Name		Reg. No	Class

MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL

3EX

SCIENCE (PHYSICS)

5076/01

SEMESTRAL EXAMINATION ONE
MAY 2017

Additional Materials:
Approved calculator

1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Do not start reading the questions until you are told to do so.

Write your name, class, and index number on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use paper clips, highlighters, glue, or correction fluid.

This paper consists of **Section A, Section B** and **Section C.**

Section A consists of **twenty** questions. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the **OTAS** provided.

FOR EXAMINER'S USE		
Section		**Marks**
Section A	MCQ	/20
Section B	Structured Questions	/30
Section C	Long Questions	/20
	Qn	
	Qn	
Total		/ 70

Answer **all** questions in **Sections B.** Answer **any two** questions in **Section C.**
Write your answer to **Sections B and C** in the spaces provided on the Question Paper.

At the end of the examination, submit your **OTAS** separately.
Fasten all loose sheets, if any, securely together and submit together as a whole.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

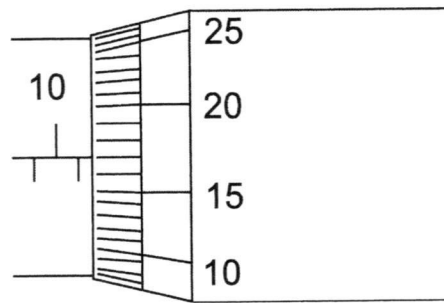This question paper consists of **19** printed pages.

2

Section A

Answer **all** the questions in the **OTAS** provided.

1 The diagram shows a micrometer reading when a ball-bearing was gripped between the anvil and the spindle. If the instrument has a zero reading of − 0.02 mm, what is the actual diameter of the ball bearing?

A 10.65 mm

B 10.69 mm

C 11.15 mm

D 11.19 mm

2 Which of the following physical quantities do not consist of vector(s)?

A speed, acceleration, time

B speed, time, velocity

C speed, temperature, time

D time, mass, velocity

3 Two cars started moving off at the same time. Both car travelled the same distance and reached their destination at the same time.

Which of the following statements is correct?

A Average speeds are different.

B Average speeds are the same.

C Speeds throughout the journey are different.

D Speeds throughout the journey are the same.

4   The diagram below shows a series of photographs of a ball rolling with constant velocity.

5.0 m
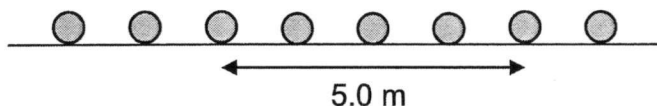
The camera was taking pictures at a constant rate of 1 per second.

What was the speed of the ball?

A   1.0 m/s

B   1.25 m/s

C   10 m/s

D   12.5 m/s

5   The speed of a car is 36 km/h. What is the speed in m/s?

A   6 m/s

B   10 m/s

C   20 m/s

D   60 m/s

6   "A constant force on the object produces constant _____. "

Which of the following correctly fills in the blank in the sentence above?

A   acceleration

B   displacement

C   speed

D   velocity

7   The diagram shows three forces acting on a block. What is the resultant force?

4 N

3 N

3 N
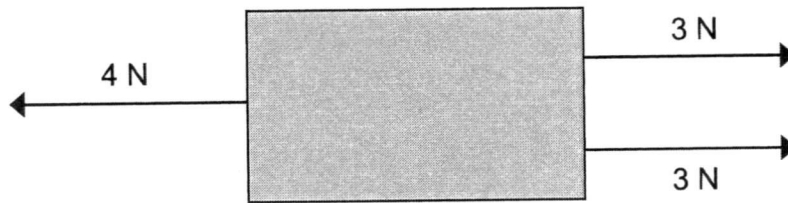
What is the resultant force?

A   2 N to the left

B   2 N to the right

C   4 N to the left

D   6 N to the right

8   A car with mass 800 kg travels on a level road at a constant speed of 10 m/s. It has to overcome a resistive force of 600 N.

What is the driving force of the car?

A   200 N

B   600 N

C   800 N

D   8000 N

9   A student throws a tennis ball vertically upwards with a velocity of 3 m/s.

What is the acceleration of the ball when it is at the highest point?

A   0 m/s^2 downwards

B   3 m/s^2 downwards

C   10 m/s^2 downwards

D   10 m/s^2 upwards

10 The wheel of a moving car is driven by the engine. The car is accelerating in the direction shown.

In which direction does the frictional force act on the wheel?
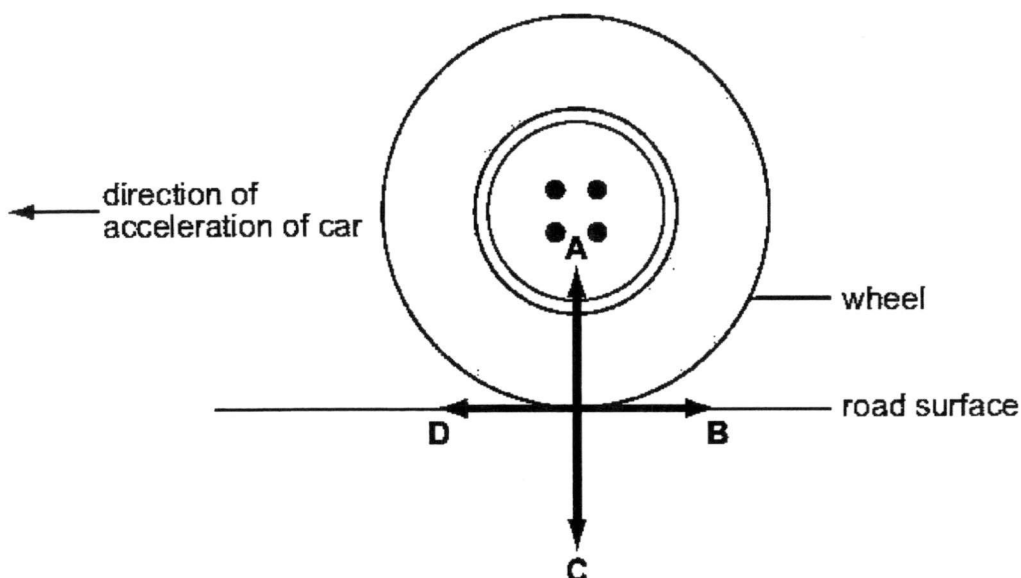
11 Which of the following can be the approximate weight of a 16 year-old boy?

A 20 N

B 60 N

C 200 N

D 600 N

12 Which of the following statements concerning mass and weight is correct?

A At a particular place, weight of an object is directly proportionate to its mass.

B Both mass and weight are measured in kilograms.

C Both mass and weight do not change with location.

D Both mass and weight have directions pointing to the ground.

13 Which one of the following has the greatest inertia?

A A boy running the 100 m race in 10 s.

B A moving car of mass 1500 kg.

C A cyclist moving at 10 m/s.

D A climber on top of Mount Everest.

[Turn over

14 The distance-time graph of a body is as shown below.
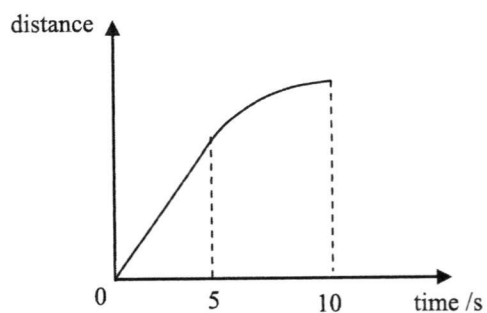
Which is the speed-time graph of the body?

A
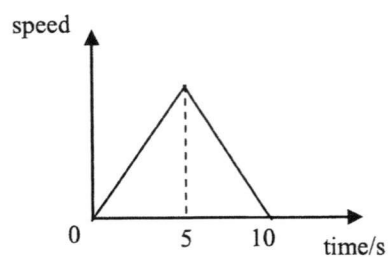
B
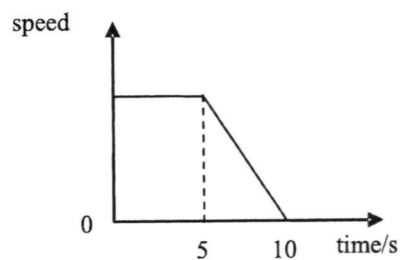
C
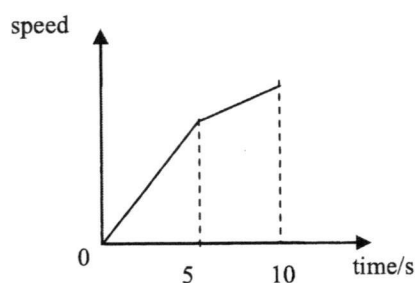
D
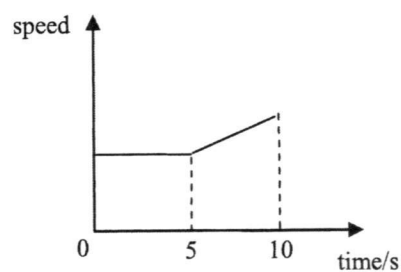
15 A hexagonal piece of card has its centre of gravity at X.

Which of the diagrams below correctly show how it hangs in equilibrium when suspended by a thread?
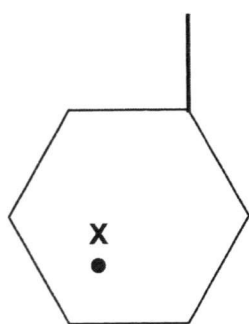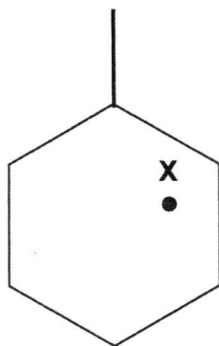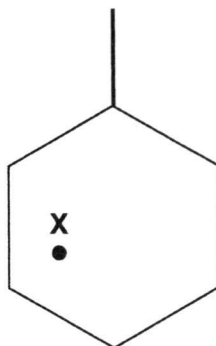
A   B   C   D
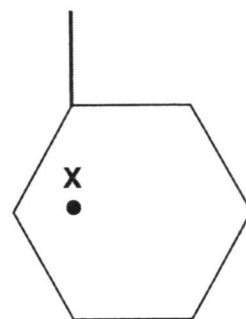
16 A brick of mass 8 kg stands upright on the ground as shown.
The gravitational field strength, g, is 10 N/kg.

10 cm   5 cm

20 cm
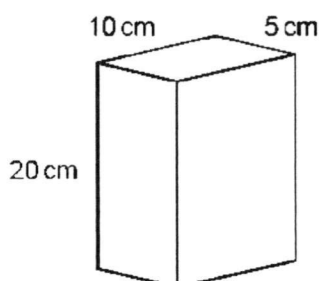
What is the smallest pressure it can exert on the ground?

A $\dfrac{8}{5 \times 10}$ N/cm²

B $\dfrac{8 \times 10}{5 \times 10}$ N/cm²

C $\dfrac{8}{10 \times 20}$ N/cm²

D $\dfrac{8 \times 10}{10 \times 20}$ N/cm²

17 A pivoted window, weighing 100 N, is opened with a force of 30 N.

pivot

0.3 m   0.7 m

0.2 m   0.5 m

pivot   weight   force
         100 N   30 N
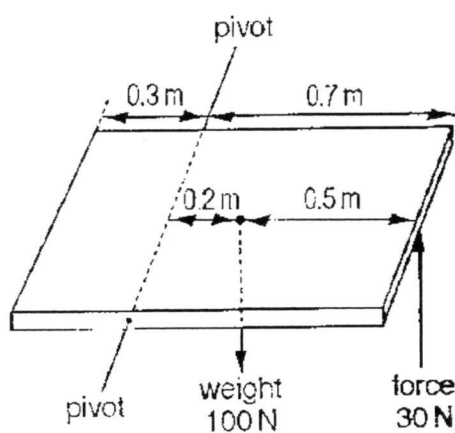
What is the magnitude of the resultant moment about the pivot?

A 1 Nm

B 5 Nm

C 35 Nm

D 41 Nm

18 A car of mass 500 kg is moving at a speed of 25 m/s.

What is the kinetic energy of the car?

A   156 kJ

B   202 kJ

C   1560 kJ

D   2030 kJ

19 A heavy object is allowed to fall through a height of 6 m.

Which graph below best represents the relation between the total energy (E) of the object and the vertical distance (h) fallen?
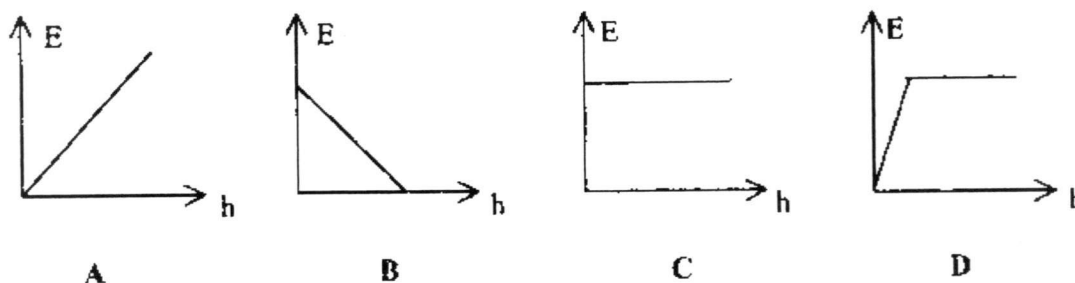
20 A force of 10 N pushes an object along of a rough inclined plane of length 0.50 m and height 0.30 m as shown in the figure.
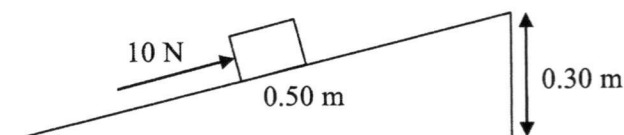
What is the work done by the force on the object?

A   2.0 J

B   3.0 J

C   4.0 J

D   5.0 J

- END OF SECTION A -

Section B

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

21 Distinguish between a scalar and vector.

....

....

[1]

22 Figure 1 shows the reading of vernier calipers when its jaws are fully closed. Figure 2 shows the reading when it measures the external diameter of a metal tube.
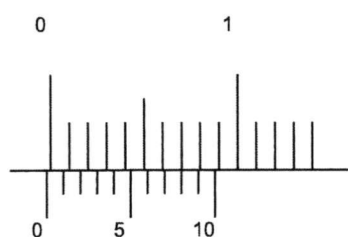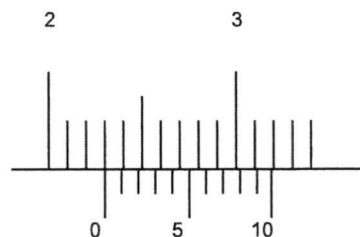
Figure 1   Figure 2

(a) What is the zero error of the vernier calipers?

....

[1]

(b) Determine the external diameter of the metal tube.

diameter = ...cm [1]

23 The figure below shows the speed-time graph of a car for the first 150 s of its journey. The graph has a straight line portion from the 50th second to the 75th second.
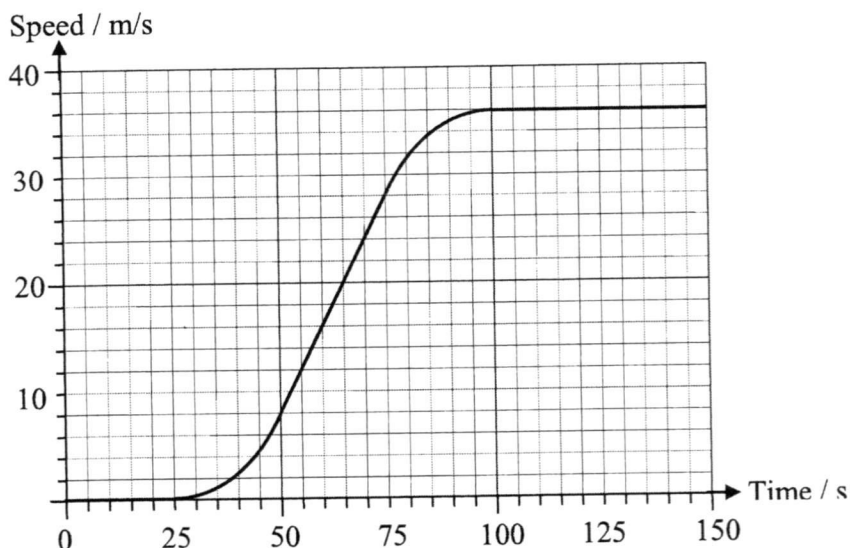
(a) Calculate the maximum acceleration of the car for the journey.

Maximum acceleration = ...m/s² [2]

(b) For the duration of the journey when the car is accelerating, describe how the acceleration changes.

....

....

....

[2]

(c) Assuming that the car has travelled 1 350 m for the first 100 s, find the average speed of the car for the entire journey.

Average speed = ...m/s² [2]

24 Two forces of magnitude 5.0 N and 7.0 N act on a small body, B. The angle between the directions along which the forces act is 40°, as illustrated in the figure below.
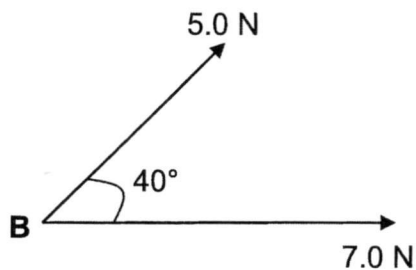
By means of a scale diagram, find the resultant force of the two tensions.

Resultant force = ...N [3]

25 The four tyres of a car are inflated to a total gauge pressure of 2 x 10⁵ Pa. Each tyre has an area of 0.015 m² in contact with the road.

(a) What is meant by pressure?

....
[1]

(b) Calculate the weight of the car.

Weight = ...N [2]

[Turn over

(c) If the pressure in the tyres has been reduced to 1.5×10^5 Pa, what is the area of contact of each tyre with the road?

Area of contact = ...m^2 [2]

(d) Suggest a reason why large vehicles such as cement trucks have more than four large tyres.

....

[1]

26 A student performed an experiment to measure the densities of almonds. He used a sinker to submerge the almonds inside a measuring cylinder with a known volume of water and recorded the new volumes as shown in the table below.

measurement	reading
initial volume of water	250 cm^3
volume of water with sinker	300 cm^3
volume of water with sinker and almond	410 cm^3
mass of almonds	60 g

(a) State two differences between mass and weight.

....

....

....

[2]

(b) Calculate the density of almonds in g/cm^3.

density = ... g/cm^3 [2]

(c) Suggest why sinker is used to submerge the almonds.

....

[1]

27 The stability of a lorry is tested, as shown in the figure. The rough ramp is tilted as much as possible without the lorry falling over. The ramp is then fixed at this angle and the lorry remains at rest in the position shown.
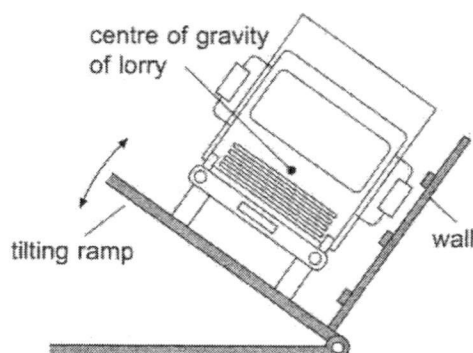
(a) State what is meant by the centre of gravity of the lorry means.

....

....

[1]

(b) Explain why the lorry will fall over if the ramp is tilted any further.

....

....

....

[2]

28 A power generator with a power rating of 2000 W is used to power a mini heater as shown in the figure below.
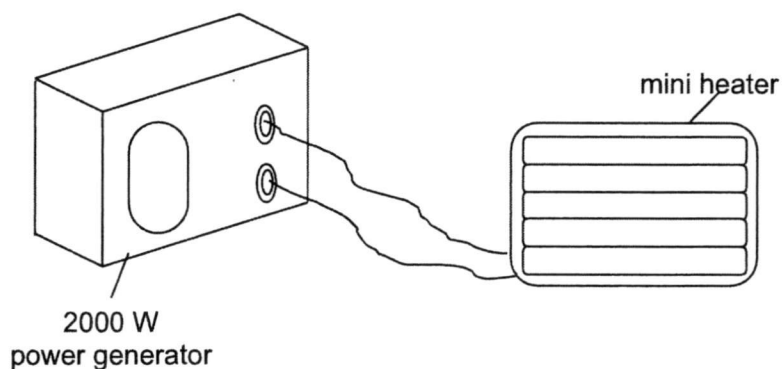
(a) Explain what is meant by a power rating of 2000 W.

....

....

[1]

[Turn over

(b) State the energy conversions of the power generator in powering a mini heater.

....
[1]

(c) Determine the power output of the mini heater, given that it generates 100 000 J of heat in 90 s.

power = ... W [2]

- END OF SECTION B -

15

Section C

Answer **any two** questions in this section.

29 It is the year 2174 and the Singapore Space Agency (SSA) has successfully completed a manned mission to Titan. Titan is the largest moon of the planet Saturn. It is the only natural moon known to have a dense atmosphere and the only object other than Earth where clear evidence of stable bodies of surface liquid has been found.

The table below shows some data of Titan's physical characteristics.

physical characteristics of Titan	
volume	7.16×10^{19} m³
surface area	8.3×10^7 km²
mass	1.3452×10^{23} kg
gravitational field strength	1.352 N/kg
escape velocity	2.639×10^3 m/s

(a) Calculate the density of Titan in kg/m³.

density = ... kg/m³ [2]

(b) Convert your answer in (a) to g/cm³.

density = ... g/cm³ [1]

(c) An astronaut conducted an experiment using a block of hardened clay on Titan. The hardened clay has a weight of 500 N on Earth.

In the experiment, he lifted the clay to a height of 1.5 m above the ground at constant speed.

(i) Calculate the mass of the hardened clay.

Mass = ... kg [2]

[Turn over

(ii) Calculate the weight of the hardened clay on Titan.

Weight = ... N [1]

(iii) State and explain whether the force required to lift the hardened clay to a height of 1.5 m above the ground at constant speed increases, decreases or stays the same if this experiment is repeated on Earth.

....

....

....
[2]

(d) The hardened clay is released from rest at 1.5 m above the ground on Earth. Calculate the time taken for the hardened clay to reach the ground.

Time taken = ... s [2]

30 A uniform wooden plank AB, 2 m long, weighing 54 N, rests on a knife's edge 0.50 m from centre of gravity. The end is supported by a vertical string represented by tension T in the diagram below, so that AB is horizontal.
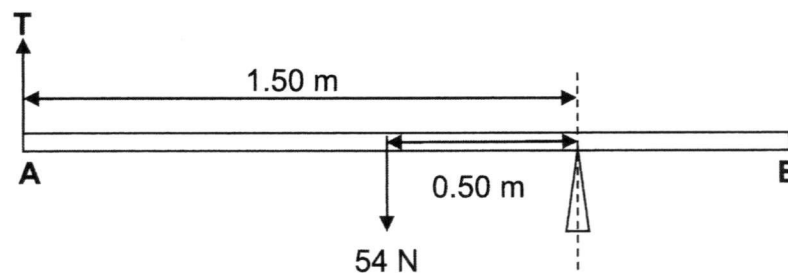
(a) State the principle of moments.

....

....
[2]

(b) State the direction of moment generated by the weight of the plank.

....
[1]

(c) Calculate the tension T in the string required to balance the plank.

T = ... N [3]

Jordon is given a cone-shaped object. To ensure that the object does not topple, he placed the object on the table as shown in below.
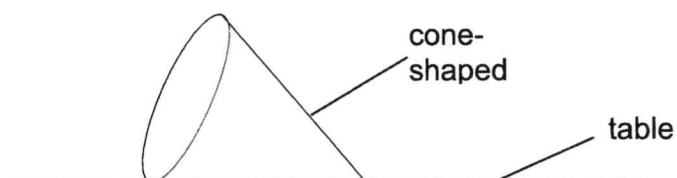
(d) What type of equilibrium state is the cone-shaped object in?

....
[1]

(e) Explain your answer in **(d)**.

....

....
[1]

(f) State the two ways to increase the stability of an object.

....

....
[2]

18

31 A metallic pellet of mass 0.3 kg is placed at the starting position S and rolls along the slope of the track. The initial speed of the pellet at S is zero.
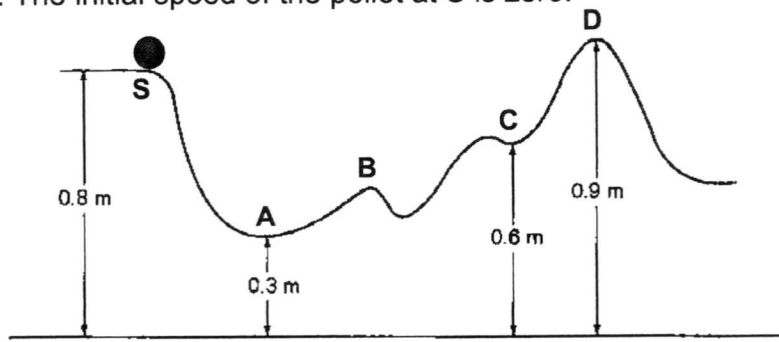
Assuming there are no frictional forces acting on the pellet as it is moving across the track. (Assume g = 10 m s^{-2})

(a) State what form of energy the pellet possesses at position S.

....

....
[1]

(b) Calculate the gravitational potential energy of the pellet at position S.

Gravitational potential energy = ... J [2]

(c) Calculate the gravitational potential energy of the pellet at position C.

Gravitational potential energy = ... J [1]

(d) Based on your answers from **(b)** and **(c)**, calculate the kinetic energy of the pellet at position C.

kinetic energy = ... J [2]

(e) At which position on the platform track is the pellet travelling at its maximum speed? Give an explanation for your answer.

....

....

....

[2]

(f) Is it possible for the pellet to reach position D? Give an explanation for your answer.

....

....

....

[2]

- - - - - END OF SECTION C - - - - -
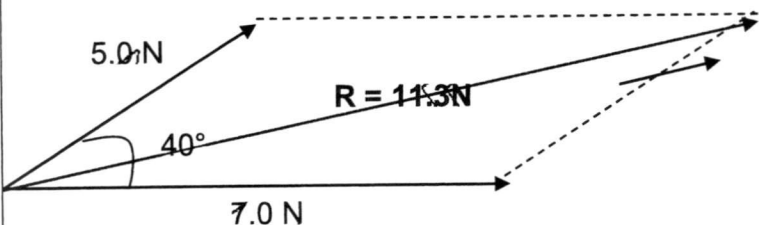
- - - - - - - - - - - - - - - - - END OF PAPER -

ANSWER SCHEME FOR 2017 SA1 3EX 5076 SCIENCE-PHYSICS
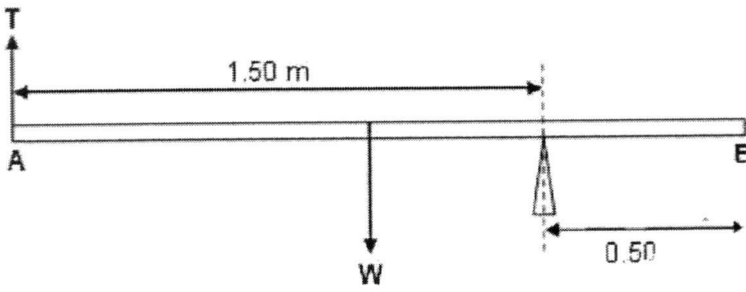
Section A: Multiple Choice Questions (20 Marks)

1	B	2	C	3	B	4	B	5	B	6	A	7	B	8	B	9	C	10	D
11	D	12	A	13	B	14	B	15	D	16	D	17	A	18	A	19	C	20	D

Section B: Structured Questions (30 Marks)

21	Scalar: A physical quantity that has only magnitude. Vector: A physical quantity that has magnitude and direction.	1
22a	- 0.02 cm No negative sign and si unit (no marks)	1
b	2.30 + 0.02 = 2.32 cm	1
23a	Maximum acceleration, $a = v-u \,/t$ $= \dfrac{28-8}{75-50}$ $= 0.800 \text{ m s}^{-2}$	1
b	The car has increasing acceleration from 25 to 50 s. From 50 to 75 s, the car has a constant acceleration of 0.800 ms^{-2} 75 to 100 s, the car is undergoing decreasing acceleration.	1 1 Any 2
c	Total distance travelled by the car = $1350 + 36 \times 50$ $= 3150$ m Average speed of car = Total distance / Total time $= 3150 / 150$ $= 21.0 \text{ ms}^{-1}$	1 1
24	 1 m for scale 1 m for correct label for all forces 1 m for correct vector diagram (with arrows) 1 m for correct answer	4
25a	Pressure is defined as the force acting per unit area.	1
b	$P = F / A$ $F = (200 \times 1000) \times (4 \times 0.015)$ $= 12000$ N	1 1
c	$P = F / A$ $A = 12000 / (4 \times 150 \times 1000)$ $= 0.020 \text{ m}^2$	1 1
d	This is to <u>increase the surface area</u> of the vehicle in <u>contact</u> with the road so that <u>pressure exerted is minimal</u>.	1

26a	Any two: Mass is the amount of substance in a body whereas weight is the gravitational force acting on a body S.I. unit of mass is kg whereas S.I. unit of weight is N Mass is measured by the beam / electronic balance whereas weight is measured by the spring balance Mass remains constant whereas weight changes according to the gravitational field. Mass is a scalar quantity whereas weight is a vector quantity.	2
b	Density = mass / volume 　　　= 60 / (410 - 300) 　　　= 0.545 g/cm^3	1 1
c	Almond is less dense than water. To measure the volume of almond, sinker is used to sink the almond	1
27a	It is the point where the whole weight of the lorry appears to act on	1
b	If the ramp is tilted further, the line of action of the weight will fall out of the base of the lorry. A moment will be created about the wheels on one side, and the lorry will fall over	1 1
28a	Power is the energy conversion of 2000 joule per second or 2000 joules of work done in 1 second. Award 1 m for rate of work done **or** energy conversion Award 1 m for stating 2000 J in 1 sec or 2000 J/s	1
b	Electrical energy to thermal energy	1
	P = E/ t = 100000/ 90 =1110 W	1 1
Section C: Long Structured Questions (20 Marks)		
29a	Density = Mass/Volume 　　　=(1.3452 × 10^{23})/(7.16 × 10^{19}) 　　　= 1878.77095 　　　= 1880 kg/m^3	1 1
b	Density = 1880 * 1000 / (1 * 100^3) 　　　= 1.88 g/cm^3	1 1
ci	Weight on Earth = 500 N Mass = 500/10 　　= 50 kg	1
cii	Weight on Titan = 50 x 1.352 　　　= 67.6 N	1

ciii	In order to lift the hardened clay at constant speed, the resultant force is zero. The force required to lift the clay is equal to the weight of the clay.	1
	Since the Earth's gravitational field strength is more than the gravitational field strength of Titan, the weight of the clay on Earth is higher and therefore the force required increases.	1
d	Distance = 0.5 * 10t * t 1.5 = 0.5*10t*t t^2=0.3 t=0.55s	1 1
30a	When a body is in **equilibrium**, the sum of the clockwise moments about **any point** is equal to the sum of the anti-clockwise moments about **that point**.	1 1 1
b		

c	Using the principle of moment,
	    sum of clockwise moment = sum of anticlockwise moment
	        T x 1.50 = 54 x 0.50
	            T = 18.0 N
		1
		1
		1

d	neutral equilibrium	1
e	The centre of gravity will remain at the same height.	1
f	- lower the centre of gravity of the object - increase the base of the object	1 1
31a	Gravitational potential energy	1
b	Total energy at S = mgh = 0.3 x 10 x 0.8 = 2.40 J	1 1
c	Gravitational potential energy at C = mgh = 0. = 1.80 J	1
d	TE = GPE + KE or using principle of conservation of energy KE at C = 2.40 J – 1.80 J = 0.60 J	1 1
e	Point A. This is because the gravitational potential energy of sphere is lowest while the KE at A is the highest.	1 1
f	No, it will not be able to reach position D. To reach D, it would need a total energy of 0.3 x 10 x 0.9 = 2.70 J, but its total energy is only 2.40 J [from question (a)], hence it will not reach position D.	1 1

[Turn over