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90255

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Physics, 2007

90255 Demonstrate understanding of mechanics

Credits: Six
2.00 pm Friday 30 November 2007

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles.	Give descriptions or explanations in terms of phenomena, concepts, principles and / or relationships.	Give concise explanations that show clear understanding, in terms of phenomena, concepts, principles and / or relationships.
Solve straightforward problems.	Solve problems.	Solve complex problems.
Overall Level of Performance (all criteria within a column are met)		

You are advised to spend 60 minutes answering the questions in this booklet.

You may find the following formulae useful.

$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad v_f = v_i + at$$

$$d = v_i t + \frac{1}{2}at^2 \qquad d = \frac{v_i + v_f}{2}t \qquad {v_f}^2 = {v_i}^2 + 2ad$$

$$a_c = \frac{v^2}{r}$$

$$F = ma \qquad t = Fd \qquad F = -kx$$

$$F_c = \frac{mv^2}{r} \qquad p = mv \qquad \Delta p = F\Delta t$$

$$E_p = \frac{1}{2}kx^2 \qquad E_k = \frac{1}{2}mv^2 \qquad \Delta E_p = mg\Delta h$$

$$W = Fd \qquad P = \frac{W}{t}$$

$$c = 2\pi r$$

where needed, use $g = 10 \text{ m s}^{-2}$

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QUESTION ONE: THE AIRCRAFT

An aircraft is flying at a height of 600 m above the ground.

(a) Explain why the aircraft flying is **not** an example of projectile motion.

(b) While the aircraft is flying **horizontally** at a speed of 35 m s^{-1}, a packet is dropped from it.

Calculate the **speed** of the packet when it reaches the ground (include a vector diagram).

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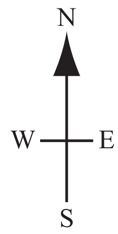
(c) The aircraft has a **new** constant horizontal airspeed of 100 m s^{-1}.
The pilot wants to fly directly east, but there is a wind blowing **from the north** with a speed of 40 m s^{-1}.

Draw a **labelled** vector diagram showing the direction in which the pilot must **point** the aircraft.

Use the diagram to calculate the angle between the aircraft and north (the bearing).



(d) While landing, the speed of the aircraft reduces from 80.0 m s^{-1} to 25.0 m s^{-1} in 8.0 seconds.

Calculate the **size** and **direction** of the acceleration. Express your answer to the correct number of **significant figures**.

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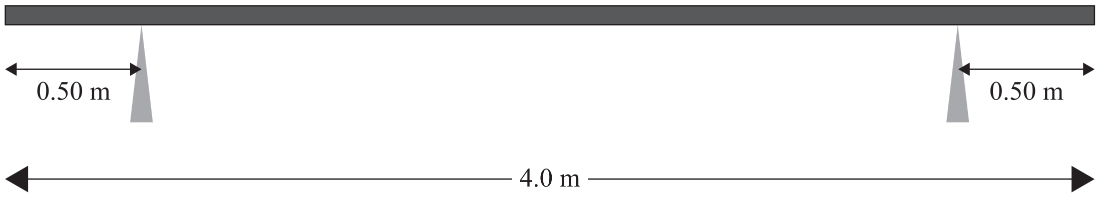
QUESTION TWO: AT THE AIRPORT

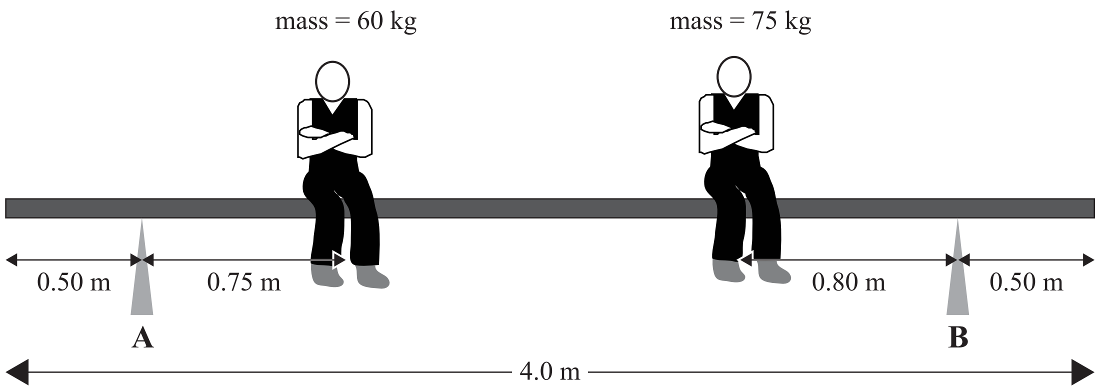
Some painters are working at the airport. They have a uniform plank resting on two supports. The plank is 4.0 m long. It has a mass of 22 kg. The two legs that support the plank are 0.50 m from either end, as shown in the figure below.



(a) The plank is in equilibrium.

Draw labelled arrows of **appropriate sizes in the correct position** showing the **forces** acting on the **plank** on the diagram above.

(b) Calculate the support force on the plank at A if a painter of mass 60 kg sits 0.75 m from A, and another painter of mass 75 kg sits at a distance of 0.80 m from B.
Use $g = 10 \text{ m s}^{-2}$.



QUESTION THREE: THE BAGGAGE SECTION

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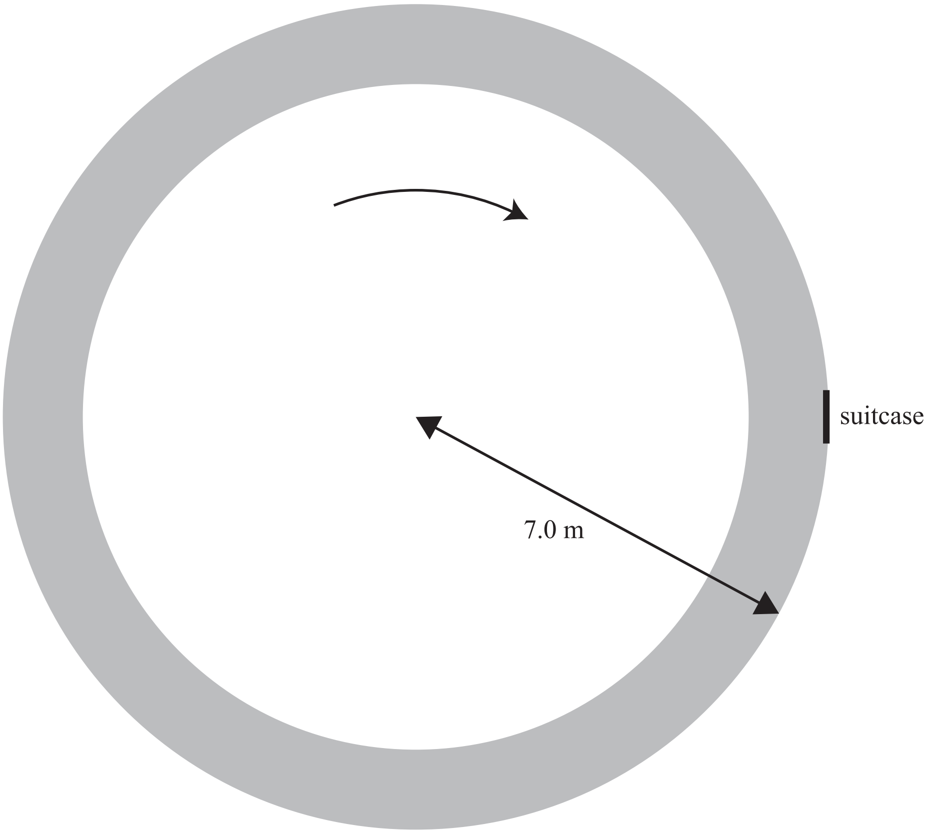
The baggage at the airport is delivered on a horizontal circular conveyor belt that is moving at constant speed. The radius of the circular belt is 7.0 m.

(a) Draw an **arrow** in the diagram below to show **the direction** of the velocity of the suitcase that is on the moving circular belt.

View from above



(b) Explain why the motion of the suitcase on the belt that is moving in a circle at constant speed is accelerated motion.

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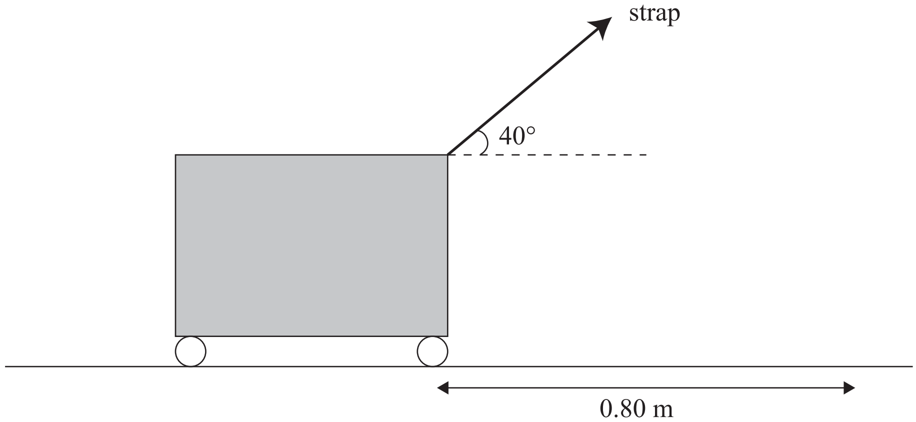
(c) Calculate the time it takes for the belt to complete one rotation if the **unbalanced force** on the suitcase is 5.5 N.

The mass of the suitcase is 18 kg.

(d) The suitcase is on wheels. The owner pulls it across the floor with a strap as shown in the diagram below. The force applied to pull the suitcase is 25 N and the strap is at an angle of 40° to the horizontal.



Calculate the **work done** pulling the suitcase 0.80 m along the floor.

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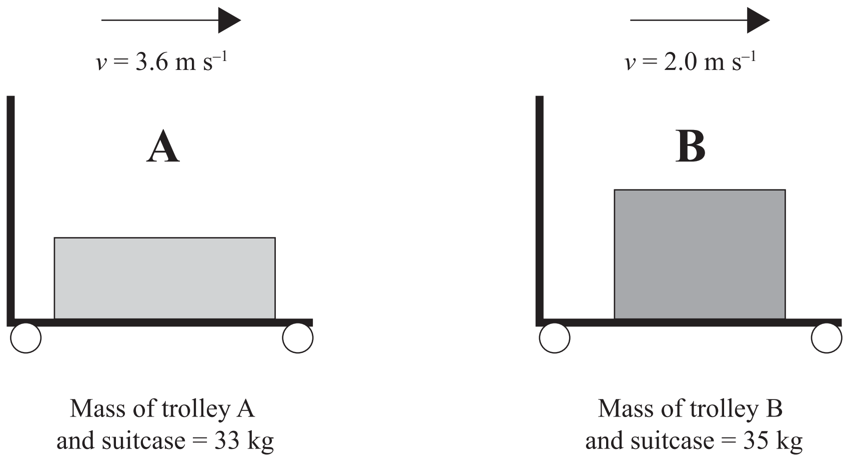
(e) The suitcase is put on trolley A. The total mass of trolley A and the suitcase is 33 kg. Trolley A with the suitcase is moving with a speed of 3.6 m s^{-1} when it collides **inelastically** with trolley B moving in the same direction with a speed of 2.0 m s^{-1}. The total mass of trolley B and its suitcase is 35 kg.



After the collision, trolley A is moving with a speed of 2.4 m s^{-1} in the same direction.

Calculate the kinetic energy of trolley B and its suitcase after the collision.

(f) What assumptions did you make in order to answer the above question?

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(g) This collision is described as **inelastic**.

Explain clearly what happens to *momentum* **and** *kinetic energy* in both *elastic* **and** *inelastic* collisions.

Note that Question Four is on the next page.

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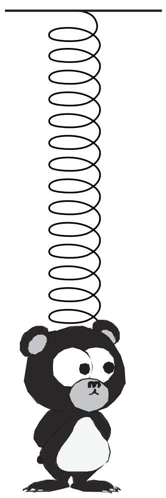
QUESTION FOUR: THE DUTY-FREE SHOP

At a duty-free shop at the airport, a toy teddy bear is hanging at the end of a spring. The spring is 51.0 cm long when hanging vertically. When the teddy bear of mass 400 g is hung from the end of the spring, the length of spring becomes 72.0 cm.



(a) Calculate the **spring constant**. Write a **unit** with your answer.

(b) Calculate the energy stored in the spring when a second toy of mass 300 g is also hung along with the teddy bear on the spring.

(c) The 400 g teddy bear is now hung on a stiffer spring which has **double** the spring constant.

Discuss how this affects the **extension** and the **elastic energy** stored in the spring.

Extra paper for continuation of answers if required.
Clearly number the question.

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