Second: Essay questions:

1) **Write down the slope of the straight line and the mathematical relation for each of the following:**

	Slope	Mathematical relation
a)	$\frac{v^2}{r} = a_c$	$\frac{v^2}{r} = a_c$
b)	$Fr=mv^2$	$\frac{mv^2}{r} = F_c$
c)	$\frac{F}{v^2} = \frac{m}{r}$	$\frac{mv^2}{r} = F_c$
d)	$\frac{Fr}{m} = v^2$	$\frac{mv^2}{r} = F_c$
e)	$\frac{2v^2}{a} = 2r$	$\frac{v^2}{r} = a_c$

2)

$$\frac{mv^2}{r} = F_c$$

A. decrease the velocity to decrease the centripetal force
B. increase the radius to decrease the centripetal force

3)
The force acts on the stone normal to its direction of motion in a direction towards the center of the circle. And it changes the direction to circular path , When the rope is cut the stone moves in a straight line tangent to the circular path.

5) The point lies on the equator, because the point on the equator is at larger distance from the rotation axis of the Earth compared to that point on the tropics of Capricorn and the cancer where(v α r).

6) The water wouldn't spill out from the opening of the bucket due to the centripetal force acting on water which is normal to the direction of motion. This force changes the direction of velocity making it always tangent to the circular path without changing its magnitude that keeps water inside the bucket rotating in a circular path.

7) Explain the following statements:

(1) Because when the body moves in a circular motion it acquires centripetal acceleration to change the direction of its velocity without changing its magnitude.

(2) Because the gravitational force between the Sun and the Earth is normal to the direction of motion of the Earth's surface acts as centripetal force that makes it moves in a circular path.

(3) Because the friction force between the road and car tyres is normal to the direction of motion of the car and acts towards the center of the curved road causing the car to move in a curved path.

(4) The sum of Horizontal components of reaction and frictional force act as centripetal force

(5) Because according to the relation: $\frac{mv^2}{r} = F_c$

the centripetal force is directly proportional to the mass of the car (F α m) and inversely to the radius of the curved road

(6) Because according to the relation: $\frac{mv^2}{r} = F_c$

the centripetal force is directly proportional to the mass of the car(F α m) The centripetal force that is required to keep the cars in these curved roads increases according so the possibility of accidents increases in these curves.

8) according to the relation: $\frac{mv^2}{r} = F_c$

Because according the relation the centripetal force is directly proportional to velocity, so when the velocity decreases the centripetal force that is responsible to keep the car in the curved road decreases, so the car doesn't overturn.

9) The arrangement:(3)>(1)>(2)

The possibility of slipping of car (3) is larger than that of car(1) because the mass of car(3)is greater than that of car(1)and the radius of the curved road for the two cars is the same, so the centripetal force that is required to keep the car

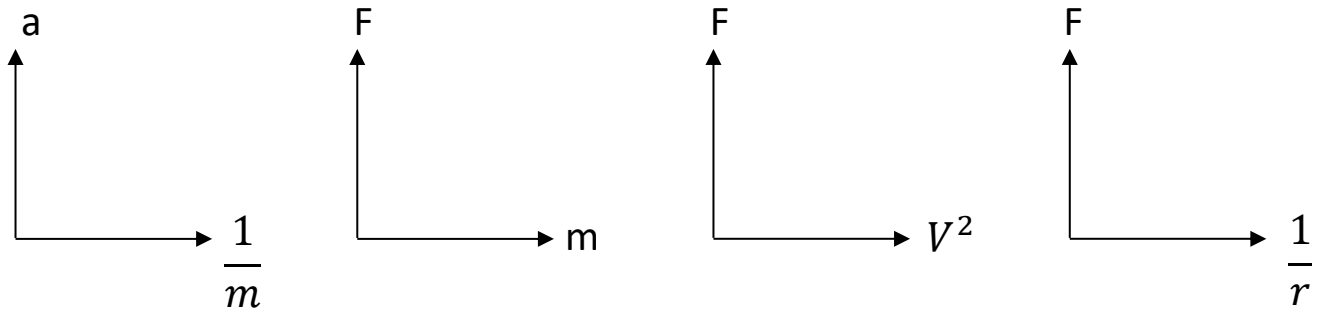
The possibility of slipping of car(1)is larger than that of car(2),because the radius of the curved road of car(1) is less than that of car(2)and the mass of the two cars is the same,so the centripetal force that is required to keep the car(1) on its path increases where

10) The slippery road decreases the friction forces between the tyres of the car and the road and because the centripetal force depends on the friction forces, so the centripetal force will not be enough to keep the car in the same curved road

11) according to the relation: $\frac{mv^2}{r} = F_c$

Because according the relation the centripetal force is inversely proportional to radius, so when the radius decreases the centripetal force that is responsible to keep the car in the curved road increases , so the possibility of accidents increases .

12) You have four graph under each of them a statement, draw this graph and write down the physical quantities which are represented on the axis:



(a) **(b)** **(c)** **(d)**

13)

(a) $\ell = 2\pi r = 6.28$ m

(b) The velocity can be determined from the relation: $v = \frac{2\pi r}{T} = 0.52$ m/s

(c) The centripetal acceleration is determined from the relation: $a = \frac{v^2}{r} = a_c = 0.27 m/s^2$

Third problems

1) a. $a_c = \frac{v^2}{r} = \frac{5^2}{2} = 12.5$ m/s²

b. $F_c = a_c x\ m = 5x\ 12.5 = 62.5$ N

c. the linear acceleration=Zero

2)

$$F_c = \frac{mv^2}{r}$$

$$377 = \frac{mx\ 13.2^2}{40}$$

m=86.5 kg

3)

$$F_c = \frac{mv^2}{r}$$

$$2140 = \frac{905x\ v^2}{517}$$

V=34.9 m/s

4)

$a_1 = 10\ \mathrm{m/s^2} = \frac{v^2}{r}$

$a_2 = \frac{(2v)^2}{0.5r} = \frac{2^2}{0.5}\, x\, \frac{v^2}{r} = 8x10 = 80\ \mathrm{m/s^2}$

5)

$v = \frac{2\pi r}{T}$

$\frac{r}{T} = \frac{v}{2\pi} = \frac{10}{2\pi}$

$$d = \sqrt{2}\, r$$

$V = \frac{d}{t} = \frac{\sqrt{2}\, r}{\frac{T}{4}} = \frac{4\sqrt{2}\ x10}{2\pi} = 9\ \mathrm{m/s}$

6)

a) $v = \frac{2\pi r}{T} = \frac{2\pi x\ 1.5}{\frac{1}{3}} = 28.27\ m/s$

b) $a_c = \frac{v^2}{r} = \frac{(28.27)^2}{1.5} = 532.79\ \mathrm{m/s^2}$

c) F=ma =2x 532.79=1065.58 N

7)

a) $T = \frac{t}{N} = \frac{90}{45} = 2\ s$

b) $v = \frac{2\pi r}{T} = \frac{2\pi x\ 0.5}{2} = 1.57\ m/s$

c) $a_c = \frac{v^2}{r} = \frac{(1.57)^2}{0.5} = 4.929\ \mathrm{m/s^2}$

8)

$$T = \frac{t}{N} = \frac{20}{100} = 0.2s$$

$$v = \frac{2\pi r}{T} = \frac{2\pi x\ 1}{0.2} = 31.42\ m/s$$

$$a_c = \frac{v^2}{r} = \frac{(31.42)^2}{1} = 987.2164\ \mathrm{m/s^2}$$

$$F_c = ma_c = 0.1\ X987.2164 = 98.72\ N$$

9)

$a)\ a_c = \frac{v^2}{r} = \frac{10^2}{10} = 10\ m/s^2$

$b)\ T = \frac{2\pi r}{v} = \frac{2\pi x\ 10}{10} = 6.3\ s$

2T=2x 6.3=12.6 s

c) d=2r=2x 10 =20 m

d) m=$\frac{w}{g}$=$\frac{100}{10} = 10\ kg$

F=ma =10 x10 =100N

10) $F_c = \frac{mv^2}{r}$

$$= \frac{600x\ 10^{-3} x\ 3^2}{10x\ 10^{-2}} = 54\ N$$

The thread will be cut because the tension will be greater than the maximum force that the thread can withstand.

11) F=0.08 w=0.08 mg

$F_c = \frac{mv^2}{r}$

$$0.08\ mx\ 10 = \frac{mx\ v^2}{500}$$

V=20 m/s

12) $F_c = \frac{mv^2}{r}$

Slope=$\frac{\Delta F_c}{\Delta V^2} = \frac{60-0}{12-0} = 5\ kg/m$

m=slope x r=5 x 2 =10 kg

13) Slope=$\frac{\Delta V^2}{\Delta r} = a = \frac{48-0}{12-0} = 4\ m/s^2$

14)

Slope=$\frac{\Delta a_c}{\Delta \frac{1}{r}} = V^2 = \frac{14-0}{0.7-0} = 20\ m^2/s^2$

V=4.47 m/s

15) Slope=$\frac{\Delta a_c}{\Delta V^2} = \frac{1}{r} = \frac{10-0}{1000-0} = \frac{1}{100}\ m^{-1}$

$$r = \frac{1}{slope} = 100\ m$$