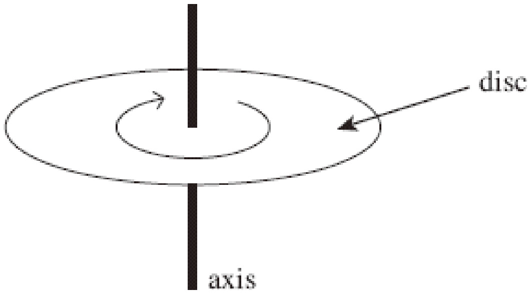
B a horizontal circle.

C a parabola in a horizontal plane.

D a parabola in a vertical plane.

(Total 1 mark)

Q6. The diagram shows a disc of diameter 120 mm that can turn about an axis through its centre.



The disc is turned through an angle of 30° in 20 ms. What is the average speed of a point on the edge of the disc during this time?

A 0.5π m s^{-1}

B π m s^{-1}

C 1.5π m s^{-1}

D 2π m s^{-1}

(Total 1 mark)

Q7. A particle of mass *m* moves in a circle of radius *r* at a uniform speed with frequency *f*. What is the kinetic energy of the particle?

A $\frac{mf^2r^2}{4\pi^2}$

B $\frac{mf^2r}{2}$

C $2\pi^2 mf^2r^2$

D $4\pi^2 mf^2r^2$

(Total 1 mark)

Q8. 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 $20\pi\sqrt{\frac{r}{a}}$

(Total 1 mark)

Q9. 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 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

(Total 1 mark)

Q10. A satellite of mass *m* travels in a circular orbit of radius *r* around a planet of mass *M*. Which one of the following expressions gives the angular speed of the satellite?

A $\sqrt{GMr}$

B $\sqrt{Gmr}$

C $\sqrt{\frac{Gm}{r^3}}$

D $\sqrt{\frac{GM}{r^3}}$

(Total 1 mark)

Q11. 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)

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

answer = ... m

(3)

(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)

(Total 8 marks)

M1. A

[1]

M2. B

[1]

M3. D

[1]

M4. B

[1]

M5. D

[1]

M6. A

[1]

M7. C

[1]

M8. D

[1]

M9. A

[1]

M10. D

[1]

M11. (a) $\omega \left(= \frac{2\pi}{T}\right) = \frac{2\pi}{97 \times 60}$ [or $\omega\left(= \frac{360}{T}\right) = \frac{360}{97 \times 60}$]

$= 1.1 \times 10^{-3}$ (1.08×10^{-3}) **(1)** [$= 6.2$ (6.19) $\times 10^{-2}$]

rad s^{-1} [accept s^{-1}] **(1)** [degree s^{-1}]

3

(b) (i) $\frac{GMm}{r^2} = m\omega^2 r$ **or** $r^3 = \frac{GM}{\omega^2}$ **(1)**

gives $r^3 = \frac{6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{(1.08 \times 10^{-3})^2}$ **(1)**

$\therefore r = 6.99 \times 10^6$ (m) **(1)**

3

(ii) F (= $m\omega^2 r$) $= 1.1 \times 10^4 \times (1.08 \times 10^{-3})^2 \times 6.99 \times 10^6$ **(1)**

$= 9.0 \times 10^4$ (8.97×10^4) (N) **(1)**

[**or** $F\left(= \frac{GMm}{r^2}\right) = \frac{6.67 \times 10^{-11} \times 5.98 \times 10^{24} \times 1.1 \times 10^4}{(6.99 \times 10^6)^2}$ **(1)**

$= 9.0 \times 10^4$ (8.98×10^4) (N) **(1)**]

2

[8]