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ASSUMPTION ENGLISH SCHOOL
MID-YEAR EXAMINATION 2019

PHYSICS 6091
BOOKLET A

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LEVEL:	Sec 3 Express	**DATE:**	13 May 2019
CLASS:	Sec 3/2	**DURATION:**	2 hours 30 minutes (for Booklets **A** and **B**)

Additional Materials provided: 1 sheet of OAS paper

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page and on the OAS paper. **Shade your index number on the OAS paper.**

This paper consists of 3 sections.

BOOKLET A:
SECTION A – MULTIPLE CHOICE QUESTIONS (30 marks)
There are 30 questions in this section. Answer all questions. For each question, there are four possible answers A, B, C and D. **Record your choice in pencil on the OAS paper provided. DO NOT fold or bend the OAS paper.**

BOOKLET B:
SECTION B – SHORT STRUCTURED QUESTIONS (40 marks)
Answer **all** questions. Write your answers in the spaces provided on the question paper.

SECTION C – FREE RESPONSE QUESTIONS (30 marks)
Answer **all** questions. Answer only one of the two alternative questions in **Question 12**. Write your answers in the spaces provided.

At the end of the examination, hand in your OAS paper, Booklets **A** and **B** separately.

This Question Paper consists of 11 printed pages including this page.
[Turn over

Section A – Multiple Choice Questions (30 marks)

Answer **all** questions on the OAS paper provided.

1 Which of the following represents the longest length?

A 1.5×10^{-9} Mm **B** 1.5×10^{7} mm

C 1.5×10^{7} µm **D** 1.5×10^{8} nm

2 Which row correctly shows one scalar and one vector quantity?

	scalar	vector
A	displacement	distance
B	mass	weight
C	moment	speed
D	velocity	acceleration

3 A pendulum clock is running too fast, what is the correct way of increasing the period of the pendulum?

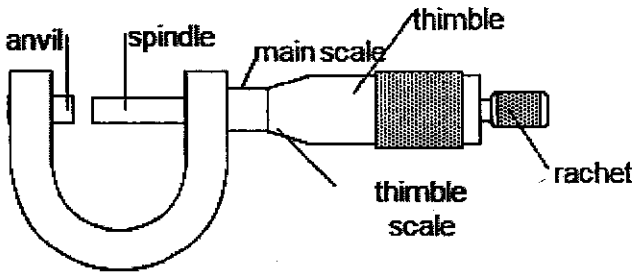
A decrease the amplitude of the pendulum

B decrease the length of the pendulum

C increase the amplitude of the pendulum

D increase the length of the pendulum

4 A student measures the thickness of a coin using a micrometer screw gauge.



The following steps are carried out but are in the wrong order.

1. Turn the ratchet until a 'click' is heard.
2. Take the reading on the thimble.
3. Place the coin between the anvil and the spindle.
4. Take the reading on the main scale.
5. Turn the thimble to close the anvil and the spindle.

What is the correct order?

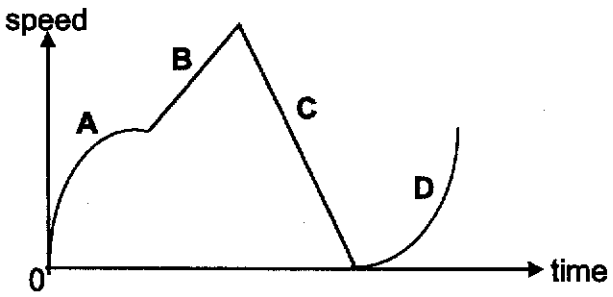
A 1 → 5 → 3 → 2 → 4

B 3 → 1 → 5 → 4 → 2

C 3 → 5 → 1 → 4 → 2

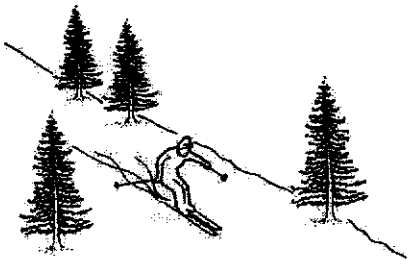
D 5 → 3 → 1 → 2 → 4

5 The speed-time graph of an object is shown.

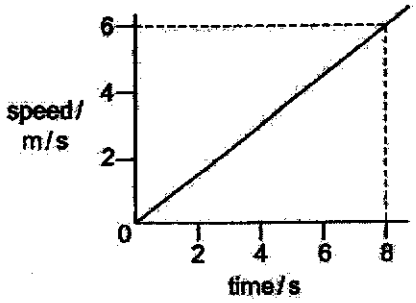


Which labelled section, **A**, **B**, **C** or **D**, shows the object moving with increasing acceleration?

6 A skier starts to ski down a snow-covered mountain.



The speed-time graph for first part of his journey is shown.



How far does the skier travel in the first 8 s?

A 6 m **B** 8 m

C 24 m **D** 48 m

7 A boy throws a stone vertically up to a man standing 2.0 m above the boy. If the stone is thrown up with a velocity of 7.0 m/s, what is the velocity of the stone at the instant when it is caught by the man? The acceleration due to free fall is 10 m/s^2.

A 3.0 m/s **B** 6.2 m/s

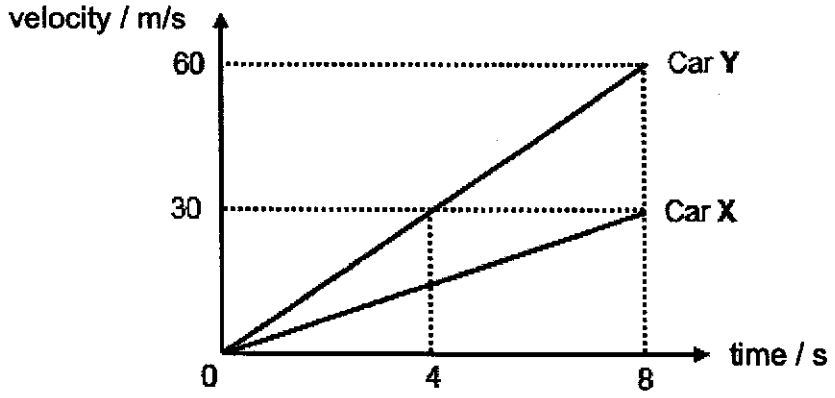
C 9.0 m/s **D** 9.2 m/s

8 An object starts from rest and undergoes constant acceleration. In the first second, it travels 2.0 m. How far does it travel in the next second?

A 2 m **B** 4 m

C 6 m **D** 8 m

9 The velocity-time graph of two cars is shown below.



Which statement is true?

A Cars **X** and **Y** have the same acceleration.

B Cars **X** and **Y** will pass each other after 4 s.

C Car **X** travels a total distance of 30 m and car **Y** travels a total distance of 60 m.

D The acceleration of car **X** is half that of car **Y**.

10 Which of the following **must** be changing when a body is accelerating uniformly?

A the force acting on the body

B the mass of the body

C the speed of the body

D the velocity of the body

11 When a block of wood of mass 2 kg was pushed along a horizontal flat surface of a bench, the friction force measured was 4 N. If the block was pushed along the same bench with a force of 10 N, which statement is correct?

A constant acceleration of 3 m/s^2

B constant acceleration of 5 m/s^2

C constant speed of 3 m/s

D constant speed of 5 m/s

12 A car is travelling at constant speed along a road and drives onto a large patch of oil. The driver applies the brakes to stop the car. Compared to braking on a dry road, what may happen?

A The car slows down more quickly because of the reduced friction between the tyres and the road.

B The car speeds up because of the reduced friction between the tyres and the road.

C The car takes longer to slow down because of the reduced friction between the tyres and the road.

D The car takes longer to slow down because of the greater friction between the tyres and the road.

13 Why does an object falling in the Earth's gravitational field reach a steady velocity?

A Air resistance increases with increase of velocity.

B The Earth's gravitational field decreases as the objects falls.

C The mass of the object remains constant.

D The weight of the object increases as it falls.

14 A body resists changes to its motion. Which property of the body is responsible for this resistance?

A density **B** inertia

C kinetic energy **D** potential energy

15 The table shows the weights of some masses on the surface of four different planets. Which planet has the greatest gravitational strength?

	mass / kg	weight / N
A	0.5	20
B	0.5	40
C	2.0	20
D	2.0	40

16 A cube of side 3 cm is placed in an empty graduated measuring cylinder. 125 cm^3 of water is then added and the cube remains at the bottom of the cylinder.
What will be the reading on the measuring cylinder?

A 128 cm^3 **B** 131 cm^3

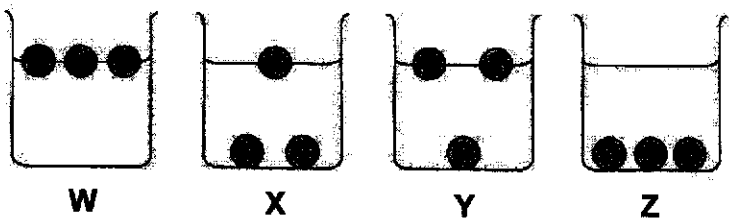
C 134 cm^3 **D** 152 cm^3

17 A wooden cube of density 8.0 g/cm^3 was cut into eight equal pieces. What is the density of each piece of wood?

A 1.0 g/cm^3 **B** 2.0 g/cm^3

C 4.0 g/cm^3 **D** 8.0 g/cm^3

18 Three balls have densities of 0.9 g/cm^3, 1.1 g/cm^3 and 1.3 g/cm^3 respectively. In turns, they are put into four beakers containing different liquids.

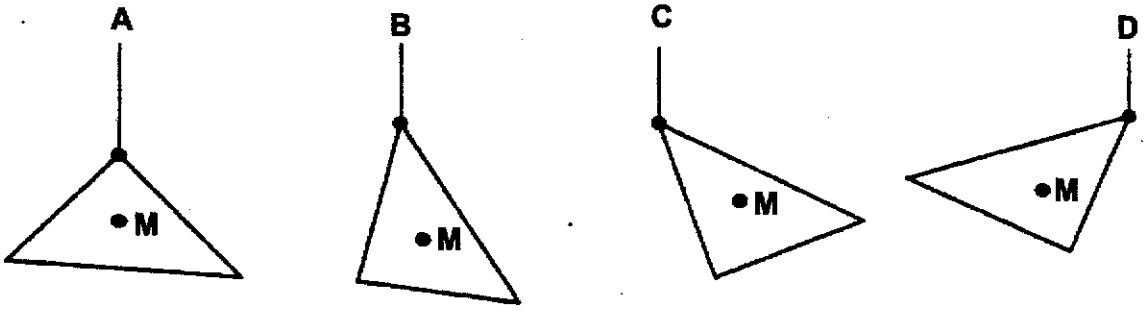


Three of the beakers hold oil of density 0.8 g/cm^3, water of density 1.0 g/cm^3 and mercury of density 13.6 g/cm^3. Which statement shows the correct sequence of the respective beaker of oil, water and mercury?

A **W**, **X** and **Z** respectively **B** **X**, **Z** and **Y** respectively

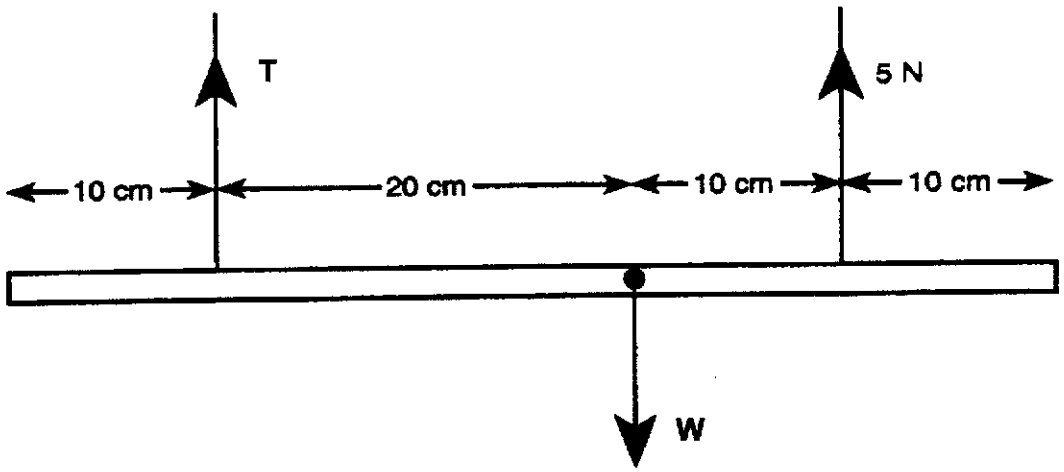
C **Y**, **Z** and **X** respectively **D** **Z**, **X** and **W** respectively

19 Which diagram shows how a piece of card, of centre of gravity **M**, hangs when suspended by a thread?



8

20 A non-uniform rod of unknown weight **W** is suspended by two strings as shown in the diagram below. The tension in one of the strings is 5 N.

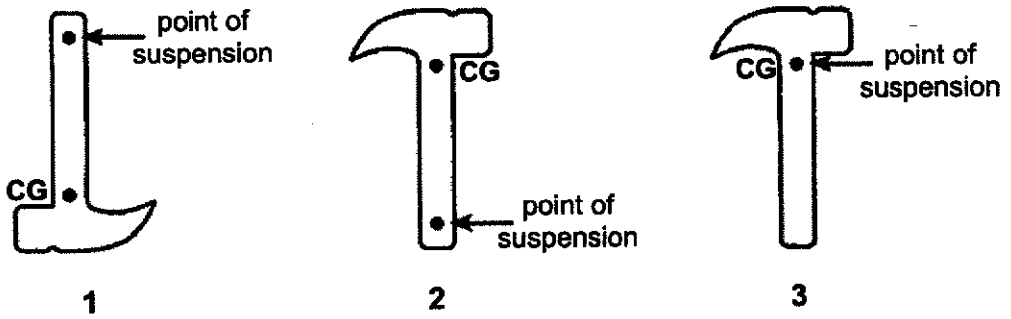


The tension **T** in the other string is .....

A 2.5 N **B** 5.0 N

C 7.5 N **D** 12.5 N

21 A hammer can be suspended in equilibrium from the three different positions as shown.



1 **2** **3**

Which row matches the figures with their respective types of equilibrium?

	neutral	stable	unstable
A	1	2	3
B	2	1	3
C	3	1	2
D	3	2	1

22 Why is it better to use a long spanner rather than a short one to tighten a nut on a bolt?

A Less force is needed to be exerted by the user.

B Less friction is present.

C Less turning effect is required on the spanner.

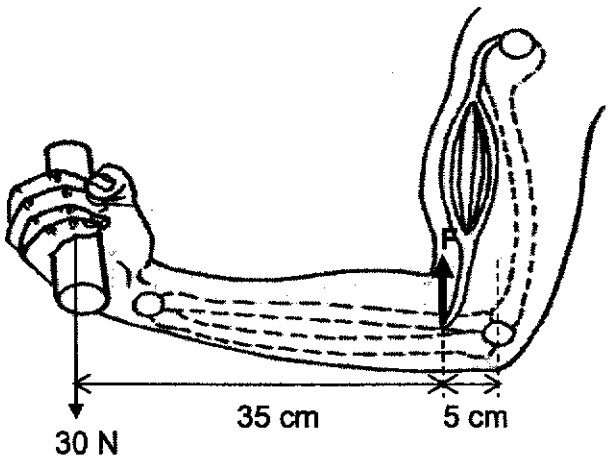
D Less work is done by the user.

23 Which item has every point on its surface equidistant to its centre of gravity?

A a cubic box **B** an egg

C a cylinder **D** a table-tennis ball

24 The diagram shows Jensen using one hand to hold a 30 N object.



What is the force **F**, exerted by Jensen's bicep muscle in order to hold the object in the position?

A 21 N **B** 30 N

C 210 N **D** 240 N

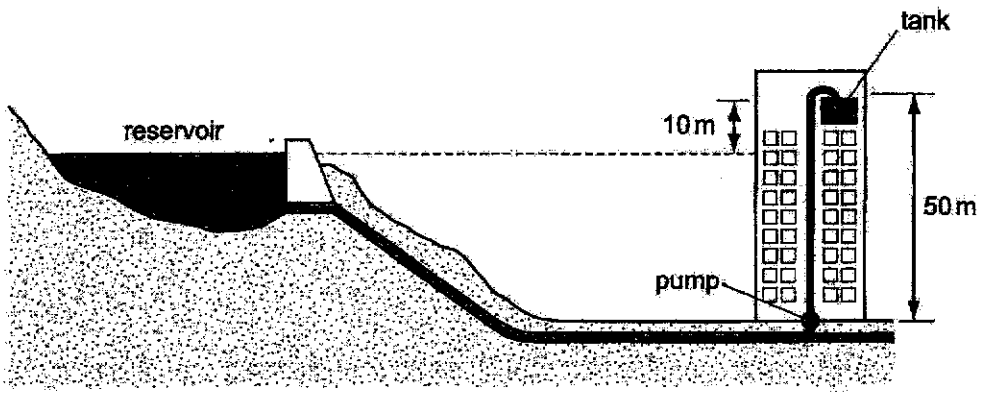
25 Which device is designed to convert electrical energy to sound energy?

A bulb **B** generator

C loudspeaker **D** motor

26 An apartment block receives water from a nearby reservoir. A pump is necessary to lift the water into a storage tank at the top of the building.

10



The gravitational field strength is 10 N/kg.

How much energy does the pump supply to lift each kilogram of water into the tank?

A 50 J **B** 100 J

C 400 J **D** 500 J

27 A dry battery can deliver 3000 J of energy to a small 2 W electric motor before the battery is exhausted. For how many minutes does the motor run?

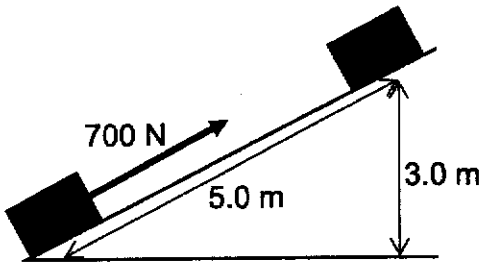
A 25 minutes **B** 100 minutes

C 150 minutes **D** 1500 minutes

28 The diagram shows a crate of mass 55 kg being pulled up a wooden ramp by a force of 700 N at a constant speed.

The crate is raised to a vertical height of 3.0 m in the process.

Take g = 10 N/kg.



What is the frictional force on the crate along the wooden ramp?

A 330 N **B** 370 N

C 700 N **D** 1850 N

29 A javelin has a mass of 0.80 kg. It possessed 250 J of kinetic energy when it is just released. What is the initial velocity of the javelin?

A 13 m/s **B** 18 m/s

C 25 m/s **D** 630 m/s

30 At what rate is energy transformed when a man of mass 50 kg and carrying a 5 kg mass went up 8 m-high flight of stairs in 20 s? The gravitational field strength is 10 N/kg.

A 20 W **B** 22 W

C 200 W **D** 220 W

– END OF BOOKLET A –

Name: .... (   )

ASSUMPTION ENGLISH SCHOOL
MID-YEAR EXAMINATION 2019

PHYSICS 6091
BOOKLET B

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LEVEL:	Sec 3 Express	**DATE:**	13 May 2019
CLASS:	Sec 3/2	**DURATION:**	2 hours 30 minutes (for Booklets **A** and **B**)

Additional Materials provided: - NIL -

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page.

This paper consists of 3 sections.

BOOKLET A:
SECTION A – MULTIPLE CHOICE QUESTIONS (30 marks)
There are 30 questions in this section. Answer **all** questions. For each question, there are four possible answers A, B, C and D. **Record your choice in pencil on the OAS paper provided. DO NOT fold or bend the OAS paper.**

BOOKLET B:
SECTION B – SHORT STRUCTURED QUESTIONS (40 marks)
Answer **all** questions. Write your answers in the spaces provided on the question paper.

SECTION C – FREE RESPONSE QUESTIONS (30 marks)
Answer **all** questions. Answer only one of the two alternative questions in **Question 12**. Write your answers in the spaces provided.

For Examiner's use:	
Section A	/ 30
Section B	/ 40
Section C	/ 30
Total	/ 100

At the end of the examination, hand in your OAS paper, Booklets **A** and **B** separately.

This Question Paper consists of 17 printed pages including this page.
[Turn over

Section B – Short Structured Questions (40 marks)

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

1 Complete the table below. Give the missing prefixes, symbols and value.

prefix	symbol	value
milli	m	10^{-3}
		10^{-6}
	n	
mega	M	10^{6}

[2]

2 A pair of vernier calipers was used to measure the diameter of a coin as shown in Fig. 2.2. The vernier calipers had a zero error as shown in Fig. 2.1.

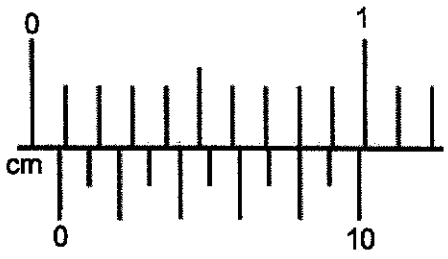


Fig. 2.1

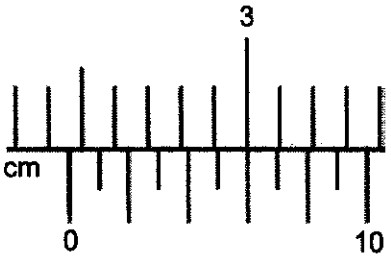
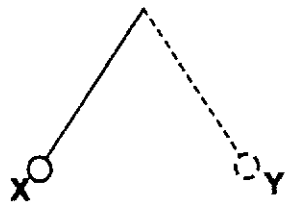


Fig. 2.2

Calculate the actual diameter of the coin.

diameter = ... [2]

3 The figure below shows a simple pendulum oscillating between positions **X** and **Y**. The period of the pendulum is 0.50 s.



(a) Explain what is meant by the *period of a pendulum*.

.....

..... [1]

(b) Calculate the time taken for the pendulum to travel from **X** to **Y**.

time = ... [1]

(c) State any change(s), if any, to the period of oscillation if

(i) the length of pendulum was to be decreased, ... [1]

(ii) a heavier pendulum bob was used instead. ..... [1]

4 Fig. 4.1 shows a micrometer screw gauge with its jaws closed when there is no object placed between the spindle and anvil. Fig. 4.2 shows the same micrometer when a small ball bearing is placed between the spindle and anvil.

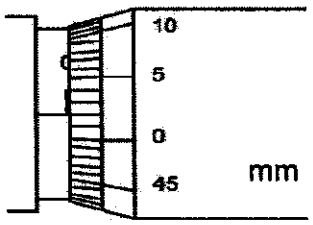


Fig. 4.1

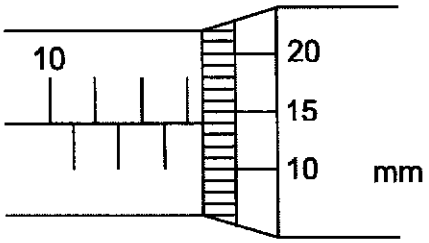


Fig. 4.2

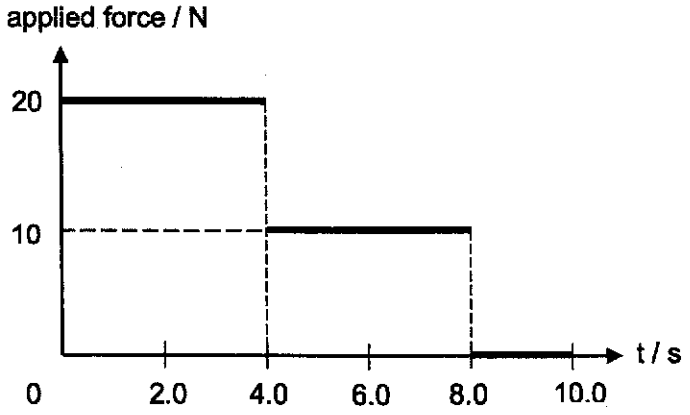
(a) State the zero error shown in Fig. 4.1.

zero error = ... [1]

(b) Calculate the actual diameter of the ball bearing.

diameter = ... [1]

5 The figure below represents a force-time graph for the force applied to a 3.0 kg box pushed over a rough surface. Assume the frictional force to be constant.



(a) Given that the box initially accelerates at an uniform rate of 5.0 m/s^2, calculate the frictional force acting on the box.

frictional force = ... [2]

(b) Assuming that the box was initially at rest, calculate the speed of the box at t = 4.0 s.

speed = ... [2]

(c) State and explain the motion of the box from t = 8.0 s to 10.0 s.

.....

.....

..... [2]

6 **(a)** State what is meant by the *density of a substance*.

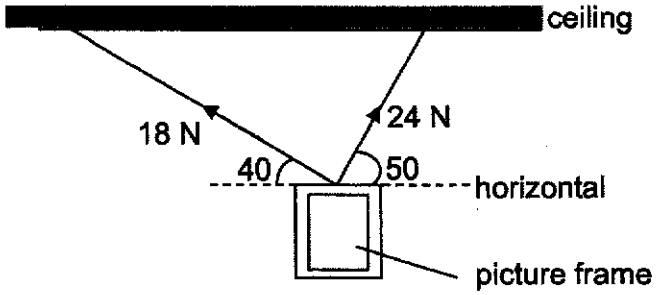
.....

..... [1]

(b) A block of sides 3.0 cm each has a density of 7.0 g cm^{-3}. A hole having the volume of 1.0 cm^3 is drilled into the cube. A substance of mass 3 g is used to fill the hole completely. Calculate the density of the composite cube.

density = ... [3]

7 The figure below shows a hanging picture frame supported by two strings that hang from a ceiling.



The tensions in the strings are 18 N and 24 N.

(a) In the space below, draw a labelled vector diagram to show the resultant of the two tensions. Determine the size and direction of the resultant force.

resultant force = ...

direction = ... [4]

(b) Hence, determine the mass of the picture frame. The gravitational field strength is 10 N/kg.

mass = ... [2]

8 Fig. 8.1 shows a uniform wooden block, **ABCD** resting on a table with a pushing force exerted on it from the right. Fig. 8.2 shows the block **ABCD** being tilted at an angle of 40°.

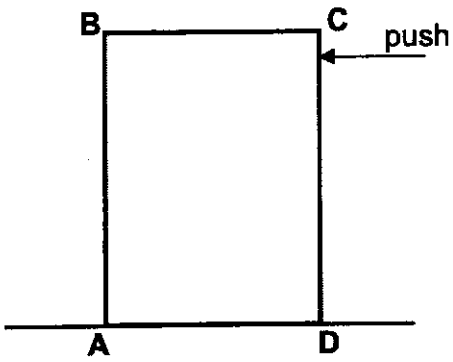


Fig. 8.1

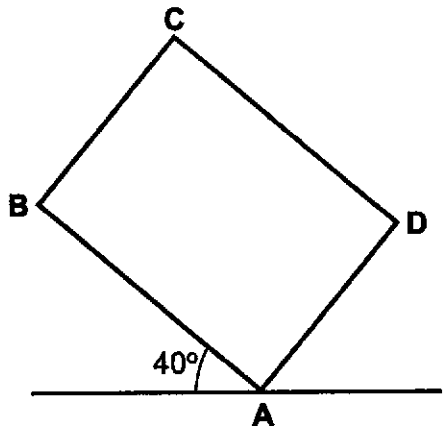


Fig. 8.2

(a) Define *centre of gravity*.

.....

..... [1]

(b) On Fig. 8.2, draw appropriate lines to show how you would locate the centre of gravity of the block accurately. Label the point **CG**. [1]

(c) On Fig. 8.2, draw and label the arrow, **W** to represent the weight of the block. [1]

(d) State the side (**AB** or **AD**) on which the block will fall on. Explain your answer clearly.

.....

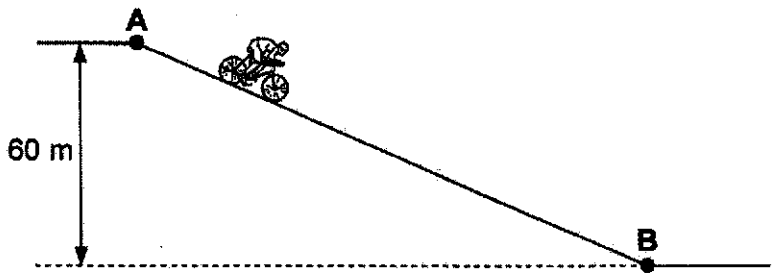
.....

.....

.....

..... [2]

9 The figure below shows a cyclist travelling downhill on a race track.



(not to scale)

The cyclist starts from rest at **A** and rolls down the hill to **B**, through a vertical distance of 60 m. He does not brake or use the pedals. The speed of the cyclist at **B** is 12 m/s. The total mass of the cyclist and bicycle is 90 kg. The acceleration of free fall, g, is 10 m/s^2.

(a) State the *principle of conservation of energy.*

.....

.....

..... [2]

(b) Calculate

(i) the loss in gravitational potential energy between **A** and **B**,

loss in gravitational potential energy = ... [2]

(ii) the increase in kinetic energy as the cyclist travels from **A** to **B**.

increase in kinetic energy = ... [2]

(c) Suggest why the loss in gravitational potential energy and increase in kinetic energy are different and explain how the law of conservation of energy applies to this situation.

.....

.....

..... [2]

(d) Suggest two ways how this loss in gravitational potential energy can be reduced.

method 1 .....

.....

method 2 .....

..... [2]

Section C – Free Response Questions (30 marks)

Answer **all** questions from this section. Answer only one of the two alternative questions in **Question 12**. Write your answers in the spaces provided.

10 In an Olympic 100 m finals, the table below shows the breakdown in terms of distance, **d** and time, **t** for two athletes **G** and **A**.

d / m	0	10	20	30	40	50	60	70	80	90	100
Athlete **G** t_G / s	0	2.00	3.09	4.09	5.04	5.97	6.89	7.80	8.71	9.62	10.53
Athlete **A** t_A / s	0	2.02	3.13	4.15	5.11	6.07	7.01	7.96	8.91	9.87	10.83

(a) Explain how the data shown in the table above for athlete **G** suggests that the speed is increasing at **d** = 20 m.

.....

..... [1]

(b) On Fig 10.1, draw a best fit curve graph of **d** against **t** for athlete **G**.

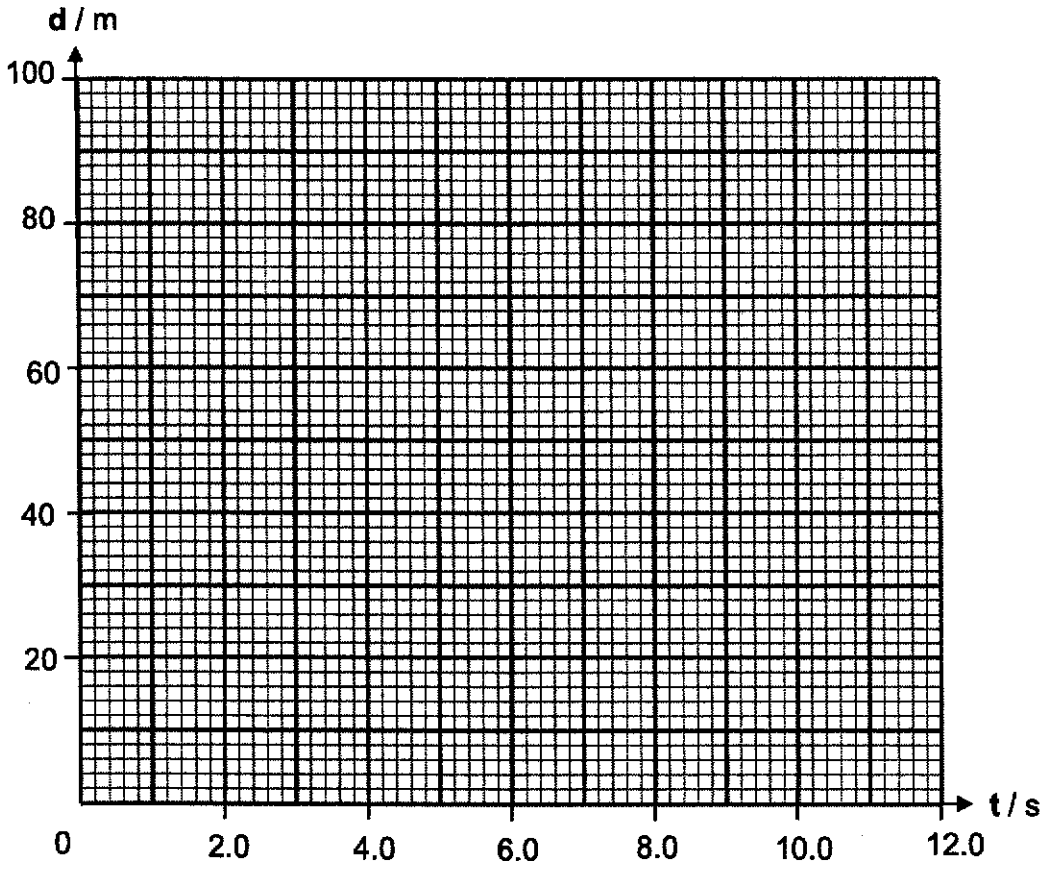


Fig. 10.1

[2]

(c) Explain how the graph shows that athlete **G** reaches her maximum speed.

.....

..... [1]

(d) Use your graph to determine the magnitude of the maximum speed of **G**.

maximum speed = ... [2]

(e) Fig. 10.2 shows the position of athlete **G** at the 50 m mark on the track. The force applied by the muscles for a forward motion is known as the propulsion force, **P**.

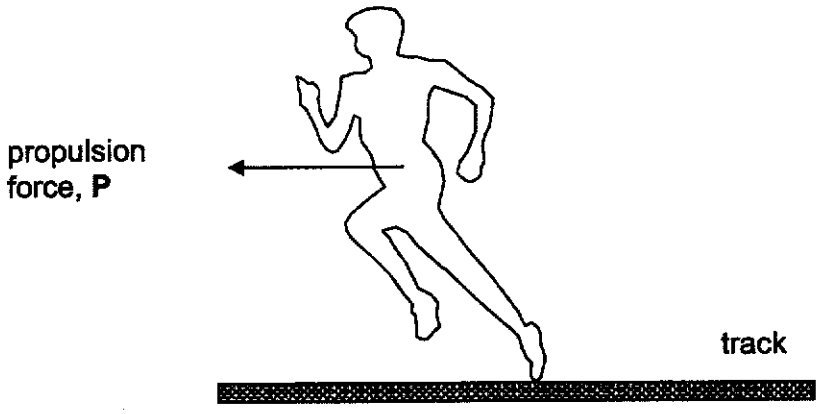


Fig. 10.2

(i) Label on Fig.10.2, the rest of the forces acting on athlete **G**. [2]

(ii) Explain how the position of the athlete in Fig. 10.2 helps the athlete reach her maximum speed.

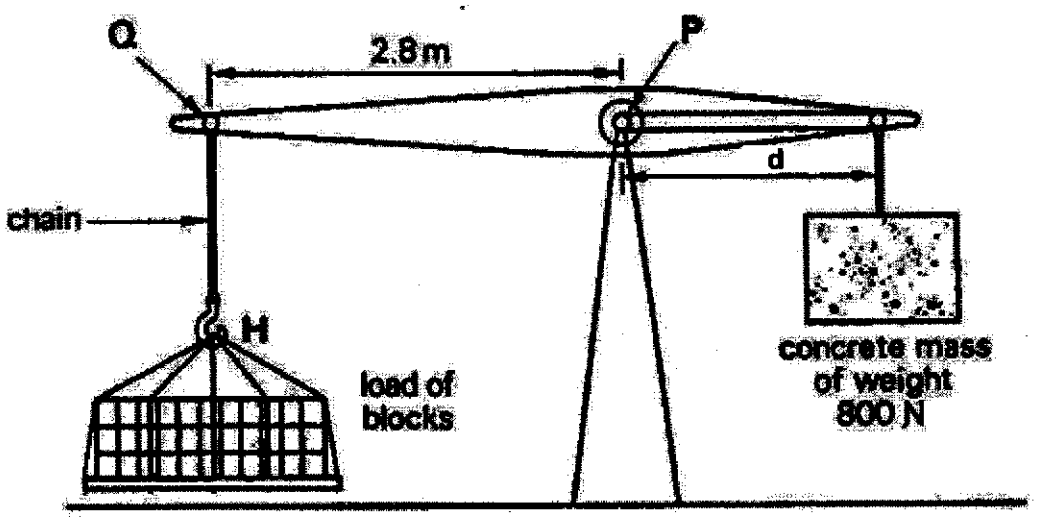
.....

.....

.....

..... [2]

11 The figure below shows the essential features of a simple crane used for lifting blocks which are attached to the hook **H**.



(a) With no blocks suspended from **H**, the crane arm balances horizontally when the position of the concrete mass is adjusted so that **d** is 0.6 m.

Calculate the moment of the weight of the concrete mass about the pivot **P**.

moment = ... [2]

(b) A mechanism on the right-hand side moves the concrete mass away from the pivot **P** until the blocks are lifted from ground. Calculate the weight of the blocks when **d** = 1.7 m.

weight = ... [3]

(c) An electric motor is fitted at **Q** which, by shortening the chain, increases the height to which the blocks can be raised.

(i) State, with a reason, whether or not raising the height of the blocks increases the moment of the weight of the blocks about the pivot **P**.

.....

.....

..... [2]

(ii) What would be the effect of the weight of this electric motor on the operation of the crane? Explain in terms of moment.

.....

.....

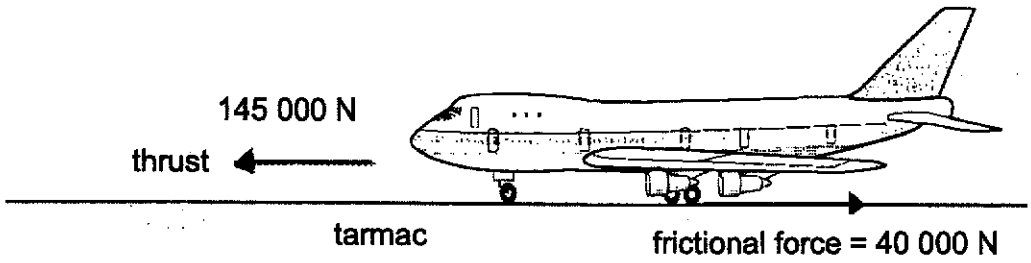
.....

.....

..... [3]

12 EITHER

An aircraft of mass 60 000 kg makes its take-off run from rest. The engines produce a constant thrust of 145 000 N which is directed parallel to the ground. The frictional force on the tarmac is 40 000 N.



(a) Calculate the initial acceleration of the aircraft along the horizontal runway just as the plane started its take-off run.

acceleration = ... [2]

(b) **(i)** Calculate the time taken for the take-off run if the aircraft becomes airborne at a speed of 60 m/s.

time = ... [2]

(ii) Hence, calculate the distance of the take-off run.

distance = ... [2]

(c) Apart from thrust from engine and friction from tarmac, in real life, air resistance is also exerted on the plane when it is moving.

(i) When the sum of air resistance and frictional force is equal to 145 000 N, what is the acceleration of the plane? Explain how you obtain the answer.

.....

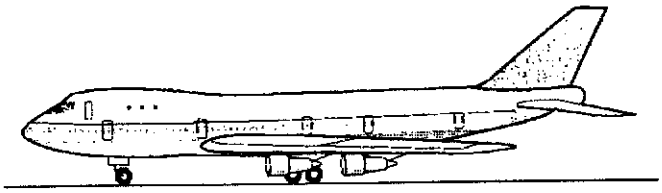
.....

.....

.....

..... [2]

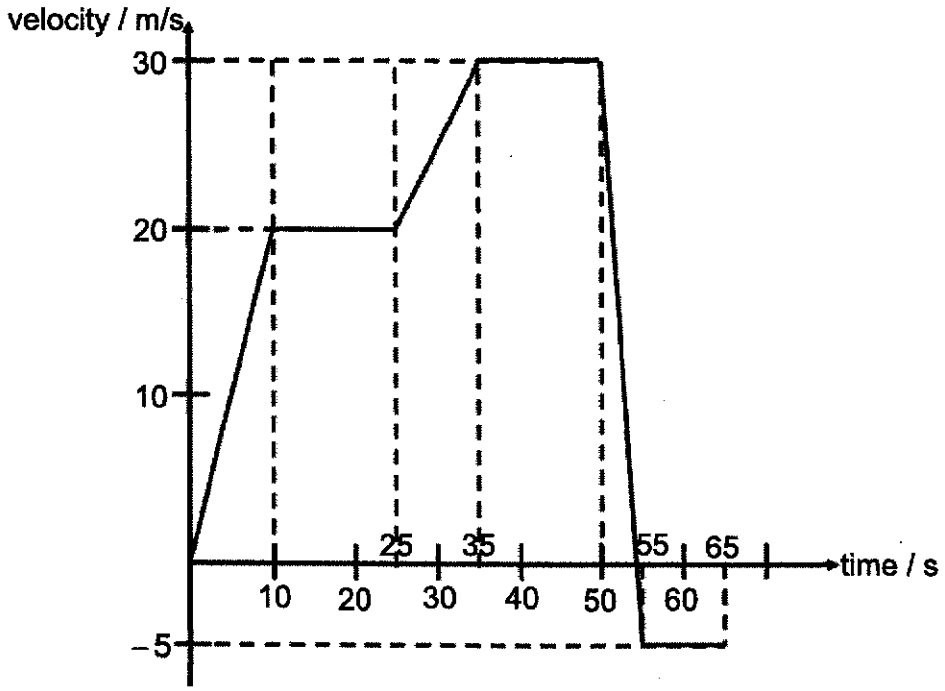
(ii) Based on the real-life scenario in **(d)(i)**, draw a free body diagram to show the forces acting on the plane as it is about to take off.



[2]

12 OR

The figure below shows the velocity-time graph of a car.



(a) (i) State all the time intervals where the resultant force acting on the car is zero.

.....

..... [1]

(ii) Explain your answer in **(a)(i)**.

.....

..... [1]

(b) Calculate the acceleration of the car in the first 10 s of the journey.

acceleration = ... [2]

(c) Calculate the total displacement travelled in the first 50 s of the journey.

displacement = ... [2]

(d) Calculate the average velocity of the car for the first 50 s of the journey.

average velocity = ... [2]

(e) Describe the motion of the car from t = 50 s to t = 55 s.

.....

.....

.....

..... [2]

– END OF BOOKLET B –

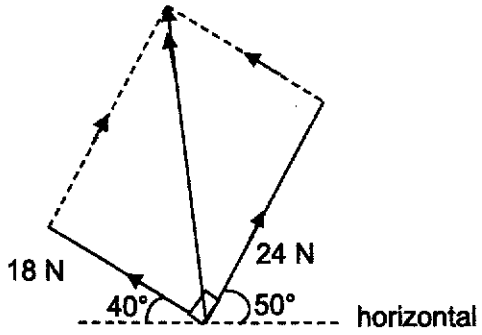
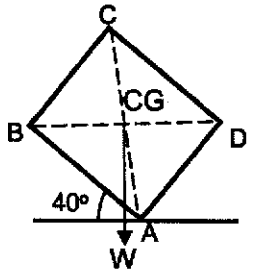
3Pure (Physics) MYE Marking Scheme 2019

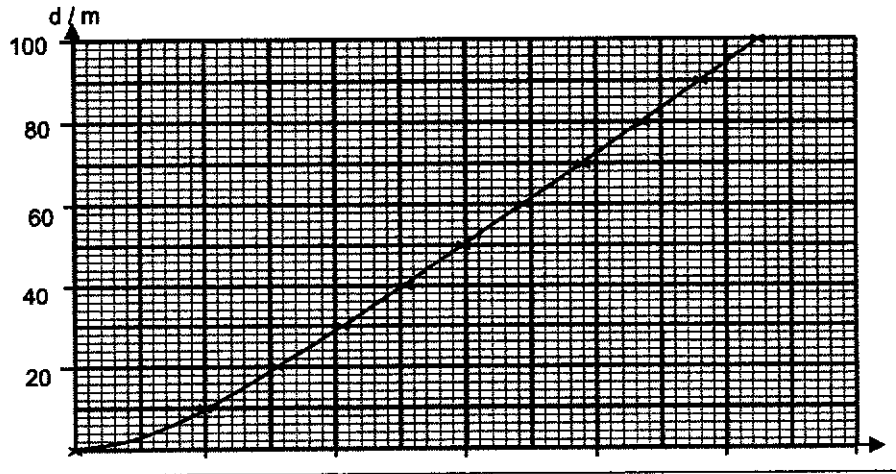
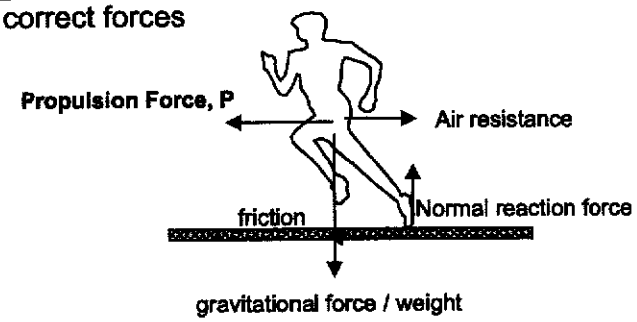
Section A[30 m]

1	2	3	4	5	6	7	8	9	10
B	**B**	**D**	**C**	**D**	**C**	**A**	**C**	**D**	**D**
11	12	13	14	15	16	17	18	19	20
A	**C**	**A**	**B**	**B**	**D**	**D**	**D**	**A**	**A**
21	22	23	24	25	26	27	28	29	30
C	**A**	**D**	**D**	**C**	**B**	**A**	**B**	**C**	**D**

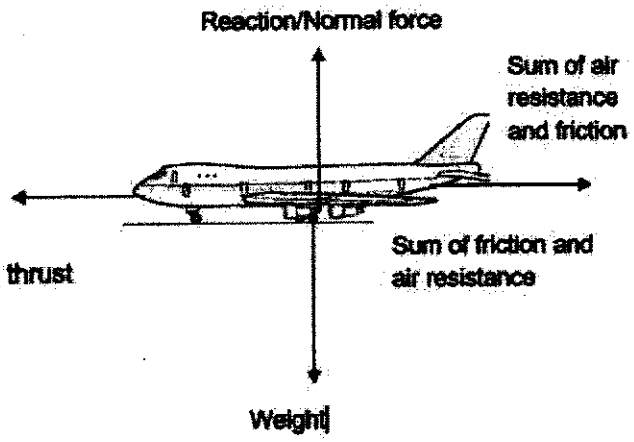
Section B[40 m]

1		<table><tr><th>prefix</th><th>symbol</th><th>value</th></tr><tr><td>milli</td><td>m</td><td>10^{-3}</td></tr><tr><td>micro</td><td>μ</td><td>10^{-6}</td></tr><tr><td>nano</td><td>n</td><td>10^{-9}</td></tr><tr><td>mega</td><td>M</td><td>10^{6}</td></tr></table> 1 mark for every 2 correct answers	B1 B1
2		Zero error = 0.08 cm 2.46 – 0.08 = 2.38 cm	B1 B1 ECF
3	a	Period is the time taken for one oscillation / for the bob to travel from X to Y and back to X.	B1
	b	$\frac{0.50}{2} = 0.25\ s$	B1
	ci	decrease	B1
	cii	no change	B1
4	a	Zero error = +0.02 mm	B1
	b	Diameter = 13.12 mm	B1
5	a	Resultant force = 3 x 5.0 = 15 N 20 – friction = 15 friction = 5.0 N	C1 A1
	b	a = (v-u)/t 5 = (v – 0)/4 v = 20 m/s	C1 A1
	c	Box **moves with constant deceleration** as there is a **resultant force acting opposite to the direction of motion** of the box.	B1 B1

6	a	Density is the amount of mass per unit volume of a substance.	B1
	b	mass of block= 7.0 × 27 = 189 g mass of drilled block=7.0 × 1.0 = 7.0 g new mass of block=189 - 7 = 182 g mass of composite= 3.0 + 182 = 185 g density= 185 / 27 = 6.9 g/cm^3	 C1 C1 C1
7	a	 **Accept either parallelogram or tip-to-toe method.** Appropriate scale: at least 1 cm : 5 N. 18 N and 24 N drawn according to specified scale and labelled. Resultant force = 30 N ± 2 N Angle = 90° ± 2°	 B1 B1 B1 B1
	b	Weight = m x g m = W / g = 30 N / 10 = 3.0 kg	 C1 A1 ECF
8	a	a point from which the weight of a body or system may be considered to act.	B1
	b	 Dotted construction line for CG and correct position	 B1
	c	Arrow from CG and labelled as W	B1
	d	Side AB As the line of action of the weight through the CG of the block lies outside the base area, it causes an anti-clockwise moment about point A, causing the block to topple on side AB.	B1 B1 B1
9	a	The principle of conservation of energy states that energy in a system cannot be created or destroyed. It can only be converted from one form to another without any loss in total energy.	B1 B1
	bi	Loss in GPE = mgh = 90 x 10 x 60 = 54 000 J	C1 A1

	bii	Gain in KE = ½ mv^2 = ½ (90)(12^2) = 6480 J	**C1** **A1**
	c	Increase in KE is lower than loss in GPE as work is done against frictional forces on the slope and against air resistance. Applying the law of conservation of energy, the work done in overcoming resistive forces added to the increase in kinetic energy should be equal to the loss in gravitational potential energy.	**B1** **B1**
	d	1. Smoother tyres 2. Streamlining (any other acceptable answer in reducing effects of friction/air resistance)	**B1** **B1**
		Section C	
10	**a**	From the table, 1.09 s taken for the 20-30m distance interval < 1.00 s taken for the 10-20 m distance interval. As speed = distance / time, speed is inversely proportional to time for a constant distance. The speed increases when the **time interval is smaller / shorter time interval** to travel the same distance	**B1**
	b	Points plotted correctly, best fit curve  	**B1** **B1**
	c	The gradient (=velocity) is a constant and maximum after 60 m mark	**B1**
	d	Maximum speed = gradient =100 - 60 / (10.53 - 6.89) = 10.989 = 11 m/s	**C1** **A1**
	ei	Any two correct forces  	**B1** **B1**
	eii	The forward inclined position of the athlete body with the line of action of the weight to the left of the pivot (toe) allows the turning effect of the weight about the pivot (toe) to topple him forward. The bend position of the body helps to streamlined his body to reduce the air resistance he encounters when he runs.	**Any 2** **B1** **B1** **Or**

		The bend arms and bend leg swing and creates the pendulum effect where a shorter length of pendulum enables it to swing faster and thus increases the speed running.	
11	a	moment = F x d = 800 x 0.6 = 480 N m	C1 A1
	b	Total clockwise moment = 800 x 1.7 = 1360 N m Moment due to blocks = 1360 – 480 = 880 N m Total clockwise moment = Total anticlockwise moment 880 = weight x 2.8 Weight = 314 N	C1 C1 A1
	ci	No Perpendicular distance from line of action of weight to pivot remains the same	B1 B1
	cii	Motor's weight causes **anticlockwise moment** about P Use of formula for moments to explain less blocks can be lifted / how the position of block (or concrete mass) should be adjusted to maintain balance	B1 B1 B1
12 E	a	Resultant force, F_R = 145 000 – 40 000 = 105 000N $a = \frac{F_R}{m} = \frac{105000}{60000}$ (formula and working) = 1.75 m/s^2	C1 A1
	bi	v = 60 m/s u = 0 m/s $a = \frac{v-u}{t}$ $1.75 = \frac{60-0}{t}$ (formula and working) t = 34.3 s	C1 A1
	bii	Distance = $\frac{1}{2}(60)(34.3)$ = 1029 m	C1 A1
	ci	When the thrust force of 145 000 N is similar to sum of air resistance and frictional force, there will be no resultant force on the plane as both opposing forces have same magnitude. As such there is no acceleration by the plane and it moves at constant velocity.	B1 B1

	cii	 1 mark for each correct pair	B1 B1
12 O	ai aii	10 s – 25 s, 35 s – 50 s and 55 s to 65 s During these intervals, the car is moving with constant velocity. By Newton's first law, car will move with constant speed in a straight line when resultant force is zero. Or During these intervals, the car is moving with constant speed. By Newton's second law, F = ma, resultant force is zero when acceleration is zero.	B1 B1
	b	$a = \frac{20-0}{10}$ $= 2.0\ m/s^2$	C1 A1
	c	Displacement $= \left[\frac{1}{2}\times(15+25)\times 20\right] + \left[\frac{1}{2}\times(20+30)\times 10\right] + (15\times 30)$ $= 1100m$	C1 A1
	d	$Avg\ vel = \frac{1100}{50}$ $= 22\ m/s$	C1 A1
	e	From t = 50 s, the car **decelerates uniformly** until it is momentarily **at rest**. It then **accelerates uniformly in the opposite direction** till it reaches a speed of 5.0 m/s at t = 55 s.	B1 B1