Year 10 Physics - Forces and Energy - Test

Name……………………………

<u>/ 34 marks</u>

Information:

Use the following formulae where they are relevant to questions:

$$v = \frac{d}{t}$$

$$a = \frac{\Delta v}{t}$$

$$v = u + at$$

$$F = m\,a \quad \text{(also: } Weight = m\,g)$$

$$Work\ done = Force \text{ x distance}$$

$$KE = \tfrac{1}{2}\,m\,v^2$$

$$PE_{grav} = mgh$$

Take acceleration due to gravity as 10 m/s²

**Section A: select the best answer for questions 1-10**

1. Which of the following is not a type of energy?

A   Kinetic
B   Heat
C   Gravitational
D   Acceleration

2. A student pushes a 0.500 kg trolley along a frictionless surface and accelerates it from rest to 4 m/s. How much kinetic energy does the trolley gain?

A   4 J
B   4000 J
C   20 J
D   2 J

3.   On Earth object's experience a gravitational acceleration of 9.8 m/s^2 while on Jupiter objects experience a gravitational acceleration of 24 m/s^2.

Which of the following is NOT true:

A   Objects on Jupiter experience a gravitational force of 24 N/kg
B   An object would weigh more on Jupiter than it does on earth
C   An object dropped on either planet would experience the same magnitude force due to gravity
D   A 100 kg person would weigh 2400 N on Jupiter and 980 N on earth

4.   What is the size of the net force required to accelerate a large bullet of mass 40 g at a rate of 3000 m/s^2?

A   120 N
B   12 000 N
C   0.75 N
D   75 N

5.   A force (F1) pushes an object to the right and a second force (F2) equal in magnitude to (F1) pushes the object to the left, at the same time. That is:
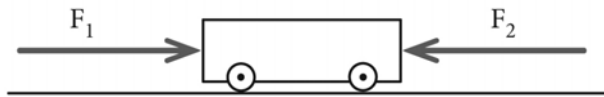
A FALSE statement about the effect of these two forces is:

A   the object will only move if one force is greater than the other.
B   the net force on the object is zero
C   the object has constant velocity
D   the object could be moving even if the two forces are equal.

6.   A 100 g rubber band powered car is wound up so that 0.1 J of elastic potential energy is temporarily stored in the rubber band. When the car is released the maximum kinetic energy the car attains:

A   will be at least 0.1 J.
B   will be exactly 0.1 J.
C   will be less than 0.1 J.
D   will be equal to the gravitational potential energy of the car.

7.   If a 200 kg object has a force of 10 N acting on it, it will have an acceleration of:

A 0.05 m/s^2
B 5 m/s^2
C 20 m/s^2
D 4.0 m/s^2

8.   A person pushes vertically down with a force of 100 N on a set of bathroom scales sitting on a table. Which of the following statements is true:

A   The table pushes back up with 100 N on the scales giving a total reading of 200 N.
B   The scales would register a force of 100 N.
C   The reaction force and applied force cancel out giving a reading of 0 N on the scales.
D   The scales can only measure weight and not force.

9.   A seatbelt in a motorcar is an important safety device, particularly in the event of a head-on collision.
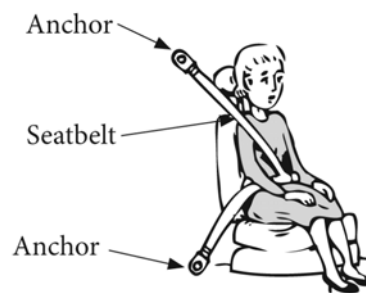
        Without a seatbelt, in a head-on collision:

A   the force of the person's speed would continue to make them move.
B   the person would collide with parts of the car that had slowed down in the collision.
C   the person would not lose any inertia.
D   the person would experience a forwards force that makes them 'fly forward' into the dash or windscreen.

10.   Which of the following statements is correct?

A   A car at rest has at least four forces acting on it.
B   A car at rest has no forces acting on it.
C   When you take your foot off the car's pedals, the car slows down because there are no more forces acting on it.
D   When a car is travelling at a constant speed there will be friction acting on the car and the forces on the car will be balanced.

Section B – Short Answer Questions - write out the appropriate equation and show all working.

Question 11

Two students, Sam and Katie are at the skate park. Sam is 50 kg and Katie is 60 kg. Sam is riding on his scooter when he accidentally collides with Katie, also on her scooter. Sam applied a force of 100 N to Katie during the collision but they both manage to stay on their scooters.

(a) What size force does Katie apply to Sam?

1 mark

(b) **Identify** which student experiences the largest acceleration as a result of their collision and **explain** why.

2 marks

Question 12

(a) It is often stated that it is not how fast you are going but how fast you stop that affects your ability to survive an incident. In terms of Newtons 2nd law, **explain** the validity of the above statement.

2 marks

(b) **Explain** how head restraints would reduce your risk of neck injuries if another car were to run into the back of yours.

2 marks

Question 13 A pack of Coco Pops with total mass of 500 g is lifted from a bag of shopping on the floor onto a 1.2 metre high bench.

(a) **Calculate** the weight of the Coco Pops.

1 mark

(b) **Calculate** how much work is done lifting the Coco Pops pack onto the bench.

1 mark

(c) If the Coco Pops were then accidentally knocked off the bench and fall to the ground, assuming no air resistance, **determine** the kinetic energy of the pack just as it's about to impact the ground.

1 mark

(d) In reality the pack of Coco Pops would experience a force due to air resistance as it fell. **Explain** how this would affect the energy transformation that takes place as it falls.

1 mark

Question 14 - write out the appropriate equation and show all working

The picture above shows a tractor pull competition. Tractors attempt to accelerate whilst pulling a high friction trailer that drags along the ground (drag load).

In the above assume the tractor and the trailer combined have a total mass of 4000 kg. The tractor can pull with a force of 10 000 N, whilst the drag load creates a resistive force of 4000 N.

(i) **Calculate** the net force on the tractor and trailer.

2 marks

(ii) **Calculate** the acceleration of the tractor and the trailer.

2 marks

Speed vs. Time for Skydiver

Question 15. The graph above shows the variation in speed of an 80 kg parachutist who jumps from an air balloon.

(i) **Calculate** the acceleration of the parachutist in the first four seconds.

2 marks

(ii) **Identify** the greatest speed reached by the parachutist.

1 mark

(iii) **Calculate** the maximum kinetic energy of the parachutist.

2 marks

(iv) **Describe** the motion of the parachutist in section C (between 12 and 28 seconds).

1 mark

(v) Draw force vectors on the diagram below to represent the main forces acting on the parachutist during section C of their jump. Be sure to label the forces and to draw them to represent their relative sizes.

1 mark

(vi) **Calculate** the force due to gravity acting on the parachutist.

1 mark

(vii) **Determine** the force of air resistance in section C.

1 mark

-- End of Test --