ORCHID PARK SECONDARY SCHOOL
Mid-Year Examination 2017

CANDIDATE NAME

CLASS 3 A

INDEX NUMBER

SCIENCE (PHYSICS) **5076**

Booklet Multiple Choice Questions **4 May 2017**

Secondary 3 Express **1 hour 15 minutes**

Setter: Mr Jason Law **50 Marks**

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black ink pen. You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use paper clips, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

There are **15** multiple choice questions in this paper.
Answer **all** questions.
For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and write your answer in the boxes on **page 2**.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised to spend no longer than 20 minutes on this booklet. You may proceed to answer the Theory booklet as soon as you have completed this booklet.

Any rough working should be done in this booklet.

Section A: Multiple Choice Questions [15 marks]
For each question, there are four possible answers A, B, C and D. Choose the one you consider correct and write your answers in the boxes provided below.

Answer **all** the questions in this section

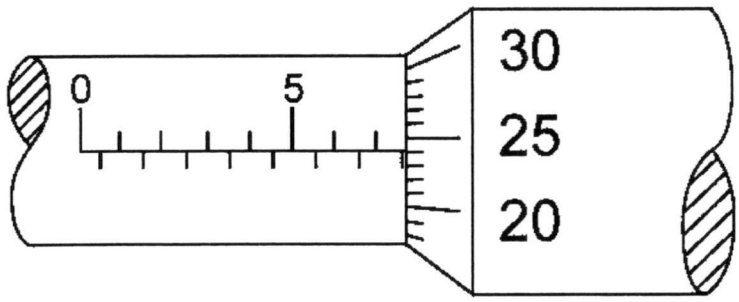
Answer boxes

1	2	3	4	5

6	7	8	9	10

11	12	13	14	15

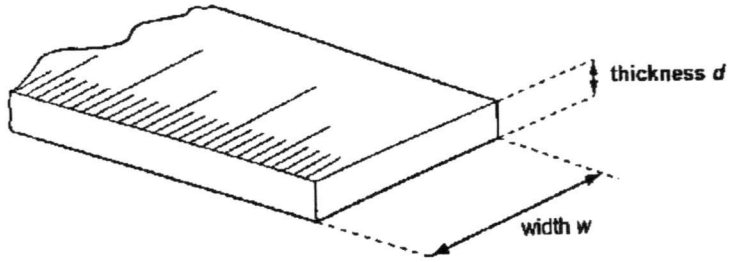
1 A micrometer screw gauge is used to measure the thickness of a stack of paper. Its reading is shown in the diagram below.



There are 10 pieces of paper in the stack. What is the thickness of **one** piece of paper?

A 0.72 mm **B** 0.77 mm **C** 7.24 mm **D** 7.74 mm

2 Which of the following combinations of instruments can be used to measure the thickness, *d*, and width, *w*, of a metre rule shown in the diagram below?



	Measurement of *d*	Measurement of *w*
A	half-metre rule	half-metre rule
B	half-metre rule	vernier caliper
C	vernier caliper	half-metre rule
D	vernier caliper	vernier caliper

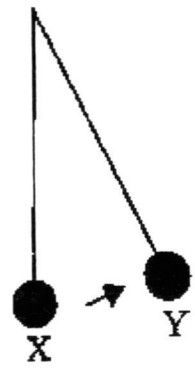
3 Three lengths, X, Y and Z, are measured during a practical session and they are shown below.

$\mathbf{X} = 1.24\ \mu m, \quad \mathbf{Y} = 1.24 \times 10^{4}\ nm, \quad \mathbf{Z} = 1.24 \times 10^{-4}\ mm$

Arrange the lengths in order from the largest to the smallest values.

	Largest		Smallest
A	X	Y	Z
B	X	Z	Y
C	Y	X	Z
D	Y	Z	X

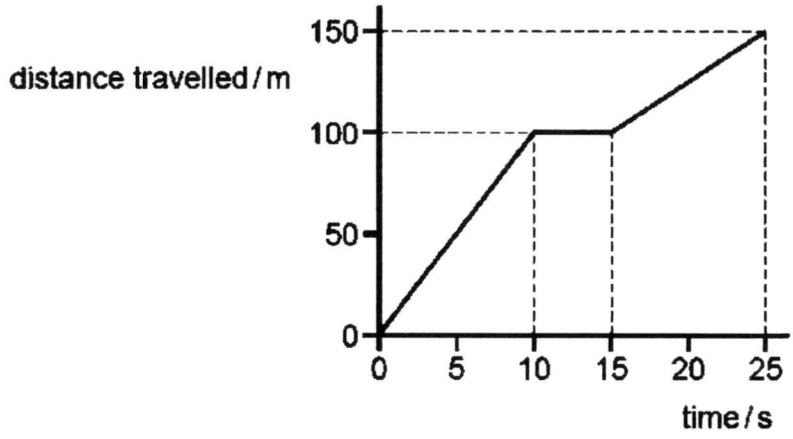
4 The time taken for a pendulum to swing from X to its maximum displacement position Y is 0.5 s.



What is the time taken for the pendulum to complete 20 oscillations?

A 2.0 s **B** 10.0 s **C** 20.0 s **D** 40.0 s

5 The diagram shows how the distance travelled by a cyclist changes with time.

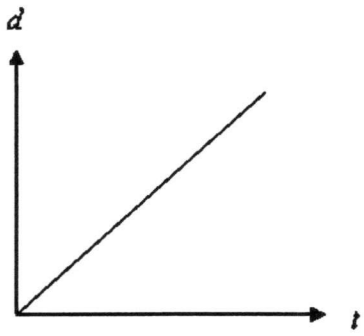


Calculate the average speed of the cyclist for the whole journey.

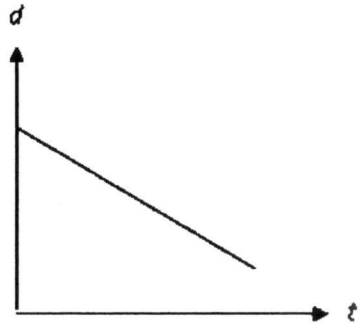
A 6.0 m/s **B** 7.5 m/s **C** 10 m/s **D** 11 m/s

6 Which of the following distance-time graphs shows that an object is moving with an increasing speed?

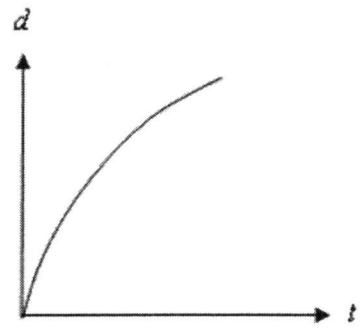
A



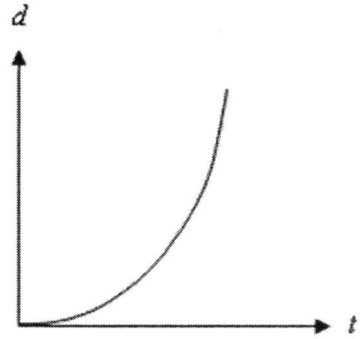
B



C



D



7 Which of the following **cannot** be the resultant of a 5 N and 12 N force?

A 4N **B** 7 N **C** 13 N **D** 17 N

8 The weight of a rock on Earth is 20 N.

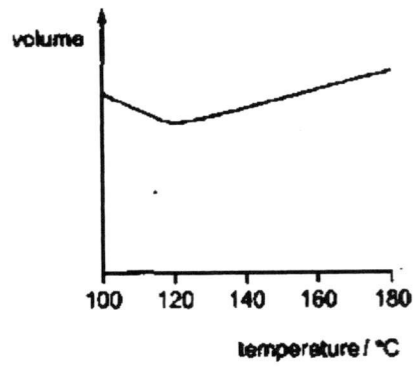
If the gravitational field strength on the Moon is approximately 1.7 N/kg, what is its weight on the Moon?

A 2.0 N **B** 3.4 N **C** 13 N **D** 20 N

9 A moving aeroplane on the runway has high inertia. How difficult is it to make it start moving and to slow it down?

	To start moving	To slow down
A	Difficult	Difficult
B	Difficult	Easy
C	Easy	Difficult
D	Easy	Easy

10 The graph below shows how the volume of a fixed mass of liquid changes with temperature.



Which of the following is true about its density?

A Its density is at a maximum value at 120 °C.
B Its density is at a maximum value at 180 °C.
C Its density is at a minimum value at 100 °C.
D Its density is at a minimum value at 120 °C.

11 A 3200 kg rectangular box has dimensions 0.20 m by 0.25 m by 0.10 m.

What is the **maximum** pressure exerted by the box on a flat surface?

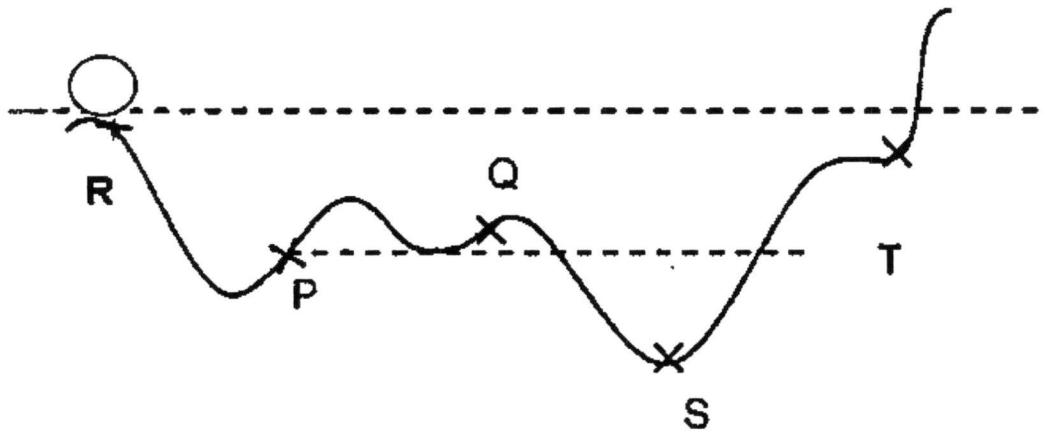
A 160 kPa **B** 1 600 kPa **C** 3 200 kPa **D** 6 400 kPa

12 A rocket of total mass m is travelling at a speed v. The engine of the rocket is fired and fuel is used up. The mass of the rocket decreases to $\frac{1}{2}m$ and its speed increases to $2v$.

What happens to the kinetic energy of the rocket?

A It is doubled.
B It is halved.
C It increases by four times.
D It remains the same.

13 A marble is at rest at R. It is then allowed to roll along a plane as shown below. It is at rest at R. Neglect air resistance and assume the plane is smooth.

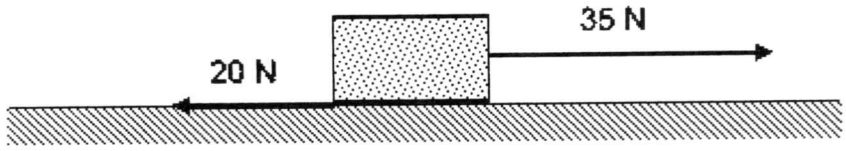


Which of the following statement(s) is/are correct?

I. The marble has maximum kinetic energy at S.
II. The marble will at most roll up to Q and return to R.
III. The speed of the marble at P is slightly greater than at Q.

A I only
B II only
C I and II only
D I and III only

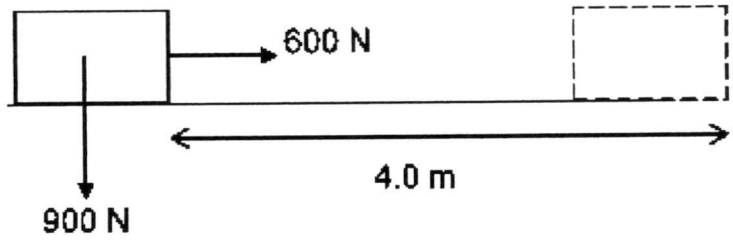
14 A box experiences a pushing force of 35 N in order to move forward by 5.0 m. The frictional force acting against the box is 20 N.



What is the work done against friction in moving the box?

A 25 J **B** 75 J **C** 100 J **D** 180 J

15 A box weighing 900 N is moved horizontally by a 600 N force. The box moved over a distance of 4.0 m in 20 s.



What is the average power in moving the box?

A 60 W **B** 120 W **C** 180 W **D** 2400 W

– **End of Section A** –

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ORCHID PARK SECONDARY SCHOOL
Mid-Year Examination 2017

CANDIDATE NAME

CLASS 3 A INDEX NUMBER

SCIENCE (PHYSICS) **5076**

Booklet Theory **4 May 2017**

Secondary 3 Express **1 hour 15 minutes**

Setter: Mr Jason Law **50 Marks**

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black ink pen. You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use paper clips, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section B
Answer **all** questions.
Write your answer in the spaces provided on the question paper.

Section C
Answer **ONE** question. Indicate your choice in the box on the right.
Write your answer in the spaces provided on the question paper.

For Examiner's Use		
P1	Section A	/15
P2	Section B	/25
	Section C	
	.....	/10
	Total	/50

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **10** printed pages inclusive of one blank page.

Section B: Structured Questions [25 marks]
Write your answers to all questions in this section on the lines or in the spaces provided.

For Examiner's Use

Answer **all** the questions in this section.

1 The speed-time graph of a lorry is shown in Fig. 1.1.

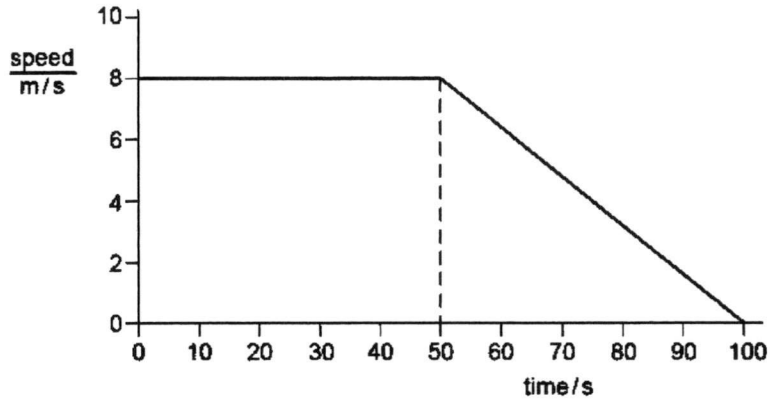


Fig. 1.1

(a) Describe the motion of the lorry from t = 0 s to t = 100 s.

.....

.....

.....

..... [2]

(b) **(i)** Calculate the total distance travelled by the lorry from t = 0 s to t = 100 s.

distance = ... [2]

(ii) On Fig. 1.1 above, sketch and label the speed-time graph for a car which travels at constant speed from t = 0 s to t = 60 s in order to travel the same distance as the lorry calculated in (b)(i). [2]

For Examiner's Use

2 A cow is led by two herders using ropes as shown in Fig. 2.1 below. Herder 1 exerts a force T_1 of 1600 N while herder 2 exerts a force T_2 of 1200 N perpendicular to T_1.

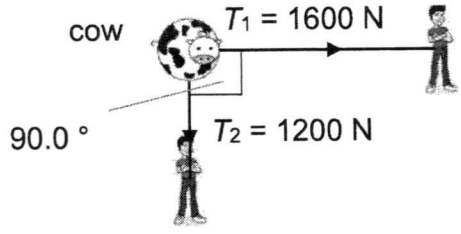


Fig. 2.1 (not to scale)

By using a suitable scale diagram, determine the resultant force acting on the cow due to the forces exerted by the herders and the angle between T_2 and the resultant force.

scale: 1 cm represents ..... [1]

[2]

resultant force = ... [1]

angle to T_2 = ... [1]

For Examiner's Use

3 A school bag is pulled along the floor as shown in Fig. 3.1. Fig. 3.2 shows how the acceleration of the school bag changes when the pulling force, P, is varied.

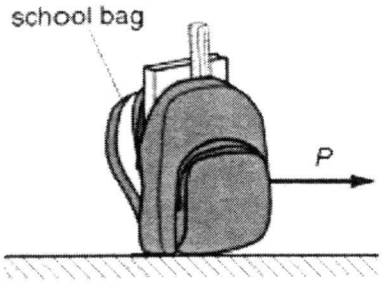


Fig. 3.1

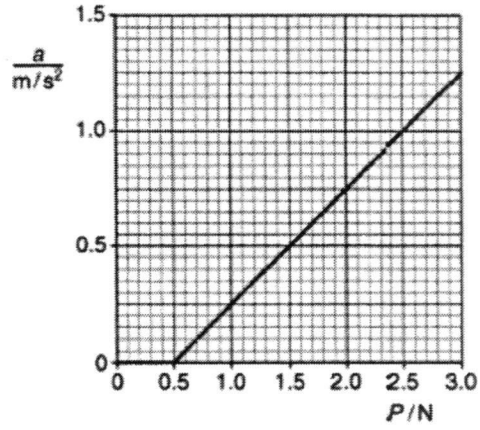


Fig. 3.2

(a) On Fig. 3.1 above, draw and label the direction of friction acting on the school bag. [1]

(b) The school bag only begins to accelerate when P is greater than 0.5 N.

(i) Suggest and explain why the school bag does not accelerate when P is equal to 0.5 N.

.....

.....

..... [2]

(ii) Hence or otherwise, state the magnitude of friction acting on the school bag as it moves.

friction = ... [1]

(c) The school bag now experiences a constant pulling force P of 2.5 N.

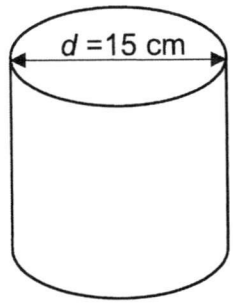
Using Fig. 3.2 or otherwise, determine the mass of the school bag. Take g = 10 N/kg.

mass = ... [3]

For Examiner's Use

4 Brass is an alloy made by melting copper and zinc metal together. A cylinder made from a specific brass alloy is shown in Fig. 4.1.

Density values
Copper: 840 kg/m^3
Zinc: 700 kg/m^3



Masses used
Copper: 840 g
Zinc: 700 g

Fig. 4.1

(a) The brass alloy is said to be under the effects of Earth's gravitational field.

State what is meant by Earth's *gravitational field*.

.....

..... [1]

(b) By using the information given in Fig. 4.1, determine the density of this brass alloy.

density = ... [3]

(c) Determine the pressure that the cylinder exerts when its circular face is placed on the ground.

[Hint: area of circle = $\frac{1}{4}\pi d^2$]

pressure = ... [3]

– **End of Section B** –

Section C: Free Response Questions [10 marks]
Write your answers to all questions in this section on the lines or in the spaces provided.

For Examiner's Use

Answer **only one** of the questions in this section.

1 A typical carpark barrier is shown in Fig. 1.1.

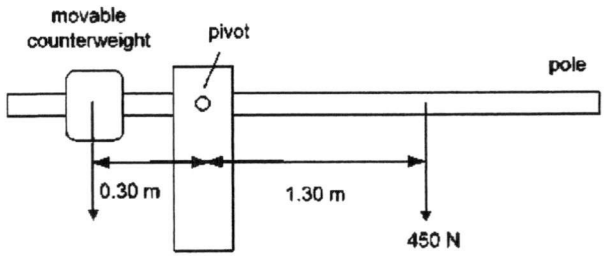


Fig. 1.1

(a) Describe and explain how the barrier can be lifted by adjusting the movable counterweight.

.....

.....

..... [2]

(b) When the system is in equilibrium, the movable counterweight is at a distance of 0.30 m away from the pivot. The pole has a weight of 450 N and its centre of gravity is 1.30 m away from the pivot

(i) State the *Principle of Moments*.

.....

.....

..... [1]

(ii) Hence or otherwise, determine the mass of the movable counterweight. Take g = 10 N/kg.

mass = ... [3]

For Examiner's Use

(c) A martial artist figurine is shown in Fig. 1.2 below.

Fig. 1.2

(i) State and explain how any two features of the figurine help to make it stable.

1. .....

.....

2. .....

.....

[2]

(ii) Explain, in terms of moments, how the toy remains stable and returns to its original position after being tilted to the right slightly when pushed.

.....

.....

.....

.....

..... [2]

For Examiner's Use

2 A playground ride is shown in Fig. 2.1. The vehicle starts from rest at point A, which is at the top of the smooth curved track and then rolls down the track to point X. Beyond point X, the track is horizontal, and it slows down as it passes through a trough containing water, before coming to rest at point B.

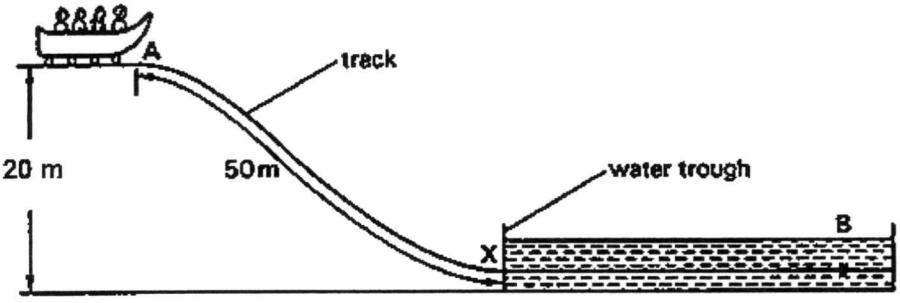


Fig. 2.1

The vehicle has a mass of 100 kg. Take g = 10 N/kg.

(a) Describe the main energy conversions taking place for the vehicle as it moves from

A to X .....

.....

X to B .....

.....

[2]

(b) Determine the maximum speed of the vehicle at point X.

speed = ... [3]

(c) Explain, using ideas about energy, why the vehicle will not be able to reach the speed calculated in (b) in real life.

.....

.....

..... [2]

For Examiner's Use

(d) The vehicle takes about 4.0 s to come to a complete stop.

The vehicle enters the trough with the maximum speed at X as calculated in (b).

Assuming that all resistive forces acting on the vehicle remain constant throughout its motion in the trough, determine the

(i) average deceleration of the vehicle;

deceleration = ... [2]

(ii) minimum length of the water trough (from X to B) for the vehicle to stop completely.

length = ... [1]

– **End of Section C** –

– **End of Paper** –

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Orchid Park Secondary School
MYE 2017
Answer Scheme: 3E SCI (PHY)

Section A

1	B	**6**	D	**11**	B
2	D	**7**	A	**12**	A
3	C	**8**	B	**13**	D
4	D	**9**	A	**14**	C
5	A	**10**	A	**15**	B

Section B

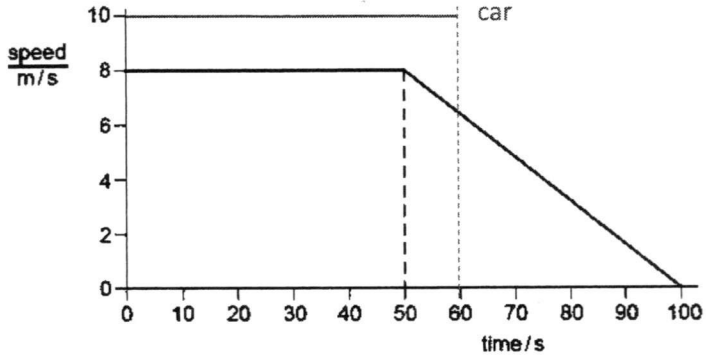
1 **(a)** t = 0 s to t = 50 s: moving with zero acceleration/constant speed
t = 50 s to t = 100 s: moving with constant deceleration (of 1.6 m/s constant acceleration (of - 1.6 m/s^2) OR speed decreases uniformly

NOTE: decreasing uniform speed" does not mean constant decelera

b)

d = area under graph
½ × (50 + 100) × (8)
600 m

(ii)



Work backwards to determine that car needs to move at constant speed of 10 m/s in order to reach the same distance travelled using v = d/t.

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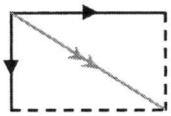
2

T_1 = 1600 N (8.0 cm line)

T_2 = 1200 N (6.0 cm line)

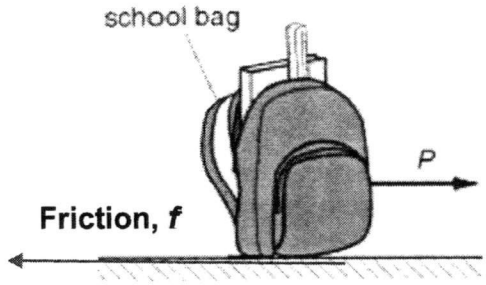


Scale: 1 cm: **200 N**
Resultant: **(2000 ± 20) N**
Angle: **(53.0 ± 0.5)°**

*see sample on last page

NOTE:
① Many candidates had **blatant** parallax error (e.g. 6.9 cm instead of 6.0 cm)
② Angles should be kept to 1dp.
③ Arrows on vectors should be drawn and point as shown in question.
④ Resultant **in between two starting vectors**.

3 (a)



Friction is a contact force and should be drawn **between two surfaces**.

(b)

(i) No resultant force acts on school bag
Magnitude of friction is equal to *P*

(ii) 0.5 N

(c) When P = 2.5 N, a = 1.0 m/s
$m = F_{net}/a = (P - f)/a = [(2.5) - (0.5)]/(1.0)$
= 2 kg (exact)

NOTE: Some students did not read question to use Fig. B3.2. Also, students forgot that F in F_{net} = ma requires **resultant force**.

4 (a) Region (in space) where a mass experiences gravitational force/a force due to gravitational attraction

(b) $m_T = m_{Cu} + m_{Zn}$ = 840 + 700 = 1540 g = 1.54 kg
$V_T = V_{Cu} + V_{Zn} = (840 \div 10^3)/(840) + (700 \div 10^3)/(700) = 2.0 \times 10^{-3}$ m^3
$\rho = m_T/V_T = (1.54) \div (2.0 \times 10^{-3})$ = 770 kg/m^3

NOTE: Many students forgot how to find density of mixtures (from *E*-learning).

(c) $A = \frac{1}{4}\pi d^2 = \frac{1}{4}\pi(15 \times 10^{-2})^2 = 0.01767$ m^2/ 1767 cm^2
$p = F/A = W/A = mg/A = (1.54)(10) \div (0.0177)$
= 871 Pa (3sf)/ 0.0871 N/cm^2 (3sf)

Section C

1 (a) Counterweight can be moved to the left/ further away from pivot
A resultant anticlockwise moment will act on pole to cause it to turn anticlockwise/move up to open the barrier

NOTE: Many students did not **describe how** to adjust counterweight. Also, conceptual error: Counterweight was not removed and changed, hence its weight/force **should not increase**.

(b)
(i) Object is in equilibrium and sum of clockwise moments about a point/the pivot is equal to the sum of anticlockwise moments about the same point/pivot

NOTE: Standard definition – No credit if any part missing.

clockwise moment = sum of anticlockwise momen
$(450)(1.3) = (m_{CW})(10)(0.30)$
$m_{CW} = 195$ kg

(c)
(i) Most of mass near bottom hence centre of gravity is lowered
Feet spread apart to increase base area/giving wider base

NOTE: Students did not **state feature** before **explaining**. Some candidates did not show understanding of factors for stability.

(ii) Line of action of weight (through CG) remains within base
Resultant (anticlockwise) moment causes figurine to turn (anticlockwise) and return to original position

2 (a) A to X: Gravitational potential energy to kinetic energy
X to B: Kinetic energy to sound and thermal energy
NOTE: No such thing as "heat energy".

(b) By COE, Δ (decrease) in GPE = Δ in KE
$mg\Delta h = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{(2g\Delta h)} = \sqrt{[2 \times (10) \times (20)]}$
= 20 m/s (2sf)
ACCEPT: Variant of working to determine loss in GPE first before equating.

(c) Loss of energy as thermal energy due to friction along track and air resistance
Less gravitational potential energy converted to kinetic energy hence vehicle will have lower speed

(d)
(i) $a = (v - u) \div t = [(0) - (20)] \div (4.0) = -5.0$ m/s^2
deceleration = $-a$ = 5.0 m/s^2

(ii) $d = \frac{1}{2} \times 4.0 \times 20$ = 40 m (draw speed-time graph to see)

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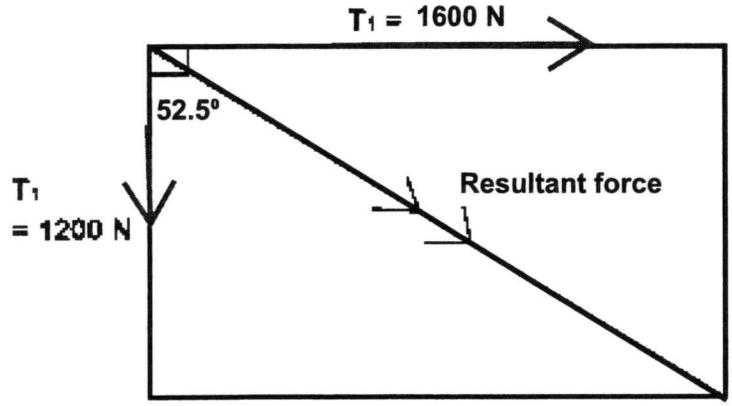
Sample for Section B Q2

By using a suitable scale diagram, determine the resultant force acting on the cow due to the forces exerted by the herders and the angle between T_2 and the resultant force.

200N

scale: 1 cm represents ..... [1]



F net = 10 x 200

=2000 N

[2]

2000N

resultant force = ... [1]

52.5°

angle to T_2 = ... [1]