1. Complete the retrieval practice quiz below:

i) Forces can occur as…?

- ☐ A pull force only
- ☐ B push forces only
- ☐ C push and pull forces

ii) Forces are measured using which unit?

- ☐ A Joules
- ☐ B Newtons
- ☐ C Tesla's

iii) Forces are represented by using…?

- ☐ A arrows
- ☐ B number lines
- ☐ C parallel lines

iv) Which type of diagram is used to represent the forces acting on an object?

- ☐ A force graphs
- ☐ B free-body diagram
- ☐ C vector diagram

v) What is the resultant force acting on the object shown below?

- ☐ A -20N ←
- ☐ B 20N →
- ☐ C 140N

vi) What happens to an object when the forces on it are unbalanced?

- ☐ A acceleration
- ☐ B it floats
- ☐ C no change

vii) Which of the following is an example of a force?

- ☐ A mass
- ☐ B speed
- ☐ C weight

viii) Which statement about action-reaction forces is correct?

- ☐ A always opposite and different
- ☐ B always opposite and equal
- ☐ C always parallel and different

ix) The forces acting on the object below are…?

- ☐ A balanced
- ☐ B equidistant
- ☐ C unbalanced

x) Three vehicles of different masses are all travelling at the same speed.

Which of the three vehicles engines will produce the largest force?

- ☐ A 350kg motorcycle
- ☐ B 1200 kg car
- ☐ C 3500kg lorry

1) Describe the differences and similarities between scalar and vector quantities, giving an example of each.

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2) Recall and define Newton's Laws of motion:

- Newton's First Law of Motion:

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- Newton's Second Law of Motion:

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- Newton's Third Law of Motion:

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3) Recall the equations that link the following quantities and the units of each of the quantities:

a) Acceleration, force, and mass

b) Mass, momentum, and velocity

c) Kinetic energy, mass, and velocity

d) Gravitational field strength, gravitational potential energy, height, and mass

4) State the value of the following:

- Gravitational Field Strength of Earth: ……N/kg
- Acceleration due to Gravity on Earth: ……m/s^2

Exam Practice – Forces

1) Figure 1 shows a typical family car.

Figure 1

The engine provides a forward force of 100,000N and there is an air resistance of 75,000N.

(a) Draw a free body diagram to show the forces acting on the car. *(2)*

(b) Calculate the resultant force acting on the car. *(1)*

resultant force: ……N

(c) Describe the motion of the car. *(2)*

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(d) The car accelerates at 10.8m/s2.

Calculate the mass of the car. Give your answer to 2 significant figures. *(2)*

mass: ……kg

2) The graph in Figure 2 shows how the braking distance, *d*, of a car depends on the velocity, *v*, of the car when the brakes are first applied.

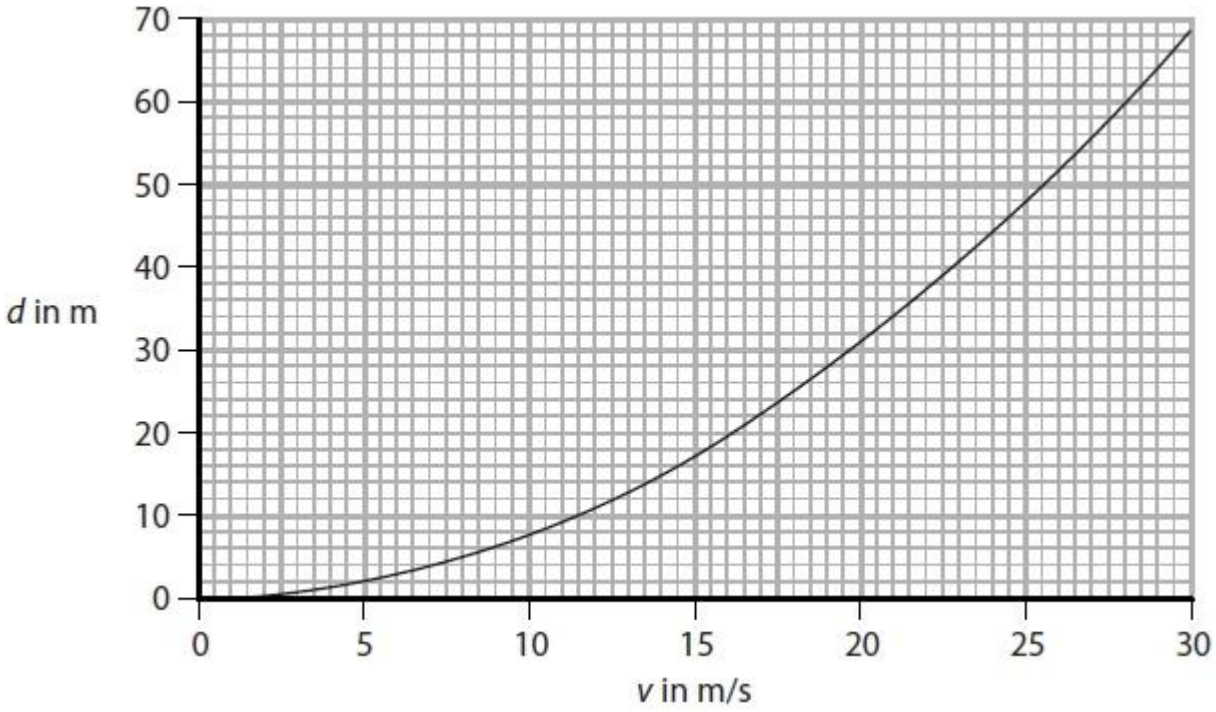

Figure 2

An equation relating braking distance, *d*, to velocity, *v*, is

$$d = \frac{v^2}{C}$$

where *C* is a constant.

Use the equation and data from the graph in Figure 1 to calculate a value for *C*. *(4)*
Give a unit for *C*.

C ……unit ……

3) The symbol '*g*' can be used to refer to the acceleration due to gravity. The acceleration due to gravity '*g*' has the unit of m/s^2. '*g*' can also have another unit.

Which of these is also a unit for *g*? *(1)*

- ☒ A J/kg
- ☒ B J/kg^2
- ☒ C N/kg
- ☒ D N/kg^2

4) Figure 3 shows how the thinking distance and braking distance change depending on the speed of a car.

speed in km / h	speed in m / s	thinking distance in m	braking distance in m	stopping distance in m
50	14	21	21	42
60	17	25	31	56
70		29	42	71
80	22	33	55	88
90	25	37	85	107
100	28	42	85	127

Figure 3

(i) Fill in the gap in the table. *(1)*

(ii) A student studies these results and writes the conclusion:

'The thinking distance is proportional to the speed of the car'.

Comment on the student's conclusion. *(3)*

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5) Figure 4 shows an object moving in a circular path.

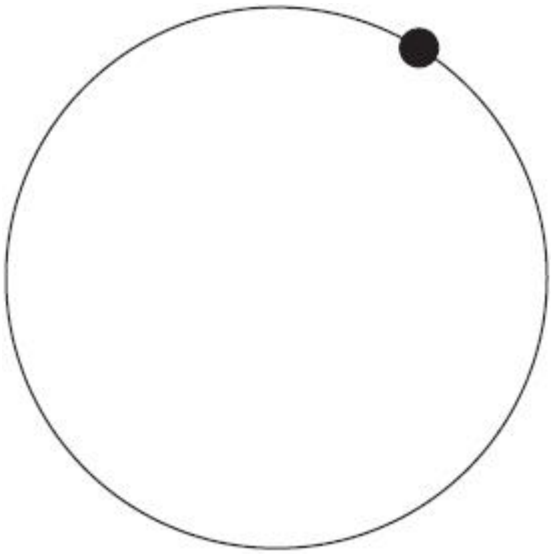

Figure 4

(i) Draw an arrow on Figure 4 to show the direction of the force that keeps the object moving in a circular path. *(1)*

(ii) The object in Figure 4 is moving at constant speed.

Explain why it is not moving with constant velocity. *(2)*

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6) A student investigates the relationship between force and acceleration for a trolley on a runway. Figure 5 shows some of the apparatus the student uses.

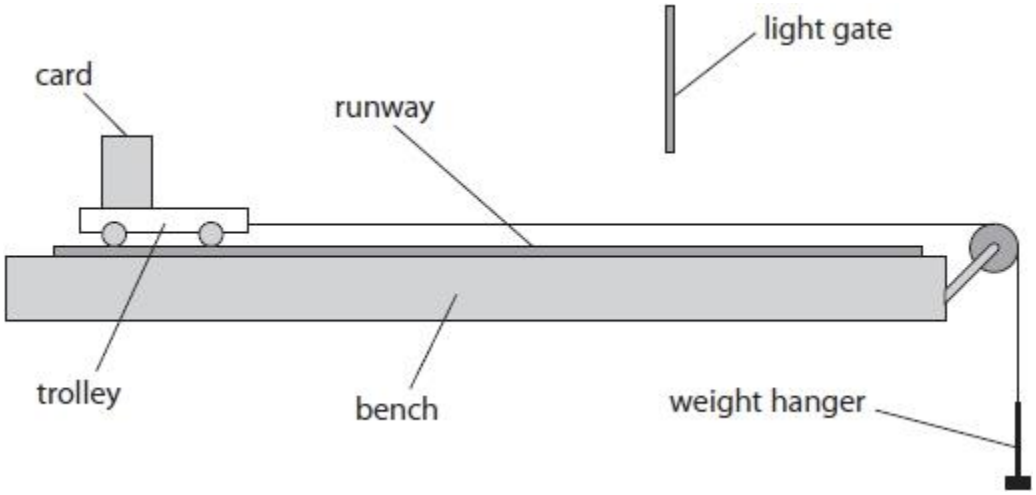

Figure 5

(i) Describe how the student could increase the accelerating force applied to the trolley. *(2)*

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(ii) Describe how the mass of the moving system can be kept constant. *(2)*

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(iii) Explain how the student could improve the procedure to compensate for the effects of frictional forces acting on the trolley. *(2)*

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7) Isaac and Albert ski down a hill.

Isaac returns to the top of the hill and starts again. Albert takes a well earned nap.

(i) His mass is 67 kg.

Show that his momentum is about 2000 kg m/s when his velocity is 31 m/s. *(2)*

(ii) He falls over when his momentum is 2000 kg m/s. After he falls over, he slows down by sliding across the snow. It takes 2.3 s for his momentum to reduce to zero.

Calculate the average force on Andrew as he slows down. *(2)*

average force: .....N

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured. *(2)*

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8) Two students try to determine a value for *g*, the acceleration due to gravity.

(i) They measure the time, *t*, for a small steel ball to fall through a height, *h*, from rest. They measure *t* to be 0.74 s, using a stopwatch. They measure *h* to be 2.50 m, using a metre rule.

Calculate a value for *g* from the students' measurements.

Use the equation

$$g = \frac{2h}{t^2}$$

(2)

g = ...m/s^2

(ii) They record the time *t* for two more drops from the same height.

The three values for time *t* are:

0.74 s, 0.69 s, 0.81 s.

Calculate the average value of time *t* to an appropriate number of significant figures. *(2)*

average value of time *t* = ...s

9) Figure 6 shows a submarine being propelled forward underwater.

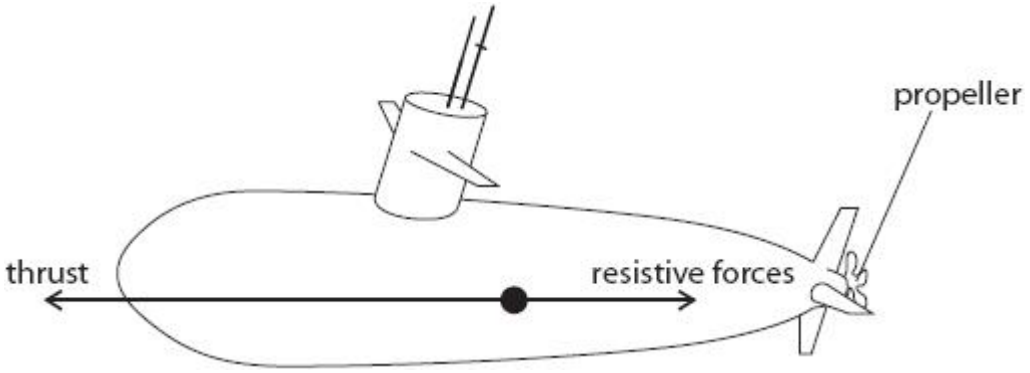

Figure 6

The thrust and the resistive forces are represented in magnitude and direction by the arrows in Figure 6.

(i) Which one of the following is correct? *(1)*

☒ A The submarine is speeding up.

☒ B The submarine is slowing down.

☒ C The submarine is moving at a constant speed.

☒ D The submarine is moving at a constant velocity.

(ii) The propeller forces water away from the back of the submarine.

Explain why this produces a thrust in the forward direction. *(2)*

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(iii) For a submarine to come to a standstill, its engines are put in reverse.

The propeller then runs in a reverse direction, producing a force causing the submarine to decelerate. It takes many minutes to come to rest.

Explain, using Newton's second law, why it takes many minutes for the submarine to slow down and come to a standstill. *(2)*

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10) (a) Which of these situations can increase the reaction time of a driver?

Put a cross (☒) in the box next to your answer. *(1)*

- ☐ A an icy road
- ☐ B worn tyres on his car
- ☐ C stopping for a cup of coffee
- ☐ D driving for a long time without taking a break

(b) (i) A car engine produces an average driving force of 1200 N. The car travels 8.0 m.

Calculate the work done by the force over this distance. *(2)*

work done = ...J

(ii) The car has a mass of 1400 kg and travels at a velocity of 25 m/s.

Calculate the kinetic energy of the car. *(3)*

kinetic energy = ……J

11) A student investigates the motion of a trolley along a horizontal runway using the apparatus in Figure 7.

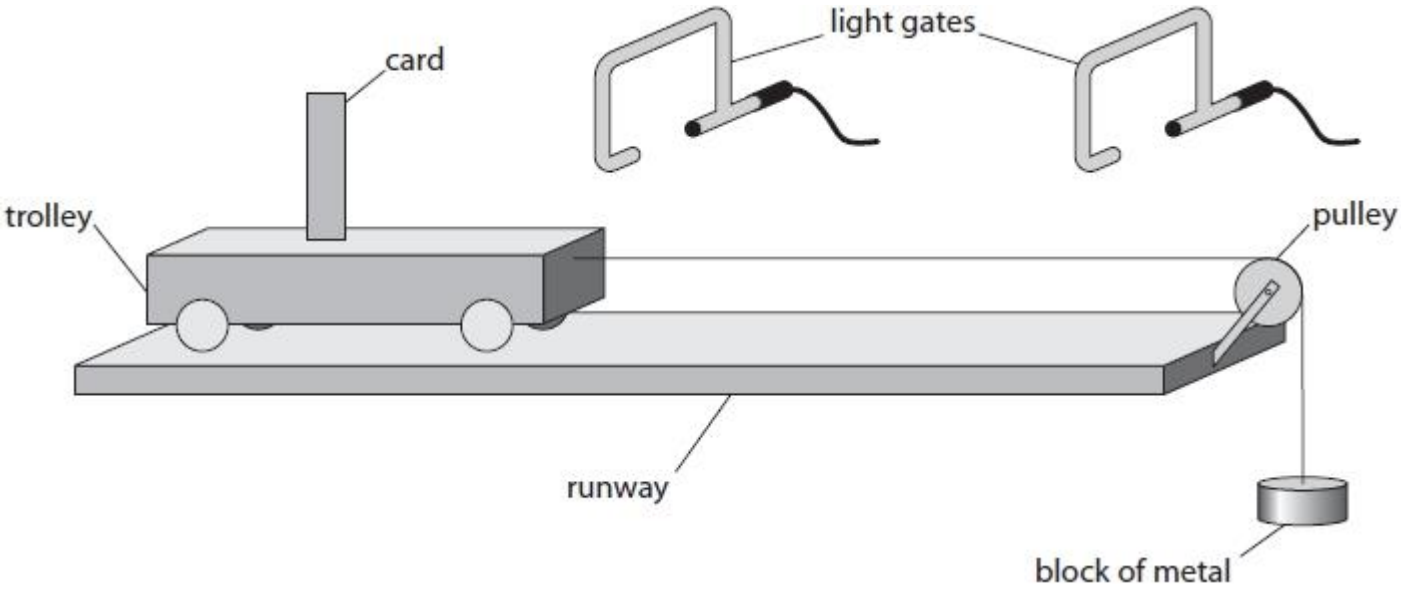

Figure 7

A trolley is attached to a string passing over a pulley. A block of metal hangs on the end of the string. Each light gate measures the time it takes for the card to pass through the gate. When the trolley is released, it moves along the track. A computer measures the time it takes for the card to pass between each light gate.

Figure 8 shows a graph of acceleration against force for three trollies of different mass that are pulled along the runway. The graphs for the trollies are labelled P, Q and R.

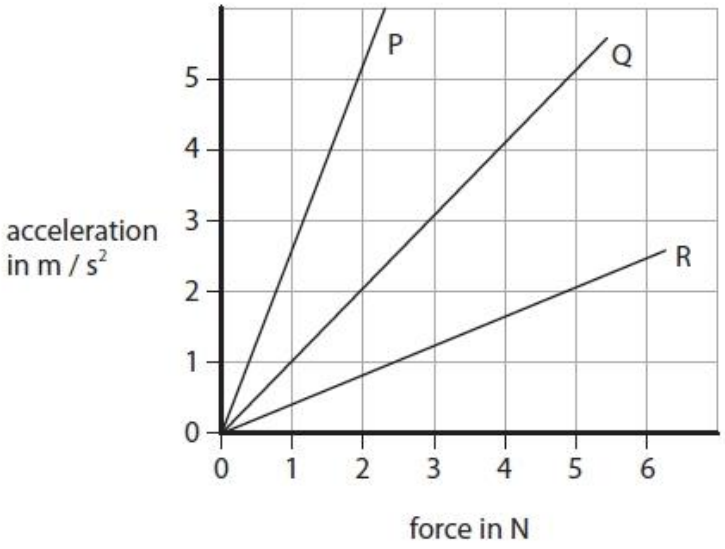

Figure 8

Use the information from the graph.

(i) Calculate the mass of trolley Q *(2)*

mass of trolley Q = ……kg

(ii) Describe how the graph shows that trolley R has the greatest mass. *(2)*

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