2015 Sec 3 Physics EOY Answers (Students' Copy)

<u>Paper 1 (30)</u>:	1 5	6 10	11 15	16 20	21 25	26 30
	CBCAD	**CACBC**	**DDCDA**	**CCCBC**	**CDBCB**	**BAADA**

Solutions to selected questions:

7: The object attains terminal velocity (constant velocity) means there is air resistance which would reduce the acceleration from 10 m s^{-2} till 0 m s^{-2} (when net force becomes zero).

15: The fan blows air towards the right, the air exerts an equal and opposite force <u>on the fan towards the left</u>. This air also exerts <u>a force on the board towards the right</u>. There is <u>no net force</u> on the fan & board (both mounted on the cart).

17: Apply Newton's 3rd law of motion. (3) Your weight is the <u>gravitational force acting on your body by Earth</u>, while normal contact force is the force acting <u>on your body by the ground</u>. Both forces act <u>on the same body</u>, so they are <u>not</u> a pair of action-reaction forces.

21: 1st cube: $P_1 = W/A = mg/A = V\rho g/A = x^3\rho g/x^2 = x\rho g$; $P_2 = (2x)^3\rho g/(2x)^2 = 2x\rho g = 2\,P_1$

24: efficiency = useful work / total energy = useful work / (P x t), t = 3600 s.

<u>Paper 2 Section A (40 marks)</u>

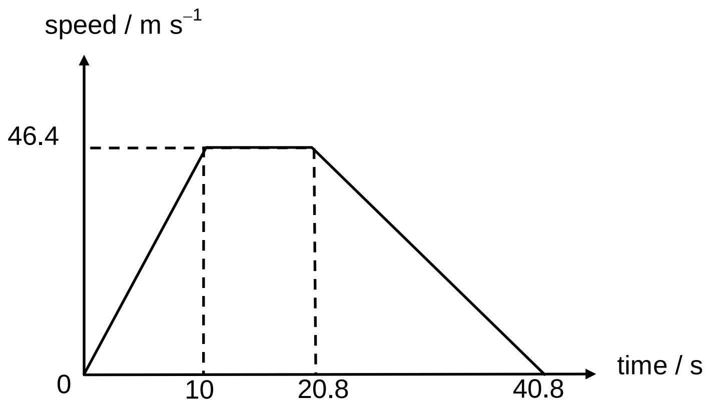
1(a) 1.10 kg [1]

1(b) Mrs Tan's method is more accurate. [1]
Each time a measurement is taken with the weighing scale, <u>an error of ± 50 g</u> could be made. [1]
EITHER weighing n number of fruits separately could result in an error of ± n × 50 g, hence, it is better to weigh all the fruits at once. [1]
OR The mass of more fruits weighed together is much greater than a single fruit. The error of ± 50 g hence, becomes less significant. [1]

2(a) $a = (v - u)/t = (46.4 - 0) / 10.0$ [1]
$= 4.639 \approx$ <u>4.64 m s^{-2}</u> [1]

(b) t = distance / v= 500 / 46.39 [1]
$= 10.78 \approx$ <u>10.8 s</u> [1]

(c)



- <u>Shape</u> of graph [1]
- <u>Labelling</u> of axes, speed and times <u>for each stage</u> [1]

3(a) $P = F_{net} = ma = (4.0 + 3.0 + 2.0) \times 2.1 =$ <u>19 N</u> [1]

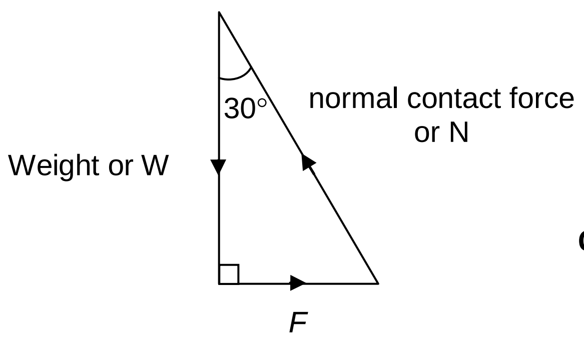
3(b) block *A*: $P - F_A = ma$ ➔ $18.9 - F_A = 4.0 \times 2.1$ [1]
Force on A by B, $F_A =$ <u>10.5 N</u> [1]
OR F_A =force on B by A = $F_{net} = ma = (3.0 + 2.0) \times (2.1)$

3(c) Net force on C, $F_{net} = ma = 2.0 \times 2.1 =$ <u>4.2 N</u> [1]

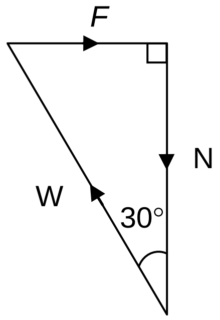
4(a) "weight" (or gravitational force) & "normal contact force" [1]

- Correct <u>direction</u> of arrows

4(b)



OR



- Correct <u>shape</u> & <u>orientation</u> of triangle [1]
- <u>Forces</u> labelled (or with suitable symbols) and at least 2 <u>angles</u> [1]
- Correct <u>direction</u> of arrows [1]

Note: Draw forces in same direction as original forces in the diagram!

4(c) Apply the force F <u>parallel</u> to the plane (or at any angle closer to the surface of the plane) at the same point on the box. [1]

5(a) For a system/body/object in equilibrium, the clockwise moments about any point must equal the anti-clockwise moments about the same point. [1]

5(b) Applying principle of moments, $3.0 \times 180 = y \times 70$ [1]

$y = 7.7$ cm [1]

5(c) Total mass of R and S = 180 + 70 = 250 g [1]

R and S must be of the same mass.

Therefore, mass of R = mass of S = 250 ÷ 2 = 125 g [1]

5(d) Rod 1: Rod 1 will turn in the anti-clockwise direction. [1]

Rod 3: Rod 3 will turn in the clockwise direction. [1]

6(a) Pressure due to water = 40.0 × 1000 × 10 = 400000 Pa [1]

Pressure in bubble = pressure due to atmosphere + pressure due to water

= 400 000 + 101 000 [1]

= 501 000 Pa or 501 kPa [1]

6(b) Volume of the bubble will <u>increase</u>. [1]

As <u>the bubble rises</u>, the <u>pressure in the bubble decreases</u>,

according to <u>Boyle's Law</u>,

the <u>volume will then increase</u> accordingly. [1]

7(a) Speed of car = 70 km h^{-1} = 70000/3600 = 19.4 ms^{-1} [1]

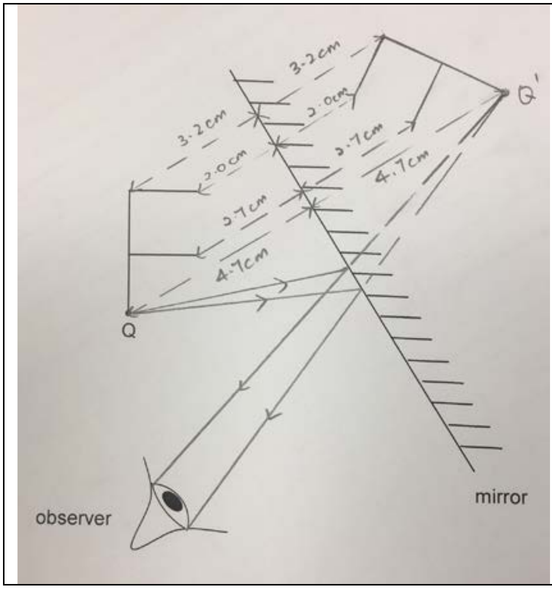
Kinetic energy of the car = ½ $(1800)(19.4)^2$= 338 724 J = 339 kJ [1]

7(b) Distance travelled by car in 1 min = 70 / 60 × 1000 = 1167 m [1]

Or 19.4 × 60 = 1164 m

Work done against friction = F × d = 400 × 1167 = 466 667 J = 467 kJ (3 s.f) [1]

7(c) Power required = Work done / time = 466 667 J/ 60 s = 7778 W = 7.78 kW [1]



8(a) Distance of object in front of mirror = distance of image behind mirror.
Correct image, laterally inverted.
All construction lines must be drawn. [2]

8(b) Light rays with arrows in correct direction, going into observer's eye.
2 sets of rays drawn from Q to two corners of eye to image of Q.
Angle of incidence = Angle of reflection [2]

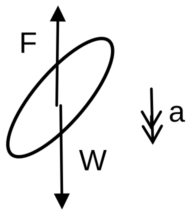
Paper 2 Section B (30 marks)

9(a)(i) freefall: $v^2 = u^2 + 2as$ ➔ $v = \sqrt{(0^2 + 2(10)(3.0)}$ [1]
$= 7.746 \approx 7.7\ \text{m s}^{-1}$ (2 s.f.) [1]

OR Loss in g.p.e. = Gain in k.e.
mgh = ½ mv^2 ➔ $v = \sqrt{(2gh)} = 7.7\ \text{m s}^{-1}$

9(a)(ii) on impact: $v^2 = u^2 + 2as$ ➔ $a = (v^2 - u^2)/ 2s = (0^2 - 7.746^2) / 2(0.65)$ [1]
$= - 46.15 \approx - 46\ \text{m s}^{-2}$ (2 s.f.) [1]
deceleration = 46 m s^{-2}

9(a)(iii) F: force on torso by his legs
W – F = ma
F = W - ma = m (g - a) = 45 (10 – (-46.15)) [1]
= 2529 ≈ 2500 N [1]



9 (b) When the parachute opens, a large air resistance (or drag force) acts upwards on the parachute & trainee. [1]
This air resistance is greater than the total weight of parachute and trainee. [1]
/ the net force is upwards causing him to decelerate.

9(c) As he slows down (or decelerates), the air resistance decreases. [1]
When air resistance is equal to the total weight (of parachute and trainee) [1]
/ net force is zero / acceleration is zero, hence he reaches a constant speed.

10(a) Construction lines on a **fully labelled proper diagram**. Connection between diagram and subsequent working must be explicit. Diagram to show reasonable proportions. [1]
Explicit and clear working with statements leading to answer of 2.4 m. Answers with insufficient working will not be given the mark. [1]

10(b) There are many approaches to solving this question. Explicit and clear working with statements leading to answer of 3.26 m or 3.3 m must be shown. [2]
length = 3.26 m or 3.3 m. Answers with insufficient working will not be given the mark. [1]

10(ci) clearly indicate angle *i* and and angle *r* on Fig 10.2 [1]
10(cii) Some form of Snell's Law clearly indicated: $1.00 \sin 50^\circ = 1.5 \sin r$ [1]
Angle of refraction = 30.7 ° or 31 ° [1]
10(ciii) Glass of a higher refractive index reduces the angle of refraction, leading to a smaller angle of incidence and reflection at the reflective coating. [1]
The ray from the main image will emerge closer to the ray from the ghost image, making the ghost image less distinct. [1]

11 EITHER

11(a)(i) s = 0.60 + 0.40 = 1.00 m [1]
11(a)(ii) $u = 20\ \text{m s}^{-1}$, $v = 0\ \text{m s}^{-1}$, s = 1.00 m
$v^2 = u^2 + 2as$ ➔ $a = (0 - 20^2) / 2(1.00) = -200\ \text{m s}^{-2}$ [1]
average deceleration = $200\ \text{m s}^{-2}$ [1]

11(b) $u = 20\ \text{m s}^{-1}$, $v = 0\ \text{m s}^{-1}$, s = 1.00 m
v = u + at ➔ t = (0 – 20) / (-200) [1]
= 0.10 s [1]

11(c) F = ma = 65 x 200 = 13 000 N or 1.3×10^4 N [1]

11(d) K.E. = $\frac{1}{2} mv^2 = \frac{1}{2}(65)(20)^2$ [1]
= 13 000 J or 1.3×10^4 J [1]

11(e) K.E. of the car decreases to zero. [1]
K.E. is converted to thermal (and sound) energy in the brakes which is dissipated to surroundings.
(Other irrelevant energies mentioned will void the answer) [1]

11 OR

11(a) P = F / A = 25 200 / 4 x 120 x $(0.01)^2$ [1]
= 525 000 ≈ 530 000 Pa or 5.3×10^5 Pa [1]

11(b) Ballerina: P = F / A = mg/A = (56 x 10)/ $(0.01)^2$ = 5.6×10^6 Pa [1]
Ballerina exerts a higher pressure on the ground than the elephant. [1]

11(c)(i) weight and normal contact force indicated with the length of the weight vector at least equal to the normal contact force vector. [1]

11(c)(ii) horizontal component = $1200 \cos 25^\circ$ [1]
= 1088 ≈ 1100 N (2 s.f.) [1]

11(c)(iii) net force = 1088 – 100 = 990 N (2 s.f.) [1]

11(c)(iv) acceleration a = F / m = 988 / 950 [1]
= 1.04 ≈ $1.0\ \text{m s}^{-2}$ (2 s.f.) [1]