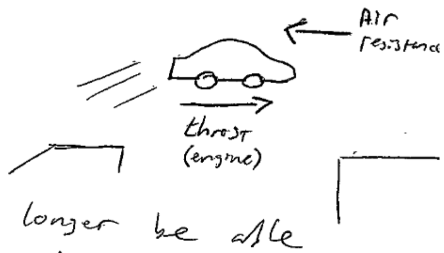
Q4

Maximum Mark: 3

RESPONSE 1

In the real world you must take friction into account.

As the car leaves the 1st truck



it will no longer be able to accelerate and will be faced with resistance from the air.

The truck in front will also continue to move on at its constant speed.

RESPONSE 2

The stunt driver will have to ensure that the distance in which the car 'jumps' is greater than the gap between the two vehicles. This is because the lorry is still moving, and therefore during the time which the car 'jumps', the required distance to land safely will increase as the lorry moves away from the stunt car.

In order to calculate the 'jump' distance, the velocity of the two vehicles will need to be known. The distance can then be calculated using the gap distance + distance travelled by moving lorry during time of stunt jump.

Once the minimum required jumping distance is known, a required velocity for the stunt car can be calculated using $v = \frac{s}{t}$. The stunt car moving at this minimum required velocity will land safely on the moving lorry, as total jumping distance has been considered.

RESPONSE 3

lorry ① left lorry ② right.

the car to be able to drive up the ramp of lorry ① would need to have a greater velocity than lorry ①. Lorry ② would need to have the same velocity as lorry ① to ensure the distance between them didn't change. when the car does land on lorry ② it would need to slow down very quickly to ensure it didn't drive off of lorry ②

If the car was going at $40 ms^{-1}$ and the roof of the lorry was 10m and the driver executed a perfect landing to give him all 10m to slow down.

$s = 10m$
$u = 40$
$v = 0$
$A =$
$T = ?$

$v^2 = u^2 + 2as$

$a = \frac{v^2 - u^2}{2s}$ $\frac{-40^2}{20}$
$= -80 ms^{-2}$

the driver would need to decelerate at 80 ms^{-2}.

RESPONSE 4

Both ~~...~~ lorries have to be moving with a constant velocity and their velocity must b equal, because it it isn't, either the 1st lorry will crush into the one in front, or if the second lorry is faster, the gap between them will increase and the car will mi the speed of the car has to be ~~not~~ high than the one of both lorries for it reach the 2nd lorry and it has to overcome air resistance.

RESPONSE 5

~~One~~ Some of the Challenges ~~...~~ Involved for the Stunt is for the driver to maintain a higher speed than the two ~~trucks~~ lorries whilst calculating the speed he will need to clear the gap inbetween the two lorries. ~~and the speed~~ Also to make sure the driver of the car doesn't go too fast and over-shoots the second ~~truck~~ lorry. As well as this the two trucks need to stay at the same speed to keep the gap between them consistent as if one was going slower or faster the gap would ~~decrease~~ increase or decrease in size. Further more the ~~truck~~ lorry drivers need to stay on the same path/gradient as if they weren't this increases the chance of the stunt driver missing the second ~~...~~ lorry.

RESPONSE 6

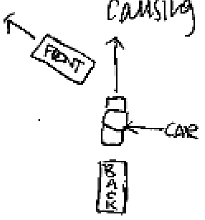
A challenge to carry out the stunt succesfully is that air resistance would have to be factored in, as it is real life scenario.
The car must have a greater acceleration than that of the lorries so that it can drive off it.
The cars final velocity must be the same as the second lorry. or it will not land on the back of the second lorry.
Another challange ~~at~~ is that the friction of the ~~tyres~~ tires ~~are~~ needs to be factored into the equation as it is a real world scenario

RESPONSE 7

The car must be travelling faster than both lorrys so it does not land in the gap between although it must not go too fast and overshoot the landing lorry. The angle the car leaves at must be big enough that it gets in the air but not so big that it again overshoots. Air resistance on the car must also be taken into account as this will slow the car down.

RESPONSE 8

Since the lorries will already be moving, the car will have to travel at great speeds to reach a sufficient vertical component of velocity to clear the gap between the lorries. both lorries must travel at same speeds so the gap doesn't increase or decrease. they must carry out the stunt on a straight road otherwise, if the car is in mid air and the front lorry turns, the car will continue to travel in a straight line while the lorry is to the side, causing the stunt to fail. lorries must not brake or the car will overjump.



Response 9

The stunt driver must make sure the car is at the correct speed, or else it will either land in the gap between the two lorries or it may fall off the lorry in the front (the second lorry). The vertical ~~speed~~ velocity should be great enough for it to land on top of the second lorry and not crash into it. The horizontal velocity should be great enough for it to be able to reach the second lorry but not fall off it. It should be considered that the additional speed of the car on the ramp due to the first lorry as it is moving as well. The distance between the two lorries should also be taken into account as it cannot be too far. Due to the large mass of the car it will have a large weight acting downwards on it, meaning that the forces acting on the car will affect the distance and height the car will reach. The angle at which the car is released from the first lorry must be considered: ~~too~~ if its too big, the car may not reach the second lorry, if too small, it may ~~st~~ fall off the ~~last~~ lorry from the front. The stunt driver musn't stop abruptly on the first lorry because it may harm them. The abrupt stop will mean the time of collision decreases and the force of impact increases, as demonstrated by the equation $Ft = mv - mu$.

Response 10

For the stunt to be successful the two ~~Add~~ lorries must be moving at ~~xx con~~ the same and constant speed. If they are then due to Newton's relativity the stunt should be simple to pull off as, if they are moving at the same constant speed then this will not affect the stunt driver.

Response 11

$W = mg\sin\theta$

m → mass of car

θ → angle of elevation up ramp

to determine acceleration

$a = \frac{F_{un}}{m}$ (F_{un} → w; m → of car)

Potential energy ⇒ the energy gained

$E_p = mgh$ (h → height during air time)

E_k ⇒ ~~kinetic~~ kinetic energy lost

$E_k = \frac{1}{2}mv^2$

$E_w = Fd$ ↓ difference in E_k and E_p to find work done

~~xx~~ final speed of car can be determined by using

$v^2 = u^2 + 2as$

Response 12

A major challenge is that the car must have sufficient horizontal velocity to cover the gap between the lorries, but also sufficient vertical velocity to allow it to stay in the air long enough to make this transition. ~~They The~~ both of these are determined by the car's speed, v, and the angle at which it leaves the first lorry, θ.

$V_h = V\cos\theta$
$V_v = V\sin\theta$

the car can ~~better~~ ensure a successful crossing by maximising its speed, since both velocity components will increase with this, allowing the car more time to make crossing at a faster V_h

The time in the air, assuming the lorries are the same height, is given by

$0 = V_v t + \frac{1}{2}at^2 = V_v t - \frac{9.8}{2}t^2$, since displacement vertically is 0 on the second lorry

t=0 when it leaves the first lorry so when it reaches the same height again, $t = \frac{2}{9.8} \times V_v$

The horizontal distance, d gives

$d = V_h t = \frac{2V_hV_v}{9.8} \Rightarrow V_h = \frac{9.8}{2V_v}d$ ~~$\frac{9.8}{2d}V_v$~~ $= \frac{9.8d}{2V_v}$

~~Thee~~ So the values of V_h and V_v that satisfy this relationship will allow a crossing

Q 6(c) **Maximum Mark: 3**

RESPONSE 1

The model is good as it shows the circular motion taken by a particle in the LHC, but the plastic block doesn't show the same level of collision that happens between particles as in the LHC, particles are accelerated towards eachother but in this case the plastic block is stationary meaning that it's not the same effect as in the LHC

RESPONSE 2

- The ball represents the particle. when the ball hits the block, energy is released. In the hadron collider the same process happens with a particle hitting into an object. The object causes the particle to break down. Energy is released in this process also.

RESPONSE 3

The Motor speeding up the ball is realistic as in the large hadron collider the particles are sped up by a changing electric field. The second ball which is used to collide with the first ball is also realistic as particles are moved through tubes in the opposite direction towards a target where a magnetic field will influence their direction so they will collide with one another.

RESPONSE 4

model	CERN
ball turned mechanically due to contact with track	particles turned using magnetic fields
ball accelerated at one point on loop at the motor	particles accelerated at one point when they reach the electric field
ball accelerated by motor	particles accelerated by electric field
Collision caused by block being pulled onto track	Collision caused by particles going in opposite direction.

RESPONSE 5

In the model, the ball is only accelerated at one point in the circle. In the large hadron colli particles can be accelerated at more than one pla Cyclotrons ~~Synchrotrons~~ are used to accelerate the particles before they enter the LHC Synchotron. In the model the plastic block is stationary when the ba collides with it whereas in the large hadron colli the particles are accelerated in opposite directio around the accelerator. This makes the particles collide with much more energy than if ~~they~~ are was stationary before impact. In the model friction is used to keep the ball on the track. In the large hadron collider an alternating electric field is used to accelerate the particles through drift tubes. Electromagnets are used to focus the beam of particles ~~into the middle~~ so that the ~~particles~~ can turn ~~the~~ along the circlar path.

RESPONSE 6

A large hadron collider such as the one at CERN, does not use motors to fire a "ball" around a track. It uses magnetic fields to fire particles at great speeds. In CERN, they also don't push a block onto the path of the particle, The particle is guided to an end point when a controlled collision can take place

RESPONSE 7

The track in this model represents a magnetic field. This magnetic field keeps the particle stay in circular motion moving at high speeds. the ball represents the particle in a real particle accelerator. when the block is released and obstructs the ball, they will both collide.

In a particle accelerator, this collision releases incredible amounts of energy which can be collected and readings can be determined for further scientific analysis.

RESPONSE 8

In some particle accelerators (circular accelerators), ~~[illegible]~~ particles are accelerated in a large circle to build up speed. This is similar to what is shown in the model. The particles are accelerated using magnets (for this reason, neutrons cannot be used) and electromagnets are used to ~~[illegible]~~ keep the particles in a concentrated stream. The particles then hit a target and scientists study the data to see what has been ~~[illegible]~~ created. It was in this manner that many fundamental particles were discovered, such as the quarks that make up protons, ~~and~~ (and neutrons, though these cannot be used in a particle accelerator.

RESPONSE 9

Although this model is similar to a real particle accelerator, it is not the same.
In a real particle accelerator the particle does not sit on a track as the ball does, eletric fields are used so it does not touch any thing. This makes the model less good as the ball can be slowed down by friction.
Also in a real particle accelerator the particle is constantly being pushed around by electric fields however this model is only being pushed around

at a certain point of the track making it less like a real particle accelerator.
Also in a real particle accelerator 2 particles collide with each other therefore 2 of the same thing collide however in this model it is not 2 of the same thing as it is a ball and a block.
This model would be more like a real particle accelerator if 2 balls ~~were~~ are used the collide with each other.

Response 10

The ball acts as a ~~[illegible]~~ negatively charged particle. The plastic block acts as a magnetic field. Both of these are negatively charged (like charges repell). Therefore, when the ball hits the plastic block, this simulates two 'like' charges repelling. This causes greater collisions between particles of the same charge. As a result, this generates ~~[illegible]~~ more kinetic energy.

Response 11

This is a good model, because it has all the basics, it has a circular ~~[illegible]~~ track so that it can be accelerated for as much as you want, unlike a linear accelerator where it can only accelerate until the end of the track. The motor accelerates the ball like the electric fields in the particle accelerator and the block will cause a collision

Response 12

At CERN an AC current is used to attract and repel the particle accordingly to ensure the maximum attraction/repulsion is acting on the ball to ensure maximum speeds are reached. In CERN there are many forces being exerted on particles, here it is only the force from the battery motor. The speed ~~[illegible]~~ generated would be far greater at CERN.

Response 13

This model of a particle accelerator has no magnetic fields ore electric fields.

The hadron collider has magnetic fields so the partiles move in a circular path and the electric fields accelerate the particles so the move fast enough. They accelerate due to the unbalanced force from the electric field.

Hadron has 'dees' and the polarity is constantly changed so the

6. (c) (continued)

particles can cross the dees in both directions.

This model uses a motor to accelerate the ball.

A real one uses an electric field to accelerate the particle.

This model uses a circular track to create a curved path for the ball. A real one use an magnetic field to create a circular path.

This model uses a plastic block to collide with the ball.

A real one uses other particles to collide with particles.

Response 14

This model represents a synchrotron like the LHC, which uses both electric and magnetic fields to accelerate particles around a ring.
In the LHC, sources of potential difference located around the ring increase the particles energy by generating electric fields, according to $E_w = QV$. This causes them to accelerate. In the model, the battery-operated motors fulfill this role as they accelerate the ball. In the LHC, Magnetic fields are used to

control the particles' direction and ensure they follow the correct path around the ring. The fields deflect the particles in a direction perpendicular to both the field direction and the particles' velocity. It is called a synchrotron because the magnetic field strength must synchronise with the particle's increasing speed to ensure correct deflection.
There is no direct comparison to be made in the model with this, as it is kept going in the right direction by the normal force caused by the constant contact with the plastic track.
Another difference between the two situations is that in the model, the collision is between a moving and stationary object, whereas in the LHC, two streams of particles are accelerated in opposite directions before being made to collide at very high energy, effectively doubling the energy of the collision. This would be impossible in the model unless another circular track was added so another ball could go in the other direction before they collided at a crossing between the tracks