Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

Mid-Year Examination 2018
Secondary Three

ADVANCED PHYSICS

Sections B & C **2 hours**

Wednesday **9 May 2018** **08:45 – 10:45**

Calculators may be used

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section A (20 marks)
Printed in a separate document.

Section B (30 marks)
Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section C (10 marks)
Answer the **free-response** question in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES
The intended number of marks is given in the brackets [ ] at the end of each question or part question. You are advised to spend no longer than 30 minutes on Section A and no longer than 1 hour on Sections B and C.

You are reminded that all quantitative answers should include appropriate units. You are advised to show all your working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The use of an approved scientific calculator is expected, where appropriate.

Take the acceleration due to gravity to be 10 m s^{-2} or gravitational field strength to be 10 N kg^{-1}.

Examiner's Use	
Section A	
Section B	
21	
22	
23	
24	
25	
26	
Section C	
27	
Total	
	60
	%

Section B (30 marks)

Write your answers in the spaces provided.

21 A hospital in Japan offers one of the best surgical internship programs in the country. To qualify for the position, medical students have to prove their skills in a challenge.
The challenge is to create miniature sushi out of a single grain of rice as shown in Fig. 21.1.

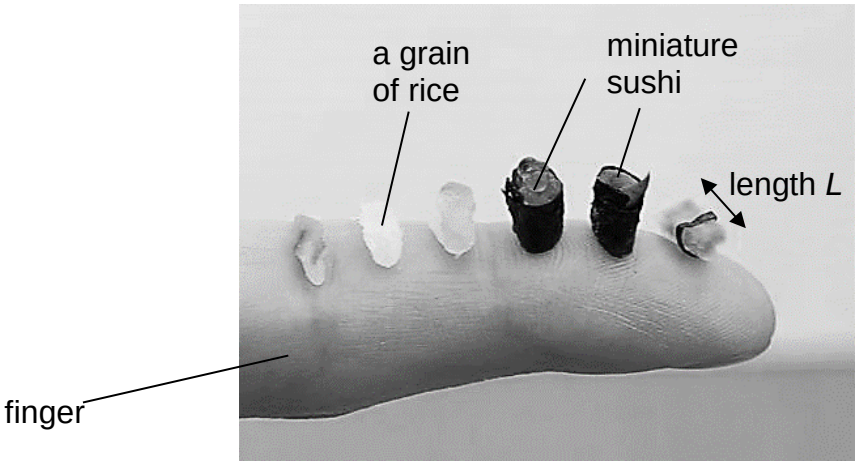


Fig. 21.1

The information of a sample of a grain of rice is given in Table 21.1.

length, *L*	6.23 mm
mass, *m*	0.0187 g

Table 21.1

(a) State the instrument that was used in the measurement of the length of the sample grain of rice in Table 21.1. Explain the reason for your choice.

……

……..... [2]

(b) Describe how you can measure, as accurately as possible, the average mass of a single grain of rice using an electronic balance.

……

……

……

……

……..... [3]

22 A cyclist starts from rest. He accelerates and then travels at a constant speed.

At 12 s, the cyclist applies the brakes and slows down. Photographs are taken of the cyclist at 4 s intervals. Fig. 22.1 shows the results.

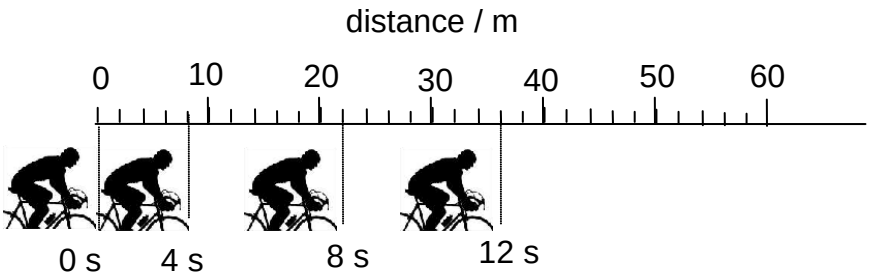
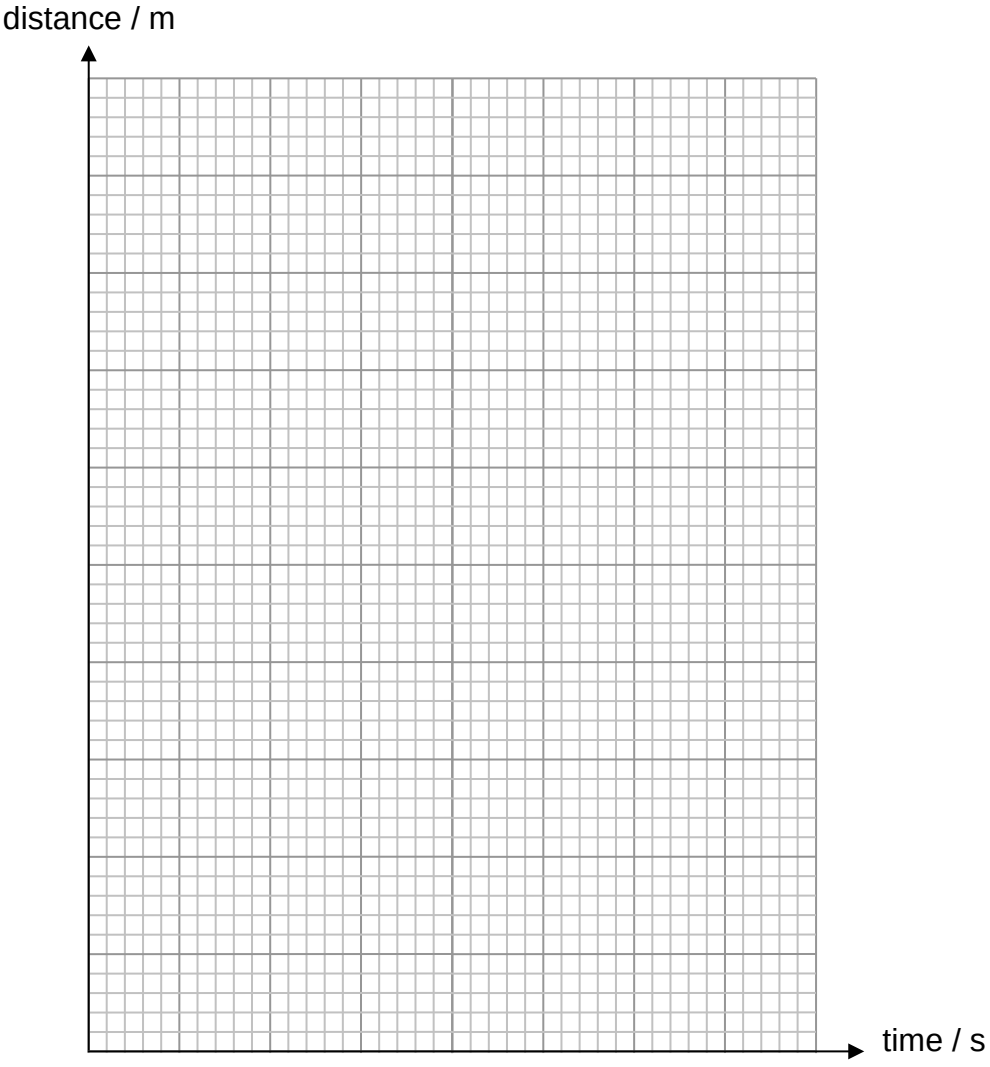


Fig. 22.1

(a) On Fig. 22.1, draw a vertical line on the distance scale to show a possible position of the front wheel of the bicycle at 16 s. [1]

(b) On the graph below, plot a distance-time graph of the cyclist for the first 12 s.



[2]

23 Ethan tosses a coin up as shown in Fig. 23.1. The coin takes 1.50 s to return to his hand. Air resistance can be taken as negligible.

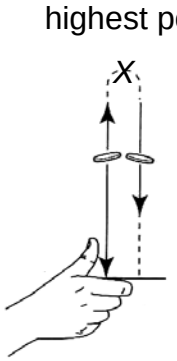


Fig. 23.1

(a) State the time taken for the coin to reach the highest point, *X*.

time taken = ... [1]

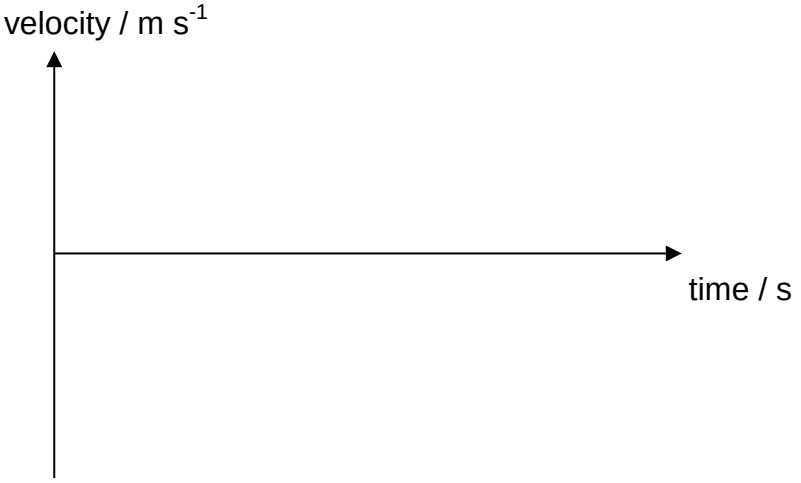
(b) State the acceleration of the coin at the highest point, *X*.

acceleration = ... [1]

(c) Calculate the initial speed of the coin.

speed = ... [2]

(d)(i) In the space below, sketch the velocity-time graph of the motion of the coin, starting from the time the coin leaves Ethan's hand to the time it returns to his hand. Label all values on the axes where appropriate.

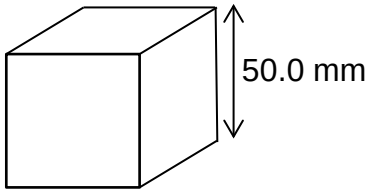


[2]

(ii) Hence, calculate the distance between his hand and the highest point, *X*.

distance = ... [2]

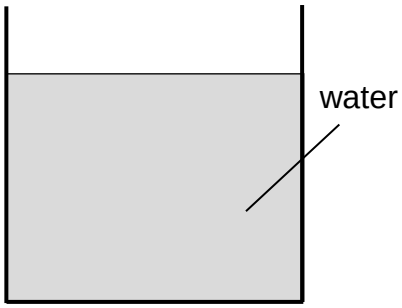
24 A cube Q of mass 1.0 kg has a length of 50.0 mm.



(a) Calculate the density of the cube.

density of cube = …… [2]

(b) Cube Q is placed in a tank of water. Given that the density of water is 1000 kg m^{-3}, draw on the diagram to show where the cube will settle in the tank of water.



[1]

25 A spaceship descends vertically towards the surface of the Moon. The total mass of the spaceship is 5.0×10^3 kg. Assume the gravitational field strength on the Moon is 1.60 N kg^{-1}.

(a) State Newton's First Law of Motion.

……

……..... [1]

(b) Determine the thrust required for the spaceship to descend with a constant speed.

thrust = …… [2]

(c) As the spaceship approaches the surface of the Moon, the thrust is changed to 1.0×10^4 N. Calculate the deceleration of the spaceship.

deceleration = …… [2]

26 When filled with helium gas, a big advertising balloon has a mass of 25 kg. The upthrust on the balloon is 450 N.

(a) Calculate the resultant force on the balloon when released in air.

resultant force = …… [1]

(b) To prevent the balloon from floating up and away, it is tied to the ground as shown in Fig 26.1.

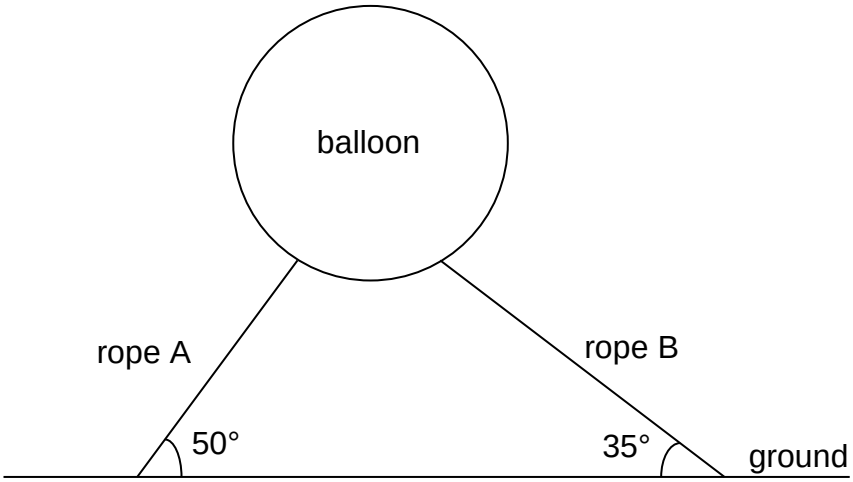


Fig. 26.1

By using a scaled diagram or otherwise, find the tensions in the two ropes.

tension in rope A = ……..

tension in rope B = …….. [3]

(c) When the helium gas is replaced with hydrogen, the upthrust experienced by the balloon would increase.

If the balloon is still tied to the ground by rope A and B at the same angles, how will the tensions in both ropes change? Explain your answer.

…….

……..... [2]

Section C (10 marks)

Write your answers in the spaces provided.

27 Block A rests on a frictionless surface and is attached to block B by a light, thin string which passes over a frictionless pulley. Block A has mass 2.0 kg, while block B has mass 1.0 kg. Block B is released at 0.50 m above the floor (Fig. 27.1) and it accelerates downwards.

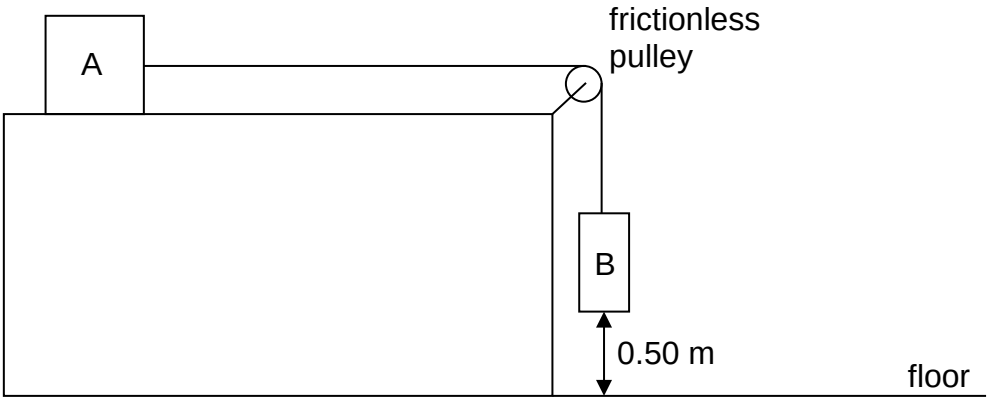


Fig. 27.1

(a) State Newton's Second Law of Motion.

……

……..... [1]

(b) Draw and label the free-body diagrams for both blocks A and B in Fig. 27.2 and Fig. 27.3 below. [3]

Block A:

Block B:

Fig. 27.2

Fig. 27.3

(c) Hence or otherwise, calculate the magnitude of acceleration of block B.

acceleration = ……. [2]

(d) Calculate the final speed of block B after falling through a distance of 0.50 m.

speed = ……. [2]

(e) Sketch and label the velocity-time graph for the motion of block B. Indicate on the graph any known values. [2]

End of paper

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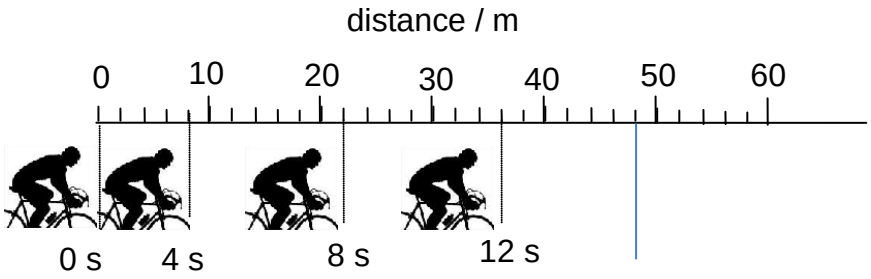
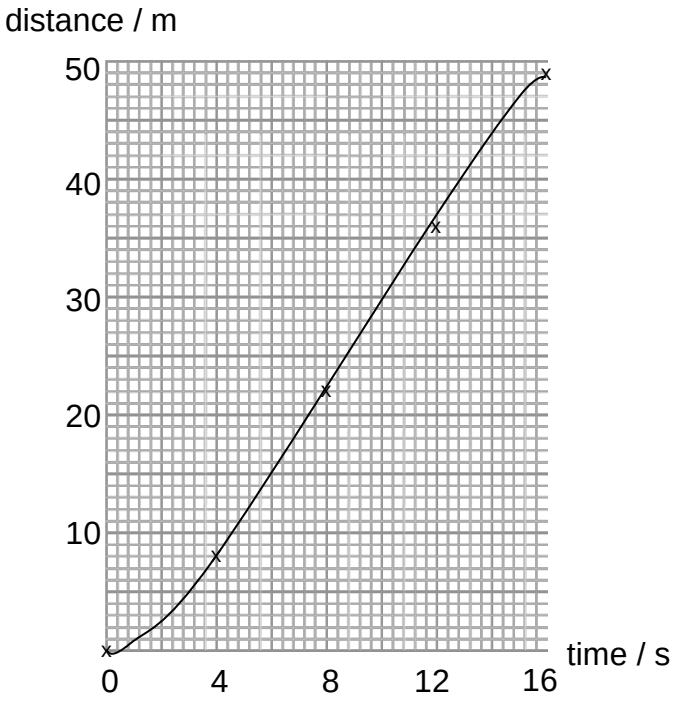
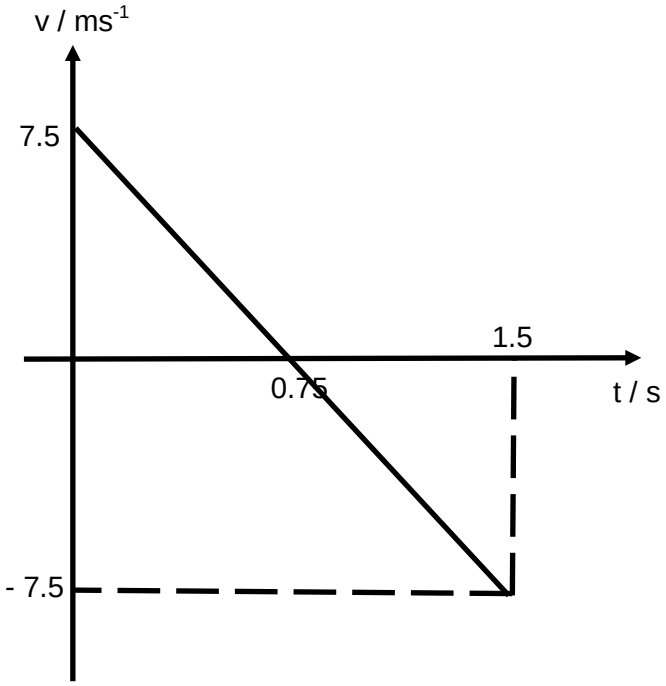
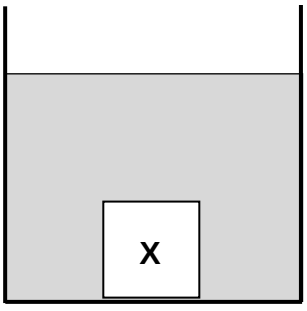
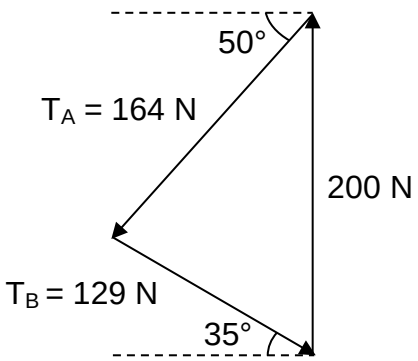
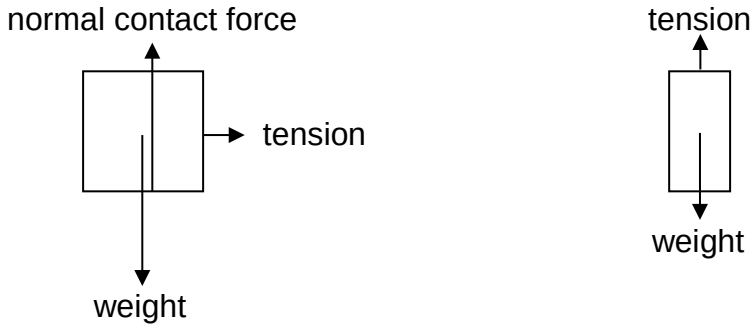
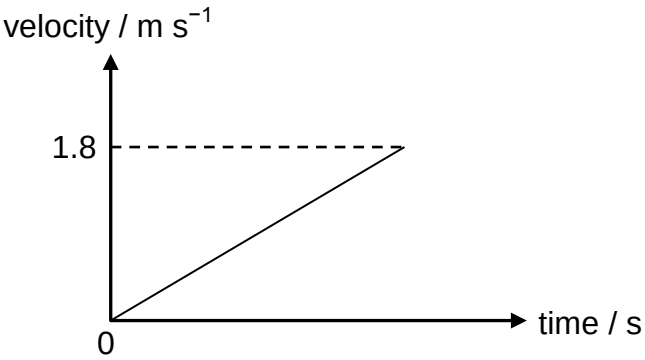
Answer Scheme

21	**(a)**	Micrometer screw gauge. The precision of the measurement is 0.01mm. This is the precision of the micrometer screw gauge.
	(b)	1) Count and measure the mass of 100 grains of rice using an electronic balance. 2) **Repeat** the measurement 2 more times to obtain 2 more sets of mass of 100 grains of rice. 3) Calculate the average mass of 1 grain of rice. Take the average of the 3 measurements then divide the mass by 100 to obtain the mass of 1 grain of rice.
22	**(a)**	 Anywhere less than 50 m
	(b)	 Correct plotting Smooth line of best fit
23	**(a)**	0.75 s
	(b)	10 ms^{-2}
	(c)	a = (v-u)/t 10 = (0 – u)/0.75 u = 7.5 m/s

	(d)	**(i)**  correct line correct values
	(d)	**(ii)** Distance = Area under graph = ½ (7.5)(0.75) = 2.81 m
24	**(a)**	ρ = m/V = 1.0/(0.05 × 0.05 × 0.05) = 8000 kg m^{-3}
	(b)	 Cube is at the bottom of the container
25	**(a)**	Newton's First Law of Motion states that an object at rest will remain at rest and an object in motion will continue in motion at constant speed in a straight line unless a resultant force acts on it.
	(b)	W = mg = 5000 × 1.60 = 8000 N For the spaceship to be moving at constant velocity, the resultant force on the spaceship is zero. Therefore, thrust = weight = 8000 N

	(c)	ma = thrust − W a = (10000 − 8000)/5000 = 0.40 m s^{-2}	
26	**(a)**	450 – (25 × 10) = 200 N	
	(b)	 - Correct directions (angles are right) - Correct orientation (formation of closed triangle) - Correct tensions T_A = 160 ± 5 N, T_B = 130 ± 5 N	$T_A \cos 50° = T_B \cos 35°$ $T_A \sin 50° + T_B \sin 35° = 200$ Solving both equations simultaneously, T_A = 160 N, T_B = 130 N
	(c)	The tensions will increase. Greater vertical components from both tensions are required to balance out the increase in upthrust. Since the angles are constant, this can only be achieved by increasing the magnitudes of both tensions.	

27	**(a)**	Newton's Second Law of Motion states that the resultant force acting upon an object is equal to the product of the mass and the acceleration of the object; the direction of the force is the same as that of the object's acceleration.
	(b)	 Weight drawn correctly on both diagrams Normal contact force drawn correctly on both diagrams Tension draw correctly on both diagrams *Deduct [1] in total if relative magnitudes are incorrect in any of these scenarios:* *- Weight of A must be equal to normal contact force of A*

		- Weight of A must be greater than weight of B *- Tension should be the same magnitude on both diagrams* *- Weight of B must be larger than tension*
	(c)	Let acceleration be *a* and tension be *T* Considering forces on block A, Net force = tension $2a = T$ Considering forces on block B, Net force = weight − tension $a = 10 - T$ Solving them simultaneously, $a = 3.3\ m\ s^{-2}$
	(d)	$v^2 = u^2 + 2as$ $v^2 = 2(3.33)(0.50)$ $v = 1.8\ m\ s^{-1}$
	(e)	 Correct axes and 1.8 m s^{-1} labelled Correct shape (straight line)