M1.(a) centripetal (force)

allow tension (between astronaut and seatbelt)

1

towards the centre (of the G-machine / circle)

*do **not** accept towards the centre of the Earth*

allow inwards

1

(b) (i) the greater the speed (of a centrifuge), the greater the force

answers must be comparative

accept velocity for speed

accept positive correlation between speed and force

speed and force are not proportional – treat as neutral

1

the smaller the radius, the greater the force (at a given speed)

*allow **(G machine) 1** has / produces a greater force (than **G machine 2**) at the same speed*

must be comparative, eg a small radius produces a large force = 0 marks on own

1

as the speed increases the rate of change in force increases

accept force is proportional to the square of the speed

or

doubling speed, quadruples the force

accept any clearly correct conclusion

1

(ii) 12000 (N)

or

12 k(N)

1

(c) (i) the current (in the coil) creates a magnetic field (around the coil)

accept the coil is an electromagnet

1

so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)

accept the two magnetic fields interact (producing a force)

*if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max **1** mark*

1

(ii) vertically downwards arrow on side A

one arrow insufficient

and

vertically upwards arrow on side C

1

(iii) the current is parallel to the magnetic field

allow the current and magnetic field are in the same direction

allow it / the wire is parallel to the magnetic field

1

(d) increase the current / p.d. (of the coil)

accept decrease resistance

accept voltage for p.d.

accept increase strength of magnetic field / electromagnet

1

(e) yes with suitable reason**or**no with suitable reason

eg

***yes** – it has increased our knowledge*

***yes** – It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific*

examples

no *– the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)*

no *mark for just* ***yes*** */* ***no***

reason must match ***yes*** */* ***no***

1

[12]

M2.(a) any **two** from:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)

accept 'the size' for radiusboth parts required for the mark

1

[4]

M3. (a) the direction of the riders is constantly changing

1

therefore the velocity of the riders is changing

1

and because acceleration is the rate of change of velocity
the acceleration is changing

1

(b) to(wards) the centre (of the cylinder / rotor)

1

(b) centripetal

1

(b) it is reduced

1

[6]

M4. (a) (from present/recent) data/evidence/observations of (the rate of change in) Phobos'/the moon's orbit (1)

or appropriate example of data (1)

and its correct use (1)

(and) continued/extended/extrapolated (the pattern/trend for the next 100 million years) (1)

example (present) distance from Phobos to Mars (1)
÷ (average) rate of approach (1)

2

(b) (it is) increasing (1)

Phobos/the moon will be nearer (to Mars) (1)

or the radius/circumference/diameter of the orbit of Phobos/the moon will decrease/be less

only credit 2nd mark if the first mark is correct

2

(c) it will increase/be more (1)

(because) Phobos/the moon will get/be closer to Mars/the planet (1)

only credit 2nd mark if the first mark is correct

note part(s) of this response may be included as the answer to part (b)

read both before marks are awarded

2

[6]

M5. (a) any **two** ideas:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) centripetal

*allow minor misspellings but do **not** credit a response which could be 'centrifugal'*

1

(d) the greater the radius / diameter / circumference (of the wheel)
the smaller the (resultant) force (required)

accept 'the size'

both parts required for the mark

accept converse

1

[5]